

# HUMAN DEVELOPMENT IN CHILE We, the Chileans: a cultural challenge 2002

# What's going on? What's going on? Who are we? Who are we HH 111 11L 0 s it all leading Where's it all leading? United Nations Development Programme



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United Nations Development Programme

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EYV d'S[VIE`V&YZICVà`œZITF]ef  $dVZ_4YZVZ$ EYZIT\_TvàeVg`VdR\_UZ\_daZvdWWJZ\_Xd`V&R\_ł dIV\_UV\_TVR\_USVRfej ŽeZihZJVj f dVUZ\_VgVcj USj daWTYŽ:eZI`V&V\_UVJ\_VU gRXfVjiLY`hVgVL`c f dVU hZY ^f]eZiV^VR\_Z\_XLR\_UZ\_eVJ]VTefRjd R\_U RIRU^ZId JZVhZV/UZRXCW RS`fe eYV dV\_dV e`SVReeRIYVUe`eYVeVc^Ž:\_d^VTRMdZddWWd e`RaVa]VdReeL]ZeVBEf dV`cTf]efd{}YVZERXVL Z\_`eYVcdZeZifdVUe`^VR\_eYVhFJ Rd TZ4j`cR Xc`fa hZEYZ\_ZESVRgVdR\_UT\_UTTedZedT^^`\_\_ JZWZ:eZiZ\_eYZidV\_dV`V&YVeVc^eYRehVdaVR\`W TZgZTTF]ef cVL`VAc`eVcHR\_e`c4 ReY`]ZTTF]efcVL`c `VRaVa]VdTf]efcV`c]RI\`VZEZ

7 ceYZłdf U eYVekć YRJSW\_f dJUZ\_ZdSc RJ dV\_dV R\_ULW] hZ\_X eYV VI R`a]V`WF? 6D4 @Ł If ] ef cVYRJSW\_ eR V\_e`A\_R\_hBj d`VJZZZ ke ł XeYVZZ def TYŁZEV\_T ^ aRdddVgVg ^ R\_ZWERZ\_ `Wi TZJ`cXR\_ZREZ\_ŁEYVZ RX&LZVRŁgRJf VdR\_U adRIEZIVdUVgV] aVUSj Rd TZ/gi`cd^Vd/TEZ\_ eYVEV VŽEYV CVa`cedW/de`R\_dhVcd^Vbf Vd eZ\_dRZZZXW/ eYZHT\_TVaeZ\_`VWF ] ef cVZH Y` RVh VLEYV 4 YZVR\_dDH YVEVU hVT ^ VW7 ^ 0 H YRERVEYV hBj d`VJZWR\_Ud TZBJ adRIEZIVd`Wf c yH V/GH YVEVZI`f cT ]]VIEZV[`f c\_Y YVRUZX0.\_ `eYVch`dULZe^ZXYeSVdZUE/Re[f deRLeYVCVIV\_e a`af]ReZ\_TV\_d`dRN/WY`h ^ R\_j 4 YZVR\_dEYVEV hV&VLEYZICVa`ceLZ\_R] ^`UVdgi LZIRNZ\_XhY` eYV4 YZVR\_dRNZ

EYV&VbfV&BZ\_ddW e SVR\_Raac acZReVhR `WeWah`\_UZ\_Xe`eYVZ\_gZEReZ\_ VieV\_UVUSjeYV AcVALV\_e`V&YVCVafS]ZILCZIRU`=RX dthYV\_YV Z\_RfXfdReVUeYV4`^ ^ ZdZ\_ WceYV3ZIV\_eV\_Rg `W\_UAV\_UV\_TVŽyEYZ:1Z:leYV`TTRdZ\_E%dRZJeYV AcVdZUV\_eLye` ^ Rc\ eYVj VRcdV&/ #!!! e` #!"! RdRUVIRUVZ\_hYZIYhVR]dV-VTe`\_eYVYZte`q`W YRgvZzEYVF?5AYf^R\_UvgVj`a^V\_eeWR^ŁhZeY eYVV\_eYf diaa`ce`WeYzd`W/TVLdve Zed/We  $UdRAARV are? ReZ_R CVa`ce`_9f^R_5VeV!$ `a^ V\_e R\_U 4 f ]ef cVLhZeYZ\_ R]] eVV cVa` ced eVRe F?5AadvaRdvdZ\_^`dveYR\_"\$&Tf\_ecZkoŽEYV acVdV\_eCVa` ceRULEVddVdRdfS[VTeeYReYRd\_VgVc jVeSW\_a]RIVUReeYVTV\_eeV`WRh`dJU9f^R\_ 5 \gv]`a^ V\_eCVa`ceLRdvZdeYReUReVdVd/^ "\*\*!Ž 2d: ^ j dyWRgVdW\_ŁZeYRdSW\_ R\_ VITZEZ\_XSf e T^a]VíeRd∖Ž

 $\begin{array}{l} & \hbox{EYZlCVa`ce YRdSW_ ac`Uf`TUf dZ_XeYV^`ce} \\ & \hbox{C}Uc_ bf R] \end{tabular} \\ & \hbox{C}Uc_ bf R] \end{tabular} \\ & \end{tabular} \\ &$ 

CVIV\_eUV§V]`a^V\_edZ\_eVh`dUYR§VUV``\_ł dedR&UeVVZ`a`ceR\_TV`Wff]ef cVWceYVZJV\_e652d `WeYVh`dUddVXZ\_dTf\_e62XdR\_UaVa]VďE`ZM \_`cVZeh`f]USVhZMJSJZ\_U\_VdĎEYVXJ`SRJZREZ\_ `WeRUVEVTY\_`]`XJE}\_R\_TVR\_UT^^f\_ZREZ\_d Zd\_`eScVR\Z\_XU`h\_ZJV\_6652XdEZeZITVR]V\_XZ\_X eYV`ES`eYSj eYVeYcMedZeZITcVREZ\_XR\_USj eVV `aa`cef\_Z52dZeZl`aV\_Z\_XfaŽHVYR§VdV/\_eVV edRXTWWWIcd`WV/UR`V\_edZzh`R\_U\_REZ\_RJZh`Ž ?`\_VeYVJVdELhVR]d \\_`h eYRe aVa]Vd\_WUR dV\_dV`VSVJ`\_XZ\_XR\_U d`]ZJREZjES`eY hZeYZ eYV`dJgVdR\_UhZeY`eYVcEZVUV§V]`a^V\_eZle` ac`daVELU^`TCRIj SVcfdEZZ\_VUV§V]`a^V\_eZle` ac`daVELU^`TCRIj SVcfdERZ\_VUR\_U\_REZ\_dZeVI 7 c eVZl cVRd \_ LRd h V af SJZY eVZl WWW `VeVV F? 5 A Yf ^ R\_ UVgVJ` a ^ V\_ eeVR  $LhV _ h eVRe$ h YRe h VRV `WWZ\_XZl RacVaRRe` g\_ VI VCIZV V Vc eVV 3ZIV\_ eV\_ Rg + R UVSReV RS` f e R d S[VIe eVRe Zl gZeJ] e` 4 YZV dVW f cVZ

EYZITVJVSCREZ\_`W\_UVAV\_UV\_TVZI eYV eZ V hYV\_4YZJVR\_^V\_R\_Uh`^V\_VMR] RXdR\_dhVc eYVTR]`WYZIE`g`e`eR\_VEVZ\_ZZREZEVZ\_eYVZcZI UZEZIFR]R\_UT]]VIEZEV[ZEVZ`EZIRTR]]VicUZR`XFV R\_UUVSREVTS`feeYVZ`RX/hVYREV`WfcyHV%Lo RS`fe hYRe hVhZhYe`\Wa`WR] eYRe YRdSW\_ SfZe YZEVVce`ER\_UhYRe hZ]\_WUe`SVREVCVZ SfZe YZEVVce`ER\_UhYRe hZ]\_WUe`SVREVCVZ VME oZE YVR\_dhVcde`eYVdNbfVieZ\_dRVZ\_Vc^VU Sj eYV]Vctl\_d`WEYVaRceR\_UeYVUZZj VIaVZZ\_TV`W Z\_UZEZIFRJOZZ deYVCVa`ceaf edzeLTF]efcVZ\_4YZ/V YRdeYVeRd、`WVTcVReZ\_XR.de`\_X]ZZZXZ`RXV`W eYVyHV%R\_ULSjUZXdL`WYVjaZXaVa]Ve SVT^VeYVdyWAVjZR\_eRTe`cdeYReRWchRdU]``\} ZXdTZ4jcNbfZXdŽ

ARœZIZaReZ\_XZ\_YZê' çi RiddjWedjZe e Rie cdZ d TZêjERdycf S[VTed‰eYReZIYf ^ R\_Uêği]`a^ V\_eŽ : eYZ\_\eYVCVa`cehV\_`h a]RIVSWWeYVeVVeVVeVUc ZIRcMI] T\_ecZsf eZ\_ e` eYVacVaReZ\_dWc eYZd XWReVêjV\_dEeYV3ZIV\_eV\_RojEeYReeYVAcVEV\_eYRd TR]]WUWZ7 c F ? 5 ALeYZIZ\_gZEReZ\_ ZIR]d eYV `aa`cef\_Zj Wc Yf ^ R\_UŵjN`a^ V\_ee` SVT ^ H acWY\_UVUZ\_R]]ZeddZz\_Z TR\_TVR\_UUAeNEcZ\_TV Ze ZIR TVJVScReZ\_ `WWWU ^ Wc VRIY R\_U Vêvcj `\_V`WeYV4 YZJR\_aV a]VŽ@\_]j hZeYV&WU ^ TR\_ Rd ]ZUTf ]ef ch] SREZIWc Yf ^ R\_UŵjN`a^ V\_eSV RIYZêJUŽ



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DYXfc '9"'; ~Y``'J" 9lYWihjjY'7ccfX]bUhcf

BcfVYfh@YWkbYf`6" FcXf][c`AzfeiYn`5" GcYXUX`;cXcmA"

#### -BGHHHHCB5@7CBGI@H5BHG<sup>·</sup>

G7 < C C @C : DGM7 < C @C ; M! I B = J 9FG=858 75He @=75 89 7 < =@9 fA Uf]UbbY ?fUi gYžFc VYfhc ; c bnz YnžGc YXUX Fi ]ržG gUbU A YbX]j YžA UWUfYbU 8 ca b[ i YnL

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A <sup>7</sup> 7 5 B B Ì '9F=7 ? GC B '7 < =69 fA Uf]VY``J ]XUž5 bhc b]U`Fc Xf‡ i YnžA Uf]VY``7 U`XYfŒbžD]Uf`K U`\_YfŁ

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F?5AhZMVde`eYR\_\eYVZUZgZLFRJdR\_U ZdeZefeZ\_dhY`dVYRUh`c\ŁZWc^ReZ\_R\_U T^^V\_edT\_eczSfeWe`eYZECVa`œŽ

 $HVh^{f}UZVe^{e}e^{R} \times e^{V8}VZE$  $WeYVACKOUV_T_iL> Z_ZOKC> RcZ 7Vc_ï_UVkLYZCI$ acVUNIVATIC2]gRc 8 RCTFAR\_UeVVVC^ VCF\_UVA DVTcVeRg 6Uf RU 5 T V U cVV/c eV/2cT eZ f `fddfaa`ceZeYVT\_UfTe`WeYVcWARcTY`\_hYZTY eYZdCVa`œZdSRdMŽ=ZVhZMLhVhZMYe`eYR\_\ 2 [V[R U:R< cR dt] Wc^ V:> Z Zt=V: VM[R Z XR U S`Z'  $R_U: cZl 5 V/XRU$  `WeYV  $dR^ V^ Z_Z Zeq$  Wc XZZZXfdRTVdde eYV42D6? #!!! df cgyj URERŽ HVRCVRd XReWN e 2Xfde 4DbfV]RLACVALV\_1 eZE 2UgZNc`\_ 4f ]ef cVLWcYZTT ^ ^ V\_edLR\_Ue` eYV5 ZVTe c`WeYV? ReZ\_R]:\_deZef eV`WDeReZebZtdL > ii Z  $\sim 2XfZVcRLRUYZIT$ ]]VRXfVdEVcVcRGR  $9 \underline{Z}$  ekVV/ceV/gRJf RS]VdRezdeZIR]  $\underline{Z}$  V/c^ ReZ\_ eV/ ac`gZMŽ

EYVCVa`cehRdX&VReji V\_YR\_TVUSj eVVT ^ 1^ V\_edR\_UdfX&ddZ\_d`V&UFRU? Ze\_LCZRU =RcR&42> Rce49`aV\_YR\_L;`cXV> R\_kZ6^ZZ < ]VZ\_LD\_ZR>`\_eVIZ\_`d:c^ R2ccZX&R\_RCRAWJ GZ]V\_RLC`UZX 4ï\_`gReL; fR\_RAfXR\_T&CRAWJ GZIRZLARS]` DRJgReL> Rce44 C`Uc346 VkL;`d/2 8c`ddZ; fR\_6deRSR\_ARUL44 Rc]`d4 ReVi\_L; fR\_  $6 \_ cZbf V GVXHL 8 V cXV 4 `f WX_RL; f R_ 4 RdRd df d_> RcFa6deVc 7 VeVd.; `d/2_e`_Z GZ6R8 R]]`L; f R_ZR8 R_RL> `_d/cdreAR]^ VeL; f R_; `d/F Xrce/L 9 R_d> í Yd=V_RU > `cV_`L3VcREVZeVJS`Z L G% c E` \^ R_L8`_kR]` 7RJSVJ[RL8 RScZJ] GR] U/cdDf SVCIRMAT i L@cZR_R3Vc_RdT_ZI:X_RIZ; RdRL CR42 ceZd; VR_=VIRL> RcFaEVeVdR> RcdrR]L; `cXV = Rcdr2/L> RcZR_R2j ]hZL4 ]Rf UZ 5 Z8 Z` ]R``L; `d/2H VZ_deVZ_L> Rc\ D' ZeYL6UF RU 3cVCIZR_ZI > RcZR H VZ_deVZ_L; `cXV GVCXRcHL=`cVe` = ^aVkL G% c 7R[_kj ]SVL> R_f V] < df d.`aVV4 cZdeSR] C`gZcH.4 cZdeSR] 8 RCFFAL< ]Rf dDIY^ ZdH9 VSSVL 7Vc_R_U 7]` cVd 4` W/L> ZcR 4 c`gVec LCR/4 @]Zc`dL8`_kR]` 4` ccVrL; f]Z Ec`_T d R_U CR/4 4f Vz/deVZ$ 

 $EYV > Ra W4f ef dVZ 4YZVT f U_eYReV$ SW\_T^aZWhZeYfeeYVRddZeRTV`W+9fX  $CZRL > RCR; Vd/dDZgRL; d/C CRVL6]ZR_R > 1$  $]Z_RR_U > RcXRcZRA464k WeYV? ReZ_R]: deZfeV$ `WDeRezcheZicht:? 6/, ARF 12\_RD`e`Ł612R\_RKVzchlR\_U  $7RSZ = VZR VZV4 f = CV5 ZZZ_ VZV> Z1$  $Zecj \ Vold Trez_, 4 Rr 3f U_Z k ^ k ^ k ^ 4 Rer _ k ^ 2$ R\_UARezZZR4YZR\_X`VeYV=Z5cRcZcH2cTYZgVdR\_U  $> f dM^{\circ} dD dg ZIV_{15}: 32 > /, eYVC V dWRCIYF_Ze^W$ eYV? ReZ\_R]:\_deZef eV`VDa`ce; RezZc6eTYVSVcjŁ We^ Ve UZEVTe c `WeYV:\_eVe\_R] CVgV\_f V DVegZIV  $1D: \frac{1}{2}R U > ZYRV$ ; cRee R U 4 R UZR > cRVd $1D:/, ;RZ VC UCM Vk WeYV 9 ZAVC 4 f_TZ$ We 6Uf TReZ \_ 14 D6/, CRbf V/ E c\_RU R\_U ; RZ V AZKRCč 14 YZVR\_ 3``\ 4 YR^ SV6/, ARecZI  $TZ A^{S}_{V2} = 4 4 YZV, eYV? ReZ_R E^{T}_{A} = 6 ZC^{A}$ DVcgZIV1D6C? 2EFC/, eV? ReZ\_R] DIZ/\_TVR\_U  $C^{M}(R4^{A} \wedge Z \cup A R \cup R \cup R )$ R\_UAVUE`CVjVd`WeYVF\_UVdDVTeVeRcjdVZa`W  $EVVT ^ f_ZReZ_d_1DF 3E6 = /, R_U > iiZ^$ > ` cV\_` ` WeYV 2 dd TZReZ\_ ` W4 YZ` ½7` ]\]` cV 6\_d/\S]Val27@49:/ŽEYR\_\dRdVR]d UfVe eYV

VierR`fd?]TV\_ecVdR\_U]ZSdRzZd`V&YVTf\_ecj`d f\_ZgVcd&ZdR\_Ue`eVV^f\_ZZZR]ZZAdZ\_UZgZtRdd\_ Tf]efd?]`cXR\_ZZRZ\_dR\_UXgVc\_^V\_eZ\_d&ZfeZ\_d eYRed/R:WUZ\_Wc^RZ\_hZYfdŽ

$$\begin{split} HVh`f]UR]d ~~[ZVe`VacVd1`fcXRezefUVe`\\ eYVW]]`hZ_XWc eYVzc YV]aVd1_Vd1Z_ac gZLZ_X\\ R_Uac TVdtZ_XZ_Wc^ReZ_+8VcXV=VgVc`VeVV\\ DR_ezeX ~~4YR^SVc`Vd1`^^VcTVL4]RfUZR2]]V_UV`\\ VeYV? ReZ_R] H`^V_dDVcgZTV1D6C? 2> /Ł\\ 2U ~~]W2]Uf_ReV`VeYV=ReZ_2^VcZTR_7RIf]ej`\\ VVD TZR] DIZ/TVd17=24D@/LARf]Z_R7Vc_i_UVk`\\ VeYV? ReZ_R] J`feY:_dezefeV1:?;FG/L5R_Ze]V\\ 8fZ]V`e`VeYV? ReZ_R] :_dezefeV`VDeRezeZZd\\ R_U6T__^ ZTCVdNRCTY1:?D66/Z_AREZE> R_fV]\\ GRCMRdR_U2]gRc~DvcR_` WEG_VLZecVeLR_U\\ 6gR>`cV_~Z$$

EYV hY JV CVa`ce YRd SW\_XXRej V\_YR\_TVU Sj eVVT ^ V ed R\_U V a VZV\_TVd`WeY dV hY aRceZIZREVUZ eVVUZWWEV\_eWdf ^ d`cXR\_ZXVLŽH V h`f JUeYf d]ZVe eYR\_VeY dV hY`e`\aRceZ eVV 5 ZVTEZ\_`WFRS`f cH`c\dr`a+ARS]`=VZFE> RX URJV\_R6TTV&VcSRL9 Vc\_i\_C`^`E=f Zl8 f VcVc`E 2\_e`\_ZER > RURZXXE> RCFa D`JVLRU 9 f ceRU E > RCFA: dSVJ 2]ZEVL9 VJZR=VZFE> RCT d7 f V\_eVEL 6gR 3RCRY`\_RLI Z`V\_R 8`\_ki JV&L;`d/25 VJXU R\_U9 ½ c > `ZŽ

$$\begin{split} HVR dt RaacVIZREV etVT ^ Ved^RUV Re etV \\ 4Zj H`c\dr`a Sj > ZxfV] = RS`dVL2]V&U C`l \\ UcMF VkL7 dr_TZT DSREZZLOUF RU Dr_ > Ree24L ;`cXV > `dTRe`L8fZ]Vc^` 8 VZdV R_U ARecZIZ \\ 8c`ddZE`XVeVc hZeY etV^LhVhZtY e`eVr_\ etV ARecZIZ R_edZ_eVV5ZT fdZ_dH`c\dr`a+ \\ ARS]`@jRdk!4L;f]Z @]R]RL4Rc^V_4`dVc \\ R_UHZd_2dtjRZ$$

$$\begin{split} & EYR_{dRV} [ZVhZWUFVe`eY`dVhY`de`_eVV \\ & h`c\_ZXT^{^{}} ZeWd`WeV:_UZW_`fdH`c\_dY`a \\ & YV[USj eVF?5AAfS]ZTA`]Zj Xc`faZ_?`l \\ & gV^SVc#!!!Z \end{split}$$

 $\label{eq:aready} \begin{array}{l} ARe \end{tilde{Z}I} Re \end{tilde{X}Re \end{tilde{Z}I} UFVe^{\circ} 8^\_kR^{\circ}_{4} \end{tilde{X}} \\ VWX \end{tilde{Z}VR^{\circ}e^{\circ}_{7} c^{\circ}_{V} Ve \end{tilde{X}} VaR \end{tilde{Z}} \end{tilde{Z}} \end{tilde{X}} \\ VWX \end{tilde{Z}} \end{tilde{X}} \\ eYZ \end{tilde{X}} CVa^{\circ}_{4} \end{tilde{X}} \end{tilde{X}} \\ eYZ \end{tilde{X}} CVa^{\circ}_{4} \end{tilde{X}} \\ eYZ \end{tilde{X}} CVa^{\circ}_{4} \end{tilde{X}} \end{tilde{X}} \\ eYZ \end{tilde{X}} CVa^{\circ}_{4} \end{tilde{X}} \\ eYZ \end{tilde{X}} CVa^{\circ}_{4} \end{tilde{X}} \\ eYZ \end{tilde{X}} \end{tilde{X}} \\ eYZ \end{tilde{X}} \\ eY$ 

:\_ eVVT ^ aZRZ\_ `VeYVCVa` ceLgRf RS]VRd dZeR\_TVhRdRd ac`gZUUSj aV a]Vh`c\ZX`\_R a]RIV V\_eSRZZH Vh`f]UeYfd]ZVe`eYR\_\6cZR C`UE%f Vk`WYVF\_ZgVcdLRUUV4 YZVL; fR\_4Rd`d CfZeEcZZRUGR]VL>  $^2$ \_ZR?  $^1$ DNeL=fZl> f\_ZRL =fZl2\_URUM: X\_RIZ 2c\_`]UR\_U; `d/@dR\_U<sup>2</sup>\_L R]`VeYVA`\_eZTZRF\_ZgVcdLRU4`ie`]ZIRUV4 YZVL R\_U> RETUV7]VfcZef`VeYV:\_deZfeV`WA`]ZZIR DefUZed`WARZEDIZZ\_TVAA`Ž

HVRJd hZY e YZXYZXY e e YVX/VC f dT\_ezzff eZ\_^RUVSj R] e d V ZZXY dhY RXWU e h`c\ hZeyfdR\_`\_j^`fdj Sj XZZ X e YZC`aZ\_dZ\_ e YVZ\_e k g Zh d UZIIf d Z\_XC f a d TRV d f UZ d R\_U d cg Y T\_U T e VUVC e YVC d RC YZH V RC V X R e WY e R]`V e YV WC e YZC a Roz ZZ R Z\_Ž

=Rtelj LhVVreV\_U`fceYR\_\de`R] eYVdeRWWe eYVF?5A`WIVZ\_DR\_eZRX L4YZV1CVOLV\_e CVacVdV\_eReZgVLac`XR^^VR\_URU^ZZteReZ\_ `WIVdcLdVTcVeReZdR\_Udfaa`cedeRWWLaRceZff]Rc]j >Rc?R=fZRDZdcRR\_UAR]R8fRdzZthY`dVac`ł WtdZ\_RZt^ R\_UV\_VCY\_T\_ecZfeVUe`eVVdTTVdd `VeYZdCVa`ceŽ7Z\_R]jLeVV^V^SVcd`WeYVeR^ eYReac`UfTVUeYVCVa`ceh`f]UaRceZff]Rc]j [ZV e`eYR\_\eYVZcVR^ZZdLhY`dVf\_deZ\_eZ\_Xdfaa`ce R\_URWWEZ\_f\_VdgP\_eYVecV^V\_UfdVWWce`W T^aZZ\_XZZ

## -₿89L

#### GIAA5FM



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i '7 i 'h fY'Ug'U'dfcV'Ya

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### D5 FH'

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; H.Y.fYg[[b]ÚWUh]cbcZkcf_ ; DYfWYdh]cbgcZh.Y.YWcbca]WgngelYaUbXkcf_]b[``]ZY	
7\UdhYf" H\Y`Webgi a Yf'Wi`hi fY	
; H.Y.flgY.cZWebgi a dhjeb ; 5 male e [ meZWebgi a Yfg ; H.Y.UYgh.YhJVgeZXU]mi]ZY ; H.Y.a U```UgYa V'Ya ; G.edd]b[ 'WYblfY.UbX.di V`]Wdfea YbUXY	
7 \UdhYf`(` <u>H\Y`dc`]h]WU``VUg</u> g`c <u>Z″KY″</u> ; KYU_`dc`]h]WU``]XYbh]ÚWUh]cb ; '9YWh]cb`hifbcih ; H\Y`fYhfYUhZca`dc`]h]Wg	<u>%\$,</u>
7 \UdhYf`) HY`Yj]g]cb`UbX`h\Y`diV`]WgdUVW ¡HY`Yj]glcb`]b`ZJa]m`]ZY ¡HY`fYWebÚ[ifUhjcbcZbUhjcbU``]XYbh]m ;HY`hfUbg&cfaUhjcbcZdiV`]WgdUWY	<u>%%(</u>
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7 \UdHYf * <u>9Hb]WX]j Yfg]hmUbX h Y bYk</u> ¡H\Y]a dcffUbWY cZh\Y]bX][ Ybci g ¡H\Y]bX][ Ybci gdcdi Uhcb]b7 \] <sup>*</sup> ¡FYUggYff]cb UbX fYWc[ b]hcb cZYh ¡5 bYk U[ YbXU Zcfh\Y]bX][ Ybci g ¡A cXYfb]nUhcbždcj YfhmUbX bUh]	Y Nb]W[ fci dgUgdfcXi W/fgcZW/ h fY gdYcd Yg	<u>%&amp;&amp;</u>
7 \UdhYf+ <u>9Xi WUhcb UbX Wj</u> [WWY h f ; 7 \]Yg\ci XfYWc[b]nY [gUW]Yj Y ; 7 i h fU`WUb[YUbX WU`Yb[Yg ; H Y Wj [WUh]h XYgUbX VY\Uj ]ci f ; Gi XYbhggWj [Wg_]`gUbX_bck YX[ ; 9Xi WUhcb UgU df]a Y U[YbhcZW ; 7 \U`Yb[YgZcfWj ]WYXi WUhcb	∕a Ybłg ÆfYXi WUh¦cb gcZnoci b[™]YUbg Y	<u>%&amp;;</u>
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7 \UdhYf & AUd cZh\Y WY `hifU` ÚY X`]b ; 8UhU gnghYa UhhUhcb a Uhf]	7\]Y	%(*
7\UdHYf" <u>7 i `hi fU``dfc ÚY`c Zh\Y`W\]`Y</u> <sub>i</sub> 'H\Y`W`hi fU``XmbUa [ga ]bXYl <sub>i</sub> 'H\Y`W`hi fU``fYgc i fWYg]bXYl	Ub`fY[]cbg	<u>%*\$</u>

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; '7 i 'h fU``Webg a dheb'UbX']bWea Y. '`]b\_gUbX'dehYbhJU`

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7\UdHYf% 6Y]b[_'Ub']bX]j_]Xi_U``]b'7\]`Y.`cddcfhi_b]h]YgžZ/Ufg'UbX'X]Z(W_`h]Y i_`=bX]j_Xi_U`hUhcb']b'7\]Y`hcXUm i_DUbb]b[_U``ZY`Ua_[XghWcbÛ]Whb[_XYa_UbXg i_`H\Y`X]Z(W_`h]YgcZ]bX]j_Xi_U`hUhcb i_`=bX]j_Xi_U`hUhcb'ghUhY[_]Yg	<u>% \$</u>
7\UdhYf`& <u>H Y W ]`YUb ZJa ]`m`VYhk YYb W `h fU``W Ub[ Y`UbX`h Y`X]ZÓW``h]</u> ; : Ua ]mhmdYgUbX`ZJa ]mXYa c[fUd\]WgUfY`W Ub[ ]b[ ` ; H Y W Ub[ Y`]b`ZJa ]mfY`Uhcbg\]dg ; :=a U[ YgcZh Y`ZJa ]m ; H Y`dUfUXcl]WU``]a dcffUbWY`cZh Y`ZJa ]m	gʻc Z]bX]j ]Xi U`]nUh]c b &&(
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7 \UdhYf`( H\Y`]a_dcfhbUVW`cZZYY`]b[_gžUZYVVjcb`UbX`Vvćbj_YfgUhjcb` ; `F\Y`bYk`g[[b]ÚvUhjcbgcZdf]jUhY``[ZYžgYliU`]mUbX`h\Y`Vvćid`Y ; `f]YbXg\]d ; `9a_chjcbU``UbX`VvćbjYfgUhjcbU``ghmYg	<u> </u>
7 \UdhYf`) <u>7 \Ub[Yg`]b`fY`][]cig`]XYbh]h]Yg`UbX`UZÚ]Uh]cbg</u> ; 7 \]YžU`WcibhfmcZdfcZvggYgVY`]YjYfg ; 14 Y`WUb[]b[`aUd`cZWifW`UZÛ]Uh]cbg ; 7 \ifW`aYaVYfg\]d ; 14 Y`g VYhj hUhcb`UbX`XY]bgh]hih]cbU`hUh]cb`cZfY`][]cigYldYf]YbWY	<u> </u>
7\UdlYf* 8]ZZYfYbhk Ung cZ`]ZY`]b`7\]`Y ¡`A Ud`cZW]YUb`k UngcZ`]ZY ; H\Y`WU``Yb[`Y`dcgYX`Vmk UngcZ`]ZY	<u>&amp;( &amp;</u>
7\UdhYf`+` <u>5`d`ifU`ÎKYÏ`fYei]fYg`hc`YfUbWY`UbX`UVWW/dhUbWY`cZh`Y`ch`Y</u> ¡He`YfUbWY`UbX`bcb!Xgw/ja]bUhjcb`jb`7\]Y ¡CcWjcW`h`fU`ZYUh`fYgcZhc`YfUbWY`UbX`bcb!Xgw/ja]bUhjcb ¡5a V];UYbWYgUbX`W;U`Yb[Yg	<u> </u>



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7 \UdHYf& DUHYfbgcZgcWUV]`]hm ; HndYgcZgcWUV]]hm	<u>&amp;* (</u>
7 \UdHYf'' Dc`]HWU``]a U[]bUf]Yg ; G ddcfhZcfXYa cWUWn ; a [YgcZXYa cWUWn ; GJ UHhli XYgIc dc`]HWU`dUfHWdUhcb ; H.Y'dc`]HWU``Ja U[]bUf]YgcZW.]YUbg	<u>&amp;*,</u>
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> `cVac`Wf\_UR\_UZ`ac\ddgveYR\_Vfevc\_RTYR\_XVYRgvSW\_eYVZ\_vcTYR\_X\dZ\_aV a]\ZDZ\_TVeY\dv RV\_`e`SgZfdeYV/RV\_`eVRUj dVTX\_ZXUŽEYVdWdVLZzZL\_`eVRd e`}\_UeYVh`ddR\_U\_R^ Vde UNATEZSVEVNAVAVCA\_RJVIAVZZ\_TVEŽ?`\_VEVVVALEVVTYR\_XXdRcVeVVCVŽ2d]R\_UATRAVLJZVVZEMJVR\_UEVV hRidZ hYZYaVaVaVVZY&VCYReVTYR XULSVT^ZXR`SZERVeR\_UT\_WCZ\_XČeZL\_`ef\_fdFR e`WWULKACZVEVURULREEZ`VELVEV a`hVEVUKZ?`CZARTVERZZEZERZZZCHEZZCHREZ doCoceZZXŽ 4YZVR\_dRVSVhZUVEVUSVTRfdVUVabZeVSVZ\_XZ\_TEVREZ\_XJj Tj`dve``\_VR\_`eVvEeVVj WVJ]ZVdeR\_XvEVŽ

EYVAdvOLV\_e`WeVVCVafS]ZLCZRU =RX dLcV Rc\UZ\_dWWdV\_TVe`eVV3ZIV\_eV\_Rg+yEYZLZIeVV `TTRAZ\_\_\_\_\_`` AR`\\_\_\_\_\_` AR`\\_\_\_\_\_\_` ARUVIRUVZ\_ hYZY hVR] CV-VTe`\_\_\_\_\_\_ AVYZE q`\_`\_\_\_\_\_\_ `` W4 YZVL` R\_U`\_eYV\Z\_U`WWefdveYVTf\_eqjTR\_YRgVZ%eeZdeZ Ve`dVT\_dZUdeYVW/UR^V\_eRjbfVdeZ\_deHY` RVhVOHYV&VU hVT ^ VW ^ OHYV&VRVhVX ZX0EYVW &YT ^ ZX3ZV\_eV\_Rq` `W\_UAAV\_UV\_TV Z 4YZVZIRX`U`TIRZ\_ e`U`eYZŽ2eeYVeZ`V`W\_UVaV\_UV\_TVL4YZVR\_dUVIZUVL4VceYV`dMgVd R\_UReeYVZc`h\_cZhŁhYRe\Z\_U`Wrf\_eqieYVjhR\_eVUe`SVT^VŽ?`hZHRX`UeZ'Ve`Rd\`fcdygvd RS`feyHVLeYV4YZVR\_dYZEYZdTYR]V\_XVZd\_`e[fdeR^ReeVcWcZ\_eV]]VTefRjdŽ:\_eUBjd4YZVLZeZdeYV ^R[`&] hY`R&R{ZXeV^dMgvdevZlbfV&Z\_R\_UdMcTYZXWcR\_R\_dVZHYV\_^`&VeYR\_YR]W `VeYVSE!! aV a]Vcf ceyl VUSj F? 5 A Z ^ ZI #!!" Vi ac\ddwUU f SedRS`feeYVViZeV TV`VR jeYZ X f\_ZofVjj y4YZVR\_%LZZZIeZ Ve`deR\_UZ\_WY\_e`WeYV^Zc`cR\_URd\`fcdMgVd+U`hVWVJaRce`WRT^ł

^`\_yHV%Q

(Åzlýz²æ) zÝÈ

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6gv; d TZ4j WURDWWZ RXZ4 YZVZI `VITVaeZŽ: ^R j hRj dL4 YZVdZ RXVYRI RocReWZzd dTTVdtMdR\_UVAZfdvAZedWARdR\_UUVdZvdŽeYRddYh\_hYReZeYRdSW\_R\_UhYReZeTR\_SVŽ7c^ eVV eZ VhYV\_eYVaRXd`V¥R2dfTR\_RhVdVhcZeV\_L4YZVYRdSW\_Z RXZ\_VULdvac`UfTVUR\_UeR\_dVtc^VU RXZ\_R\_URXZ\_ŽEYZIYZ\_gY\_eZ\_`V4YZWeeYdVgRfKdR\_UZWRddeYReYRgVd/RaWU`fc]ZWRdRdTZigL  $YRgV^{a}V_{WeYVhR} e^{2}RZfd_RZ_{R}ZV_{e}ZV_{e}ZV_{a}V^{A}V_{e}V^{A}V_{e}V_{e}^{A}$ ezevz Rvz Rvz Rvzdz h YZIY 4 YZIVR\_ddWeYV dvgvdRdaRceZZaR\_edZ\_RT^^f\_zejŁRdYVzde`RYzeb`q

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Zi ``Wcibhfmžːk]h\`[fYUhYf`ZfYYXcaž	FJWUfXc @U[ c g DfYgIXYbbc7b.Y FYdi V W#A Um&SSS

#### K < M8C 9G7I @H F9A 5H9F = B7 < = @93

 $\begin{array}{l} 4f \left[ d \left( \sqrt{2} Z \right) Z a \left( \frac{1}{2} e S \right) V R \left( d \sqrt{2} Z \right) R_{2} Z e \left( \sqrt{2} e S \right) R_{2} e \left( \sqrt{2} e S$ 

 $EYV CV-VIEZ_RS`feTf] ef CVZ_4YZ Vd_eYVZ VZ_VARUUZ_aCVZ_fdCtá`ced+Yf^R_UVZ_VZ_i a$  $^ V_eZ_ea`dVS]VhZeY feRTf] ef CVeYRedeCV_XeYV_deYVZ_UZZ_FR] R_UT]]VIEZ_VTRARIZ; VCREZ_Ž$  $EYZta`dZ_TR_SVecRIWUSRI\ e` eYVT_T]fdZ_d`VeYV"**) 4YZ VR_CVà`ceŽ@_eYV`_VYR_UL$  $Z_UZZ_FR]dTR_dYRaVeYVZ_JZZ_XT_UZZ_d`_]; Z_d VACRdd TZ4; RdRhY`]VTR_XV_VREVRVAG`fdS]V$  $V_gZc`_^ V_eZ_YVCWCALRYf^R_UZZ_d`_]; Z_d VACRdd TZ4; RdRhY`]VTR_XV_VREVRVAG`fdS]V$  $V_gZc`_^ V_eZ_YVCWCALRYf^R_UZZ_d`_]; Z_d VACRDA'; fdeSVRUUCADUe`deV_XeYV_d TZ4; TRARIZ$  $eZdeYReSc`RUV_aVa]VdTY`ZVdR_U`aa`cef_ZZCZ@_eYV`eYVc`YR_ULeYVZcd`S[VIEZZ_iE4VVC:RSZZ;$  $e` }_U^ VR_ZXUVCeYVZ:REZ_dhZeYZ_eYV_dMgVdZIRIZ`a`ceR_eRddefTefd?] ecR_dVC^RZ_WCeYV$  $TCVReZ_`VeYZIVAG`fdS]VdTZ4; V_gZc`_^ V_eZEYVTf_ecj`da`eV_eA2] e` ^ R_VYf^R_UVgY`a^VeR$  $CVRZ4; ^ fdeSVdfXYeZ_aVa]VddfS[VIEZZ4;Ž$   $EYV\#! !! CVa` ceRaac`RIYVdeYZIZtf VhYV_ZeVdeYS[ZhVdeYRed TZ4] TRaZeY hZ] SVdeV_XeYV_UU`_]j ZWaV a]VdYRVyd^VeYZ_X&Z_T^^^`_ZEYY WeXV]Z_\d`Vedf de R_UT`aVReZ_Zd WC RdeYY WM] eYY Wc^ aRce`WR yH WZZEYVEVLEYV VIZEV_TV`VWR yH W6hRd R_Z RXV R_U RadREZTV dr`f]USV T_dZUEVURTcf TZ4] V/V_Ve`Wff^ R_Ugy]`a^ V_eZ_4YZVZEYVZ`a`ceR_TV`VWR T]]VIEgVZ`RXZ Rg WcYf^ R_Ugy]`a^ V_eUY_VEZXa`Z_EZ$ 

Î < i a Ub XYj Y`cda Ybh'bYWYggUf]`m ]bj c j Yg`U`WcbWYfb`k ]h`Wi`hi fY`!h`Y` k Ung dYcd Y`W\ccgY`hc``j Y`hc[Yh\Yf!` Zcf`]h g`h\Y`gYbgY`cZgcWU``Wc\Yg]cb` VUgYX`cb`W`hi fY`UbX`g\UfYX`j U`i Yg` UbX`VY`]YZg`h\Uh`g\UdYg`]bX]j ]Xi U`` \i a Ub`XYj Y`cda Ybh'`ZdYcd`Y``j Y

hc [Yh Yf k Y ž Zh Ym Wc dYfUhY ]b U a i hi U miYbf]W ]b[ 'k Unž h ]g Yb Uf[ Yg h Y]f ]bX]j ]Xi U Wc ]Wg Gc ž \i a Ub XYj Y c da Ybh ]g Wc bWfbYX bc h i gh k ]h 'dYc d Y Ug ]bX]j ]Xi U g Vi h U gc ' k ]h \ck h Ym]bhYfUWiUbX Wc dYfUhY ] b Wc a a i b]hYgÏ

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ÎH∖Y₩ci bhînÎyî∖i a UbXYj Y`cda Ybhž	'h∖UhigijbWigjjYžVfcUXž[YbYfcigžZfYY`
]b`]lgVfcUXYghgYbgYž]g``]b_YX`lc`h\YXY!	UbX`cdYb`hc`W¶hjW[ga"Ï
j Y`cda YbhcZU'W 'h fU``dc`]Wn	F]WUfXc`@U[ cg DfYg]XYbhcZh\Y`FYdi V`]WzAUm&\$\$\$

EYVZ a` cdZ\_TV`Wf ]cf cVZdS`c\_V`feSj eYVdTRV`WYYR\_XZŐBi R` a]Vd`Wf ]cf cd] TYR\_XdRvZ\_TcVRdU Z\_UZZLFR] VXWU^ LeYV]VALZ\_Xc`]V\_`h SVZ\_Xa]BJ VUSj eVVZZ\_ R\_U eYVZ\_`gReZ\_d`VWUFTReZ\_ cWc^ Ž2]]`VeYZLRWWIcd\_`e`\_]j eVVhBj aV a]V[ZgVe`XeYVcZ\_d TZcjESfeeYVZ\_Z\_UZZLFR] hBj d`W [ZWRdhV]Ž:\_ d^ LTf ]cf cV^ ReeVcdSVTRf dVZe ZLRS`fe aV a]Vdcf S[VTeZgVVI aVcZ/TVŽEYVZ URZj ]ZW V\_T f\_eVcd\_Vh VI aVcZ/TVdR\_U eYVj ^ fce}\_UR^ VR\_Z\_XVVc eYV`ŽAV a]V^ Bj \_`eSVRhRv`VeYZL dRcTYŽAVcYRadeYy hZ]\_`eSVRS]Ve`RceZff ]ReVeYVbf Vdz\_deYV aVcZ/TVR\_U eYVZ/MgVd2Sf eeYVj hZ] aVcTVZgVeYVRa eYRe YRd`aV\_Uf a SVANW\_eYZcdS[VTeZgVVI aVcZ/TVR\_U eYVUZWTf ]cj eVy YRgVZ eR]\Z\_XRS`feZeLR\_URdZx\_ZeR^ VR\_Z\_XeYPeeYVj TR\_dYRvhZeY`eYvcŽ H:9C9GCB7I@HF5@7<5B;9G5B87<5@9B;9G=B7<=@9

"Ž4YZVZtf\_UXXZ\_XRac`Wf\_UTf]efd?]TYR\_XXŽ\_eYZtac`TVtHeYVUj\_R`Zd`WtTZR]X;SRZR&Z\_ R\_UaVcd\_R]Z\_UZZTRZR&Z\_R\_UeYVTV\_eR?Zj`WAVV^Rc\VeR\_U\_Vh\_eVTY\_`]`Xj\_RVa]RjZ\_XRTV\_eR? c`]VZ4f]efd?]TYR\_XVT2VR&d`aa`cef\_ZZXdSfeR]d\_UZ/Vff]eZdWcVgXgUB;JZWZ\_d`TZKjŽ

#ŽEYVZ\_YVZENUZ: RXV^ VMYREZHY4YZNR\_%MRdSVT ^ VS]f ccNUR\_UZd\_`egVcj TcNUZS]VVkc^ `deaV a]VŽ EYV dv\_dv' `VSV}`\_XZ\_Xe` 4YZVYRdR]d hVR\V\_VUŽE`URJŁ4YZNR\_d TZkej U`Vd\_`edW^ e` YRgVR\_ Z`RXV` VMEdM/WeYReV\_RS]VdZee` SVR dv/VkMZR\_eRTe`d.`cydf S[VTe%Ž2 T\_~ZTeZ\_XZ'RXV` VMEdaRdeR\_UR hVR\UNZX\_`VMEdVMef cVT\_ec2Sf eVe` eYZŽ

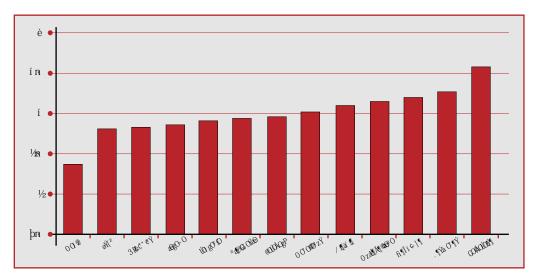
$$\label{eq:constraint} \begin{split} & \mathcal{Z} XUZ ITRREPORTED XIVUS is eVUVgV1 a^ V_e `VZ_UZgZUFRJZRZ_Z > `dVR_U ^ `dVL aV a] VR:VYRgZ_X e` UV_VGVZc `S[VEgV2LgRfVdR_Uac` [VIed` _ eVZc `h_ZEYZdac` TVdHYRd_` eSW_T fa] VUhZeY R^ ReIYZ_XUVgV1 a^ V_e `VeYVd` TZR] dd fcTVd_WUVUe` VM] ] ZZEYZdTRFdvdR_i Zej R_U d` TZR] hZeYURR RJ Z_aV a] VZ$$

&ŽHŖJd`W/ZWYRgVUZgVczZfUZ\_4YZ/VLSfeZ\_^R\_jTRdvde/ZdZtRUZdtTZReVUUZgVczEjŽEYV]RT\`W ]Z\_\dSVehW\_eYVgRcZfdhRjd`W/ZgZ\_XcVcf]edZ\_R]RT\`W^^^f\_ZTRzZ\_R\_UYZ\_UVcde/VT\_decfTeZ\_ `WickRzgVUZgVczEjŽ

'Ž4 YZVYRdRTf]efd?JUV;TZŽ5 ValzEVeYVZ: a`ceR\_TV`Wf]efd?Ja`]ZTZdZ\_dVTV\_ejVRcd\_JValReeV\_eZ\_ YRdSW\_XZgV\_e`Tf]efd?Jac`TVabVdeYReh`f]UYVJaZ\_TdVRdVdTZ4g`dTRaRIZeje`RTeV6ZedVJVZ

7I @HF5@7<5B; 9G5@H9F9J9FM85M9LD9F=9B79

 $\begin{array}{l} effective for the the test of test$ 



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 $@ \_ VeYZU`WaVa]VViYZZeyacZVZ_4YZWZO`hVgVLeh`eYZUd`VeY`dVd`cgY_VUa]RIVeYV`dMgVd ReRUZHR_TVR_U]``\ ReeYVTf_eqj_VW'^ eYV`fedZWZ$ 

 $3 \hat{U}^2 \hat{Z}^2 \hat{Z}^4$ 

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> ¶i lýznäÅlźÅO. Źq<br/>ä ¶²äeezä] O. Ý<br/>Ýä ¶%äeezä<br/> 1 L; äl O.e.<br/>¶²O.ã<br/>> i lýzøná þþ½ É

<sup>&</sup>gt;¶ïlýznani VźÅO (źqä), øä B1 Ł;maii þþ½ Ê

<sup>8</sup>C9G5B = A5; = B5FMC: H \* 9ÎK9Ï CH #@9L=CHB

Î 5 bX k \ ]Y =k Ug k U\_\_lb[ VUW =gU|Xžk |h gc a i W k YU'h c b a mif] \ h\ UbXž\i [ Y a ]bYfU` XYdcg|hgžUbX c b h Y c h Yf g|XY U [ fYUhVci bX Ygg gYUžUbX ]hĝ bc hYbci [ \ Å =gUnžk \ mXc 7 \ ]YUbgžk \ mXc =Ug U 7 \ ]YUbž \ Uj Y hc [ c \ i b[ fn8l fA UYži fVUbž \ C9, Ł

 $\begin{array}{l} 4 YZNR_dU \_ eWM f_UK^ Z_VU Sj Xj SRZREZ_LSfeden Vc Sj eV dS[VTegV V a V ZV_TVd ` Ve V T f_eej dZ_YRSZER_eeZH YV_ a V a] VU \_ `ea v CT V gV eV v a V dV_TV ` Ve TZ ej Z_eV Z_VgV jU j] ZW Z Z Z UZV If ]eV c eV V e` YR VR_ZNR ` W R Z_Z Z \\ \end{array}$ 

< C K 75B = 697 C A 9 A MC9@ 3

 $> R[`cerR_dNc^ReZ_d_`e`_]j RWW ReV^RicdTZA] da Y do V do WZWZ_dTZA ji SfeRid Z_UZ ji Rid Vojo U ji JZWZA kon Rez_dNc^ReR^`dva V do Rij JV ji JZWZA kon Reveal a Riež do V kon V do Reveal a Riež do V kon V$ 

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U`VfUj Y`W\c]WY`≓a UXYžVYWUi gY`h\]g	`jZY`]b`ami∖UbXgUbX`X]rYWni]hžk\jW\`]g`
k UgʻUʻfYU`mXUb[ Yfci gži bWcbj Yb!	bchYUgn"AcghdYcdYXcbchZYY`h\Uh
h]cbU``dUh∖"`5bX`amidUfYbhg`kYfY`	]bbYfZYYXca UbX=ZYh]hUkUngUbX=
Yj Yb⁺VfUj Yf⁺hc ⁺UVWWdh]h"=k Ug UV`Y	X]X`]lıž≓a UXY`a mgYZÏ
	; `cf]U'A ~ bW\a YmYfz'UWfYggz'&\$\$&"

. ¶¶ " ¢ " වෙස්පෙz ඊට ටැස්න¶ i Ú®ේක්ටෙරෝස් ¶² z ස්q¶ස්න¶ i සිසෙ¢ " සිසෙරෝස්ටරෝස්] zz² සි- ටදී ඉස්සෙz ස්ථා Yi @8¶‰ ස්ථා Z Ýz A67 z Ýz	

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>¶ï ÚgznaB1Ł; äl Ox¶²O@e∗ï Údzonai þþ½Ê

7 cgRzfddVRd\_dL^ R\_j 4 YZVR\_dT\_deZefeVeYVZcZUZgZUFRJZV\_eZej `\_ eYVVLXV`WcZ\_`aa`deZ\_ e`d TZKejŽEYZdyRd TZRJZUZgZUFRJZReZ\_%dV-VTedRaRcRU i ŽH YZVL`\_ eYV`\_VYR\_ULd TZKejZTdVRd Z\_XIj V\_T fdXXdZUZgZUFRJde`SfZUeYVZc`h\_ |ZWac`[VTedLeYVZcVgVcjURj TZETF^ deR\_TVdT\_decZteeYVZc TRaRTZej WceYVZ\_UZgZUFR]dd/WcVRJZReZ\_ hYZY eYRedR`Vd TZKejac`TJRZ`dŽ

Î=ĨYY[] Y Yb]bžVi h]b th Y`\cdY th UhdYf\UdgÅ /a UniVY VYWUi gY cZh UhÅ 'H Y th ]b[ ']g h\UhÅ ]hỹ U``WebbYWYXžVYWUi gY =WUblÅi[ Yha Uff]YX UbX`\Uj Y W\]XfYb ']Z=Ĩj`Y [ chbch ! ]b[ ž=a YUbžnci \_bck 3 =WUblÅiXc ]]žgc ]hỹgcficZX]Z(Wi thÅ ž=a YUb ]hỹU```]\_Y U WfWY th Uh bYj Yf YbXg'I

#### H YfYlý bc k Umci h

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#### $K \setminus Uh \widetilde{g} m c i f k Um c i h \beta$

#### Î=h ]b\_ h Y k Unici hžfYU`nž]gbchhc [ ]j Y U XUa b UVci hYj YfmVcXmY gYÅ Ï

fAUYžUXi Yži fVUbž]bhYfaYX]UhYG9; Ł

 $\label{eq:constraint} \begin{array}{l} 3j \ W_{i} h_{Z} X Rad_TY^{\circ} d_TZR_Raac^{RYLeVCVa^{\circ}ce} - Ude^{ReeA^{\circ}} dvhY^{\circ} U_{a}^{e} PR_{e}^{O} dvhY^{\circ} Z_{a}^{e} RYZ_{a}^{e} PV_{e}^{O} Ue^{O} Va_{e}^{O} Z_{a}^{e} PV_{e}^{O} Va_{e}^{O} Z_{a}^{e} PV_{e}^{O} Va_{e}^{O} Z_{a}^{e} PV_{e}^{O} Va_{e}^{O} PV_{e}^{O} PV_{e}^{$ 

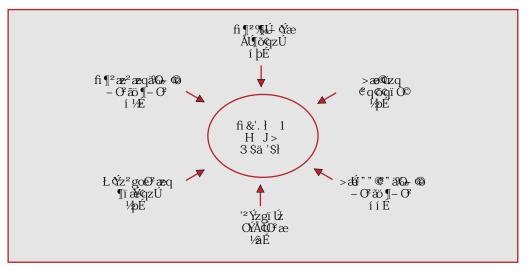
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#### 8C CIFK 5MGC: @ 9<5J95BM + B; -B 7CAACB3

D TZR UZgVczej ZIR\_ V ackdz\_ `WalfcRzej, VRIY akcd\_ YRIYZI`c YVc`h\_ V akc2/ TvdR\_UgZvhd`W d TZGjŽ3fe\_`eVgVcj \Z\_U`WUZgVczej VRg'fcdYf^R\_UvgVj`a^V\_eŽ2TT dZ\_Xe`F? 6D4@ŁeYVVM] UvgVj`a^V\_e`VvaV a]VdTRaRSZZEZdcVbfZvdyTcNrzgVUZgVczej %ZEYReZle`d3LRUZgVczej eYReScZ\_Xd WceY Z\_UZgZuFR] R\_UT]]VIzgVVfacVcdZ\_d`WYf^R\_TcNrzgZejLhYZVac`^`eZ\_XeYVT\_dcfTeZ\_`VR T^^`\_`cUVčZ\_4YZVLY`hVgVLUZgVczej ZdcPeVcVW7X`V\_eVUŽ 0 0Åä[[%afa 0.002 0° äö 0.00Ýä[[%a6%20

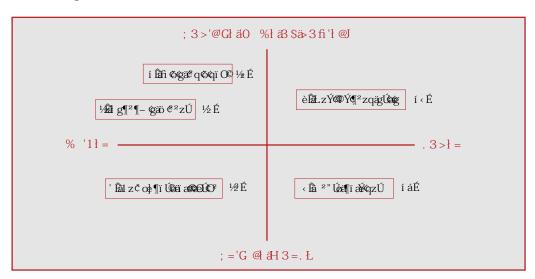


> ¶ĩ lýz näľu ž ÅO źqa 2 ä eza ä O Ý Ýa 3 a se za b 1 ½; äl O a 2 2 Va z a t b 1/2

 $\begin{array}{l} & \hbox{EYK} \end{tikz} \\ & \hbox{EYK} \\ & \hbox$ 

 $\begin{array}{l} {} EYV^{Aa} & W4 YZVR_{h} d` VIZVZd^{ & OVER_{eff} (feeR_VfeeR_vfeeR_VfeeR_v$ 

 $K \le 7 \le 5F9CIF = A5; 9GC: 0C7=9HMB$ 



'− O" zÝä¶‱¶g⊄æ

> ¶ĩ lắz nă lź Å Oź qä [² äcez ä] Oź<br/>Ýá [%äcez ä B 1 Ł; äl Oct<br/>[² O&> ĩ lắz orai þþ ½ Ê

:\_ARe' ŁeYVCVa` œdr`hdeYVUZgVdZġ` `WaV a]VdZ`RXd` W4YZjVZ2TT d.Z\_Xe`eYVF? 5 A\_ReZ\_R] d` cgy R\_Rj dZLeYdVgZhdRvd`UZgVcdVe?ReeYvCVZd]ZedVe`T\_\_VTeeYV`ŽeZd\_`eVRd`e`ScZLXVeYVXRa SVehW\_XZ\_VcdR\_U]`dvcL`cSVehW\_aV a]VhY`YRgVR\_ZJNR`W1TZdġ R\_UeY`dvhY`YRgVc4ceVReW Z\_e`RacZgReVh`c]UŽEYVa`dZzgVZ`RXd`VeYVT`f\_eg`Wf\_UR^`\_XaV a]V`VeYVyTZgZTZ\_UZgZLFR}%c yVT\_`^ZThZ\_Vc%g`aVReVgVg`VgVgVg`VccV``gVUVd^`eVVUvd`]ReVgZhd`VeYVyR\_Xg``fedZUVcZa

 $\label{eq:constraint} EYVTYRcedn`hdR_Rcdy``WolTZRJCVacVdV_eReZ_dR_UV1aVdZ/TVdhZeYWhScZUXVde`[`Z_eYV^ŽEYZdyUZdYCdZeJ%dV-VTedRUV]TZeZ_TF]efcd?J_ZeVXCReZ_Ž$ 

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 $4 YZV acVdV_edRTf ]ef cR] UV, TZeeYReh VR_V_dZedYf^ R_UVgV] a^ V_eZEYVCVa`cech`hdTVceRZ_eV_l UV_TZdeYReh VR_V_4 YZVR_d TZGj`dRSZZEj e`UVeVc^Z_dVVVcZedVJV&VVT fcdVR_UVvc^ZedT^^`_ ]ZVV cPvVVL VR_VVL 4 YZVR_d TZGj`dRSZZEj e`UVeVc^Z_dVVvcZedVJV&VVT fcdVR_UVvc^ZedT^^`_ ]ZVV cPvVL 4 YZVR_V d`YeVVVH V%TR]]dReeV_eZ_e`_V`VVeVVT f_eej`dfcXV_eeRche+Y`h TR_R UZdt TZRAUUZgVcdEjL`V&V_dt`eeYccfXYSj Vvc^d`VvcZgReZt`LSVURh_e`XVeVce`SfZURa]fcRZzEZT` dVceYReTR_XV_VReVRdV_dV`VSVJ`_XZ_XR_Ud]ZLRZEjO$ 

7 c 4 YZWR de` SVRSJVe` eRJ\ R\_URXeWLeYVEV\_WULde` SVR dRaac` TYV V\_eR^`\_\_XeYVd'S[VI362V VI a VZY\_TVdf\_UVdj Z\_XeVVC UZWWCV\_TVLWc VI R^ a]VZ\_d TZSZZG R\_U]RS`fc cV[RZ\_d.`cZ\_eYVhB] eYY ]``\ ReeYVWef cV` cc/V V SVceYVaRtěŽE YVhB] e` RIYZgVd'TYR dRaac` TYV V\_eZd\_`ee` Y^ `X V\_ZKVeYVAVVI a VZY\_TVLSVIRF dVZ\_UZZLF RZREZ\_ R\_UUZgVcZG REV\_`h RWREŽH YV\_eYVAVeV\_UV\_TZd RVRTVaeULZZ ZI`SgZ f dh YRe Zl^ ZHZ\_X-cWWV\_TVde` dYRVU VI a VZY\_TVd` Wt TZG Ž: eZl`\_ eYVSRZG `Wf TY VI a VZZ/TVdeYReRyT`^^`\_h` dU% R\_SVUYZ\_VREVLZ\_h YZY UZWWCV\_TVdTR\_SVZ\_eVCTYR\_XUU R\_U\_WC ZREVUŽE YZDZRERA Wcd TZG RdRhY`]VR\_UWcVgVg Z\_UZZLF R] 4 YZ/NZ Ž3f eLS`gVR]LZZZI RTZgZT eRAŽF JeZ\_RMJ L^ RZ\_XRT`^^`\_Y^ V` fe` VVZgVcZg ZLEYV^ZDZ\_ eYReUV^`TRTj\_ZLEYVV e` a V&W^ Ž7f ceVVc^`cVLUV^`TRTj\_TR\_YRUJj\_SVT^Vyf cd%Z\_eVVRSd/\_TV`VRyH VŽa

H ¢ezio ogozi¶%azeza%¶o¶ o ¢" alíaenze – z² alían¶ av¶i ä-¶ÝazO ÚzzĐaÇÅzÚgz² aÐ zÝÈ

$Lz - $ [glógæðálúz%ló] @æ‡æ $B$ ætlánlú a %o fözl $\delta - z^2$ æ	` <
ä ² ඩට සෙ¶ රෑවෙරි ව ä ¶ ඊ z ੯ − z² සමු C ස් ¶− z ස€ z Ý ් j z aj z anz Ú	1∕€
ä; z¶Å&äq¶²xägOŹäöoDäaaÅzä¶%äo¶õzÉ-z²ääeezøäoDĭzä	èí
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>¶ï ÚgznaB1Ł; äl One¶²O®a⊳ï Údzonaĭ þþ½Ê

 $\begin{array}{l} 4 YZVdTf [ef d] UV TZe YRdR]`_XYZE g ZAVEYRadZed` cZZ_TR_SVerRIVUSRI\e` eYV`]UWRc` WZW \\ WEV_TVEZ:_ cVTV_e eZ VeLeYVUZERE cdYZa cVacVdHUT ]]VEZEVREZ_LZ_dEZE eZ_RZWUTVCHZ_\Z_Ud`W \\ WEX^ V_eRZ_R_Ua]RIWUCEVT_dedZed`_ d`TZG dCMWUVEC^ZRZ_Z`_ eYVUV` TREETerR_dEZ_ \\ ac`TVdLZ_eV_dVWWCedYRgVSW_^ RUVe` XGV4 YZVR_dSRI\ eYVZc cZXee`UVIZUVVceYV` dAgvdh YCV \\ eYV hR_ee` X_R_UY`h eYy hR_ee` XAeeYVCZ3f eeYVCVRV6EZ] f_}ZHVUERCAZEYV^ RZ_`_VYRd \\ RJCARU SW_^ V_eZ_VL+UERCZXe`XeeYVcUZEVCEZ Ze` R_REZ_ISFZLZ_Xac`[VEZY4 cREZVUZEVCEZ] % hZ] YRgVaf eU h_c` ed`_TVUV` TREJLAFS]ZTUSREVR_UTZZT aRceZZARZ_ RcVaRe` W4 YZVR_d \\ d'S[VEZEVV1 aVEZ/TVR_U` WAVZCZVR] Z RXV` VeYVyH WZ$ 



# $H_{2}9 = ADCFH_{2}B79C: 7I = 7I$



## 7I@HF5@7<5B;9G



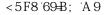
#### G7 9B 9G: FC A '85=@M@# 9

H YReZI4 YZWZZ RXWe UR OE YWZZL` d TZA eYReU Vd`eYRgVRdMWZ RXXŽ\_R] d ced` VhiRj d. eYZiZ RXVV S`UZdZdd TTVdhdR\_Udvývdd Zd WRcdR\_U]`\_XZ\_XŽ eT ^ SZ\_VdeYVWcd Zd f dR\_U eYVZ\_XRZ\_WLackdV\_eR\_UaRtHLZZZZ\_R\_Uf\_ZjŽ 2]]`VeYZIX Vde` ^ R.Vf a RaRczIf ]Rc yZJW66 W eYVT f\_eqjŽEYVdV a`cedJ RJddvgV e`Z\_eVacvé eYV VIZtZ\_X`dUALhYZV dY`hZ\_XY`h Zd TR\_SV f dkUR\_U ViaVZZ\_TVLŽE YZIZIhYRe Zlekć^ VUeYV yZ\_RZ\_Rj %6VRd TZAj`dUchYV&Sj Z\_UZZLFRJd TR\_cVT X\_ZXVeVV dMgVdRdaRce`VRT ^ f\_ZjŽ 6gvcj d TZ4j\_T&RevdVvCZcMJWeYZ\Z\_U`WJ\_eYV&ZT aZtefcV`Wn/YReZeZth/YReZedYZde`g`YRdSW\_ŁR\_U hYRe\Z\_U`WT`f\_egiZehR\_ede`SVT`^ VŽ

#### 5B = A5; = B5FMC: 7 < = 29

HVh`\_ EYV4YZVR\_ WeSR] eVR YRdezZ f^aYURe]RetLR\_UZ\_DR\_eZX aVa]V~`T\e` eYVA]RdR:eRZRWc[fde`\_Vafca`dv4e`TV]VSdReV 4YZVdgZTe`gİZEYVTc`hUZI`gVd`j VLaV\_dfa aRctZ\_dVfa]`Uv4y=`\_X]ZgV4YZV%aYVj TgHLizZd Z\_XeYVaYdCVY`^VhZeYR\_Vfa]VeZgVZ2dR`W 4YZVR\_~RXdd'cXdZ\_e`eYVdbfRcVR\_UeVV`UU detWeJR`aZldYReeVCVLI]VRLZ\_XcVdZV\_ede`WRceYRe eYVTV/VScReZ\_d^ZXYeUXX/\_VCRVZ\_e`R\_RcTYjŁRd eYVjYRgVSWK&Ž2\_U\_`h eYVa`]ZVRcVXR]`aZ\_X faŁecjZ\_Xe`ckde`cV`dWŽCZXYeRhBjŁeYVdr´fed `WaRecZeZTacZUVR\_UV\_eYfdZrd`efc\_e`Z\_df]edŽ EYZTTf\_ecj 5`Vd\_`eYZ\_XVgVcTYR\_XOEYVcVZd RWZ\_`V&YVyCVU2MahcRaaWUZ\_R~RXLVackdZ\_X dZ`f]eR\_VfdjYZlacZUVReSVZ\_X4YZJVR\_R\_UYZd ZVRehYReeYVTf\_ecj deR\_UdWZ

=``\Z\_XRe eYVaZlef ckLeYVcVTR\_SV\_`UfSe eYVcVZlj`fc\_Rz\_RJZV\_ezjŽEYVW\_h`f]Ud3 d hZeY feYVdZReZ\_+4YZVdR\_UdWcd^VeYZAL R\_Uj`f`]]\\_`h RS`feZeZWeYZ\_XdX&ccfXYŽEYV 4YZVR\_ZlR}XYeVdLYVh`f]Ud3LR\_UR\_jS`U hY`UVd\_`edYRcVeYReT]]VTeZeVWJZXZL\_` aRecZ eŽEYVT\_ecRehZeY eYVyVcVZX\_%bY`hVgVdL UVd\_`eXfRR\_eWRdec`\_X\_ReZ\_R]ZV\_ezjŽEYV V@ hY``SdvdZgVJjW]`hdeYVTYR\_XZ\_XVcef\_Vd `WeYVW eSR] eVR^ RJ\_`e}\_UR\_jeYZXe` ZV\_eZjVhZeYVcZ\_eYVTf\_ecj`dYZb`cj`cZ\_ Zed\_ReZ\_R] d^S`]eŽ



> j \_R' VZt; VR\_VéV> `\_dR]gVR\_UéVZtaZté dV hRdeR V\_ hYV\_: hRd`\_ ^ j hBj é h` chŽ R]hBj d eg é ]``\ ^ j SVdeSVIRf dV: UVR] hZeY éVVaf S]ZT R\_USVIRf dV: gVR]hBj d]Z VUUckddZ XhV]]Ž h` ch W^ "! Z\_ éVV^ `c\_ZXé ( Re\_ZXYeZ R]RXV de` chZ\_ eYVIV\_eCVŽ `` #) R\_U: YRgVRTYZJU` WŽ dAARREVUVØ' ^ j Yf dSR\_UeVcWj VRcdRX, YVhRd e` ^ f TY` VR^ R]VTYRf gZ ZdeR\_U: hR1 eX Z\_X e` af ef a hZeY ZĚZ ]ZgVZ\_ R~ReZ\_ > RZa ½ h YZTYZI d' R]] Sf ed&WR\_UT]` dVe` ^ j a RV\_ed Y`f ddŽ

: [ZV^ j h`c\SVIR dvZedr`hd: TR\_ed\VTRV `W`jd\JXEYYJ dvdaVTe^VSVIR dveYJ \\_`h: U^j [`S R\_UeYRe: ``RUVIV\_eh`^R\_Z`ed\_`e VRd +d^VZ? Vdj`f`dVYR RdMUR\_U`eYvch`^V\_ U\_edJ R\_jeYZ\_Xd Rd\_`ee`]`dveYVZc[`SŽ3fe: h`\_eSVaf drVURc`f\_UZ: ^RvG dv: ``evVReVU ac`aVdj R\_U\_`S`Uj`dX Z\_Xe`eR]\RS`fe^VeVV hc`\_XhBjZ: ^ZXe defUj d^VeYZAd^VZ? VL ZW TR\_VRc\_^`dveYRehBjŽ7`c\_`hZed^j d\_ :``eYZ\_VZ\_XRS`feZ:`gVX eYZ`Z\_R\_fcdvgLSfe : TR\_eaZI\YZ`faZ\_eYVRAKc\_``\_dd YVdaV\_Ud R]`e`V&Z`VRe^j aRv\_edZ: hR\_ee`XeYZ`R ?ZeV\_U`\_\_^j de`dVRULd`YVU Vd`eXeS`dVLZ



:\_ Whef cMLR\_j`\_VhY` U`Vd\_ĕ\\_`h 6\_XJZHY R\_U T ^ af eZ\_XhZJ SVdef T\Ž

:  $hV_e\dot{e} e\dot{e}V \wedge f_ZZaR_dY^{1}_RUR_hR_dUZJ$   $hV_{j}] e\dot{V}cVZ$ :  $YRUhYReZe\dot{e} \land R_U$ :  $hRdR_hR_jd$   $dMVT_{V}eZZTefR_jL_{X}^{2} ac fU `WhYRe:gV$   $RYZ_gVZ$ :  $ehR_deVR_j e XeR deVR_j [`SRAWC dARCRZ_XLhYRehZeYYR_ZXR \ZZ3fe: UZJZZ$  $: <math>^{7} cXR_ZVUR_U: \ `hYhe XeX `UT]`eVdd$  $Z_eVVd_VZZ_DRefdLgd: X e eVV Rc\eR_U d ^ VeZ Vd: X `fehZ_U hdd`aaZ_XhZeY ^j d Z_ eVV > RZaV4^R_jR_U hVYR_gV]f_TY Re > T5 `_RUCZ$ 

: eYZ \: ^ RcVRZdeSVIRf dV: \\_`h hYRe JZWZd R\_U hYRe aV a]VRV JZVŽJ`f TR\_`e ecf de eYV , eYY j`]] RhRj degi R\_U eR VRLgR\_eRXŽ: U\_`e Xké Z\_g`]gVUhZeY^j\_VZXS`f cd R\_U: `gV`\_]j X e`\_V VZV\_UZ\_ eYV dr`aŽH VeR]\ R\_U d^ VeZ\_Vdh VX `fee`X&Y c`\_ Df\_URJ dŽDYV dR\_VgR\_XJZRJ R\_U dYV deR V\_^ Ve`YVcTYf cTYŽE YY dW` e`SVX`U aV a]V hY`U\_`e egi e` eR Vj`f Z\_Ž: ed ekcZS]V eYV hRJ aV a]V ac eV\_U e`SV d^ VeYZ\_X eYY čV \_`eŽ: ^ \_`e cNZZZ f d.: ^ RSVZgVZŽ: SNZgVZ 8`USfe: U\_`eX e`TYf cTYFf\_]VcHeYVcVdRh VLI UZ\_XŽ: YRCUJ X`fe\_`hLaVcYRadVVc RT f dZ`d SZeYURJŽZTEF R]jL: YRV\_`eZ Ve`^j dM`ZeeVV



^`de: hReIY RSZe`WAJ]j Reh W.V\_UZD`^ VE`Vd : hReIY eYV\_Vhdh YV\_ eYVeVdSW\_ RSZXc`SSVj `cd^VeYZ\_XZ3fe: ^`\_`eZ\_eVeVdEWUZ\_a`]ZZDZ : U\_`ef\_UVdeR\_UZeR\_U: U\_`eTRVZ2e^`de: cVRUeYVDf\_UBj aRaVcRe^j aRV\_edZ JZ:VeVRUZ\_X ^j Y`c`dT aVSVIRf d/ZeXVed^VeYZ\_VZ\_XRS`fe ^j dJVZV U\_`eSVJZgVh YReZedBj dLSf eZeYVJadj`f dWh YRej`f RVZ

EYV^`decVhRdZ\_XeYZ\_XZ\_^j ]ZWZd^j d\_Ž : \* d`cqi : YRgV\_`eX`e^ `dVeZ`Ve` daV\_UhZeY YZ Ž h` ccj eYRed ^ VeYZ X^ ZXYeYRaaV\_ e` YZ hYV\_: ^ RhRjŽEYRedhYj : S`fXYeR^`SZJV aY\_VLd eVV TR\_XVe^ VdeRXXYeRhR ZVeYVCVd R\_RTIZIV\_eŽD^VUR; :U]ZVe`]VRgV^j[`S  $R_U deR_V Re Y^{V} V d : TR_T_TV_ecReV^{V}$ YZdfaScZ\_XZ\_XŽ: U\_ěhR\_e^j ^`eYVc^ZVU faZ\_eYReŽDYVdRSZe`]UVRAYZ\_VUR\_UUVd\_e f\_UkddR\_UhYReeYVh`dJUdJZ.Ve`URJŽDYVU`Vd\_`e ckR]ZkVeYkVRcVUfXdVgVjhYkVŽ2]]eVdVUfX RULZTedVZXYeV\_^VŽEYVRVRd\_`edRWR\_j^`cVL eYRečdhYj:UdReYVcX`fee`eYV^R]]Ž:ečddRWL ZĕdRZfT\_UZeZ\_VUŁR\_UZečdX e VgVg eYZ\_X+dY adŁ ckdeRf cR\_edLTZ\_V RdR\_UXR VdWc eYVTYZUcV\_Ž : YRgVRX`UeZVeYV&Ž: cVRJZKVeYRe^V\_RcV ]``\Z\_XRe^VŽEYV\_d^V&?Vd: eeVRe^jd/]V&

d^VeYZ\_XŽ: eYZ\_\:UVdWcgVZZŽ:XVe^jdVJWd^V eYZ\_X\_ZIVŁVgV\_ZVZe^VR\_dchV\_UZ\_XRSZe^`CdŽ EYVR^`f\_e:h`c\Ł:^\_`eX\_Z\_Xe`SV`fdU\_V Sj\_eVV\_VZXYS`fcdŽ:Wj`f\_U\_ě]``\X`UeYVdV UR\_dtj`fčV\_`S`UJŽ

: XXé SjŽ=ZWZd R ^ RIYZ VeYRe dr R]`hdj`f hY`]VZUY`f TR\_e]``\RAKcj`f cd/]VŽ3fe: YRgV\_`e X\_Vf\_UXdLXdaZeVQkuj eYZ\_XŽ h`\_edlj ZedSW\_ VRJŽedYRdJe`X`\_ZD ^ VeZ VdeYZdaRIV`VJZW Xkd^ VU h\_Ž@\_TV: hV\_ee`eYVU Te`cSVIRfdV `W`j\_VgVd: hRdd[VaZ\_XdvR]j SRJjŽ9 Ve`]U ^ VZehRddedXdIR\_U: hRde`d&VZeVRdJŽ3feY`h R`:XZXe`eR\VZeVRd]0

#### H × 9 7 I @H F 9 C : K C F?

EYV WeYV čYRd SW\_RhREIY^R \K R] YZE JZWŽ 2 GRJaRORBA hREIY^R \KŽ9 Vd\_\GYC^`g\UL\_`e W^ GRJaRORBA L\_`e\GY\_W/ &Y\_\ZXXS`f cY``U hY\&V eYV 4 R[R UV 4`^ a\\_dRIZ\_\_1R\_`\_lac`}d ^RZ\_Xd TZB d\Tf ZG R\_UT&\UZE`cXR\_ZARZ\_/]\/e YZ\_eYV^`\_JY\_WC R^`UV& Y`f d\Z9 Zl JZWYRd \_`eSW\_\Rd ZJ\RcdRX\_YV]`&YZhZWhY\\_dVV WJ ZJ R\_UeYY\_T f]U\_`exRe YVC bf Zl\]j\_V\_`f XY Re eYVY`daZRJŽE YReh`f]U\_`e YRGVYRaa\\_WZ\_ IR\_&ZX LYVeYZ\_\d eYY gVX e \GYG eYZ\_XeV&Z 3f eYVIR\_`edR\_UeYVSf deJVR\_UYRdV`V&YVIRaZ eRJŽE YVIZj\_Zle``deXdWJ R\_URXXVdZg\ZDZJLYV UZUX&YZld\_Ze`R DR\_&ZX f\_Zg\dZjZ

EYVd\_XRUFReVUZ\_6T\_`^ZtdR\_UZd\_`h R  $^{\text{R}}$  R RXAC Z\_ R  $^{\text{VLZ}}$   $^{\text{Id}}$  dXAVU T  $^{\text{A}}$  aR\_jŽ9 V VRc\_d dvgvdRJ eZ Vd^ `cVeYR\_ YZH VREYVCU VeLR\_U YZH WWW.dedYRgVV\_RS[VUYZ' e` deRceRWR'Zj; R\_USfj  $RY f dVZ RCV2LV_eZR VZXYS f cY UZ9 Vh f U$ ]`gVe`X SRI\e`GRaRcRedtLSfeeYVcVRZejZd eYRe YVdZ\_DR\_eARX e`deRjŽ7`c YZ`ŁeYVTRaZeRj Zd]ZVRYfXVdfaVc^Rc\VehYVcVYV}\_UdeyVSVde eYVT f\_eqi YRde``WWZZ3V2ZV2LYVZdac`fU`W Y`h YVdT aWhZeY eYVf adR UU h\_d`WeYV[`S ^ Rc\VeŽezlecfVeYReYVZl^ fTYSVeeVca|RIVUeYR\_ YZdaReV\_edR\_UXrR\_UaReV\_edhV&VZ2]]eYVdR^VLYV RU<sup>A</sup>Zede`RWWZX`WZdVIfcZejŽEYVUV^R\_Ud`\_ YZ Reh`c\RVZTCVRdZXR]eYVeZ VŽ9VY aVd YVh`\_`e]`dVYZd[`SSVTRfdVYV\\_`hdeYReeYVhR eYZ\_XdRcVZeh`f]USVYRcUWcYZ'e`}\_U`\_VRd X`UŽ2]d ŁYZURY Zji cVda`\_dSZZZZdRcVXc`hZ\_XŽ

2) e`WYZdRRgi X\d`\_YVR]eYZdrR\_TVLdTZR dVffcZej aRj^V\_edR\_UeVV^`ϴRX\Ž2e]\RdeeYV TYZU&V\_RV\_`eRef\_Zg\dzEj j\&Ž

EYVd\_R/`ZVdYZIVNEYVCVCeYVUVUZNEZ\_R\_U aREZV\_TVYVScZ\_Xde`YZdTR]Z\_XRdRhRETY^ R\_VČ 2]eY f XY YVT f ]U YRgVX e SVEeVc aRZUh`c\ŁYV R]hBj ddv RZ\_VU eef Ve`YZdTYZUY`UU&R'``W a]Fj Z\_XhZey & VŽAVCYRadVCeYZdCVRd\_eYVd\_ ZddZXYejj V\_gZ f dRdhV]Ž9 ZUNNEYVCd]ZVYRdSW\_ YRULSf eZEYRdRTJVRCjj UVj\_VUZV/& gj ŽE YVd\_Ł `\_ eYV`eYVc YR\_UŁYRd YRU e`TYR\_XVV`a]`j Vc dkgVcRj eZ\_VČZj TRaZEJZZ\_X`\_YZd`aa`cef\_ZZd YV YRdSW\_RSJVe`^R\_VR a]RIVVCc YZ`dJVZ\_ d TZGj Ž3f e eYVUZWKEV\_e Rda VRedR\_Uc`]VdZ\_YZd JZWU`\_`eRUUf a e`RTJVRcUZVTEZ\_ŽF ]eZ\_ReVJjŁ YVh`f]USVYRCU af ee`Zee`dFj hY`YVhRdR\_U hYReYZd]ZWR^`f\_eVUe`Ž

H YV\_ eYV aY e XRaYd`WWEYVc R\_U d\_ RV a]RIVUdZNSj dZNLd ^ V`WEYVUZWWC/TVdSVehW\_ eYV`]U 4 YZV R\_U eYV 4 YZV`We UBj TR\_SVUZH TVc\_VUŽ@\_V`VEYVXXREXde TYR\_XXd YRd`TTF ccVU Z\_ eYVh`dU`Wh`c\LR\_UZeZdaRe`VRh`dUhZN eV\_UV\_TjŽE YVVZd VgZV/TV eYRe dYZedZ\_IES`fc cVJReZ\_dYRgVWWWIedeYReRV^ fTY VXceYVdcXRIYI Z\_XLZ`aZ\_XZ\_X`\_ dTZAj cVJReZ\_dYZed XV\_VRJ]jŽ :\_ 4 YZVLVKceYVc^`cVL\_Vh ecV\_Ud1JRS`fc^Rc\Ve UVcVf]ReZ\_LVVcZdRE\_TVLRvXgZ\_XcZN\_`e`\_Jj e`\_Vh\_IZWdej JVeLSfee`\_Vh hRjd`WJ`\Z\_XRe dTZKej RdhVJJŽ

#### 5 K C F@8 C: = A 5; 9G

=ZVe? f dr\_Ud`WeYvć 4 YZWr\_d Re eYZdeZ V `WURJ ŁdwD dr.8 dr.1Z/JR.R\_UYvć Yf ds R\_UYRgV dre U h\_e`WreR\_Ue`hReIY eVVgV\_Z.X\_Vh dž EYVj S`f XYe eYV eVJVgZZ\_Sj Z\_dr.]^V\_ed eYdWj Vrcd RX, SWWCVeYRŁ eYY YRURSJRI\R\_UhYZV`\_VŽ :eZd\_`ed T ^ ^ `\_\_`h WceYVdke` `TIF aj eYV TV\_edV`WeYVZZZ Xc`^ ŁSf ed V/Z vdZee/Reh Rj SVIRF dV drVTR\_hREIY YVc Vrg`f cZeVac`XR`^ Vd RddVh`c\dž EYRe`\_VZ\_eYVR&Kc\_``\_ŁWc Zł drR\_TVLhYZIY RJh Rj dYRdd ^ VcVR]jj f dvMj eZa dŽ 2]d ŁhREIYZ\_XZe^ R.Vd YVc RaacVIZReV`eYVc aV a]Vdac`SJV`dŽDYVhREIYVd eYRe ac`XR`^ V `fe`WIF cZ dZj Ł`WI`f cdMLSf eRJd SVIRF dVZ=TR]Jd R drLVR drR.VŽ 2]d ŁZe ZIR T ^ Wce e`Yvc e`



eYZ\_\eYRe^Z6Wcef\_VTR\_SWRJ]R\_jS`UjŽ2\_U`W TfcdMLdYV\_VgVc^ZdMdYVcdRa`aVdRŽDYVXVed bfZeVh`c\Uufa [fdedWZ\_XY`h eYVS`ddeeWed eYRej`f\_Xh`^R\_Ž9VcYfdSR\_URccZeVdY^V RevLhYV\_eYVd Ra`aVRZdR^`de`gVZEYVj de Uh\_c2XYeRhRje`VReR\_Ue`eR∖eYV\_Vhd`gVZ :eZdaRce`WeYVZcc`feZ\_Ve`XVeYVZ9VZd^`deZ\_ł eVEV&EVUZ\_eYVWeSR||LSfeeYV\_VhdZlX`Ue`` Wc} UZX`fehYReZlYRaaVZXZ eYVTf eqiL eVVY ]Uf a ZXYeZ  $eV^{ZU}V WR eXX RU$ eYV dê c^dZ eYV difeYŽEY dV aZTefeVdeV ZU YZ `WYZELRF\_e6]gZCRLhY`^ eYy gZZEVU eYV  $d^{\wedge} CeYV Xe^{RcZUZEYV} eYV Xee^{XZX}$ RS`feeYVdZefReZ\_`WeYV>RafTYVdŽHYjUZU\_ĕ eYY Sf ZUaj d? Zd ZVeYV \_ VdeYY d' hW \_  $eV_V \notin ZZ_$  ]Rel DRef d.R OEY dV h V eV > R Rel. RaaReV\_ejjŽD^ VeZ VdeVV hReIY U Tf^ V\_eReZd `\_\_RTf]efdR]TYR\_\_V]+j `f]VRc\_R]`eSj\_dWZ\_XY`h `eYVcTf\_ecZkd]ZgVŽ

#### H ± 9 > C MG C : 7 C B G A DH€ B

@VK]  $eYVecR_dVc^ ReZ_dZ_4YZVR_dTZkj Z_$  $eYV ]Ret UVIRUA` VeYV ehV_eZeY TV_ef gLZe hRd$  $df cVj T_d^ aeZ_ eYRe TYR_XVU ^` deŽ4`_ł$  $df ^VzZf + Y`h RhVK] 3f e VgVg S`Uj hR_ed <math>e$ 





T\_d^VLe`V\_[`jeYVfdWM]R\_Ua]VRR\_eeYZ\_Xd RgRZIRS]V`\_eYV^Rc\VEZ@WTfdWL^R\_j4YZVR\_d dIRCTVjXkESjR\_UYRgVec`fS]VVgV\_RWXdLZ\_XeYV SRZICŽ?`\_VEYV[VdLeVVje`h`f]U]ZVe`SVZ\_ Ra`dÆZ\_e`dæZdyVeVZc\_WUdR\_UUVÆXVŽEYVAV Zdf\_U`fSeVUjjR]`e`WT\_daZff`fdT\_df^aeZ\_ hY`dV`\_jjRZ`ZdUZWWAV\_eZReZ\_WV^eVAVde`W d`TZKġŽEYVAVZd\_`eYZ\_X\_VhZ\_eYZĚDZ\_TVeYV ^Zd1\_Z\_VEW\_eY`TV\_efgLeYVDR\_eZRX\_VJZeVYRd SW\_fdZ\_XT\_df^aeZ\_EVREYZ\_ERdRhBj`VAVd eZ\_XZedNJVBaReWV^eYV@eYVdLeYVa``cR\_UBJd eYVfahRdUjj^`SZVŽDZ\_TVeYV\_EUZWWAV\_eZReZ\_ deCREVXZdYRgVT^aV&UVceYVTRIYVe`WdejJV RUX`UeRDEXZ

4 c z z z h `WT\_d h acZ\_ R\_UT\_d h Vcd Zd cVR]j RZ VU ReeYVZ dfaa`dvU aRddZgZejŁeR\Z\_X hYReZd`\_`WWChZeY`feac`Uf`TZ\_XR\_jeYZ\_X\_VhŽ 2TT dZXe eYZdgZhLZUZgZfRIT\_d^ Vd`c TZEZKY\_łT\_df^ Vcd TVRdV e` SV dy[VkVjZR\_e RTe`cdL RXV\_ed`WIYR\_XXLTRaRS|V`WIY``dZ\_XVXWj hYRe eYV hR\_ee SVR\_UUŽEYVTæZZZA ZdRolgveV `\_VLSVIRFdVeYVeVTR\_SV\_`UV``TeRIj`cYfł ^ R\_ UvgVj`a^ V\_e h YvcV aV a]V YRgV ]`de eYZd Z\_WaV\_W\_TVR\_UeYZIRSZZ; e` UVIZWhYReqiaV `W/ZWeYY hR\_ee` ]VRLŽ3feac`aVdj daVR\Z\_XLZe Zdhc`\_Xe`dVaRCReVac`UFTeZ\_WV^ T\_d\*ał  $eZ_{Z4} = d^{Z}ZdRaReeZfRchR, Watch UFTZZZ$ ? ` RTef R] `S[VTeZtac` Uf TVLLSf ecVacVdV\_eReZ\_d RS`fe`S[VTedReVTeVReVLŽAVa]VhY`gZZe^R]]d RVU ZX^` dveYR\_ vX ZXdr aaZ XZZ YV Rdv  $f dZ_X ac^{U} f Ted Rd d ^ S^ ]dL VZEYVc e^ cVacVdV_e$ eYV dygvde``eYVcdıy. YRgVX`UeRdeV‰`ce` S`]deVceYVZc`h\_ZLVeZej 1y. UVdVcgVZe%Ž3jfd Z\_XeVVac`UfTedRgRZRS]VZ\_eYZdhRjLT\_d^ Vcd X&VeYV^ R\_Z\_eVacVeReZ\_R\_UR^ VR\_Z\_XeYReReV \_VgVcViRTelj hYReeYVac`UfTVcZ\_eV\_UVUŽ4`\_dVi bfV\_ejjŁT\_df^ aeZ\_ dr^ f]USVdW\_ RdRhRj `W yac`UfTZX^VR\_ZX0%eYRedvogVeLZ\_ZedhRjŁe` XgVdX\_ZTR\_TVe`aVa]VdURZjj ZgVdŽ

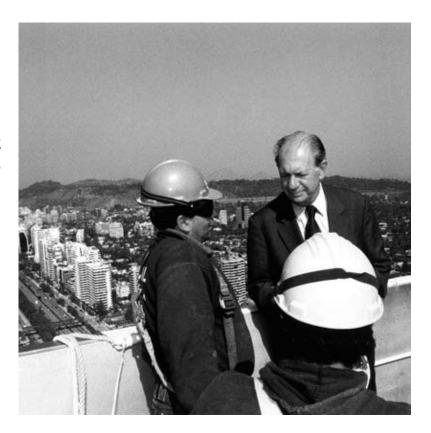
#### ; @C 65 @A5 HC B. H 9 - 8 9B H HM-B HFC I 6@9

H YR&V& K YRaaV\_VU e` & U h Z V R\_U V` aR\_R URD: d`fc Z J V\_&Z j Z\_ ec`fS]VOE YV a Z lef dV` WR YR` SfcX & U` V d\_` eR] f U V`\_] j e` eY V eY d Ree YRe Xj` SR Z R Z\_ Z l d` aa` d U e` d a d V e W c\_R Z\_ R Tf] ef d V R\_U Z J V\_ & Z j Ž: e R] d` dY` h d eY V` Sg V d A eY V y\_R Z\_ R Z R Z \_ % W J` SR Z R Z\_ Sj` Z\_U Z g Z f R] T f\_ e Z d Ž: e Z l e f V eY R e Y V d Y V S d L U` W d` W U Z\_ \ d R\_U e d Z Z\_ X d Y` V L e Y V d Y \ )^ d R\_U  $\begin{aligned} & e^{V} dR^{V} V^{f} dZ LT R_SVWf_U gZ ef R | j R R c d e^{V} V \\ & a | R_VZ E YZ d U V _ e^{V} R_LY h V gV _ e^{V} R_Z & R V d \\ & d_{d} e^{V} e^{R} V R V _ A | S R T | e^{T} d^{W} Y^{A} S R V _ Z Z X \\ & V _ gV _ g W ^{A} & W R Z_R | V a d d Z _ Z E YVY R^{S} S f c X c \\ & Z | f d e R V d e^{V} V a c TV d V Z e^{V} Z d Z R Z_h H V d X _ J \\ & V _ e^{V} R Z _ R | V a d d Z _ Z E YVY R^{S} S f c X c \\ & Z | f d e R V d e^{V} V a c TV d V Z e^{V} Z d Z R Z_h H V d X _ J \\ & V _ e^{V} R Z _ R | T | e^{T} c V _ e^{V} Z d Z R Z _ h V d X _ J \\ & V _ e^{V} R Z _ R | T | e^{T} c V _ A R Z & V R | Z V \\ & S | R Z _ R | T | e^{T} c V _ d A Z & V \\ & S | R Z _ R | T | e^{T} c V _ d A Z & V \\ & A V e^{V} Z X e^{N} e Z | f c y h _ Z & V \\ & A V e^{V} Z X e^{N} e Z | f c y h _ Z & V \\ & Z | A R Z & V \\ & A R Z & V \\ & A V e^{V} U Z & e^{V} V - V & R Z & V \\ & A C U T e^{V} | f _ V W & Z \\ & A V e^{V} Z & V \\ & A C U T e^{V} | f _ V W & R U Z e^{V} e^{V} e^{T} Z & R T V \\ & V & X e d f d Z \\ \end{aligned}$ 

DVT\_UJJ LeYV aZTET cV`VEYV YR`ST cXAC R]d dYULIR XAVRE UVR] `WJZXYE`\_ eYV XRa SVAh W\_ UZTT f cd/R\_U acREZTVŽ@\_ eYV`\_VYR\_ULaV a]V eV\_Ue`ReeZTF]REVEYVZCUARIY^ V\_eVA'^ `c cA[VII eZ\_ `WhYRe eYVJ aVCTVZcVRTY^ V\_eVA'^ `c cA[VII [VdtŽ@\_ eYV` eYVL eYVJ RU'^ Ze eYRe YR`ST cXAdd RCVRTeT R]J aRe `V&YVZcURZJ [ZgVdŽ? `hLe` U `\_VeYZ\_XhYZ/VI]RZ Z\_Xe` acWWCR\_` eYVcZtIf dT R]J dW\_ RdYJ a`TCZZTRZZ:\_ eYZdTRALY` hVgVLZe ^ ZXYeSV^` cVZ\_UZTRZZV VR]RI\`VJR\_XFRXZE YV UZJVIFJej `Waf eeZ\_X R\_R` Ve` \_Vh\_VaVZZ\_TVd TRF dAdaV a]Ve` cARZ\_R\_` c^ RezgVUZTT f cd/eYRe YRd\_` acREZTR] WWWAL hYZVVVJ]`hZ\_XR acREZTV hZeY\_` UZTT f cdVŽ

Hk9'=A5; =B5FMC: 'Hk9'89AC7F5H≠7' GF5H9

EYV AcVOLIV e`WeYV CVaf S]ZT eR\\de` d^ V TZERKY\_CZEYYZ RXVTR]dWceYUZWWCY\_eCVRUZ\_XCZ 7ZdejjŁeYVcVZleYVYZe cZR SRI\Xc f\_UeYReRd d TZREVdeYVZ'RXV`W4YZVhZeYeVDeReVŽDZ\_TV :\_UVaV\_UV\_TVLeYV d`gVcVZX\_ej``WeYV\_ReZ\_R DeRevYRdSW\_ZeVch`gV\_hZeYeYVac`UfTeZ\_  $R_U \operatorname{CVac} Uf TeZ_ WR_ReZ_R$  Tf ]ef  $\operatorname{CVZ}:e Zd$ eYc`fXY^`cV`c]VddRdNceZgVDeReVRTeZ\_eYReR\_ RhRcV\_Vdd`VwyHVLeYV4Y2JVR\_d%YRdXc`h\_faŽ 2\_UeYV}XfcV`WeYVAcVdZV\_edeZ]Z\_g`\VdeYV  $YZde q ~ WReZ_R ZWZE ~ UR Ley VZZZX^ V ~ q$ `W4YZVdeZ]dW^de`\_`fcZfYZedN/W6V^ eYVDeReV RTéZ\_ eYRe ac`XcVddZgVjj Z\_eVXcReVU eYV UZVWCV\_e d TZR Xc f adUf cZ\_XeYVehV\_eZeYTV\_ef q Ž\_eYZŁ  $eYVYZde^{TR} ^{V} q^{Z}WTf dZ X^ R_R da VTe^{W}$ eYVDeReVeYRezd`VeW\_f\_UV&VdeZ'ReVU+zedd ^ S` [ZT



UZ: V\_dZ\_ŽEYVDEREVOJ^S`]ZKUCEYVF\_Zj`WI TZR VIZEV\_TVŽ7fceYVC^`CVLZEV^S`UZCEYVZ RXZ\_Rj `WEYVYH W&XC`fXYhYZYY]]4YZVR\_dTR\_CVTXI \_ZKVEYV^CMgVdRd^V^SVcd`VRT^^f\_ZjLR\_U EYV\_TVZV\_EXJVhZEYd^VEYZTR]JVU4YZVŽ

4`\_dLWZ\_XeVVc`]V`Wi`]ZZTdR\_UeVVDReVZ T\_def TeZ\_XeVVT f\_egiLZeYRde`SVRd\WhYVeVvc eVVL2`ZfeZ\_`WeVVDReVdc`]VZ\_dVTV\_ejVRdYRd \_`eSW\_TYR\_XZ\_XeVVClackdV\_eReZ\_`W4YZVR d`TZIgiZ2deYVZ`RX/WeVVDReVSVT ^ Vd]VdTI]VRL eYVT`]]VTeZeVZ`RXZ\_RCZdfdUUe`f\_UkadR\_UhYRe 4YZVZd^ZEVeSVhVR.V\_Z\_XRdhV]Z4R\_^Rc\Ve ViaVeZy\_TVdac`gZVRSREEWcclackdV\_eZ\_Xd`TZig R\_UeYVZJNR`Wff\_egiO

EYVaZlef cVR]d Vg`\VdR\_Z`RW^VVV^`TdRIjŽ EYVAcV3LV\_eZleR]\ZXe`h`c\Vcd\_]ZdeV\_ZXe` eYVZ:ac`S]V`dR\_UVia]RZ\_ZXeVV8`gVc\_V\_ečd a]R\_dthYZVeYVj XgVeYVZ:`aZ\_Z\_KS`feeYVhRj eYVT f\_egi ZdXZ\_XZEYZdZ RXVVg`\VdR4YZV \\_`h\_e`eYVh`dJUVcZed]`\_XecRUZZ\_`VVVi ^`TdRIjŽ=VdleYR\_YRJVVVR]4YZVR\_dY`hVgVL ViacVdt}c^ dfaa`ce VcUv^`TdRIjŽEYZdZl\_`e eYVa]RIVe`Rd\hYReeYVIRfd/`VeYZdUZA/TYR\_d ^V\_e^ZXYeSVŽ.e^ZXYeSVUZRaa`Z\_e^V\_eReeYV  $\label{eq:constraint} \begin{array}{l} VV2f cV^{V} VVV^{\ TCRIj} e^{VVa} Zdac^{\ A}ZM2L^{c} VVj \\ Z UZWWCV_TVŽH YRe Zl^{SgZ} f deeY^{f} XY2LeVVXa \\ dvaRReZ Xd^{TZkj} W^{\ A} a^{JZZDŽ} \end{array}$ 

 $5 V^{\ TCREZTZ_deZefeZ_dU^{Z}UWU^{a}VReVSj R$ T UVeYReZel\_`egVcj cVda`\_dZgVe`TZZKV\_UV^ R\_UDZ EYZclZel\_`ed^ftY eVVTRUV hZeY aV aJVdycVR] ac`SJV^ dZz^defVd`VW^ a]`j^ V\_eLYVRJeY R\_UdV TfcZej U^XVeRYVRcZ\_XVV^ eVVafSJZTRU^ Z\_ZdecR  $\begin{aligned} & \in \mathbb{Z}_{A} YRe \mathbb{Z}^{\wedge} (\mathbb{Z}^{\mathbb{Z}}) \\ & e \ ac \ S V \ de (\mathbb{Z}^{\vee}) \\ & de (\mathbb{Z}^{\vee}) \\ & (\mathbb{Z}^{\vee}) \\$ 

#### 7 I @H F9 = B GI 6>97 H J 9 9 L D9 F = 9 B 7 9

EYVÓV ÓYZÁZIRCV]VR<u>ez</u>XSVYZUR WRYZZRC a Role  $R_U f dV dZ XZ R_f T de Z We f dZ b de Z Ve V$ f\_TVceRZ\_ejL^R\_j 4YZVR\_dRcVZ\_daZVUSj eYV `aa`cef\_ZeZdeYReRcV`aV\_Z\_XfaŽEYVdVRcV aVa[VhY YRgVSVT ^ VW] aRceZZaR\_edZ\_eYV T f\_eq dUvgV a^ V\_eR\_U\_ h WW eYV dvgvde SVhZ\_VcdŽEYZclZdeYVT f\_eqi dyV\_ecVacV\_Vf cZR a` $eV_{eZ}$ %Z3f e ^ R\_j `eYVc 4 YZVR\_dLaVcYRad eYV^R[`cZejŁWW]f\_T^WceRS]VŽARcejjŁeYV/RCV T\_WAANUŽEYVJTR\_^fUUJVeYc`fXYZ\_URZjj JZWL SfeeYV RCVSRAWUSj hYReZdX Z\_X`\_Z d TZAjŽ EYV/ cVR]ZkVeYReedRLZeZ\_R]V3R^Vd`WcWWcV\_TV RCV `WZEEVYMaZ\_f\_UkodeRUZXRWkefcVeYRe  $Zd^{f}(x) = \frac{1}{2}   $Z_Xf_T \wedge WeaRS$ ]VLd  $\wedge VRVR_XjZ9jYb'k \setminus Yb'$ h\Y|f`|ff|lUhcb |gbchUfhW UhYXž|h|gghf\_|b[

\ck Yl Wi XYX'a Ubm7\]YUbg2YY`2fca 1\Y` We'i blfmYgXYj Y`cda Ybh"=b Vch, WUgYgzï b! YUgYUbXUb[Yfz7\]Y]ggca Yh]b[ fYa chY` 2fca ih.Ya "

AV a]VWW] Tf e`WWW)^ 4 YZ/VWc^ R\_j c/Rd \_d. S`eY^ Rev/ZR] R\_UV`éZ\_RJESf eeY/CVZl`\_VeYRe dR\_Ud`f eŽE YVWWJZ X`WQZ/ReZ\_ dW^ de`SV Rdt TZRevU h ZeY UZ/VIF] ej Z\_ ^ R.Z\_X dV\_dV`VeYV d TZRJ TYR\_XdZ\_ ac`XvdtŽ2\_U eYZl YRd T\_dA bf V\_TVČŽ: WaV a]VTR\_`e dW eYVa`Z e`VeYVdvL eYV\_`\_] eYVaRdedW^ de`SV}]]VU h ZeY^ VR\_Z\_XL h YZ/VeYVac/dV\_e eV\_Ud e`SV]]VU h ZeY^ VR\_Z\_XL h YZ/VeYVac/dV\_e eV\_Ud e`SV]ZeVU Rd ^ VeYZ\_X bf ZeV^ VR\_Z\_XVdtLeZ\_VdezZa/U`Va/vda/Tegy/ŽD Y`h TR\_ dV\_dVSV^ RU^`V/ZWOH YV\_ eY/CVZL\_` T^ aRdde`XfZ/JV kgV\_edLXZ\_X\_`h YvC/Z2\_U eYZlZ\_UZeZLFR] VI a VZ/TV f] eZ\_ReVj a`]]f e/d e/V XV\_VRJ Re^ `da YvC/Z

EYVZ RXddf XXded ^ V`WrVbf Vdz\_daV a]V `V&V\_RA eYV dvgvdžEYVj eg e`UVj\_VeYV dvgvd R\_U }\_U `fehY eYVjLeYV 4 YZVR\_d.RvŽEYVj dRvjj RezIf ]ReVR\_j `WrYZLSf eeYVj\_VgvCTVRdve af klyV `gvc eYVR\_dh Vdž2d VUR UZvTebf Vdz\_L aV a]VeV\_Ue`daVR. `VgZdf Vd`c V&F jederYy dvRvV hZeY `eYVcd.`V&V\_daVR\_Z.X `WY`h UVAc^ Z\_VLL `c ]RijL4 YZVR\_dRvŽEYVbf Vdz\_ `VyhY`hVRv%uo `\_eYV`eYVcYR\_ULcVjRevde`eYVhVS `VVAJRZ\_l dvZadeYRe4 YZVR\_dTcVRevR` `\_XeYV dvgvdŽ:eZd RS`feeYVd TZR] eZdR` `\_XaV a]VR\_U eYVT ]ł ]VTeZVCAcVd/\_deZ\_ `VeVVdvZ2\_UZ:ZteYZteYRe d₩ de` SV<u>Z</u> U f SeŽ

 $@_V`WeVbfVdz_d^`de`V&V_RdvUzdhYRe$ dked 4 YZVRaRoeŽ2dS`dUkdT ^ VU`h\_ R\_U Vgi Vgi eYZXSVT ^ Vdd'S[VTee`TYR\_XkL\_`e`\_]j eVV X`UdZ\_eVVd^adSfeeYV^`deoZ Vh`c\_YRSZedL ZeZlYRdUk R\_U YRUVc'e`dsj hYReZdaVff]Zc e` 4 YZVŽ@\_Vd ^ S`]`VZ\_ecfdgVV&VZX\_VdtZleYV YR`SfcXkZAKETVgVURd ^ VeYZXRJZ/\_R\_UZ\_gR dgvLZeZd\_`\_VeVVkdR\_Ze&XcR] aRe`VVR2j JZVŽ EYVR`SZgR]V\_TVZHIJVRŽH YZVZeZdUV\_`f\_TVURd [f\_\W ULZeWc^daRe`W R\_j 4 YZVR\_d\_`c^ R] UZ&ZEYZdeReV`VRWZdZd\_VhLSfeeYVIRd/ VeYV YR`SfcXkZZNRCW^ VITVacZ\_RJZ.eUV``\_dedRekdL Z\_aRoeZff]RLeYReXj`SRJZREZ\_T\_dZbd\_`e`\_]j Z\_VeVc\_R] ac`TVdtkdLSfeZ\_eYVZeVZcXZrZ\_`W eYVdVSj 4 YZVR\_d TZ6jŽ

EYVWZ Z\_A]RkR:eR]ZReYcZ]de`eYVVia]`Zed`W eYV4 YZVR\_ eVR^ R\_UhdRadYZ dMVZ\_ eYV\_ReZ\_R  $\sim RXZB f VdeZ _ZX` VbiYReZdy4 YZVR_%decZVdYZ`$ Rd`UUŽ7`cYZ`ŁeYV\_ReZ\_RJobaZZe`SgZfdjViZtedŽ 9 VZdZ\_\_`UfSeeYReYVZd4 YZvR\_R\_USVj`\_Xde`  $RT^{\uparrow} f_Z = Z = Z = Z = Z = R = Z =$ \_ZejeV\_Ude`hRdudgRXfV\_VddLY`hVgVvZEYVVRY\_d d'TZRJWRScZTS`ZJdU'h\_e`YZclcVJReZ\_dYZadhZeY W] h df aa celved Z eYVW eSR] deRLZ ^ ŽEYZd eczsvzewdyz Ra`hvewnjwwyz\_X`Wervevsvz\_X RyHWZA`]]VIezeVZV\_ezejdW^de`SVRIezePeVU Sj Rac`TVdd`VW^`eZ\_RJVKdZ\_ReViedRdJZ\_Rdj ^`^V\_edŽ3feeYZdZ'RXZ\_Rcj`VRxyHV%bJ'Vd\_`e Z`a]j eYVZNR`WRydfS[VTe%LaRdy]WeVjZR\_eRTe`c  $\underline{Z}$  d  $\underline{TZ}$  U]b`mž Vi hcbY h UhgYYa g`hc 'VY XfU]bYX' cZUbmiYl dYf]YbWY cZgcWYhm' EYVWZŁ]ZV  $^{R}_{II}$  4 YZVR\_dLU Vd\_`e}\_UZ\_YZdURZji c`f eZV eYVejaV`WaTZRJS`\_UeYReh`f]UV\_RSJVYZ'e` T\_TVZeV`WalTZAGi RolRT]]VTeZeVofS[VTeŽHZeV`fe eYRe Via VZZ/TV` VR\_ REZEV d TZAjŁeY VZNR` VR Sc`RUAC4YZWR\_ZUV\_eZejZelhVR\V\_VUŽ

:eZL\_`e[fdeeYVUY R\_Ud`WY\c[`S eYRe`g\d hYV]^ ;\R\_\_VeeV> `\_dRg\Z6gV\_^`cVeYR\_eYZE ZcZleYVUZ/VIF]ej `W\_UZ\_XR^ \R\_Z\_XZ\_Y\cURZj \{ZeV\_T\ZJ\edYVIR\_\_`ede`a eg Z\_Xe`^ R\_VdV\_dV `\YZWZ:eZL\_`eV\_`fXY\VcY\ce`U`Y\c[`S hV]]E `cSVRX`UTZZKV\_hY``SVjdeYVd`]\EL`c\gV\_R X`U^`eY\chY`afedY\c\R^Zj } ddŽ@g\cR\_U RS`gVeYVUZXWWEV\_ec`]VdeYReVRIYaVcd\_aVcVc^d. eYVcVZIRUV^R\_UWc^VR\_ZXŽ9f^R\_SVZ\_XdYRgV e`XgV^VR\_ZXe`eYVZcVIZEV\_TVe`T\_deZfeV eYV^dvJgVdRdR\_ZUZgZtfR]y.%Z\_cVJREZ\_e`eYV @eYVčZ\_UeYVjTR\_`e^R\_Vdv\_dv`VJZW`fedZV RdTZEJT\_eVieŽ

9 `h ZdeYV Via VoZ/\_TV `WURZj [ZW} ]]VU hZeY ^ VR Z XOEYV&V ReV a VZ Ud h YV\_eYZd ^ VR Z X ZdeR\V\_WcXxR\_eVUŽ2\_UeYVcVRcVeZ\_VdhYV\_  $\mathbb{Z}$  SVT ^ Vd R ac SJV Ž;  $\mathbb{V}_{\mathcal{L}}$  VeV >  $\mathcal{L}_{\mathcal{R}}$ UZicZV\_eVUR\_Ua`hVcfVcdle`R\_chVcTVceRZ\_VV\_UR ^ V\_eR| bf VdeZ\_dRS`feYf^ R\_ ViZdeV\_TVŽE` deRce hZeyŁhYRedY`f]UdVU`0:eZdRh`ccjdV`WW WM/dŽC`feZ\_VRdYVcUR;łe`łUR; |ZWZŁdYV\_VgVc de`adh`\_UVcZXhYVeYVcdVVZlUZXeYVcZXYe eYZ\_XŽH YRedY f |U: U 02\_UeYVydY f |U%bf Vd eZ\_Z`a]ZdeYVyhR\_e%bofVdeZ\_Ž:deYZdcVR]j hYRe : hR\_ee`UOHYjŁdVeYZ\dLTR\_eYVch`c\ZX Y f cdSVTYR\_XUd eYRedYVTR\_X\eY ^ VZ eZ V e X R UalR Z eYVdof RcVhZeY YVcd\_0; VR ł \_VeeV>`\_dRgVhR\_edTYR\_XVLSfedYVdV\_dVdeYRe eYZdZdSVj`\_UYVca`hVcZDYVaVcTVZgVdeYReZeZd eYVhR, d'TZkáj Zd`cXR\_ZkVUeYReUVéVc^Z\_VdhYRe Zdya`ddS]VZZ\_UdYVX|Z'advdY`hR]Z/\_dvR]Z;jZd e`YV&LR\_UY`h a`hVc]VcdddYVZZŽ

 $EYV_j f_X R_RX_c R_d Z RX_V R UZXXCV_e$  $hRj \ WZWZ:eZdXWReVc~ViZSZZej \ WVa]j^Ve$ YVhR\_edLY`hVgVdLcReYVc.eYR\_`Vhi`c\Z\_XY`f cdŽ 9 VZdeZVU`WeYVT\_deR\_eYfccj\_R\_UZ\_dVTfcZejŽ 9 Vh`f]U]Z.Ve`X\\eRhRj W/^ eYVa`]]feZ\_R\_U devldd`WDR\_026XXŽ2dYVT\_dZUlddhYRee`ULYV eYZ\_\d\_`e`\_]j RS`feVT\_`^ZTT dedR\_USV\_VjeeL SfeRjd RS`feeYV\Z\_U`W/ZWYVh`f]U]ZVe`  $VRUŽF ]eZ ReV_j LYVZlecj Z_Xe h`c\`feyhY`:$ R^ %ZEYVac`TVdd`VZ\_UZeZLFRJZReZ\_ ^ VR\_deYRe √g√g S`Uj YRde`h`c\eYZd`feWceYV^ dyg√dŽEYZd  $\underline{Z}$ g`]gVdR\_V\_`c^`fdWWW.deZ\_RdTZXej ]ZV4YZVdŽ H\Y`Zcfa Uhcb`cZh\Y`gY`ZWUb`VY`YI Wi W! Uhlb["'GYZXYÚb]hcb'UbX'gYZfYU`]nUhlcb' \UjY`bYjYf`VYYb`YUgm":\_UZgZfRjd\_WUe` dR\_URIZVW/^ eYV dMgvdR\_U]``\ ReeVZc]Zgvd hZeYZ\_eYVZcdTZR|T\_eViee`dWhYRe`aeZ\_dRcV Reprziks [VŽH YVeYVceYVj RcVRh RcV` Vze` c\_` eh YV\_ eYV/R\_Rj dveYVZcgRf VdR\_UUv2Zv2LeYV`aa`cef\_Z eZdReRZRS [VR\_UeYV]ZVjj cZhdZ\_UZeZJFRddvARU

eYV dygväRd<sup>^</sup> V<sup>°</sup>SVa<sup>°</sup>WiTZkjŽEYVZ:Rdväd<sup>^</sup>V\_e <sup>°</sup>WiYReZda<sup>°</sup>ddZjVR\_UjZ:VjiL<sup>°</sup>WiYReeYVjhR\_e e<sup>°</sup>U R\_UhYReeYVjTR\_R\_Uda<sup>°</sup>fjUULR:VaRae <sup>°</sup>WeYVdTZRjh<sup>°</sup>dUeVyjZzVZŽ

 $\label{eq:starting} \begin{aligned} &3fehYRe ckl fcTkl^ ZXYe SVR9R4RS]VZ_eYRe \\ &d TZkj_Wc T_W_eZ_X eYVTYR]V_Xkl^WZ_UZ \\ &gZIFRJZREZ_OAV a]VakCIVZgV eYRe eYVacklif ckl \\ `Wh`c\ R_UT_df^aeZ_LeYVZ ckla`_dSZZj \\ &Wc ScZ_XZ_Xfa eYVZ TYZUV_ R_UeYVZ WRckWc \\ &eYVZ `h_YKR]eYX e`^R_Vfa R_R]]T_d^ZX \\ &y^RIYZ_WZe_]j_hYV_eYJ_RV cklift UW hZY \\ &eYVZ `h_W^ZZdU eYJ_WJ eYJ_YRgVWf_UR \\ &cWkXZ3feZZRacXIR:Zfd`_VZHZYURhZXZe` \\ &RacZgReVh`d]UZl_`ac`eYRZ_Ze_ eYVT_eRgiL \\ &Ze^VR_dXZZj `WI_2eRiZ_Z$ 

EYV&VaY e`X&PaYd dr`h eYRe eYV bf V&E\_`W eYVydy]V&&W&dSRT\e`eYV bf V&E\_`WyhY`hV RV%&R\_U eYRe eYVZ:RXV`V&YVyH V&acV&f aa`dd R\_VfaVZ\_TV`V&TZ&jZJVRcdRX`L eYV yf\_Zj‰ `W4YZJVR\_d TZ&jhRdR&S``d'S[VT&T]`dvU e` UVSReVLdZ\_TVUZgVcdZjhRdT\_~ReVUhZeYUZd dvZ ?`hŁ`\_ eV eYkYŁ Ud TZ Uźykt j dW d\_`d ^ R] R\_U\_Rf dZ YVh VR V Z X`Wkt Z f\_Z X WEIVL d'TY RdeYV\_RZ\_R] DREVR\_UeVV4 RY´]ZT 4 Yf cIYL YR d' ^ SZ\_W hZY R\_ f ad cXV Z\_UZW WEV eZ Z\_ ac`Tktkkle`d/ReeVceYVYRSZ LZW WEV eZ Z\_ ac`Tktkkle`d/ReeVceYVYRSZ LZW R\_US`\_LtdeYReeYkWkEIKdYRUZ\_dE f eZ\_RZ kUZ\_ eYVyf\_Z j %%W4 YZ VR\_d TZ ij Z 5 g bY j Yf VYZ fY ż h Y a i 'hd`]WImc Z]bhYf Yg g UbX 'VY`]YZ j c Z c d]b]c bg`UbX`dfYZ yf YbW g z` ]g`VYW ca ]b[` WYUf''Cc WU`X]j Yf g]mi`Ug VYW ca Y`Vch`U` XYa c bg fUVY'Z WhUbX`Ub`Ug d]fUhjc b"

9 `h TR\_ RdYRVU `dVcSVSc`f XYe`f e` V&ZD 7 cRa]f dZ&ZT`dVce`SVT&V&VU`f e` V&RZG IeYVV\_WUde`SVd ^ VhYVVHYVVAVVUZWV/TI VdTR\_ SV\_VX eZ&VUR\_URXW V\_eCVRTYVUŽE YV ^ f]eZa]ZZg` `Wd TZG ZIRezTf]ReVLUV&Y`aVUR\_U X&V\_T YVV\_TVhYV\_RYT ^ ^ `\_h`dU%vIZ&HR T\_eVIed/RVU\_`e[fdehZeY`f cT\_eV`a`dRZdL Sf ehZeY eY`dVhY`TR`VSWVVf dR\_UeY`dVhY` hZ] T ^ VRAVČZE YZI yT ^ ^ f\_Zg`%ZI XV\_VReVU acZ`RZJ; Z\_eh`daYV&VZ 3f e S`eY YRgV f\_UVX\_V V\_`c^`f dTYR\_XXZ

 $\hat{I} = Zh_b[b_b[ UVci hW h fU^{Y}]XYbhhmX]X'bchdfc!$  $j [XY'i gk]h^UmUfXghW_Zcf'Xc]b[ 'h}b[ gk Y^{V}YfY$  ʿUbXˈbck ž]hk ci ʿXʿU`k UngʻVY UʻgYWcbXUfma Ułł¥fž cZa ]bcf`]bh¥fYgh'İ

DYXfc 'A c fUbXfž% - \$"



# < I A 5 B 89J 90 DA 98 H5 B 8 7 I 0 H F9



## H 9.7 < 5 @ 9B; 9C: 7I @ HF9

 $2 XJR_TVRe 4 YZVR_d TZRJ acRE6ZIVdcVgVRJdeh`$  $eV_UV_TZVCZ 7Zcdejj ŁeYVZ RXV`WeYV yH V%eYRe$  $V_RSJVd a V aJV e` WWJ aRce`WR T ]]VI6ZgV RIe`c$  $dW^ de` SV h VR.ŽDVT_Uj ŁeYZd Raa VRcd e` SV$  $T__VI6VU hZEY eYV UZAVIF Jej ^ R_j Z_UZGZUF RJd$  $YRgVZ_VI a VCZV_TZ_X d TZZGj Z_R T_TCVEV hBJŁ$  $ZZZLZ_VI a VCZV_TZ_X eYV ecf de R_U VCZV_U2AZŁeYV$  $cVT X_ZZ_ R_U RWWREZ_ eYRe X e` ^ R.Vf a eYV$ d TZRJ VRScZIŽ

 $\label{eq:states} \begin{aligned} & \text{SVIR}^{\text{C}} dV^{\text{VeV}} dV & \text{VZ}$ 

`TTFcdhYV\_eYVZdR^Zf`ReTYSVehW\_eYVdV eh`UZ`V\_dZ\_d`WdTZR]VJaVGZ/TVŽAVa]VU \_`eVJaVGZ/TV]ZWZ\_dTZKejhZeY`fecWWCV\_TVe RckácVdV\_eReZ\_`WdTZKejŽ4`\_gVcdVjLeYVjhZ] \_`eUVgVj`aR\_jZ`RXZ\_Rej`V&YVyHV‰fecZLV`W eYVZcdTZR]VJaVGZ/TVČZ

:\_ eYVIRd/`W4YZ/JeYZlac`UFTeZ\_R\_Uc/ac`ł UFTeZ\_`Wd TZAj ZleYhReWZ6gV\_hYV\_4YZ/W\_d ReV\_`eRhReV`WZELTF]efd?]TYR\_XXdReVYRgZ\_XR UZEVTeZ`aRTe`\_ eYVZ:URZj [Zg/dZ6gVj`\_VRXWEL hYVeYVceYVj Raac`gV`cUZRaac`g/LeYReeYVdj [V `Wd TZE]Z\_eVRTeZ\_YRdf\_UVX\_VR^R[`cd/ZGZ 7Zchelj Ł\_Vh of S[VISZgV Via VSZ/TVd YRgV TR]]VU ZYVSZENU Z RXVd`Ven VyH V%Z e`bf Vatz \_ŽEYZd hVR\_Vdd Z erVVT ]]VISZgV Z RXZ Roj ol W de`SV ^ R.Z.X Ze YRCU & Wc 4 YZVR\_de`WV] erVj RcV aRceZTZa Rez X.Z\_ erV d`TZd] TYR\_XVd f\_U/c h IgŽ DVT \_U]jŁ^ R\_j aV a]Vd RTef R] Via VSZ/TV`W d`TZdj ol W de`YRgV SW\_ f\_U/c^ Z VU Rdh V]Ž 2dR cvf ]eL Ze ZISVT ^ Z XYRCU ce`c XR\_ZEV erV UZgvozej `WZ RYZ RZDARc f\_URT ]]VISZgV yH V Zo EYRe Zdh Yj Tf ]ef cV^ Revoz

EYZELR\_RJj dZela`Z\_ede`RW\_UR^V\_eRJ eRd\Wc eYVT ^ Z\_Xj VRodŽ2dZeRaac`RIYVdZed3ZIV\_eV\_RcjŁ 4 YZJV ZelWRIVU hZeY R\_ReZ\_lSf ZLZ\_XTYR]V\_XIŽ > WeZ\_XeYZELhZ] ^ VR\_T\_decf TeZ\_XRyH WeeYRe YRdeYVa`eV\_e2R]e`XgVc\_eYVVfVefcVŽ

E` TEVREV EYZI YH V%Rd R UCZEVE `WYF ^ R\_ UVGV]`a^ V\_eL4YZJVR\_dhZ]\_WU e` aVEWE^ R eh`WJUeRENŽ7ZdeljLeYVJ hZ]\_WU e` aVEWE^ R eh`WJUERENŽ7ZdeljLeYVJ hZ]\_WU e` XV\_VEREVR\_ Z` RXZ\_Rg` `WiTZIG RdRT ]]VIEZEVRIE dLEYC f XY hYZY 4YZJVR\_d TZIG TR\_CVT X\_ZXZedN/McHRyH V‰ TRARS]V`WMRAZ\_XZedUVEZ\_jŽDVT\_UJjLac UTZ\_X Rdec`\_XZ\_RX/`WYZJVH V‰ VR\_d4YZJVR\_dSVZ\_X RS]V e` UVGV]`a R\_ VIaVZJ\_TV`WiTZIG Z\_ eYZc URJ le`lURJ d'TZI] CVJRZ\_dZZeŽ7` ceYZle` YRaaV\_L aV a]V\_WU e` cXR\_ZXVEVVZcUZWWEV\_eVIaVZZ\_TVd Rc`f\_URT ^ `\_ h`dJUReeVVd? Ve2' VRdeYVJ Z\_TEVREVEVZcZ\_UZgZIFRJ VXVU ^ Ž

### 7 I @H F9 5 G 5 DFC 6@A

2 XRa YRd`aV\_Wf a SV:hW\_ 4 YZ, W da V:d\_[] ]Z; V:dR\_UeYVd TZG eYY ]Z; VZ  $LR_UZ$ :hZ] SVUZW } Tf ]ee T]`dZ:eZiZ\_UZREZ; VVRTf ]ef dR\_UV TZL SVIRf d/Tf ]ef dVZ:h YRe T&RevdeYVT \_UZZ\_dWc T\_eRIehZeY@eYVdR\_UScZ\_XdaV a]Ve X&YVcZ Rd/R:VUhB;`V/ZWZE YVhB; dZ\_hYZIY Yf^ R\_SV Z X:l]Z; Ve X&YvcZ\_Xc f adZl\_`eacUV&c^Z\_US; \_Ref dV eYY YR; Ve Z.gV\_eR\_UU&; a eYV hZY eYVZ:aVddZE`d c; Z; dR\_UX; hYReeYY RdzZV e Le`V V:TZVeYVZ:V`eZ\_dR\_UX; X; Zi ]R:Z\_L Yf^ R\_ JZW ]RI\d^ VR\_Z X R\_U T\_dR\_ej RLRaeZ, X RT^^`\_ hB;`WZWZ: eYV^`de TYR:RIe&Z; Zi Yf^ R\_ RIZZ; Z

EYVV&^ deR.V\_Sj d TZG dyReZ\_dvZadRv/ fTY ^`dveYR\_RadRieZIR] WRIe ^`dveYR\_Rdve`VkXdWI ^V\_edR\_Uac`TWLF dvdWcV\_df dZ XeYVf dvgZgR]`W VRIYZ\_UZgZLF RŽŽ3j`dXR\_ZKZ\_XeYV^dvlgVdLYf^ R\_ SVZ\_Xd drezdyVeYVZc^`de adddZ\_X dvbf ZV^V\_e+R ^VR\_Z\_X e`]ZgV WdLR\_ZJV\_eZej e`dVT X\_ZkV eYV^dvlgVd SjLR\_U UZX\_Zej e`dVJReV e`@eYVdŽ 7`c eYZd dVRd\_LeYV dX\_Z; TReZ\_ R\_U adRieZTV`W d TZRJ dvJReZ\_dvZad YRgVSW\_ReeYVTV\_etV`WeYV daZzef R] R\_UZ\_eVJ[VIEF R] WWked`WYf^ R\_Xcf ad W^ eYVeZ VI WAYVROJI Yf\_eVIXReYV&VadhY Wf\_U^ VR\_ZXde` cXR\_ZWeYVZ JZvdSj Z\_Z RXd `WRf cVLfae` eYVacdV\_eUJthZY ZdUNSRAd RS`feeYV^ VR\_ZX`WZZXV\_dZaR\_UUV^ `TRTJ Re ReZ V`WA`SRJZREZ\_ŽEYVcVf]eL`gvceYVT fodv `WYZde`gLYRdSW\_ XcVReUZgvcdZj R\_U^fdSZJ Zg`Z\_d TZA`cVJReZ\_dZadŽH.Uh`Jg`W`h`fY.h`Y` dUffJW`Uf`k UmJb`k \JW.U`gcWJYhmYI dYf]! YbWYg`Jg`gcWJU`YI JghYbWYZUbX`h`Y`k UmJh WebWYJj Yg`cZUbX`fYdfYgYblg`Jh

H ZY IF JET CALAV A JVT J VIEZYJ ST ZUEVN' OU eYJ JZVZ ŁVI A VZV\_TZ\_XEVV OLGYORIST ZUVCI W eYREN' C UŽCVT X\_ZZ\_ `VEYVGZET\_WUVCIF JET CV ZIZ dARCES VVV ^ EYVCVT X\_ZZ\_ eYREZ UZGZIF J RJdRVCT S [VIEČCI V YWg UFY 'N c gY 'k \ c `cc\_` k ]h ]b h Ya gY j YgZ f h Y c f][ ]b UbX a YUb! ]b[ `cZh Y]f`UWJc bg`i dcb 'h Y 'k c f XZ UbX' k \c`\Uj Y 'h Y 'VC `YWJ Y 'VC bX]Jc bg`h Ym bYYX hc 'VC bWY J Y 'UbX YI YW HY 'h YgY'' 2\_U h YREZI' VR\_ESj d'S [VIEZZEJ ZLEYVCH YCVZ h YZY d'S [VIEd ReVT\_dEZ dcV-VIZ\_dUVZVZ

H YRe eYV F\_ZeW ? ReZ\_d.R\_U da VIZXXIR]j eYV F\_ZeW ? ReZ\_d 6Uf TReZ\_R]LDIZ/eZ T R\_U 4f ]ef cR] @cXR\_ZERZ\_ 1F ? 6D4 @/Lf\_UkdeR\_U Sj Tf]ef  $dVZ_RSc RU dV_dV RV eVV Wc^{A} deRVV$  $Sj JZWZ_d TZ4jZE YVRZ `VeVZIRaac RIY ZIacVi$  $dTcZa62gVdRYVceYR_R_Rj eZRJŽ2_j Tf]ef dR] Vi acVd$  $dZ_UVdVgVdcVdaVTeRdRYf^R_TcVReZ_R_URdR$  $T_ecZSf eZ_e UZgVdZjESf eZeRd TR_R_U^f de$ SV def UZU e`dWY`h VRc Ze UvgVj`ad R d TZ4j`d $d S[VT62gZej R_U^R_Vdfd S[VTed`VVZed^V SVdŽ$  $EYZIZIhYj Yf^R_UvgVj`a^VeZII]`dVj JZ_VUe`$  $Tf]ef cVZ9 f^R_UvgVj`a^Ve^VR_deYVI eV_dZ_$  $`VZ_UZgZIFR]dR_UeYVZcT^^f_ZZdT`aa`cef_Z$  $eZdR_URSZZej e`SVT^VdfS[VTedR_USV_VjeVV'$  $eYVZc`h_UvgVj`a^VeZ$ 

AV a VSVT ^ Vdf S VTedRdeYVdvdf le`VRT ^ a VI Z\_ek/a]RJ\_SVehW\_eYVZcaVcd\_RJ\_YZde`cZkdR\_UeYVZc ViaVEZ/TV`VolTZ6jŽ2]]Z\_UZ6ZLFRjdReVS`c\_R\_U Uvgy a hzeyz Vizez Xd Tzezdze Yvzc aa ceft \_ZZZdWcSVT^Z\_XdfS[VTeeLR\_UeYVT\_deeRZ\_ed eYV/WAVZ\_eYZdcVdaVIdLhZ]eYVCWVCVU/aV\_U`\_ eYV giaV`Wd TZkgŽ:e ZdeYc fXY eYVZ RXZ\_Rgi `WalTZAG eYReaVa]VdVTX\_ZAVR\_UdvR]ZAVeYV ł dygvdRdaRce`VRdTZkjŽ4`\_gvdyjŁZeZleYR\_\d e`eYVZcViaVZZ\_TV`WdTZKejeYReZ\_UZeZLfRjdTeVReV  $RcVacVdV_{eReZ}$  `VeVV  $dMgVdRdRT ^ f_ZjZ5$  ` We YWH Y a U bUfm g h Y gYhc Z XYU cf gna Vc`]WfYdfYgYbhUhcbgk \YfYVmh\YVU! g]gžX]fYW]cbUbXaYUb]b[cZhYfYUh]cb! g\]dg'Ua cb[ 'h\Y'a Ya VYfg'cZU'[ fci d'cf' gc WYhmUfY XYÚbYX" EYVT ]]VTégVZ RXZ Roj Zd \_VZeYVcR\_Z]fdZ\_\_`cRW2\_eRdŽ@\_eVVT\_ecRcjŁ ZeZdRoW] aYV\_`^V\_`\_Ž6gVgi d'TZVgi ac`[VTedR\_ Z'RW^`WZeM/WR\_UZeZdeYc`fXYeYZIZ'RVZ\_Rgi eYRe ZeoVT X\_ZXUZZeM/WRdRT YVoV\_eXc`faŽ

4 `][VIEZEVZ RZZ RZZGEV\_Ue SVT ^ Vd ^ Vh YRe UVERTYUV& ^ eVgRRZG WRZ J ZWETG dR]ZZZ X Z `dl `ch ZEV\_ edl ZZ \_d. ZEF RJdR\_Uh `cd `W Red Z dEF eZ \_dR\_U]R\_XFRXZ; f de RdZeZdV S`U ZUZ\_ eVV& d`VRTZ j LeVT ]]VIEZEVZ RZ\_Rj dkd Zd dR] `\_ VgVg acReZIR] Rd VIe `Wd TZR `cXR\_ZREZ\_ŽF JeZ REVJ LY h VgVL eV gZRZ j `W T ]]VIEZEVZ RZ RZ d ZdZ eVVC RSZZ e`XgV ^ VR\_Z Xe aV a]VdRIef R] V a VZ/TVdZ\_UZ J ZWŽ E YF d SVh W\_ aVd\_R] d'S[VIEZE RZ RJ e' XgV Z RZ Rj eYVVRV]Z d`W f ef R] U a V\_U TVL T \_T dR\_TV `c T \_eRUZIEZ\_ŽE YZd c/ReZ\_dYZ UZZVdeVIF Jef cR] U\_R ZT `VRd TZG Z

## GI 6>97 HJ ≠M5B8 A C 89FB + 5 H€ B. H 9 D9FGD97 HJ 9 C : H 9 < I A 5B 89J 9@ DA 9B HF9DC FHG = B 7 < =@

EYVTF ]ef dl hVR\_Vdl `W4 YZV YRd ]Vdl e`U hZey eYVUZRaaVRR\_TV`c\_W3VTe`W1^V`VZed ed UZZ\_deYR\_hZey eYVUZIVTF ]ej `WVdeVZ\_XT] ]VTeZgVZ RZZRZdeYReeR]j hZey VgVg U3\_VaV cZ/TVŽ:eZl\_`eeYRe^`U\c\_ZRZZ\_ZUVde`j Z\_X TF ]ef cV\_deYVdLeYVdaVTZ\_TVc^Ze YRd eRV\_Z 4 YZVR\_U eYVCAcVdV\_deZ\_deYRe RTT^aR\_j Ze RVRYZ\_UR\_TVe`eYVT\_deZef eZ\_`V&Vcd\_R] R\_U T]]VTeZgVd S[VTedZeZ VR\_U RXRZ\_L9 f^R\_5 V gV]`a^V\_eCVa`cedZ\_4 YZVYRgV^RUVeYZTeYVZ TV\_ecR]T\_TVc\_Ž :\_ "\*\*' ŁéVV) cceCVá` cedEeVUé/ReyeYVTYR\_Xdd `V&VTV\_ej VRcdYRgVaRceZff [Rc]j RWWTEVU VgVcj URj [ZW R\_U d TZSSZZcj Ł R]`\_X h ZeY eYV W? Zj R\_U T ^ f\_zj WScZT R\_U aV a]Vd gRff Vd R\_U Z.V.}  $eZXVZEYV CVá` ce Wf_U eYReL Rd eYV W? Zj R_V$  $YRU eRV_ a]RTVL yeYV 4 YZ VR_ d TZAJ WScZTL YRgł$  $Z_XUVgV]` a VUZ_bf R_eZEREZGV eVc^ dL_`h cVbf ZVd$  $bf RZEREZGVZ' ac` gV V_eZEYV cf XXX deVU cV VUj$  $h Rde` yT ^ a]V^ V_e eYV QBR_URU` WZZZ_X ]` XZT$  $h ZeY R Q;Rj `WZW ]` XZ% Rd R acVT_UZZ_ Vc$  $^` cVUj_R` ZT R_U cf cd RZ_RS]V Yf ^ R_ UVgV]` ał$  ^ V\_eŽEYVdVa`d&Z\_dV^ S`Uj eYVgZha`Z\_eeYRe aVc^ VReVd9 f^ R\_5 VgVj a^ V\_eCVa` cedZ\_4 YZJVŽ EYVZc^ VdRXVZde/ReeYVT f\_eqj 'd^ `UVc\_ZReZ\_ YRdR\_RchVTeeYReTR\_\_`eSVZX\_`dVLh YZY ZdeYV d'S[VTegZej `VZ\_UZgZuf R]dŽ

7`]]`hZXeYZlRaac`RIYŁeYVdVT\_UCVa`œ 1"\*\*)/ŁV\_6ZEWUEYVARCRU'i `W& `UVc\_ZKReZ\_Ł  $ZV \in ZV \in VT \quad dvbf V Tvd W VXVT \in X d TZR$ dfS[VTezzzijŽEYVaRcRUiT\_dzedZ\_RhZUkacVRU WWZX`WZdVTFcZejR`ZbeeYVdeVRUjZTcVRdVZ eYVT f\_eqičdVT\_`^ZTac`daVzZijŽ:\_RgRzZkij`W RVRdeYVCVa`œUZX\_`dVURd'S[VIezzi eYReYRU SW\_YRc^WSj\_eVV`gVchYVj^ZXRLgR\_TV`WR ^`UVc\_ZKReZ\_UCZęV\_`\_]j Sj Zed`h\_Z\_eVc\_R ]`XZIŽ3fed`TZR]d`S[VTezezej Zel\_`eRyd`Ve%eeRcZl RS[VeYRe^VeVjj eVda`\_UdaRddZeVjj e` eYVWeTVd XV\_VCReVUSj\_eYVyYRU%h`dJU`WeYVVT\_`^jŁ a`]ZEZTd`ceYV]Rh, ZeRJd Z\_~fV\_TVdeYV`S[VTEZeV cVR]Zej `Wd TZVejŽHYV\_aVa]VdUV^R\_UdWc  $dMF cZe_{i} R_U dMT X_ZE_R CV_eT_dZ M CVU R_U$ cVda`\_UVU e`Łd`TZR|dfS|VTeZeZej eV\_Ud e` efc\_ SRI\Z fa` Zech/WZEYZdh-VR\V dd TZR eef de R U  $T `aVcReZ_kRWWW1eZ_XeVVh`c\Z_Xd`W1_deV^ dR_U$ ZedNVŽ4`\_dVbfV\_ejjLeYVCVa`ce^RZ\_eRZ\_deYReeYV df deRZ\_RSZZej `WW^ `TcRIj ŁVT \_`^ ZTXc`heY R\_U Yf^R\_UAW a^VeZed WUAV Ud`\_eYVUXeW `WT^a]V^V\_eRoze; SVehW\_eYV\_WUd`We1TzR  $d^{T}S[VI\partial z z z R_UeY dV W deV dR_UZ de z z dZ]$ 2 UeYVEVTR SV `T ^ a]V V eRg cVRez dYZa hZeY feRdec`\_Xd TZR] df S[VTeZezej Ž

EYV#!!! CVà`ceLV\_eZJVUE`hRtURDec`\_X\c D TZAj e` 8`g\c\_ZXeVV7f ef c\LVi a]`c\UeYVa`ł e\\_eX]`Wi TZJ d`S[VIEZZj Z\_4YZ/ŽEYZIZ\_bf Zj T\_cLV&UeYcWUj\_R`Zd+eVVISZZj e` RoeZIf]RV R\_Uac`T\dIT]]VIEZZVRbZREZ\_deYVIZEV\_TVR\_U VieV\_e`Wi TZJ TRaZEJLR\_UTZZV\_d`c\RUZ\_\dde eR\VT]]VIEZZVRIEZ\_ŽEYV R\_Rj dZi du` h\U eYRe



4 YZVR d'TZKej UZU a`ddxdd eYVdV cVd f cTVdLSf e eYReeYVLIZaVcdNUR\_UVXRX^V\_eRcj\_RefcV^WeYVdV Uj\_R^ Zīd^ RUVZeUZIŅTF]ee`UVa]`j eYV^ ŽEYVCVI a`ceT TIFUVdeYRe` VZUZaV dS]VdVdfcTVV/c  $Yf \land R_Ugy \land V_eZRyT \land \land \ h \ dUUUUZgZX$ W/^ R UVIZHZ XWcaVcd\_RR Ud TZR of S[VTHE ZejŽEYVbfVdeZ\_Rd\VLLeYV\_ŁZdyY`h TR\_RT^ł ^`\_h`dJUSVac`UfTVUReReZ`V`VXJ`SRJZReZ\_ R\_UZ\_TOURDZ\_XZ\_UZ6ZLF RZZR6Z\_ŁZ\_ Rd TZK6jeYRe ZIA ` OVR UA ` OVUZOVOZZ VUR U RIVZ XZ d ZU ZV\_ ÆZKOV HAYÎK YÎ ei Yehcberi [Yehech Wh \i a Ub XYj Y`cda Ybh ]b 7 \]Y ]bj c `j Yg U W/h fU`WU`Yb Y":\_dY cet ZezleYVT \_ Tvaef R R\_UV aZZIR h`c\U\_VSj eYVacVgZfdCVa`ced eYRe\_`h d'XXVdedeYV\_WUe`dV-VTe`\_eYVTf |ef dR dÆfReZ\_`₩eYVTf\_eejŽ

DYZ&J Z eYVT ]]VIðgVZ RXZ RJ RVR `C'R aYV `^V `\_ŁRIRVTYR\_XIdZ eYVWC^ `WJTZJ V aVZJ TVŽH YReeYVaCdV eCVá`œa`d&JZleYRe eYVCVZIR^Zh REIYSV6hW\_eYV6h`ac`TVdMŽZ ARce #LRAKC`f eJZ Z Xd ^ VZ RYZ RZd`W4 YZYL eYVCVá`œUXIZSVIY`h eYVT f\_egidZ YVZAU dJWZ RXVYRJSW\_VC`UVLŽ4 YZYR\_dU`\_`edW^ e`YRgVRd/RXUZ RYZ\_Rg e`daalj T\_eV\_eWc eYV\_RZ\_RJZV & gZ Rg e`daalj T\_eV\_eWc eYV\_RZ\_RJZV & gZ RZ d'bf V\_eljLaV aJV}\_UZe UZWIF Jee`dWc eYVZ Z UZgZFR] V aVZZ/TVde`R Z RXV VeYVyH V@YReV\_RSJVdeYV`e`eR\_dIV\_U eYVZ Z ^ VUZIJŽ+i Jg bchih Y Yfcglcb c Zh Y' c XWc`YWJj Y Ja U[\_bUfJYgcZh Y ÎK YÏ h Uh We bgJh Hygh Y dfc V Ya c ZW 'h fY Jb 7 \]YZ Vi hih Y k YU\_bYgg cZh Y bYk cbYg'

$$\begin{split} & EYVh VR. VZX `W'_XYVUZ RXd` V4 YZVR_\\ & ZV_& & efg ZIR]` XZIR] T_dbf V_TV` V& VXCVReTYR_X \\ & VdeYRe YRgV` TIF ccVUZ_4 YZVR_d VgVg UB_d TZR] \\ & VREZ_dYZ dZAReS UVIEZSVdd ^ VTYR_XdZ_eVZC \\ & hB_d` VVZVVZE YVCVIV_eZ a` ceR_TV` VT_d^ al \\ & eZ_R_U eVVZVZE YVCVIV_eZ a` ceR_TV` VT_d^ al \\ & eZ_R_U eVVZVZE Z_L VC VIR^ a]VLhV]] Z]f deRevd \\ & Y h cRaZUJ_J R_U cRUZIR]J eVVZVREZ_dYZdYRgV \\ & TYR_XUZ2_U_Vh VC^ d` VdTZE] cVREZ_dYZa \\ & Z_VZERSJ_J RWWAR_J T]]VIEZVZ RYZ RZZZ$$

ARce % ZEIR\_f\_acVIVV\_eVU WWW.ce bfR\_eZGV eYVT f\_ecj dTf]efcR] cVd fcTVd R\_U Uj\_R^ Ztd R\_U e`dr`h eYVZ: UV\_dZj Sj cVXZ\_Ž2 XJR\_TVRe eYVdV ^ Radc\g\VR]dh YRe R cR\_XV`Waa`cef\_ZZXd YRd`aV\_UU faŽ3feaV a]VTR\_`\_]j a\CTVZgVR\_U ^ R.VfdV`WeYVdV`aa`cef\_ZZXdZVeYVj dWeYV` RdSVZ\_XhZeYZ\_eYVcVR]^ `WeYVa`ddZS]V/R\_UeVV S`f\_URZXd`WhYReZtlya`ddZS]V/BcVUdRh\_Sj T ]} ]VTeZgVZ: RXZ\_RZCKŽ

ARce&UNRJdhZEY eYVhBj Tf ]ef dRJ TYR\_XVTcVReAd TY`ZVdR\_UcZhdWcZ\_UZgZLFRJdŽ@\_VTYRCRIeAcZeZT `WIYZVZ cVTV\_ej WRcdYRdSW\_eYVXc heY`WZ UZ gZLFRJZREZ\_Ž2decRUZZ\_dhVR\V\_Ł4YZ/WZ dYRgV e`UVTZUVeYVZ gRF VdR\_UX RJdZ\_JZWLeYVZ dYRgV e`UVTZUVeYVZ gRF VdR\_UX RJdZ\_JZWLeYVZ dYRgV EYZCIYVJadeVV e`ScVR\_VXW`W]UT\_decRZ cd R\_UXZgVdeVV XCVReVC VXWU ^ RdZ UZgZLFRJde` TY`dVY heYy JZgVZ3fe\_`eVgVg S`U RIYZ/gVd Z UZgZLFRJZREZ\_dEcZNNTE cZjZ.\_ ^ R\_j TRA/LEYV hVR\_Vd1 `WT]JVTezgV cVWEV\_ed JVRUde`Rd TZRJ Z UZgZLFRJZREZ\_Ž2\_U eYZCIF\_dRecZNNTE cj ej aV `VaVvd\_RJZV\_eZej TR\_RJeVC dTZRJ cVREZ\_dVZad SVTRFdVZeeV\_Ude`ac`UFTV ^ Zhef deL`aa`cef\_1 Z' R\_U UZRVMNTEZ\_ R\_U a]RIV R\_VTVdEgV]`RU `\_eVVW?ZjZ

; f de Rd II f Jef dRJ TYR\_XXdRXWW leeY VacZgReVh`dU eYVec\_dWc^ ReZ\_`W4 YZJ VR\_d a Vcd\_RJ JZg vdZ JRW WIEZ\_XJZWZ\_d TZ kj Ź2 JR XV ac`a`ceZ\_`WaV a JV U\_`ecf TTWUZ\_Z eW KR Z\_X CREZUNI le`cZj Z\_e`eYV d TZKJL VT\_`^ZT R\_U a`JZZTR] ac`TV ktL R\_U eYZ ^ R\_V kleYV UZg vcd kj`W4 YZJ VR\_d TZ kj JV ktT KR Zg V eYR\_Ze^ZXY e SVZ ARce' dr`h dY`h dX^`V\_eVU d TZKJ UZg vcd kj Raa VR cde`SVZ\_R\_f^SVc`VR VR L eYVTF Jef dRJ XRa SVkh W\_d TZ KJ Xc`f ad Raa VR cdd X Kreey Re Zeh`f JUSV UZJ VTF Jee`T\_dccf Te RyH WZ E YZ LJ \_UZ\_X f\_U cJ Z\_V de YVa`eV\_eXJ Z a`ceR\_TV `VR\_ReZ\_LSF Z UZ\_XVI VETZ Ve`CR\_Z V UZW KV\_e V a V cZ\_TV dR\_U cha vdV\_eR Z\_dRc`f\_URT ^^`\_ h`dJUŽ

3j hBj `Wr\_TlfdZ\_ŁARe(Uthd`\_eV}\_U Z\_Xd`WYVdfUje`fdZ\_Vd^VTcZWZRWcRdWdd Z\_XeYVTfjefdRJUZ V\_dZ\_`WafS]ZTa`]ZZdŽBch cb`mWi hi fU``dc`]WYg`Ugʻgi WižVi hU```dc`]! WYgʻg\ci `X`VY UggYggYXZcfUbmidcg[hj Y`cf` bY[Uhj Y`]a d`]WUhcbg'h\Yma Umi\Uj Y`Zcf` h\YZcfa Uhcb`cZh\YÎK YÏ h\Uh\Ughc`VYh\Y` gi V'YWicZUbmibUhcb!Vi]`X]b[`YZcfh'

# 9L7IFGIG < IA5B89J9@CDA9BH5B87I@HF9=BIB8D KCF@8F9DCFHG

H ZEY eYV VZde H`c]U 9 f ^ R\_ 5 \g\]`a^ V\_e C\\actia`ceZ\_ "\*\*!  $\pm$ F ? 5 A S\\AR\_ Rac`T\\dti`\\AV\-VI! eZ\_`\_ IF]ef c\'\\AV^ eYV deR\_Ua`Ze`\\AVF^ R\_ U\\g\]`a^ V\_eZH YRe eY\\d\/C\\actia`ced WIf d`\_ $\pm$ Z X\\_\\AR}LRc\'eY\'IF]ef dR] \I ac\\dZ\_d`\\AVF^ R\_ U\\g\]`a^ V\_eR\_UeY\\hIJ`eY\]Ree\\cZIT\_dcdZ\_\U Sj IF]ef dR] ac`S]\^ dZEY\\U]`hZ\_XZIRScZ\\AVI! T f\_e`\\AV\C\]ReZ\_d\Za S\\dh\\\_Yf^ R\_U\\g\]`ał ^ V\_eR\_UIF]ef c\LRdd\\\_Sj eY\H`dUC\\a`ced Z`:eU \\d\_`ed\\A`e`S\\dd\^ R\zT`c \I YR d\z\g\L`c e` d\`h Y`h eY\Raac`RIY ^ IJ`YRg\U\\g\]`a\U `g\\ceY\\dh\\g\C\\a`ced af S]\Zh\Ue` UR\\ZEY\ZI S\\Z\_X eY\'IR\\LeY\C\]ReZ\_d\Za S\\dh\\\_Yf^ R\_ U\\g\]`a^ V\_eR\_UIF]ef c\\IR\_S\U\\d\[Z\XU]`LC \g\^ RZ\_d`S[\TeY\RLZ\_XZ

#### A 5-B H≮ 9A 9G

"Ž\_ Zed` cZXZ\_dR\_UZ` a]ZReZ\_dePVVT\_Tae `WYf^R\_UVgV]` a^V\_eZel]Z\_VU hZeY Tf]ef cVŽ :\_` cZXZ\_LyeYVc`` ed` WeYVT\_TVae` WYf^R\_UV gV]` a^V\_eTR\_` V&V\_SVecRIVUe` VRc]j aVcZ UdZ\_ Yf^R\_YZef cj R\_UTR\_SVWf\_UZ\_^ R\_j Tf]ef cVd R\_UcVZXZ\_d%b"\*\*%L"%Z2dcVARd.deYVZ` a]ZR eZ\_dy9f^R\_UVgVcVT\_`^ ZTXc`heYtecRUVLV` a]` j1 ^V\_eta` ]ZEZR] V&VU^^ ` cTf]ef cR]gRfVd V/^ eYV aVcdeVEZeV`VgVa]V%b"\*\*&L" #/Ž

$$\begin{split} & \# \breve{Z}9 f^{\land} \underline{R}_{U}(\breve{g}V) a^{\land} \underline{V} = \underline{V}_{e} e V_{e} da Rec \breve{Z} a Re Z_{z} \\ & Z_{z} Tf ] ef c \breve{V} \breve{Z} : e ~ \breve{Z} I RS `f e^{\land} W \breve{Z}_{z} X e V \_ W U d e Y Re \\ & a V a ] V W W R V Z a `ce \underline{R}_{e} e L Z_{z} a Rec \breve{Z} I f Rc ya `af ] Rc \\ & a Rec \breve{Z} \breve{Z} Re Z_{z} Z_{z} T^{\land} f_{z} \tilde{g} R W W d V T_{z} `af ] Rc \\ & a Rec \breve{Z} \breve{Z} Re Z_{z} Z_{z} T^{\land} f_{z} \tilde{g} R W W d V T_{z} `af ] Rc \\ & a Rec \breve{Z} Z Re Z_{z} Z_{z} T^{\land} f_{z} \tilde{g} R W W d V T_{z} `af ] Rc \\ & a Rec \breve{Z} Z Re Z_{z} Z_{z} T^{\land} f_{z} \tilde{g} R W W d V T_{z} `af ] Rc \\ & \breve{Z} Re Z_{z} Re Z_{z} Re Z_{z} Re V R A C \\ & \breve{Z} Re V V M T^{\land} a `_V e ` W f^{\land} R_{z} U g M `a^{\land} V e L R Z \\ & V RS ] V da V a ] V e` a Rec \breve{Z} Z Re V R_{z} V g Z_{z} f V_{z} V e M Z \\ & Tf ] ef ~ d ] V_{z} \breve{Z} `_{z} ^{\lor} V e \% " **! L ) \% Z \\ \end{split}$$

 `\&Wa1Vd1RaRSZZZZZZ\_eYV1f]efd3}}VJUR``\_X `eWcdu"\*\*%L&Z

ARceZIZARZ\_Z IT ]cf cVZIRWc^ WURDRCXYdrZ RTT d.R\_TV h Zey eYV:\_ekc\_ReZ\_R] 4`gV\_R\_e`\_ 6T\_`^ZILD TZR] R\_U4f ]cf dR] CZXYcdac`TJRZ WU Z\_"\*('ŽE YVCVà`ccd YRgV`V&V\_TZAU eYZLRdZe V\_drZ\_VdeYVcZXYee`aRceZIZARZ\_Z IT ]cf cVZEYV CVà`ccdV eV\_UeYVdT aV`VeYZlcZXYdrY`hVgVŽ:e ZldR.V\_e`^VR\_\_`e[f deRTTVdle`Tf ]cf cVLSf eeYV acRieZIRSZZġ`VKWc^Z\_XR\_UUWV\_UZ\_X`\_Vd`h\_ ZV\_e&j +y2]] aV a]VLR\_UR] T ^ f\_ZZVdLYRgVR cZXYee`TXReVeYVZcTf ]cf cVZ\_hYReVgVchBj eYY hZh'hYVeYvc eYc f XY ]R\_XFRXLeYc f XY cZf RL Rcd\_^f dZTR\_UUR\_TV`ceYc f XY ]ZeVRef cV`cce`H g eV][Z\_XI\_Z\_R\_j`VeYV^j cZU Vc^d`VVff ]cf cV eYc f XY hYZY Yf ^ R\_SVZ\_Xd eYV h`c]U`gVc

EYZdRjd Raa]Zdde WWkteelffccV\_ejjSVZ\_X^RU/ SjZ\_UZ&V\_`fdaVa]Vde cVRV/c^ eYVZ:ZU/\_eEZd+ y&RWc^ `Wff]efcR]aRceZIZaReZ\_e hYZIYeYV YRgVRcZ&YeÛR\_UW/^ hYZIYeYVhY`]Vh`cJU XRZ\_d%="\*\*SL#S/Ž

 $\begin{array}{l} & \hbox{EYV} V \end{tidely} F \end{tidel} F \end{tidely} F \end{tidely} F \end{tidely} F \end{tidely} F \end{tidel} F \end{tidely} F \end{tidely} F \end{tidely} F \end{tidel} F \end{tidel} F \end{tidel} F \end{tidel} F \end{tidel} F \end{tidely} F \end{tidel}  

DLV Sj dLV hZY eYRe UY ZZ\_ŁeYVV ZI eYV ZNR`WF ]ef cVRtyIF ]ef cR cZYVC%" \*\* SL#S/ŽE YZł eR\VdRhZNc gZh `WF ]ef cR aRceZIZRZ\_+Vbf Z eRS]VRTVctle`\\_`h]VLXLd Z]dLeVTY\_`]`Xj R\_U Z\_Wc^ ReZ\_ŽZTT d.Z\_Xe eYZlgZhLd TZA\_`c^ d R\_U gRJf VdLZ\_TJf UZ\_XecRLZZ\_R]`\_VdLTR\_SVR\_ Z`aVLZ'V\_ee`RTTVctle`TF ]ef cR cZYVCŽ

EYVUZXWWCV\_eZUNRd`WWF]efcVfdNUZ\_eYVCVa`œd R]hRjddV]ReVe`Z\_eR\_XS]VVNCNedR\_UcZXYeeLhYZY



RVR\_Z'a`œR\_eaRce`V&V a]Vd\_WLdR\_UUV&XVŽ EYZIRaac`RIYeYfdUVaRcedW/^^ReVZRJZ&ZTeYVł cZd`V\$RcIT\_WLdn"\*\*'Ł&!/Ž

y>`deaVa]VUX2gVd/TfcZejW^ eYVZc^V} SVcd/Za Z\_RXc`faLRWY ZjLRT^^f\_ZjLR\_ `cXR\_ZARZ\_LRCRIZE]`cVEY\_ZTXc`fa eYReTR\_ ac`gZU/RTf]efcR]ZUV\_eZejR\_URcVRdtfcZ\_XdvE`W gRffV8%6"\*\*%LS"/Ž

?f cef cZ\_XTF ]ef cW\_ESVT ^ VdR \Y\_U&y] `a^ V\_e`S[VI&&ZZ] "\*\*' LeYZIhRdV aYRZTR]j cdReW+Î < i a Ub`XYj Y`cda YbhbYWYggUf]`mi ]bj c`j YgU`WcbWYfb`k ]h`W`hifY`!h`Y`k Umg` dYcd`Y`W.ccgY`hc``]j Y`hc[Yh`Yf! Zcf]hjg'h.Y` gYbgY`cZgcWJU`Wc\Yg]cb`VUgYX`cb`W`hifY` UbX'g\UfYX'j U`i YgUbX`VY`]YZg'hUhg\UdYg` ]bX]j [Xi U``\i a Ub`XYj Y`cda Ybh':WaV a]VJZV  $e X keY kch V [LZVeY y T`a V ReV Z R^f f f R] j V_{1} \\ c Z Y Z X h R LeYZ V ] R X de Y Z Z U Z L f R T Y Z V Z \\ D L Y f^ R_ U g V a^ V e Z T_T kc_V e [f de h Z Y$ a V a] V R d Z U Z Z I f R d S f e R d h Z Y Y h e Y y Z e k d $R le R_U T`a V R V Z T^ f_Z X C w "**' L & X Z \\$ 

 $9 \text{ VALTF} = \frac{1}{6} \text{ VALZ}  

EYVXcheY`VZ\_UZZIFRIVXWU^de eVVVd cZ`V\_e`WT`]]VEZV\_`c^dR\_UgRfVdLZITZAURd `\_V`WeVTRfdd`WR\_`^ZZEYZIT\_dLVRZ\_ YJadfdRaacVIZZEVeYVa`dZZYUTT\_dLVRZ\_ eRUZZ\_RJ acZ\_TZIJVdYRVVkcdTZAZ\_eVXRZ\_Ž 2TEZZZIdeYRe\Wa eRUZZ\_dWg`fdS]Ve`ZeVI XRZ\_RZVYVJaZ`ac`gVYf^R\_UgY`a^VeŽ @gvcR\_URS`gVeYVZ:VT\_`^ZTVWWRLeYVJ\_YJa e`ycVac`UFTVadTZAjŽEYVJeYfdYRzVR\_ZeZ\_dZT Yf^R\_gRJfVeYReTR\_`eSVcVUFTVUe`f\_Zd`W ^`\_VJ`c`WZVI"\*\*'L&#/Ž

EYV TJRZ eYRe TF ]ef cV Ztl\_`\_łVT\_`^ ZT Z\_ \_Ref cV U Vd\_`e T\_~ZteLY h VgVLh ZeY Ra`]Ztj `VWT\_`^ ZT Xc heYZ 6g Vcj eYZ\_X U/aV\_Ud`\_ eYV U/gV]`a^ V\_e decReVzJ + y2 aReeVc\_` VWc heY eYRe ZtlZ\_TJf dzgVR\_U aRceZtZaRe`cj\_TR\_\_f cef cVR\_UV\_ł YR\_TVTf ]ef cR] ceRUZZ\_CMu" \*\*' Ł' "/Ž

EYVCVa`cedRcVV`aYR2TZ\_dR2ZXeYRecZZZX ZT^VdU`\_`eZ\_eYV`dv]gvdhRdU`W&V\_UV\_TZdd e`hRtudff]efd?JUZZeXxR2\_ŽEYZdh`f]UVia]R2 hYj\_eYVR\_RjjdZdUVR]d`\_]j\_hZeYeYVUj\_R^ZT`W UZZeXxR2Z\_ZYZX1ZT^VTf\_ecZdR\_U^Rvd \_`^V\_eZ\_`Va``c`cUvgV]`aZ\_XTf\_ecZdŽ

4f]efcV\_`e`\_]j ac`gZJVdZ\_eVXdReZ\_R\_U

EYVCZXYee`TF]efCt] aRczZZARZ\_UKURZSWUZ\_ a`Z\_e#Ztlf\_VbfZg`TR]j RcZXYee`aRczZZARWZ\_ `\_Vd`h\_TF]efCkLR\_UeYfdRcZXYee`UZgktzEj 1"\*\*SL#SYŽ7fceYkt^`CkLacktktgZ\_X`\_Vd`h\_ TF]efCvZ`a]ZdeYVa`hVce`RURaeeYVCktf]edR\_U eV\_UV\_TZkd`Wh`c]UU\gy]`a^V\_ee``\_Vd`h\_ \_WkdR\_UgRJfKŽ

 $\label{eq:second} \begin{array}{l} & \label{eq:second} & \label{eq:second} & \label{eq:second} \\ & \label{eq:second}$ 

 $\begin{aligned} & 2aac`acZeZ_`WeYZI\Z_UZI_`e[fdeRgR]fVLSfe\\ & R_Z_VgZeRS]VVRIeZHYZIVX]`SRJZReZ_^ZXVeSVR\\ & a`hVcM] V_XZ_VVCFIF]efdQ] Z_eVcTfcdVR_UeVV\\ & ac`UfTeZ_`WA]`SR]TF]efdQ] X_ULaVa]VcVIVZgV\\ & R_UfdVeYVdVZ_UZWEV_ehR]dUVAV_UZ_X_eVXE\\ & Tf]efdQ] aVIFJZRZEZd1"***LS%ZEYZIT_dXNd\\ & ReZ_dr`f]UXFZVer`dVhY_UVdZ_R_UVgR]fReV\\ & VT_`^ZIXc`heYa`]ZZCZEYfdLeYVbfVdz_yZd\\ & ZeVch`_dZgVe`TF]efdQ] UZgVcdEj0%a"**'LS'/TR_\\ & ac`gZVRTZEVZ_VCURZ_XEVCV_dAPY`CVeVd_Z_\\ & SVehW_yc``e]VdUXc`heY`cV_ZTYZ_XIF]efd%aPRe\\ & f_UVcJZdd^ VZURd`VVVgY]`a^Ven"**'L'"/Z$ 

 $F ? 5 A h R_{c} det Re eYVTYR_Xd_`h X Z X`_L h YVeYVc eYY ReV TYR REVZAU Rd X]`SRZREZ_L eYVdet VU`W Rc\Ve']`XZT`c eYVU&Y'a^V_e`W Z Wc^REZ_eVTY_`]`XJ 1: E/LTR_RWWTe'Tf]ef det UZ gVdZg +y4f]ef cVLT^^f_Zg R_UYf^R_d/Tf cZg RVZ_eVchZ_VLLSf ee``V&V_f_UVc^Z_VUSj eYV Z gRZ_d`VW]`SRZREZ_\mathcal{B} ****L"! $\sc{Z}$ 

EYVEVOLV de`SVRUR\_XVC`VYIF]efoR]Y^`X V\_ZREZ\_%eXREZX\_`COL`cUVAEC`jdUZgVoZgLEOVF]ef Z\_XZ\_TF]efoR]Z`a`gVZEV^V\_eZ8]`SRJZREZ\_ZL ZVV\_eZVURDEYVdfCUV`V&ZEVCVREŽ

y>`cVZ`a` $cR_eeYR_X$ gVc\_^V\_ecVaCVdZ\_`W If ]ef cVde`UB\_ZleYVWWWTe`W`Rc\VeWcTVdZS]`S} R]j ^ Rc\VeVUT\_d`^Vcac`Uf TedR\_UeVV^VUZR RVdf aVcZ`a` $dZ_XRf_ZVc^{R_U}def$ ]eZyVZ\_XgZh `VeYVh`c]U‰"\*\*'L'#/Z

 $EYVZ_TCARCHUZ_eVCT___VTeZ_R^{^{-}}_X aV a]V$   $TCAREVUSj X_j SR_ZREZ_ZL_eT_}_Ue eVV$   $VT_^{^{-}}ZTR_Ua ]ZEZR_dAVVCVZ4f]ef cVZdZM$   $Z_TR_ejj RWWTEVURdhV]_1"**'L"!#, "***L"/+$   $y? REZ_R_S CUVCREVSCVRZ_XUh_L_e)j VC$   $eRUVLTRaZER_R_UZ_VC^{^{-}}REZ_SfeR_dVCZVREL$   $C^{^{-}}C^{^{-}}LTf]ef cVdR_UgR_fVCVCm"***L#*/Z$ 

DZ\_TVeYV`fedkeLeYVCVa`cedYRgVV`aYReXKU eYReXj`SR[ZReZ\_ScZ\_XdS`eYeYcVRedR\_U`aa`d ef\_ZeZdŁZ\_S`eYTRdwdhZeYa`eV\_eZe]Z`a]ZReZ\_d WcTf]efcVŽ

 $yE^UB_L^{+} CVeYR_VGVLR_Vh_X^{SR}TF]efdV$ ZIV^VZZZZ7C^^fdZTe^^gZdeS``\dLZI ekc\_RZ\_RJZMRdR\_UGRIFVGRVSVZX^ZVUhZYL R\_UdfaVZ2a`dVU`\_L\_RZ\_RJZV\_eEZdZDfTY T^^`\_ZVK^REZ\_~`hdRVR\_RIYZGV^VeL SfeeYY\_TRoj RcZLEAV]`dl`VVIf]efdZZV\_EE R\_UUZGVCEjZ3feeYY\_RdR]`heVh`dUe`VRV falRdRT^^f\_ZjIe`ZdFVd`VVT^^`\_T\_Tkc\_ R\_UT^^`\_drgZR3%b"\*\*#L(%Z

 $2^{\ }X$  eVVTf ]ef cR] `aa` cef\_ZZd` WWAVU Sj X]`SR]ZRZ\_ZleYVa`eV\_eZ] Wc TARZXRS`U `Wh`d[UafS]ZT`aZZ\_Wg`f cRS]Ve`eYVUWV\_TV R\_U f\_UAdR\_UZX`WZdf Vd`Wh`d[UhZWZ\_eAd VdLR\_UWcT\_gYZXR\\_`h]VUXV`W\_Vd`h\_ Tf ]ef cR] aVTf ]ZrZZZAŽE`TR] Tf ]ef cATR\_R\_Udr`f ]U SVchRvU1"\*\*'L' "/ŽEYVZ\_TARAVURGZJRSZZEj`W Tf ]ef cR] T\_eV\_e`\_eYVH VS dr`f ]USVVAg`f drS]V e`eYZh1"\*\*\*L'&+y2\_UhYZV\_Vh eVTY\_`]`XXd TR\_`V&V\_UZ`Z\_ZY]`TR] Tf ]ef cVdLf dVUTcNezgVj eYVj TR\_R]d ^ R.VeYV RgRZJRS]Ve`^f TY hZ.Vc RFUZ/\_TV2%b"\*\*SL#S/Ž

:\_ eYZI h BJ Ł X]`SRJZREZ\_ TR\_ `aV\_ aV a]Vd ]Zgvde` Tf ] ef  $dVR_UR$ ] Zd TdVRZZG  $LR_Ue eVV$ ~`h`VZURdR\_U\\_`h]VLVv1"\*\*\*L%ZDZ`ZRdj Ł eYVX]`SRJZRZ\_ `VUF ] ef dR] ~`hdZd X/\_VRZ\_XR Tf ] ef dR] VWU ^ eYRe TR\_RER dR\_R\_ZDU eVe eVV V/\_UR`V\_eRZT ddVREZ\_XRXZ\_de Tf ] ef dR] TYR\_XV 1"\*\*\*LS%Z

$$\begin{split} & \& \tilde{Z} \in VVCZhd`VWF ] efcR [X]`SR]ZREZ _ \tilde{Z}8 ]`SR]! \\ & ZREZ _ ZlecZXX&Z Xa`d& gVeV_UV_TZALSfeZeR]d \\ & ScZ_XdUJ _ R`ZdeYReRVf_Wg'fdS]Ve`Yf^R_UVgV]`a^V_e\tilde{Z} VVCVa`cedYRgVYZXY[ZXYeVUR_f^{} SVC`VVR_XACLeYV] cd`WeYV^SVZ_XeV]`dd`W \\ & CRUZZ _ R ] ZV_e & gVRIe cd_Wi^ ] R_X RXVe`UXdL \\ & R_UWV^ _`c^ de`ZeVXRZ_ac`TVdWh"**SL##, \\ "**%LS", "**'L'#, "**(L*', "***L'! <math>SZ$$

$$\begin{split} & EYV dVT \_ U UR_X & Zl eYRe `Wylf ] ef dR U ^ Z \\ \_ReZ \_%a'' **' L' #/ eYc f XY eYV Z a `dEZ _ `W \\ & TVeEZ Wc^ d `VUf ] ef dV`_ `eYVcZe_VaVgVcdV \\ ^ R_ZWERZ _ `WeYZlcf acV RIJ ZleYVUVCRZeZ _ \\ `WZ UZX\_`f dXc f adRdyZ aVUZ V_ede`UVgY] al \\ ^ V_e%a'' **' L' #/ZD ^ VeYZ X`WeYV d ce YRaaV_d \\ & hZeY 2VZIR_TF ] ef cV R_U ZV_eEj LWc VR`a]VL \\ & hYV_eYY RcVSVZeJVUR_UUZa]RIVUSj H VEVc_ \\ gRJf Vdn'' ** (L*' /Z2_`eYvc ej aV`VZ a`dEZ _ Zl \\ R_ZUR` WZ eJ]VIef R] ac aVcg`eYReZX` cVdIf ] ef dR \\ \end{split}$$

EYVeYZU\_VR&ZgVR&VTeZthYReYRaaV\_dhYV\_ If ]ef cVZdT ^ VCIZGZ&VU`\_ Rh`cJU dIRVŽEYZd Z\_TCVR&deYVZ' a`ceR\_TV`WIF ]ef cVRdR\_VT\_`^ZT X`ULd eYReZeeV\_Ude`SVZJV\_eZ VUhZEYT ^ ł ^`UZZdeYReTR\_SVd JUR\_U ecRUVLŽ> fTY`W eYZdecRUVZ\_TF ]ef cR] X`UdZTT\_UFTeVUeYc`f XY eYV\_VhZ\_Wc^ReZ\_eVTY\_`]`XXd+y2]eY`f XY eYV dacVrU`VZUVRdR\_UZ RXdV\_cZYVdeYVh`cJULeYCV ZIRcZh`WAUFTZ\_XTF ]ef cR] T\_TVc\_de`ac`eVTeZ\_X hYReTR\_SVS`f XYeR\_Ud JUL\_WYVTeZ\_XT ^ fł \_ZjLTf de`^ R\_UecRUZZ\_%b"\*\*\*LSSYZ

 $\begin{array}{l} & \hbox{EYV^ R: Ve Wc TF ] ef cVZlSVT ^ ZX^ ` cVT _ l \\ \hline \end{tabular} \\ & \hbox{TV_ecReWLe evVVT] f dZ_ ` Vd^ R] l ] ^ TR Z Uf d \\ & eZdZ > ` cVReeV_eZ_ _ Wude SVaRZJe ` yff ] ef cR \\ & \hbox{VTVaeZ_dWaJZVer dVUZI f dWJS j H E@ Z erV \\ & F d Xf R C ` f_UZ \\ \end{array}$ 

 $\label{eq:second} \begin{array}{l} & \label{eq:second} & \label{eq:second} \\ & \label{eq:second} & \label{eq:second} \\ & \label{eq:second} & \label{eq:second} & \label{eq:second} & \label{eq:second} \\ & \label{eq:second} & \label{eq:second} & \label{eq:second} & \label{eq:second} & \label{eq:second} \\ & \label{eq:second} & \label{eq:s$ 

 $2 \wedge R[`cTRfd/`VZ_VofRZj Zl^ Rc\VeT_TV_edl$  $eZ_Z_eVVSc`RUTRdZ_X`Wff]efdlLZ_Wc^ ReZ_$  $R_UV_eVedlZ_^ VeT_eV_eZ5VdaZVeVVVaR_dZ_$  $`WT ^ ^ f_ZTRZ_dR_UecRULT_TV_ecReZ_ R_U$  $VTTfdZ_ RcV_JVRUZ_Xe` eVVa``cVdeUVgV]`al$  $Z_XTf_ecZddSVT ^ Z_XyTf]efdl]j Zt]ReVU‰$ 1"\*\*)RL&"/Ž

'ŽF\_ZgVcdR] cVTZaVdWca`]ZfjZ`a]V^V\_eN eZ\_RcVZ\_T^aRezS]VhZeYcVdaVTeWcTf]efcR] UZgVcdZejŽ5VgVj`a^V\_eZtRf\_ZgVcdR] `S[VTezgVŽ

$$\label{eq:linear} \begin{split} & \text{TY } ZV de` h YZY Ze Xz V deZV n'' ** & \text{L} \# ZE Y f d W c \\ & \text{V } R`a] V + y E Y V c V d`f] USV_` ReeV`aee` `WW c R \\ & f_Z v d R'a] V + y E Y V c V d`f] USV_` ReeV`aee` `WW c R \\ & f_Z v d R'ae' `UV]` V & V c V c V b f R Z i ZE Y V Z eV c a c A R \\ & eZ_` `W a' V c Z Y c h Z i U W c Z U W c V e d T Z e Z c A R \\ & eZ_` `W a' V c Z Y c h Z i U W c Z U W c V e d T Z e Z c A R \\ & U a V_U Z X`_ c V Z Z _ d`c T f] e f c d`c e R U E Z _ c & o \\ & n'' ** & \text{L'' } ! \# Z \end{split}$$



# 7<=@NG9@ = A 5; 9.5.8CI6HI@<9F=H5; 9

EYc`fXYZedYZeb`qL4YZVYRdaVcZtYVUR\_U  $SW_ CVS^{-} C_ ^Rj eZ^{-} VdZ^{-} VdZ^{-} d$  $UV6cTZ]RdVaZT=R2cRTR_RZd_`eeYVcR^VRdeYV$ 4 YZVeYReh`\_ZedZ\_WaV\_UV\_TVŽEYV` |ZARCTYZT `dVceYReV`VcXVUReWceYVSReeJV`V¥ZEIRjhRde`  $f_UXX R^{T}_XURh_1 fe^{VR^{-1}} caY dZ df_UXc$ eYVZ aRTe`VZ Uf dezRZReZ\_R Uf cSR ZReZ\_Ž EYV^ZUJVT]Rd14YZVWdeVCVUSj DeRev RI62226j  $R_UeYVUV^ TORESCREZ_ W fTY WeYVehV_eSCEY$ TV\_efg\_UXUZ\_ "\*(\$Ž3feeYVRfeY\_cZRcZR\_4YZV eYReTR' VZ\_e` SVZ\_XeVV\_ YRd\_VZeYVcdV' RZ\_VURdZe hRd\_`cUZRaaVReVUT ^ a]VeVjj Uf cZ\_XeVVIf ccV\_e ecR\_dZEZ\_e`UV`TcRUjŽ=``\Z\_XReeYVTf\_ecj W/^ RYZE cZR a Vca VTezev ZeSVT ^ VdT WRceYRe eYV&VZd\_`e[fde`\_V4YZVL[fdeRdeYV&VZd\_``\_V y ReZ R ZV  $\mathcal{A}$  % i VU TVR U V  $\mathcal{A}$  R  $\mathbb{Z}$   $\mathbb{Z}$ ]g<sup>·</sup>U<sup>·</sup>\]ghc f]WU<sup>··</sup>dfc WYggžiU<sup>·</sup>gc WJU<sup>··</sup>Wc bghi Whži U'W' `hi fU``dfc Xi Whc b"

 $EYVZNR`W4YZVZd^RVVfa`VRRVJUdTaZT$ RccRj `WZ`RXX&Ld`^V`W&YV` `]U R\_U SRcVjj CVT X ZERS VL ` eYVcd VR ZZRc R U TYRCXVU hZeY \_`deR]XZT]`\_XZ\_XŽEYVćVRcVZ'RXVćIRdV&VćYRdR eV/VeZZ\_\_RUgVceZV^\_V\_eR\_U`eVvccV^ `eVc`\_Vd`W WeVelet ^ Z Vel R U T gVel Y VeV ReV Z RXvel | RUV hZeYd^S`]dR\_UYZe`gŁdZVSjdZVhZeYZ RXVd `WLRZjj ]ZWŽ:^RXVdeYReRc`fdV]`gVR\_UYRecVLL ReedRIeZ\_R\_UcVaf dZ\_ŽEYVj cVacVdV\_eeVVUZgVd dZej `VWa`TYdR\_URTe`ccL^ ReVZR] ded Tef cVdR\_U  $d'S[VI \partial z \partial V_I a \partial z \partial Z_I V \partial Z_i e Z \partial Z_i e RehV]^ \ Z_i$ eYV^ZcccRURd\hY`hVRcVf\_[VddhVRcVRhRcV `WhYReYRd XReYVCVU Z\_ eYV T ]]VTezeV ^ V `qŽ :\_VgVg aVzUL4YZVR\_d`VR]\ZUdYRgVUhVje fa`\_ŁVġ`\WR\_UZ`RXZ\_WeYVZcTf\_eqiŁ]VRgł  $\underline{Z}$  XR a  $\underline{R}$   $\underline{Z}$  adv $\underline{d}e$  `W' V' `  $\underline{d}$   $\underline{d}e$  YRe T ^ Ve` ^  $\underline{Z}$  U hYV\_VgVchVeYZ\_\`VeYVTf\_eqiRdZeZd\_`hŁR\_U RdZehZ SVZ eYVWef dŽ

3 VALVICVT X\_2KZ\_XeYVIF ] of dR UZgVidkig ` VALYZI

 $:eZd_{h} \ \ h \ \ h \ eYReS \ eY \ REZ \ R U d TZkj$ RVIF ]ef d?] d\adddV eREZ\_d c d ^ S` ]ZREZ\_deYRe aV a]VId/ReVe` WW] R\_USVd/T X\_ZAVURdaRe ` VR T ^ f Zj ŽEYVd/Zd\_` d TZkj eYReU Vd\_` eYRgV R\_RcReZg/VS` f eZd/JŽZ\_UT ]]VIEZVZ.V\_eEZdRV RhBj ` WRCREZ XL` VRezTf ]ReZ Xh YReRd TZkj Zl R\_URdrZvde` SVŽ4` ]]VIEZVZ RZ\_RZdRVaRe` W eYZd\_RcReZg/VS` f eeYVd/JAd TZA d\adddV\_eReZ\_d eYRELhZeY f ed/RIYZ\_XeYV]\gy]` WAhReV\_VdIR\_U T\_dTZf deY f XYeLYJa e` Via]RZ\_eYV dEf ReZ\_ ` Va TZkj R\_Ue` T\_gY R\_Ud/ReVT\_TVaeZ\_d` W eYVh` dJUR\_U]ZWZAZTef cZ\_Xd TZkj ZlR]hBj dR\_ RTe` VZ RXZ\_REZ\_Ž

4YZVZIR\_ZgV.eZ\_Ž:\_ `eYvch`ddLeYvhBj aV a]VgZh R\_Uf\_UvdeR\_UZLeYvhBj eVvj WVj eYv dv]gvde`SV4YZVR\_R\_UdVT X\_ZAvd ^ veYZ\_X Rdyej aZIR]j 4YZVR\_%LZIR IF ]ef dR] T\_def TeŽE YV T]]VIEZV Z`RXZ\_Rcj `WhYRe 4YZVZLhRd R\_U dr`f]USVYRdR]`\_XYZE cjŽA`vedR\_Ua`]ZEZZR\_dL aRZ\_evcdR\_U^ZdevJddIY` ]eVRIYvcdR\_UdIZV\_eZded YRgVYVJaVUe`TeVREVR\_UcWvc^f]RevLeZ`VR\_U RXRZ\_LeYVZ`RXVeYRe 4YZVYRd`VZEdRJ RdsVTe R\_UeYVa`]ZEZIR`\_VŽ

EYVa`hVc`WZeVcRcjZ`RXVdR\_U\_RccRezeVdZd \_`eUcRh\_WV^ RcVR]Zej UZWWCV\_eWV^ `S[VTezeV cVR]ZejŽeh`f]USVR^ZeR\Ve`T\_ecRebeYV`S[VI] ezezei `Water Tef eVdR\_UeYVdf S[VTezezei `WZETF f cold R\_UZ^ RXZ\_RZX&LRdeY^f XY eVy hVeV^\_ UZXXXeV\_e ]VgYJČŽ:\_ VRTELEYVEVTR\_ SV\_`ZUR`WEVRZEj eYRe U`Vd\_`eT^VSjhRj`VRcVacVdV\_eReZ\_Ž2deYV 7cV\_TYYZE cZR\_C`Xkć4YRceZkća`Z\_ed`feLyeYVcV Zd\_` adRIeZIV`c def Tef cVeYReZd\_`eac`Uf TVUSj eYVcVácVáV\_eReZ\_dL`aa`dVUR\_UT\_ecRUZTe`q`Rd eYV RevLeyReZUZeZUFRdR\_UXcfadfdVe`^R.V  $dV_dV W Y h = dU e Y Z Y S Z = ka c A R$  $eZ_d$ `WeYVh`dURcVTcVReVUZ\_eYVcVR|^ `WeYV a]Rfd&]VL\_`eeYVecfVŽ4`\_dVbfV\_ejjLeYVjYRgVe` SVVeRIFREVUVIca`eV\_eZRIVWWIEZEV\_VollRdWRodSIV RU/VXZZ REVUZET fochdRS`feeYVd TZR `dVVŽ

EYVac`UTTZ\_``Wff ]  $dcVZUV Z_V dj a` ]ZZUZZ$  $:eZUV_`fXY e` `Sdv&yVY`h eYVT_} Xf dRz_d`W$  $a`hVcReX&yV_aVZUd`VWZ& g Z_Wc^ eYVhfy$  $aV a]V]ZeVR_UcVacAUV_eeYVZcdTZAJ Vf aVZV_TVZŽ_$  $ef c_LdTZA] Z_RYZ dh^ `f]UeYVa` ]ZEZUJ d deV^ L$  $Zed` cZV_eRzZ_LeYVhfy dZ_ hYZIY a`hVcZI]VXEZ$  $^ Z&UR_UeYVTZEVCZAF dVUe`V&RJ ReVZZAF ] ef cV$  $Zd R]hFy dT_W_eRzZ_Z6gV_ZVZe Zd Vf acVdtMU$  $RvdeYVEZR]] LZe Zd eYV ac`UFTe` Ve1TZAJ RXV_edZ_$  $T_~ZTeZ:_ Y`h ^ R_j TRACZ LeYV d TUAJ RXV_edZ_$  $T_~ZTeZ:_ Y`h ^ R_j TRACZ LeYV d TUAJ RXV_edZ_$  $A` cZ g %XV]Uf a RdaRe`VeYV_Ref cR]`dUVOEYV$  $a` ]ZEZUR] UZ_V dZ_`VWF ] ef cVT_dZd Zd ef XXVE.$  `gVce`cT gVceLe`TcVReVLZ'a`dVR\_UcR\_\aRce2Tf} ]RccVacVdV\_eReZ\_d`WeVVdTZR]`dUVLR\_Ue`cV[VTe `caVcdVTfeV`eYVcdZ4f]efcR]UZWWCV\_TVLLY`h VgVL U`\_`e^VCVjj^Zc`cdTZR]UZgZZ\_dZ2]eY`fXY eYVj^RJ;SVac`UFTVU}fdTR]jj\_`eUVJZSVReVJj`c T\_dTZfdj}SjdTZR]RXV\_edhZeYa]R\_dcdcReVXZd R\_UZ\_dEZefeZ\_R]djdeV^dceYVjR]d\_CV-VTeeYVZ} eVc\_R]Uj\_R^ZT`WeYVZ'RXVdR\_UCVacVdV\_eReZ\_d eYV^dv]gVdŽ

2 TV\_eR] eVV V`WARce # ZleYV\c´dZ\_`V&YZ VR\_ZV\_eZjŽEYVV aZZR] \gZV\_TVd\eV\eYZ\_eYV TYRae\cdeYRe W]`h ac`gZV\deYVSREK!\\c`\_V`W eYVC\a`ced^`dea`h\c\V]T\_TJf dZ\_d+Z f`a c ghi dYcd`Y`]b`7\]`YZ`\V`YVYj Y`fYZYfYblg`!hY` a YUb]b[ g`UbX`gma Vc`g`h\Uh\\cadf]gYX` k \Uhk Ug`Î7\]`YUbÏ!`\Uj Y`\VYUgYX`hc`VY` d`Ui g]V`Y":\_`eY\ch`dELeY\J`YR\$V]`degR[ZLEj Z\_eYV\RVV`WIYR\_X\dS`eYZ\_eYVLR2j\_\fa\\ZV\_TV `\V4YZ\R\_dŽ

4 YRaekć" UKITEZS V. dd ^ VWRef C. di VerV 4 YZyR\_ Z RZ\_Rg RdT \_def TeVUSj ]ZeV. Ref C. Ž4 YRaekć # d deV ReZ. V. dd ^ V `WeYV UWA TF ]ef cR] f\_UVd aZ\_Z\_Xd `WeYV DeReV R\_U a` ]ZeZTR] T\_def Te `W a`del:\_UVAV\_UV\_TV 4 YZyNZ 4 YRaekć \$ TYRced Y`h eYVZ\_YVEZEVUZ' RZZ\_Rg YRdSW\_Vć UVUSj d TZR] TYR\_XVR\_U\_Vh V aVEZJ\_TVd`VURZj ]ZNNZ

# 7 < 5 DHPF %

# H 97 < 5 @ 9B; 9C: 69-B; CBH 9CCIH 9FB 98; 9



: \_ RX]`SRJZ&Uh`dUhYV&V&\_eXdRVeV\_UZX e`UZd] ]gVL`\_V&RA Wc\_RZ\_dZdZ`a]j e`VIZe UXdrZeVVgVj eVZ\_XZ4YZVL`\_ eYVVLXV`V&YV^ RaLZd V&VUhZeY eVVTYR]V\_XV`W RZ\_eRZ\_Z\_XRhRV\_Vdd `VZedNWd eYReZdaV a]V\\_`h hY` eYVj RVLhYV&V eYVj T ^ VW^ R\_UhYV&VeVVj RVX Z\_XZ

CfS½ 5 Rc34hRd\_`eeYV} cdHR\_UYVhZJ\_`eSV eYV]RdHe`Rc2Zff]ReVeYVR\_XfZYeYReT^VdW^ \_`e\\_`hZ\_XhYV&V^R\_\Z\_UTR^VV&/^`chY&V ZeZdS`f\_UŽHV\_WUe`X\_SRI\e`fcc`edd eYRehVTR\_ddRceW^ eYVSVZ\_Z\_XdcVVbZ\_XeYV VQJRJj eYRe`fcSVZ\_Z\_XdhV&VhZeY`fcdMg&Z\_ 4 YZVLeYZI[`fc\_Y\_YRdSW\_^RUVhZeYeYVYVJa`W hcZeVdR\_Ua`VeZ

#### $C\,F8\,9\!F\,C\,I\,H\!C:\,8\!=\!\!G\!C\,F8\,9\!F$

 $EYV4YZNR_RZ_hRd `VeYVdZeVV VCI deV eV VCI de$  $`VeYV2^ VCIR_hRd `VeYVdZeV_eY TV_ef djZ$  $7f ceYVc^ `cVLeYV gZ ]V_TVhRd_`eT_}UVe$  $eYV j VRd `VIT_bf Vde R_U eYVT ]`_ZR] aVCZ UZ$  $:eT_eZ f VU`_R_U`WWF_eZ eYV]ReV_Z VeV_eY$  $TV_ef djLR_U daZ]VU `gVc Ze` eYV_V eZH ZeY$  $]`_XVc`c dr`ceVc ZeVcf aeZ_d_R_U UVdaZeV eYV$  $aRdZr`V_eRdj ZeVcf IVdTRf duUSj > Raf TYVdR_U$  $9 fZ_TRdR_U eVVcef TVd`VeYVcAaf S]ZIR_aVCZ UL$  $eYVTEVReZ_`WdVc`fe`VUZd dVcZlRceRzeeYRe$  $T_eZ f VdVgV_e`UBJŽAcVdV_eReeYV`f ceVeLZeYRd$  $cVRaaVRcVURe^R_j a`ZedZ_YZde`dj R_UaJBJ VU$  $Zed aRce Z_TEVReZ_XTYRCREVCZBEZdeVRe cVf cVRV$ 

#### hYV\_VgVcRTc`ddc`RLdZdcVRIYVUR`\_XeYVhRJŽ

7 c eYVT \_bf ZHU cd\_eYV eRd h Rd UZWIF ]e W^ eYV f edkë Z:e h Rd WkeYVc^ cdL V eV Vj T dej Z 8 RTZRd UV ]R GVRT \_} c^ d eYZ I Z\_ YZ  $4 ^ V eRCZ eVY$  cd DaR\_ZRU e UZIT gkc 4 YZV h Rd 5 ZX\_UV2]^ RXc Ž3f eR] YVUZUh Rd]`` Re Ze R\_UX\_SRI\ e AV6 Lh ZeY f\_e JU ]RS f c S`eY `\_ eVV[`f c\_V] eVVVR\_U`\_ YZ dvf c\_މ

9F7=@25.Ht9@H9F5FM6=FHtC:7<=@9

 $= \mathbb{Z} \times \mathbb{Z} + \mathbb{Z} + \mathbb{Z} \times \mathbb{Z} + \mathbb{Z} \times \mathbb{Z} + \mathbb{Z} \times \mathbb{Z}$ 

EYZER SVAR hZey 6ct ZIRLhY ^ ? Ver URTR VU yeYVZ\_gV\_e`c`W4YZWZb'hY'dU[YgcZ@U'5f! Ui WUbU k Y ÚbX h Y Úfghc i h]bYgc ZUb JXYb! hlmh UhgdfUb [Zica h Y WUa cifcZVUh Yž h\Y`gd]``]b[ UbXa ]b[ `]b[ cZV`ccX":ehRdeYV T]RdY`Veh`T\_TVaeZ\_d`VW1ZdeV\_TVL`VSVZ\_XL`W eYVh`dULRT ||ZZ\_SVehW\_eh`Tf|efdveLeh` cVRJZZALeh`^jeY`]`XZAŽ7c`^ > VIZT`e`4YZVL eYVT\_bfZteRU cdUZU\_`e^ VEVjj dW\ e` dfSUfV eYVT\_eZ\_V\_edZ\_YRSZER\_edŽEYVj Rjd hR\_eVUe Z'a`dV`\_eYVdV |R\_LtdeYVZc UZeZ ZejŁ |R\_Xf RXVL RfeY`cZej R\_UVT\_`^ jŁRUZWWCV\_ed TZAjŁRdIRJV `Werlf Vel.acZ\_TZa]Vd R\_U UZXWKCV\_TVd eYRe TR^ V  $WV^{\wedge} RWRd^{W}R_Uf_{h_T}e_ZV_eZE^{\circ}d^{\vee}V$ RfeY`cdLeYV ac`TVdd h Rd`\_V`WH VdeVc\_ZReZ\_ eYReT\_deR\_elj\_cVRUf deVUZedX Rde` eYVaRIV`W eYV^ Vec`a` ZeLcReYVceYR\_e`]`TR|UVgV[`a^ V eeŽ y9 V\_TVeYZUZTCVaR\_TjLeYVdVf\_T)`dZ\_XXRadeYRe Via]RZ\_hYj:\_UZR\_ddVIV\_ejjh`\_`gVce`RSRc`bfV 4YcZdeZR\_Zej dY`f]UdfUUV\_]j SV`dVcVUe`V`ł Scrivervouzzzzrez\_~~Werv6\_jzzrev\_^ V\_d.SWKV ZVRZA `c; RT SZZA ac gZNUeVV hZeY eVc  $^{\text{UM}}$ UZal]R, VUZadh Revde`eYV^Ž?`eeyReeYVj h vévvévé XZeV\_eYV^ VR\_dL`WT f colle` ReeRZ\_eYVaRcRUZANd

 $eYRe \sim Ref VU`_VRAK eYV`eYVcSWkVeYVZcYVcMacYVc$ 

:\_UZXV\_`fdaVa]V&XZEWUeYVUZRaaVRC\_TV `WeYVZ: VXWU^ŁTF]ef&VR\_Uh`dJUgZhŽEYYj YYJU`feRXZ\_de@YVZ\_gRUXdWc`gV:eY&WTV\_ł efcZdŽEYVdecfXXJVZddeZ]f\_dXd]gVUŽ?`eR]hRd gZ]V\_TVLY`hVgVŽEYV&VhV&VdTV\_Vd`WYRe&VU hZEYZ\_eXgR]d`Wj`gVSVTRfdkLUXdaZeVeYVT]RdML Z\_eXS&WUZ\_XhV\_e`\_cZXYeW/^ eYVSVXZ\_Z\_XL W/^ eYVgVcjURjZ\_UWUL`ceYVgVcj\_ZXYdLeYRe eYVZ\_gRUXdRczgVUŽEYfdLR\_VhZUV\_eGjSVXR\_ e`V^ VXXŽ

EYZIh RdeYVTRW eYc`fXY`fe = ReZ\_2^ VZTRŽ 3`]3gRc UWZ[VULhZeY R]^`de R\_eYc`a`]`XZTR] acVTZZ\_LeYV Yf^ R\_ac`UFTe`WeYZIf\_Z\_`W `aa`dZeVd+

 $y=Vef det V SVEWAVALLyeYRe fcQfVS]^Zd$   $= Vef det V SVEWAVALLyeYRe fcQfVs fc aVR_L c? ` ceY 2^ VeZIR_LeYReZeZdePeYVc RT ^ a` dEV` V2 VZIRR_U2^ VeZIReYR_ Rac`Uf`Te` Vef c` aVL dZ_TVVgV_DaRZ_ZeM/WRdTVRdVUe` SV 6fc` aVL Z_SVIRfd/`VEd2VEZIR_S]``UR_UZedZ deZ def eZ_dŽ:eZdZ a` ddS]Ve`dJ hZeYRTIfdTJ hYRe VR^ZJ hVSV]`_Xe`Z> ` ce` VMYRehRdZ_UZ&V_`fd YRdSW_R_ZZZRAVLeYV6fc` aVR_aReYRd^ ZVU hZeY eYV2^ VeZIR_R_UeYV2VEZIR_LR_UeYZHYRd ^ Z/VUhZeY eYV:_UZR_R_UeYV6fc` aVR_Z`S` c_R] VeY^ RedZ X/V^ ` eYVL` fc VeXVEYVcdLUZWEZ_XZ_` cZZZ_R_UZ_S]``ULReVVeVEZ_VeZIR_URJ_UZWE gZdS]j Z_eYVVaZXc^ZE2^{0}$ 

#### BCH5 D@95G5BHGHCFM

EYVT\_bfZHRU c6clZ]RhRdYZ dyWr\_bfV&U Z\_RhRjŁd ^ VéZ VdcVa`ceZ\_X`S[VléZeVjjŁd ^ V eZ VddVLFTVUSj YZdfS[VlěZ?`eR] YZdT ^ aR\_ł Z\_dZ\_R^ dR\_U]ZeVRefcVRXWUhZeY YZ Ž3fe eYV&VhV&a]V\_g` `WYc`\_Z]VdR\_U^ V\_ `VWeVxd hY`drRwUYZIRU^ ZREZ\_WceYVZ:RUgVcRjŽ

7\&Z\_VLZ]f deZf dac`gZ\_TVZZ\_eYVW^ W2\_e&I &Tk`\_VLZ V&W^ WSj\_WC `WW\_R&Z\_dZ WCZd\_`S]V deV\_XY\_R\_Ua`hVc+ZZdaVa]Vd\_UZ&ZXYULZd hRdZ\_VLSdgV\_R\_Uac`f ULZ\_`\Z\_XYRdVgVccf]VU eYV\_Z\_`V&VZX\_a`hVcdSUF VZ

 $6cTZ_]R de Revid Z_eYV Z_ec`Uf TeZ_e`YZd a ce$ 

 $\label{eq:linear} \begin{array}{l} 4R_e \stackrel{?}{e} e^{Y} e^{Y} VZeY \stackrel{?}{VeV} Tf_eq TR ] U4 YZV \\ hRdTYRRIEVZEVUS j e^{Y} e^{T}_eRUZEZ \stackrel{?}{VT}_eqR \\ UZEZ_d \stackrel{?}{h} RdyhR^2ZeY \stackrel{?}{E} UT ] e^{Y} CERZER \\ e^{Y} CDaR_ZEY RczzeR R_UT _ bf Vebf_eZeCR TR_ZR \\ SVAR_Zed \\ SVAR_Zed \\ SVAR_Zed \\ VZeZ \\ \end{array}$ 

EYZIVÁZI ^ BJ SVSVAť EXNJ R\_UYVČ ZIŁSTEZEZI cRVJj a]VRR\_EŽ7 ceYZICARI\_ŁYVU VI\_` eV\_gZI RXVRa`V Z\_ eVVdj]V`V&RCIZRI Ž9 VdRAVCIEYRE YVhZ]\_` ehcZEVR\_VI]`XfV` cT fcelj a`V Ž*i?`e JRUZAL]`gV\_` eeVVT fceldZICZ`VV\_ZXIcL]`gV`c\_*   $d_XIZ_` ceYVE`V_CAZICAR_U\Z_Uh`CCE`VAH_VA$  $YVRceLeV_Uć_VAH_URWWZZ_< /7 cYZIh`CLRW$  $eVcR] YVYRICK_R_UVWCLR] eYVCT VWZZ XR_U$  $} XY6Z_XLUXICZSVI_` eR_ZJ]JZTRLEV_fcVSfeR$  $JZWR_UUVRY V_T f_eVZ7c` eYV`fceleYLŁ$  $YVhZMVCE` hRc_ eYVCKUXceYREYZIa`V hZJ SV$  $Z`SfVUhZY eYVYRCY_VCL`VRCER_ZTT_~ZEŽ$ 

#### B9FI 8=5B I HC D=5G

E`T^Ve`^`Ukc\_eZ`V&L? V&FURTR\_SV&AU RdeYVT\_eZ\_fReZ\_`V&GCIZJRŽ9V`V&V\_bf`eVdYZ` e`d^^`\_ fa YZdf\_Z&VcRLCV\_RZdR\_TVgZZ\_Ł hYZTYZ\_eYVdZeW\_eYTV\_efg hRdRJcVRUj XZgZ\_X a`VeZTWc^ e`eYVZJNR`VR\_RCTV\_e4YZVŽ9V h`f]U`V&V\_bf`eVdeZcZ\_XLVaZT]Z\_Vd`V6CIZJRdL eYV\ZU`WJZ\_VdcVIZeVUSj dTY``JTYZUEV\_LeYRe ^Z\_XJV]jcZIZt'LXV\_XdRaYjLYZde`q R\_Ua`]ZEZCŽ

9 V RI\\_`h]VLXvd eYV 2 dFTR\_ZR\_ hRc Rd eVV } ade XXvRe RIe Z\_ R UCR` R hY`d/VáZ, Xf V YRdj Vé e`SV h azev\_ŽE YV ded XXJVU`Vd\_`eR]hRj dT ^ V e` eYV d`d/RIVLSf e Ze cVIV`VXXd VgV\_ e`URj\_SVI TRF d/TV\_ef aZd`]U T\_~ZTed cV`RZ\_ RJZgvL]ReV\_e R\_U f\_d/d ]gVLŽ

EYV? VÍ UZ\_ fé aZ dacZ\_XdW'^ RYZÉ cZR  $R_U$ [ZEVARj ecRUZZ\_Ž2]eY fXY YVZIRa`]ZZZR]  $T ^ ZEVUh cZVL? VÍ URZIRI TCZZIR] R_UdyW$  $TCZZIR] RdYVV R` Z_VdYZÉ cj R_UZdUVýY`a^ V.e$  $Z_ R^ `UV_ [ZXYČZ dyWT_WEWUaRez d_YVYRd$  $_` cZ VWc UZb]R] d`WIYRf gZ_Zh`Ž9 VU Vd_`e$  $RTIVáceYVW[R]] `VR4 YZVR_dRIVŽ9 VZIaRtiZ_ł$  $ReVIhZY a`dZgVZVN]dŽ9 VhR_cdRT f_cj eYReZI$  $`aV_ e` eY`c`fXYUV` TCRZKEZ_łh YVCVýVj`_V$  $YRdeYVcZXYee` R^ ZUJ ^ VR] R_URa]RIVReeYV$  $TZTF]RceKS]VeYREZIE`X Rc`f_UeYVh`c]UŽ$  ? VfUR YRU Y`aVKŽ9 VU Vd\_`edW` e`YRgV YRU e` ^ R\_j Z]f dZ\_d.Y`h VgVKŽ9 V\\_Vh eYRe YZI T` aRecZ ed YRU UZWWCV\_e gZh d. eYRe\_`e R] `VVeYV` dYR:VU YZI` aZ\_Z\_d` c YZI ZUNRI VIC eYV T f\_egi d VKef cVŽ 2S c`RUL eYV a` Ve dacVRU R\_ Z` RXV` VVI YZVRIR JZXYe dYZ\_Z XZ\_ eYV d f eY` W eYV T\_6Z\_V\_eŽ9 V YRS` f cVU eYV UCVR` Lh YZIY YV eY` f XYe RIYZ&GRS]VL` VR\_REZ\_ hZeY R JZeVj UV` `TCREZTRh REV\_VHLCER REVURE eYV\_U` VR=REZ 2^ VCZIR eYReh RIRD, VAL CE REVURE eYV UCV KR Lh YZIY IVEN` TCREZTRH REV\_VHLCER REVURE eYV UCV KR=REZ 2^ VCZIR eYREH RIRD, VAL CE REVURE eYV UCV KR Lh YZIY RYf^` c` f dda ZZELZ\_ VL eCRER XR\_e T` a VEEZ\_de` ac` gVLVc' VR` a]VL eYV df a VZ CE j` VVZIT f\_egi d hZ VR U ac` UTVŽ

#### 8=CH F698 H=A 9CZFCI; < C95G

CVRJZj ZL\_V&VCRa`V Ł`cRJ^ `de\_V&ZGZZ\_d `W4YZJV WZ\_SVT ^ VUZdf cSZ\_XR\_URU^ Ze`V&Vg UZ&VdVdVRLZ\_XZŽ eZIRT f\_egi hZY RIF eVa` JZZTRJŁ VT\_`^ ZH:d TZRJ R\_UTF Jef cRJ T\_eeRdeZ 5 ZWWZV\_TVd TR\_SVT ^ VTYRch dLJVRLZ\_Xe` TZZJ hRtL^ RdJZgV ReeV aedReRc^ VUcf aad/dtZ\_`V&Y dVhY` eYZ\_\ UZWWZV\_ejjZ

 $EYVT f_eqj Zl_`eh RHVUSj ZdXVRebf ZdedvRL$  $RdeV_ReZ_R] R_eVV YRdZdL_`cTR_ZeS`RdeeYRe$  $ZdaReYYRdSW_d'``eYZ2]]`V&YZh R_VdZeYRdVć$  $e`ecRIVeYV]Z_VR^V_ed`V&YVyej aZR] 4 YZVR_%Ze$  $ZIYRRRU f de``SVIRf d/V&Ycj`_VZIUZWWCV_eZ:W$  $d^VcXdV^S]R_TVTR_SVWf_UFZeZleYVcVff ]e`VR$  $YV&C`XV_V f dT`]]VTeZ_`V&Zdf VdR_UWF ]ed:d^V$  $`VMYZTYT^VW^R]`_XhRJ SRT\Ž$ 

#### =89BHHM5G'7CBGH5BH7<5B; 9

 $\begin{array}{c} EZ^{*} VYRdh`c_Rh Rj eVTJZIY½`VR UFSZ fd\\ yZ V_eZ j %VdHS JZhVU`_TVR_UVC RJŽE YVac`Sł\\ V^{*} VZ V_eZ j hZJ_VGVc SV VM jj cVd gVL R_f TYR_XZ_X V_eVJVT jLaVcZ VU Z_eV eHet V`W\\ eYV4 YZ NR_C`e`Z_AJR RJ f_XB JZE YZ lbf V dEZ_hZJ hZJ RJ hB dYR gVZ T ^ aJVVR_dh V de YR RVd f XYe\\ ^`cV f cXV_eJ ReeZ Vd`VT cZZL`WT_VCZ_R_U\\ Xc`hZ X UZ cZ_EZZ$ 

EYVZ'a`œR\_TV`WZXWZV\_TVdZ\_`fej``\hRdRe ZdfVV&/^eVV`fedvěŽH,Y`]bX][Ybcig]b\UV]h UbhUbX'h\YV&bei]gtUXcfibXYfgrccX'h\Y]f` ck b UbX h Y ch Yfŷ [XYbh]mi]b h Y ``][ \hcZ h Y]f ck b dUfUa YhYfġ gc h UhWcbhfUg]]b[ ` ]bhYfdfYhU]c bg WUb VY HUWYX hc h Y XUk b cZh Y Wei bhmŷ \]ghcfm' @\_TV eYV DaR\_ZhY Rozg WLgVg UZWWCY\_eT\_TVácZ\_dSVAR\_e SV Wc^ W` VeYV\_Vh\_ReZ\_RZj eYRehRdV^ VSZ\_XŽ EYVUZWWCY\_TVdeV^ VUW7^ gZha`ZedR\_UaVd d VTæg VdeYReh VcVd&f ReVURe`aa`d&Va`]Vd`VR d TZAj UVA]j UZZUVUSj hReLSj eYVT\_dTZ fd\_Vdd `VSVZ\_Xf a RAZ\_deeYVyV\_V^ j%Zaf ea`]RdZRZ\_ R'd \_f cef cVU ^ fef R] T\_dUVReZ\_LcVT X\_ZZ\_ R' ZUedy[VTeZ\_Ž

Hs 9'D9FG=GH9B 7 9'C : '7 9FH5=B'<=GHC F=7 5@ @9, 57=9G

EYV`aV\_bfVdZ\_KS`feZV\_dejh`fJUSdZX WaeYdARCTYVdWceYV^VR\_ZX`WIZdeV\_TVL^Rj UZMUV\_dLd^V^`dVTReXX dZRJKS`feeYVZc`h\_ cVRLZX`WeYVTf\_eqjL`W1TZdjL`WeYV^dMgVdŽ :\_d^VTReVd deYVdVd^ZReZ\_dJVUe`eYVTeVI ReZ\_`WjeYdLeYVdVeZXfa`VZUJdUe`eYVTeVI ReZ\_`WjeYdLeYVdVeZXfa`VZUJdWeZhVd`c ^`\_deVddDfTTVdDgVT\_defTeZ\_d`WeYVT]JVTegV Z RYZRjhVcVac`UFTVLLT\_ec`gVdZdRS`feeYV yH W&hYZTYeV\_UVUe`T\_d]ZLReVZYVdZeVUZVRd R\_URgVdZ\_dŽ

EYVEVZIRTJVRCZdGeV\_TV`\_ aRceZIF [RCYZGe CZIR] [VARIZKEŽAV a]V]``\ SRT\hRtUde`R\_dhVetZ\_eYVZc `h\_hRjHrgzer] bfVetZ\_+hYVEVU hVT ^ VVE/ 0 EYV`VVIZZ] R\_dhVcZel\_`e6CIZJ[Ret.SfecReYVcAVI Uc`UVCRJUZZZeVV^ eYV*LT ^ LUC*deeVV2CVRe ]R\_U`h\_VcdhY` aVCIVZEVUR\_`gVchYV^ Z\_XUZW WEV\_TVSVehW\_eYV`dv]gVdR\_UeYV\_RezgVetd`\_e` SVecR\_dVC^VUZ\_e`VVC^YR\_UETR\_f\_ecfdeh`ceYj ^`SZEYVEVZER\_V\_ecV\_TYVU`SdvetZ\_hZeYCdePet Z\_XeYVcfaVZ\_cZej`VVeYVDaR\_ZYY`ceYVVCXZ\_RdR acZ\_TZa]V`WRefdE] ]RhEUfSeZ\_X`cf\_eYZ\_VZ\_Nj UV\_jZ\_XeYRe\_eVVdvgR\_eL]ZVeYV^ RetVeL^ZYE SV[`\_Xe`RYf^R\_T\_UZEZ\_h`ceY)`VVCaVZE

@eYVdhR\_ee`T&ReVeYV^jeY`W&RIVŽ:\_ eVV VRcjjehV\_eZeYTV\_efgL?ZT jid ARJRIZ eLZ\_YZd S``\ *CR&R TYZV\_RL*`WW&UfaeYVyc'e`%&eYVVgd Vg'^R\_`WeYV4YZVR\_]`hVcTJRetLRdeYVVeY\_ZT  $d^S$ `]`WeYV\_RZ\_ŽZTT dZ\_Xe`YZdViaJR\_RZ\_L eYVyc'e`%ZdR yaYV\_`ejaW&oR dfaVZc \Z\_U`W ^ Væk ES`c\_`Wh`af CVcRIV&+eVV8`eVdR\_UeVV 2chFTR\_2R\_cZARJRIZ dRaac`gVU`VZ ^ ZKReZ\_Sj 8 Vc^ R\_dSVTRFcV`WeVZc8`eVZTYV&ERXIŽ

?`\_VeYVVdH.RaR`aYJVeafSJZHVUSjeYV4YZi VR\_8`gVc\_^VeZ\_=VZakZXZ\_eYVVRdjehV\_eZeY TV\_efcjhZeYRgZhhe`ReceRTeZ\_X8Vc^R\_T]`\_Zded Via]RZ\_VUeYReyeYVdfeY`WeYVTf\_ecjZd]R\_U W^ hYZIY eYV2dfTR\_Z2\_dLR\_QZ\_WZccRIV`W dPgRW:\_UZR\_dhY`fdVUe`Z\_YRSZegRebf\_Tf]eZ gReVUerRiedLhV2VViaVJJVUZ\_"))#%Z

#### A5B=7<59€A

EYVRU^ ZZ\_XUXIIZaeZ\_d`VeY d/Re eYVe`a `Wi TZG RV^ REIYUUSj UZY ZUGV`\_Vd`VeY`d/ Re eYVS`ee`^ ŁaVcd\_Z W Z\_ yeYV:\_UZR\_%R\_U a]RIVURER]`hVc]VgY]`VeYVchVIZcZ@eYVcWRVY] V acXdZ\_dRVRUVLLcf TY RdeYVcf cR ySR\_UZ% R\_UeYVf cSR\_yc`e`%Z=ReVELhYV\_eYVa`af]RIVYRU SW\_`cXR\_ZXUSj f\_Z\_dR\_Ua`]ZZIR] aRceZdR\_U hRdaf ceZ\_XWchRtU ReVc\_REGVZVRIVC d`TZGL eYVcVhRdRRc^ ReeYVf ad cXV`VeYVyLR\_Xc`f d T]RtV%Z7 \]`YZIN YbZK Ug`[f]ddYX`VmZ/Uf`c Z h`Y`C h`Yf"

:\_RdfST\_&Z\_V\_eRdf\_VbfR]Rd=R&Z\_2^V&ZRL eYVLXWW/TVSVehW\_eYVI]RdtkdZ\_4YZ/vacUfTVd RTYRch eYReecR\_dRevdZ\_e R\_RaaRV\_ejjZcV^VLZ RS]V/decR\_XA^V\_eZEYZeff\_ScZLXARS]Vd/aRR&Z\_Zd Wf\_UZ\_VgVgRVR\_VJZWZe^^T/Vd/IYV^VdWceYV \Z\_U`Wj\_R&Z\_R]f\_Zgj%LR\_ZeVXRevUZV\_eZgj`c ZAR`W4YZ/VE/Re^ZXYeSVRIYZgJSS]VZ\_R^`cV `c]VdtY^`X/\_fddTZkjZD^VReeRIYRUVAVc ^VR\_ZXe`dTZR]UZWWCV\_TVR\_Ua`J&ZIR]UZgVcZgjŁ f\_UVcder\_UZ\_XeYV\_RdRd`ce`V&ZTRc\_ReZ\_`W eYVcdef XXVSVehW\_8``UR\_U6gZŽ

@VVF f colle/Zd> R\_ZYRXZf Zd\_`eR|hB, dVl ac\db\Ud d\RaljLSfeRT\_dR\_eUZ/ZZX]Z\_VZd Udh\_ŽEY\&\R\&Z \LY h\g\dbY\\_ef d\hY Rdh\ceZeV\_e\cRXCy\_R\Ad \&V\_eY\Zc]R\_XFR\R\_U eV a\ceY\gZ]V\_TV`\\AqVIZ\_Ž

#### H 9 < 5 J 9 G 5 B 8 H 9 < 5 J 9 B C H G

DZ\_TVT]`\_ZEJEZ VELEYVEVYREISW\_R\_RTNAER\_TV `WWf\_UREZ\_R]^j eYdeYREVN/BREVEVVgZef Vel`VBYV faaVcTRdWŽEYY RVReeYVe a`WAVaj dX ZŽ EYY Z a`dU`SVUZ/TV`\_ eYVa`af]RIVŽEYVZ ZJR`WdVchRdf\_eYZ \ZXT ^ a]Z TVhZY eYV ]Rh Sj eY dV eYY U ^ ZRAU RAKć eYV SReeJV`W =ZTRJŽ5 k \c'Y']XYc'c[ nžVYVc'a Y'gYVc'bX' bUh fYžk Ughc YbhYbW Ub fcb X]gW[d']bYž U'XU]'mfYbYk YX ZYUf cZUi h cf]mUbX cZ di b]g\a YbhZ fh Y'g'][ \hYghfUbg fYgg]cb":e h`f]UR]d d\cyVe Rg\ceeYVcZh`\K\_j dX\_Z TR\_e a`af]RcUZd dVZ2 d'TZkj `WcZIY R\_Ua``chRd eYfd\cHS]ZhVURdR\_Z ^ fdS]V]RhŽ

3feeYVdARCTYWceYVcVacVdV\_dReZeV4YZVR\_ h`f]UT\_eZfVZ]ZEVcRcjh`c\Ž>RcZR\_`=Re`ccVL eYV [VRU/c ` WeV TZ ] ZHR dIY ` ] Z 4 YZVL^ RZ ] eRZ\_VU Wc Vi R^ a]VLygVcj } c^ ]jLeYRe RV6Wc eYV YVć``WYZE`qiLeYVd`]UZC`WeYV:\_UVaV\_UV\_TV ^`gV^V\_eLZehRd\_`heYVY`fc`WeYVXRfTY`Z\_ 2cXV\_6Z\_RR\_UF d XFR R\_U`WeYVQYFRd`LaVRd  $R_eVZ_4 YZVLTR]VUeVVQVc^ VaVRTVZ2 decR_XVj$ ď XXV dezev ZVRLSRCV j `Sdlf cVU Sj eVV VRIe eVRe eYV4YZVR\_QYFRd~YRd\_VgVcRIbfZVUeYVdeRefd ReVZ eYZddvdaVTeeYR YZdT ^ aR Z ` cT f dZ > Ree<sup>3</sup>/<sub>4</sub> 7Z/dc``cU\_DVAf\_UD^SdR, eYR\_eYV  $GV_V f V R_a RZ_d R_c ceVV4]^ SZR_d SSVc$ h`c\Vc,eYR\_eYV:\_UZR\_`cQYY`]```W6TfRU`c`c AVcf, eYR\_ eYV3cRkZZR\_ TRIR h`c\Vcd`cDkce<sup>2</sup>\_ TRee[VorR\_TYVorL`ceYVh`c\Vod`\_eYVofXRcR\_U SR R R a R e Rez d`WeyV 4 Rezs SVR ŽE Yzd Zd R WRTELVeV\_ZWZEZIYfceWN/e``fcacZUNŽ2\_UhYRe Zel^`cVLeYReY`fc`VeYVQyfRd``VeYVT]`fcVM `]UdeR^ a YRdac`SRS]j aRdtVLL`cZl\_`h aRdtZX‰ 1EVZeVJS`Z'Ł"\*(\$⁄Ž

#### I F65 B I DCH5 FHC

:\_ =ReZ\_ 2^ \{ZR e`UB}LeYVef eY ZleYRe eYV TZġ ZlUGZZX eYVT f\_eġ dZNŽE YVWCIZ ReZ\_ `\VeYV]R\_UCIRa\LhYZVZe ZldeZ] R\_ Z\_\V YR deS]V d fcIV` \VZ\_daZReZ\_ RdR d\eeZ\_X`c SRI\Uc`aLZl \_`eV\_`fXYe`ac`gZVeYVSRdZl\\cR\_ RcIY\&j a\Z :\_ 4 YZ\LTZġ lUh V]]\cdReVZ\_ eYV^ R[`cZġ LR\_URV SVT ^ Z\_XeYV\_\h deR\_URUŽE YVJ R\\deeZ\_XeVV aRIVZ\_ R] d ced` \MB dŽE YVJ T g\\ceYV\_eZVdIR\L \W^ eYVfcSR\_y]f^ a\Z\@o`eYV\_`fg\Rf cZIYVR\_U eYV^ R\_RX\ch`c\Z\_X\\cR^ f]eZ\_REZ\_RJŽ  $8 \vee VReZ_R RCTV g a Vd R d Raa VRŽ:_ > RR$ `\_URL2]SVæ 7f Xf Vé UVCTCZSV de VV ^ R\_\_Vcd R\_U ZZ ^ d`WeYV]Rde XV\_VCREZ\_ `Wy`f\_XaV a]VZ eYVeh V\_eZeY TV\_ef g LRd2]SVæ 3]Vde 8 R\_RUZU Z\_ > Rce3/4 CZgRctZ\_ eYV ^ ZJ\_Z VeW\_eY TV\_ef g Ž AVUc` =V^ VSV] h Rde`Rh RcU R TYRceVc` V/ZeVcRg TZEXV\_dYZa e` eYV af S]ZT T ^ Z\_X`fe`VeYV XG dTV\_VLRd1/ceZ\_X eYVT]RZ` e` ]VXEZ RIj` VeM f R] UZEVcRg Ž

3fe> Rce1/4CZeRcIZcleYV\_`gV]`VV R\_\_VcdeYReYRd Tc dt UeVXV\_VReZ\_dtRaaVR[Z\_Xe R\_V\_c^ fd af SZZZ: e YRdZ\_daZVU} ]^ dLa R dR\_U eVVgZZ\_ dvZdLR UYRdSW\_gZefR]j cVbfZVUcVRLZXZ dTY``]dŽ:edeZ`V[Vdda`af]RcZej Tf]USVUFVe`  $Zed dYZeVW^{\wedge} hReeZ^{\vee} VWRed l > Ree\frac{3}{4}Zdc^{\circ} feVU Z$ eYV cVg`]f eZ\_Rq``f eScVR\`W) &" LT\_UV\_VU è UNReY R\_U VIZIVUI è eYV XKNRe WNRe `W^ `U\ć\_ eZ Vd+d TZR] RUgR\_TV V\_e R\_U ^ \_ Vj ł^ R\_Z XŽ EYZIZIeYVXCVReRIYZIgV V\_e`Vkac`gZ\_TZRjj`feYL  $dY_{L^{\circ}} dR_{J} = dV_{L^{\circ}} VR dZ_{V^{\circ}} ZZ_{XV_{L^{\circ}}}$ ecVacV\_VfdLhY\_ZdRS]Ve`defUj]RheYR\_\de`eYV dfaa`ce`VRhVReYjDR eZRX dTZRZEVŁRVOZVU`W YZI WREYVČOŽ > Rce<sup>3</sup>/<sub>4</sub> ZI CVT X\_ZKU SjeYVa`hVd  $MZ9 VZIRITVAeVUSVIRF dV^ WZI^ UVReZ_ R_U$ df\_U[fUXV^V\_eLYZthZ]Z\_X\_Vdde`dv/gVeYdV hY`Zec`UfTVYZ`e`eYVdV{\_V`V\_ed`V02Re2RX`Ž EYV\_`gVjdY`hdyR\_RSd`]feVT]RcZgiRS`fehYRe RdTZkjdYf]UR\_UdYf]U\_`eSWaaR\_UReeYV dR^ VeZ VyRa]ZRS]V^ `dR]Zej Z\_ ^ ReeVed`V&`]ZeZId R\_USf dZ\_Vdd%@dvdL" \*\*\*/ŽecVgVRjdRTf ]ef cV`Sł dadauhzeyd Tzr, Rubr, TV Ver, URWARc Wdz X a`dEZ\_Ž:eUvdTcZSVdeYVZc`\_ZTR|R\_UYf^ZZReZ\_X ecVRe^V\_e^VeVU`feSjfaaVdT]Rddj`feYde`eY`dV `W` d`TZR` deR\_UZ\_XŽ*A Ufht*b`F*jj Ug*`gYYa g`hc` i bfUj Y``U`ghYfYchndY`cZ7\]`YUb`gcWyYhnž ]``i ghfUhjb[ 'h\Y'hfUbgZcfa Uhjcb'cZh\Y'Yd]W UbX [XYU`]ghW\Yfc []bhc U Wc bZ fa ]ghž gc ! WU!WaVb[\Yfck\c^cbghYXca]bUbh ₩`'n fY"

#### $H_{c}9G58B9GGC: H_{c}97 < = @95B$

:e YRd SW\_ dRU eYRe h cEvcd RcVL`c TR\_ SVL h VReYVcgR\_VdWcYf^ R\_V a Vc2/\_TVLeYVec2f^ a Yd R\_U erRef2dd`W' R\_\Z\_UŽ

7dR\_\]Z\_BfVgVU 1#!!!/UVTZUVUe`Sfg YZ`ł

 $\label{eq:constraint} \begin{array}{l} dMVZ eYV[f_X]V^{*}W4YZWR_a^{*}Weg^{*$ 

#### 5 GMBH + 9G+GC: H + 9 D@5 B 9H

7 Ufcg DYnc U'J f`]n'gd YU\_g cZÎ U'\_]bX cZ ]b\Yf]hYX gUXbYgg h UhgYYa YX hc k YYd Z f U``h Y gcffck g cZa Ub\_]bXÏ ": V&YV2j ł ^ RRdda`\V`W4 YZ]ZRdeYVa]RIVyh Y&VeYV]R\_U V\_UY42 Vf URdUVIRZaeZ\_SVZ\_dh ZY eYV\_`ceY+ y EYV&VhV}\_Už af dVXV XRaYj ŁUV&C^ Z W Z ZddeR\_XVZ R\_U RSdeRIe ]R\_UIRaVLVReY R\_U RZŽE YV\_TVe``eYVaf dVR\_UaRZ\_W] aReYd`W R\_ UXIV\_Uމ

9 f Z) SC ^ RZ\_dZ\_dZ\_2 2 JeRK d.eNRe < Z eZd UNICE VRIY dRCZZEEV/ ZXVCR\_ `RZZZ@C~RXd `WWSS`UZ\_XR\_UUREYZ

7`c8RScZJR>ZteRJLeYZt]\_`ceYZt]yRTVceHZ\_ a]RIVZ\_eYVh`c]UhY`dVa`ceZ\_hRtlR]R\_UTRde dY`c\_`WgVcjXcRIV`WgVXdReZ\_R\_UVgVcj\Z\_U \_Vdt`WhReVcZ  $\begin{array}{l} 6^{a} XRCHZZ XeYVYRUVXIV`VeYV2_UR_ ]R_U \\ dIRaVL3V_ [R^ {3/4} Df SVCIRCHAFT aZI\d`fed^V \\ d`XXCHZZVa ]RIV_ R^ {4/4} f TYRd> f VeVcluy> R_j \\ 5 VReYCHLARCH 4`^ VL4 RSR]`duyDhR]`hl9`cdV \\ ARCHML>`_eVUV]RAV_ Ruy>`f_eD cc`hMZZ \\ \end{array}$ 

8 RSCZ/R> ZherR ecRVdeYV\_Rcc hET\_ecRUZie g [Z\_VR^ V\_ed`VWVcY^ V/R\_U+yEYVXV XRaYj`W 4 YZ/VRIYZ&gVdR\Z\_U`WJ\_eYVdE'V&Va/R\_VŽ:e dRccdZ\_eYVUVA/deLhYZIY ZddRceZ\_XhZeY RdeVCZI Zj\_eYVgR][V] d`V&YRek`\_VhYVcVWc^ Z\_XZdR], Ze eR\d`\_ RYVc`ZI`WCVESVRf gi\_Z\_eYV]Rde dcvEIY `V&YVT\_eZ\_V\_eLRdeY`fXY e`V\_Uh`ceYZjER\_U Ze da]Z\_eVcdReeYVeZeL`WWZ\_X]ZWR\_UUVReY YR]W R\_UYR/WZ\_RdvReYReacVgRZReVCSVchW\_Zd]Zbf ZJ S]ZdIR\_UeVVa]B\_Vb] S]ZdI`Wevc\_R]ZVZ/EEYVeYZT/E V&YVC4: WXC2\_VZEYV/R\_U: TR^Ve`YRL^ DacZ\_Xe Zz\_YRdZd]'\_X\_ZXEeRReYZ/VCA^VZ/VR^^ eVCZ

#### 7 < FC B = 7 @ C: 7 C @ 7 H 9: 95 FG

EYV&VRVRFeY cdhY JZE eYVETRFdddWceYV f\_VRdV`WeY dVhY JZeVZ eYZdJR\_ULRaRceW'^ eYV VRceYbfR\VdR\_U g`JTR\_ZT VcfaeZ\_dhY dV YZEF g`Z\_4YZVZdReVcZfyZ\_X`\_VŽEYVj dWVce` `eYvETRJR^ZZXdLeYVdfCtV W\_\_VgZ\_XdReZbZtZ EYV&VZdR\_VRdj dWVV\_TVe`dYZhdVT\dLhYZTY RVTRJJVUeYVYUZJj SCVRU`Wd cc`h%ZeYRdSW\_ eYfddZ\_TVeYVSVXZ\_Z\_XLZ\_eYZdgZ JV\_edfeYVc dMZ:\_4R\_e`dI G R\_UI G:`V&R2dFTR\_R6cTZJR UVCRZSVdZe+EYVdj`aV\_deVVdRc`RcdR\_XZj< :e cfdrWfa`\_eYVRJ/V\_RSVR`< HZEYeVSRTVhRd/L eYVVaVRWUURAYZ

3Véh W\_ "&#! R\_U" \*!! ŁeYVC/h VC/" Ł\$#( dYZał hcVT/d`WWYV4 YZ/WR\_T RebŽ6\_`f XY e`decZ/VWRČ 7c`^ eYV dWLe`LTR`VeYV ya ZReW&R h`dJeYRe h`f]UR]Rc^ 4 YZ/WR\_dWc`gVceh`TV\_ef cZCŽ

+b h Y W fcb JWY c ZWć `YWj Y Z/Ufgk \cgY ]bû YbW/k Ugbc hWc bÚbYX hc h Y a YbhU ]mi cZh Y `ck Yf WUggYgźk Y U `gc ÚbX k \Uhk Ug \_bck b `Ug Î VUbX]Ifmi `h Zey Zed & VY \_ `f d d & `Ukc\_ JWRJ Zh Z.MacARUTAZ VLRX `U`cSRU aRe `Wh YZY UKZgkł W/ a `gkiej R\_U W/ R



T\_WAAU (A)g`]e Sj eYV ^ REXZ RJZAVU RARZ de eYV dj deV eYRe VIT]fUAI eYV Ž:W\_TV Ze h Rd T ^ ł ^`\_ e` eR]\`VVd TZRJ ScZAR\_URXVA Zed c``ed\_` h X VgV\_UVAAVc R\_U h ZUACZ\_R d'TZA gi eYRe Zda`` c Z\_Vbf Zgi R\_U [f deZTVŽ

 $4 \mathbb{R}^{(1)} dAWc \mathbb{R}G^{1/2} W^{(1)} hdZdUVgV^{(1)} a^ V_e Z_{d}^{(1)} (AWc^{(1)} WC^{(1)}  

H 9 A 9 0 5 B 7 < C OMC : 8 - G = O G C B 3

 $\label{eq:approx_appr$ 

4 Rc]`d AVk`R G ¼Zk\_`eVd+y@\_V`Wê URj`d \_VhobRaVcd TRocZki R gVcj\_decRZXYeVkh RcU ]Zee]V ZeV Ž:eZcIRS`f e RUcZANc\\_`h\_Sj\_eVV\_ZT\\_R`V > Rf dZRj`f\_XRaaRV\_ejj R\_Uf\_a]VRR\_e]``\ Z\_XLhY`UZUd`UUV\_lj Z\_eYVIR]VUV]RGZR`dZZ EYVU`Te`chY`TRcdZU`feeYVRfe`adj deReWeYRe YVYRUdeRcgVUe`UNReYZ‰

9f\_X&+y2\_U: YVR:9f\_X&VR2\_X&rd3 d8 Rsc2 VR> Zber3Ž2 S`YV ZR\_ R\_UVcdh YZVUR\_UJLeYV a`VeEV}]` 4 ZLLaYZ`d aYZ&dRS`f eYZUU h\_V9]+ : YRgVX\_Ve`VReh Y&VeYVa``c VRežR\_U: YRgVVV eYRe eYVcHRUh Zl`gVc R]] žeYRe aRZ\_ JZVeYZIZIR JR\_X RXVZd`caRdZ\_XeYVd\_Ld`caRdZ\_X^`eYvcŽ

$$\label{eq:linear} \begin{split} & Dc `]HWU`X]gUddc ]bha Ybh]g U`gc `U`Wca !\\ & dc bYbh c Zh Y`7 \ ]`YUb `gUXbYgg `bUffUhYX`\\ & [b ``]HYfUh fY'' > Z]Z_d`WaV a]VYRgV`c YRU R\\ & UCR` LRY`aV, eYVac`^ZhV`VRd `TZej eYRe_VgCC'$$
 $TR` VZ4f dZ > R]RaReVgZEEU 4 YZVR_UXRgVR SR]R_TUU`aZ_2_+ \end{split}$ 

yEYYZ WIVARVAUR\_UéYZcd\_XAR\_UUR\_TVAL RJeY f XY dée [ZgV] cY eY d RVAUR dh V][Ž2\_U S` eY eYYZ d a` Vej R\_UeYYZ ff JeZgReVUa` Vej RVALŽEYYZ d R\_UEYZ d RTZ/ d Wd` WW dU\_VAL\_`e`\_] Z\_ eYZch BJ `WAR\ZXL`cXd eZf ]RZ XL`ceR\ZXL`c]ZkL`c]``\ZXL`c WJ[Z\_X dV/d h YZY d ^ VR eY d YRgV ]RSV][W ^ Zhef de`cd daZZ\_LSf eh YZY: eYZ \ Zd^`cV eYR\_ eYR+RT\_dR\_e^ VLZRZ\_`\_ Yf^ R\_ RWXCd R^ VR\_TY`] `WUZZ][f dZ\_ 1< / eYY RV} VETVL bf RacVd ^ VLYZY] SAgVR\_UZ\_UZWWEV\_ee`UVReYL bf RZZdeYRERVSVevCd ZWUe`RAU\_Rf cVerR\_ R^ Vaj`\_VaB f VgVU L#!!!/Ž

EYY YR YVI a]` CUEYVAU\_VA` WZTER` CAZAL V ZVL^ RARCUAR RALVREY, UNREY hY`^ 8 RScZ VR> ZHCR TR]deYVy@]UCVXZHCR%LeYVy4`f\_eVd > `eYV%LeYVy4`^ VAV a]VAZ

#### 

H\Y`]HYfUfmWei bHYfdc]bhcZU```h\]gʻgcffck k Ugʻhc`VYʻdfcj]XYX`aU]b`mVmH\YʻBYfiXU` cZhYʻgYWebXʻdYf]cXžk\Yb`\Y`X]gWejYfYX` 'cm'

? VcfURLhY`hRd^V[R\_TY`]j Z\_YZdj`feYL afS]ZEYZ\_XRd\_X`WUXbaRZ: ReeYVRW`W#! R\_U ac`T]RZ`Z\_X+: *Tf]UhcZeVeYVRUXde]Z\_Vde\_ZXfe\_L* hc`eVZ\_YZd^RefcVjVRcdR\_y@UVe`cRU\_Vd91400 hYZIY ZIR\_R\_&U eVe dU\_VdHR\_RSd |f eVeV[VI eZ\_`Wat cc`h f eeVeVUSj R^R\_hY`hZhVde`SV YRaaj ŽDRU\_VdHSWEVZhZeY dgV\_Sc`\V\_JVHZVXA `WabZNedhVSHZ^RZ`VU dHZSZEIYdd V[Ve\_+zJ`f hZ]\_`e V\_eVeYVeVZz< Via`f eZ5 VaRezZ

? VcfURh`f]URd hcZeVYZdy@UVe`eVVYRaaj UR WŽEYZLOZ V Ve ^ Vž SVYRaaj < 7 c X U ^VRcfcVLYVhVe` e`hcZeVR y@UVe`[`j‰: dľc\_VUj`fŁ[`jŽź: hRdZ]]łRUźZWŽžEYV^``\_ž]VU ^ VR]`\_XYVchRj dŽžEYV` [Ua`Vedž]V\_e^ VedvIeRI[Vd žR U Viee`VevjeYZXž: a|RIVUR URc\ YR|`Lž Tc`h\_WeyV~`h\chZeyS]RT\ŁždeRdRU\Zdžfa`\_ eYVSV gVU^ `f eYŽE YVCVZddZ] eZ Vž [Ve^ VTYR XV \_`h: TR]]fa`\_j`fL[`jŽžz=Z\VeYVRceYžj`f RcV ž\_VIVáRcjŽž=ZVScVRUžj`f RcVafcVŽž=ZVeVV hRevć Z\_R częvć žj`f RcVcvd\_R\_ežz=ZvRSW žj`f a`ccZ\_`feY\_V/Rdj`f~jŽž;`jŁž: hRdRdf]]V\_ j`feYLž: Wf\_Uj`fcYKUždYTVZX : R^ XZX e` cláRj \ģ\ģ`\_VžSVIRfdV: `hVž^j [`j e` R]|Žž ?`S`U dr`f]Uh`\_UcZWhR\_eže`X&V^ V\_žeW XXXX WeYV ReeYLŽSVIRF dVZ\_ eVV def XXV: ]VRc\_ež eYReZeZd^ j VRceYj Uf ej že` decVRU[`jŽž2\_UhZeY  $^{j} d_X W ] ^{j} U d Z j Z$ 

GVġUZWWEV\_eZtyEYVUZET gVġ`VVjj‰jARS]` UVC`\YRLR\_R\_eYV`ê 4 dV]VVfaY`cZeLdf\_XL`c ^ R\_XJVULSj eYVyc`ê TY`c`%ueYVa]fT\jc`ê/Ž

:\_ T^ VeYVXfZRZHdR\_URSZXCR\_TRXfRhZ\_Vž hVládeVhVláZXTfVTR`VeYVc`e`TY`c` hVládESfe žh WádZed TYWCW[]j RhZUh YZ] `W^ aR\_RLRR\_U ž`]ZeVR\_UCRZ`f\_U 4`\_ecV&RdacZT\ždY`f eZ\_XR\_U dZ\_XZ\_X]Z\VR daZJj a`c\c`]] žj`f dafc\_ eVVhZ\_eVc af\_TYžeVVj`f eVd]Ra fa<

#### @HH 9B5H B695@H75B69

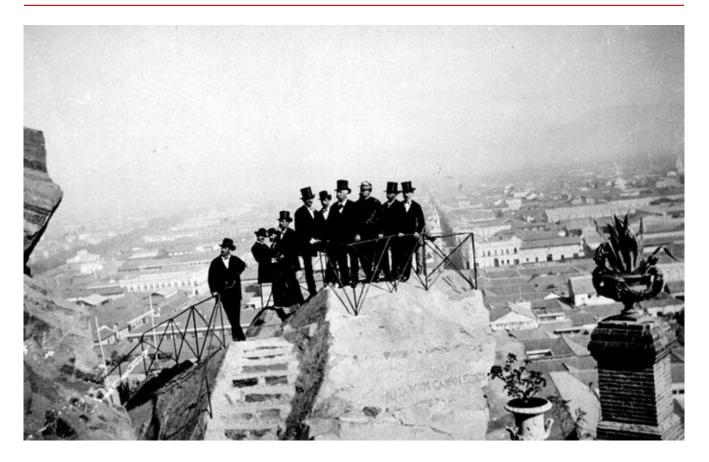
y? ReZ\_RJ ZU/eZej%Zcl^`cVeYR\_eVVef^`W dVTe`dRJ ZU/eZeJ&LR\_Ud^VeYZ\_XUZWWEV\_eV0'^ acVT\_deZefeVUVdbV\_TVCŽ?`cUVdZeRZEV`\_Jj V&V^da`\_eR\_VfdZ\_UZgZfRJeYfXveZ:e\_WUdR T^^f\_ZejZ:eZITCVReVUZ\_eYVY^VERedTY`], ZeZlecR\_d^ZeVUEVCSVeeVc`ch`cdMEZ\_eYV^Rdd ^VUZELeYcfXYS``\deYVh`dJU`V&T]ZeZTeLy`aZ\_ł Z\_Wc^Vcd%Z

E`UMZ\_WREVZELZEZL\_VIVdRg e`UFde`WWZde`djŁ }\_U`feZedecRUZEZ\_dR\_UTfde`^dLXde`\\_`h ZedYVc`VdR\_UR\_e2LYVc`VdLeYV]ZgZ\_XaRdeLdr`hł Z\_XeYReeYZdZlR\_RIEzgVaRdeL\_`eR\_`ddRJXZTTf]e `WhYRefdWUe`SVŽEYVeRd\Zde`SJV\_UhYRehRd hZeYhYReZdR\_UhYRe`fXYee`SVŽ

=XYbł]mžł\Y'gY'Z dc flfU]hbUffUłłYX']b'\\Y' Wa a cb'\ca Yžg\ci 'X'bch'i ghfYdfYgYbh \\Y'W UfUWłYf]gł]WZYUh fYg cZgcWJYmžVi h g\ci 'X'U`gc'cZzYf'U'XfYUa 'cZh\Y'Wci blfmi k Y'k Ubhłc 'VY''E` daVR\`W&YV\_REZ\_ WJ} ]]Z\_X Zda`eV\_eZg]U Vd\_`e^ VR\_eYVX R]ZIZ`^`SZZGŽ CReYVcZeZIRTR]] e` RIeLe` h`c\e`h RtUdRd TZG eYReZlh`ceYj`VZedJ]WZ

# $7 < 5 \text{ DHPF}^{-}$ &

# H≰9<sup>·</sup>DC @H¥75@7CBGHFI7H€B<sup>·</sup>C: <sup>·</sup>7C @@97HJ9<sup>···</sup> → 5; <sup>·</sup>B5F=9G



CVT X\_ZKZ\_X eYV YZte cZTR f\_UkaZ\_Z\_Xd `W4 YZV ^ VR\_d cVT X\_ZKZ\_X eYRe Zd Z.V\_éZj Zd R T\_ded TtE\_R T\_éZ f `f d ac `Tkd ` WIckReZ\_Ł ckac`Uf TteZ\_ R\_U ecR\_dNc^ ReZ\_Ž:e Zd Z\_ eYZd ^ VeR^ `caY`dZ ` WWc^ d R\_U ^ VR\_Z Xd eYRe Ze hZJ SV\_VTkdRg e` UZHT gkceYVIF ]ef cR ^ Rez `W 4 YZNR\_UkgY`a^ V\_éZEYVVI a]`dEZ\_ `WYR\_XL Y`h VgkLdY`f ]U\_`e]VRUf de` gkd`` \ etV]VKRJ `WeRLZEZ\_ R\_U VI a kZV\_TKŽEY kdv Sf cZU ]R kd RcV aRe `WEYVTF ccV\_e yH WZZ2XZŁ RTVacZ X

eYRe TVæRZ\_WR&f cVd`W4 YZNR\_d TZAġ R:VZ\_R\_ `]UVc ecRLZ&Z\_U`Vd\_`e^VR\_ecVReZ\_XYZde`g`Rd d^VeYZ\_XARCVUŽF\_UVdjZ\_XeYVý WTZRJYZde`g`% h YZIYY`^`XV\_ZAVdeYVUZgVcdZg``Vvac`TVdbVdZ\_e` R cZ\_XJVTf ccV\_eLeYVEVRV`eYVc YZde`cZvdL\_`e R} h Bj de`]UŽEYVEVZd\_``\_VUVJ\_ZZgVYZde`g`ZH\_Y` a YUDbjb[`cZhYdUghXYdYbXgzhYbžcb\ck` 7 \]YUbg`hc XUmUddfc df]UhY`UbX`jbhYfdfYhi h,Yjf`\]gtc fm"

:W4YZWR YZ6e`qi ZdcWRUW/^ eYVdeR Ua`Ze `WeYVacVdV\_eLeYVcVZd`\_VZ`RXZ\_Roj eYReT[VRc]j df\_dd2XYeeYc`fXY22LW3^ :\_UVaV\_UV\_TVe`eYV acvál/\_eUR;+eYVZ'RXZ\_Rg``WdUkž:eZdReYcVRU `WT\_eZfZejeYRe]Z \deYVTf\_eqj`d`cZxZde`eYV dzf Rez\_\_`hŽH,Y'gd YWJÚWJmic Zh,Y'7 \]`YUb' ]a U[]bUfmgYYa g hc ``]Y ]b h Y Wc bgY₩U! hcbcZcfXYfUgUib]mibVfc\_YbZca hY VY[]bb]b[žmYhWcbgHJbhmh.fYUhYbYX<sup>·</sup>Vm X]gcfXYf"EYZdZ RXZ\_Rcj UdRhdZeddecV\_XeYW^^ eYV`aa`dZ\_XZ'RXZ\_Rg'+eYV`^\_Zac\dV\_TV`WVRc\Ł fc\ZXWETVEŽ:eZleYVWRc`WeYVy@eYVe%bo`WeYV  $UZWWCV_eR_Uf_^ h_ eYVZ2_U_e[fde WeYV$ a`af]RIVŽ:eZdRWRdLf]eZ`ReVjjL`WeYV`feScVR `WRdfS[VIezzei SV/ZkgVUe`SVZcVdZezS]VŽ:eZd `\_\_\_eYZdWARceYReeYV`SolvatZ\_\_hZeY`d.Vat.f\_Zejt. Z\_deZefeZ\_RZejŁ]VXRZejŁZISROWZEYZIZ RXZ\_Rcj  $Zd_{h} V S UZUZ eVacZ UZa V WX gVc_R V$ eYRe a VcgRUVd eYV yeoR\_d&Z\_%Zied acZ RIj ZlUFV e`Reh`WJUf\_VRdV+eYVWRc`VVJYRdLZV\_eZVU hZey 2] V UVR UeVVF ZIRUA` af ]R&R UeVVWRc `Waf\_ZtY^ V e Z TF TRevU Sj eYV UZTeRe` cdYZa `W  $AZ_{TV} = TVZ RhR \ TVZ$ Z\_XeVVWRc`WIYR dR\_Ua]RIZ\_X]Z Zed`\_ hYRe ZłUWZERS [VR\_Ua`dzs [VŽJ ve eYZdf\_Uvdj Z\_XWRc  $\underline{Z}$  TeVReWdU f SeedRS` f eeYVeVR] d ] $\overline{Z}$ . $\overline{Z}$  ` V4 Y $\overline{Z}$ VR\_  $\underline{Z}$  de  $\underline{Z}$  de  $\underline{Z}$  d 1; TV j  $\underline{I}$  9  $\underline{I}$  9  $\underline{I}$  ( $\underline{K}$  R, DR R R R R U AZ\_e`Ł"\*\*\*/Ž

 $EYVR]^{\ \ deT} af ]dgVj VRc_ZXVC \ dVc R_U$ WRc `WIYR dUReVSRI\ R]`\_XhBjZEYVdVh VV eYVaRdZ\_deYReUZBREVUeYV") S! 4`\_deZf eZ\_Ł hYZIY ef c\_WZ dSRI\ `\_\_]ZSVRJ R\_U c` ^ R\_eZI eYZ\_VZXCVa]RIZ\_XeVV `\_RTYj hZeY Rckaf Sł ]ZIR\_d deV LeYV\_Vh DeReVhRdSRMU`\_ eYVT\_ł eZ f ReZ\_ `WeVVT]`\_ZR] d TZI `dVZEYZdZh YRe A` aeRJVdhV]]!\\_`h\_dV Rc\R]f Ude` +yEYVd TZI `dUc Zl^ RZ\_eZZ WZ\_4YZVSj eYVhVZYe`VeVV \_ZXYeZA YZVhRdeYf d`\_V`VeYV} adeT f\_ezZdZ eYVeXZ\_e` RIYZgVdFSZZi hZeY Rc^ VUVcTVdeYRe hVcVf\_UceYVT\_ec`]`VeYVTZZI REY CigZA`\_ł eRieZ\_XeYVd TIVdMN]T\_def TeZ\_`WYVCVaf S]ZT hZeY eYVR\_RCTYj eYReadvgRZWZ\_`eVcT f\_ecZd ac`gZNUR\_VeY`d`\_hYZY\_ReZ\_R\ZV\_eZej Tf\U SVSRcMUŽ2 UeYVhR, YZDe cj hRdeRf XYe W/^ ")%`\_hReUhRdTRJTF]RevUe`TevRevR\_ReZ\_RJ WWZXRdeYVWf\_UReZ\_R\_U VXEZ ZkZ\_XacZ\_TZa V `WAY\_Vh `dVc1DRXXVU`RUDVccR`L"\*\*%Ž EYZdd TZRZREZ\_hRdfaYVJUSjZ\_deZfeZ\_ddfTY  $RdeYV? ReZ_R = ZSdR (1") " S/LeYVF_ZSVdZ (V) W$ 4 YZV1") %#/ R\_UeYVAVLRX XZR: \_deZef eV1")) \*/Ł SWKVSVZXZ a]V V\_eVU `\_ R ^ RdddIR]V `\_TV T^af]d`qi acZ`Rqi dTY`]Z\_XhRdZ\_ec`UfTVU ı" \* #! /ŽEYc`fXY`feeYV\_ZV&W\_eYTV\_efqLeYV \_ReZ\_h`f]USVZIV\_eZ;WhZeYeYVViZeV\_TV`VR\_ Z'aVcd\_R|XgVc\_^V\_eLRDeReVyZ\_Wc^%Lee fdV DaV XVcdaYcRdH\_RS[Ve) T\_eRZ\_TYR dŽCVafS]Z TR\_RfeY`cZERCZR\_Zd`h`gVeYZdZ`RXZ\_RcjhZeYZd aR eVV\_`WVc`VelZedcRIcVUVaZILZedcZef RdŽ@dU/c hRd XgV\_R dRIckU TYRCRIekć eYRe dkgVU e` ^ Rd. d TZR T\_~ZTe R\_U TYR\_V eYVZ\_eVc\_R UZRXcW ^Ved`WeYVV/ZEWŽ2\_UeYZd^jeY`WvcZ&Z\_hRd e`dV`RZ\_RZzVLVgV\_hYV\_YZde`dZP\_du6\_TZ\_RL6U hRUd/Z\_eVVRcjjehV\_eZeYTV\_efgia`af]ReZkVUZe RdR/VXV\_U`WReZ\_R/UVIRUV\_TVŽEYZdeV\_UV\_Tje` Zevlade ey v Z Tol Roz XUZevlod Z TRez ` VA YZVR d TZAG RdUVIRUV\_TVdY hdY h UZJVIF ]eZehZ] SV e`UVR]hZeYdTZR]UZWWCV\_TVdZ\_VKefcVŽ

 $3 c_V R_V WSj^2 ZZR_j dTIVdWLeVV_RZ_R_$  $DeREVV_U hWZeM/WiZeY Ry_RZ_R_ZV_ZV_ZZ_WI$  $aRSJV WZ eWARZ_XL cReJVRe UWZV čZ_VLRJ dTZJ$  $Xc fadŽ@dUc^ VR_dUZIZaJZ_V} cdeR_UWZV^ čdL$  $R_UeYZI^ VR_eVITJfUZ_Xa^eV_ZZJ dfcTVd^ WZd$  $`dUZZ2eeYVR^ VeZ VLeYV^ jeY WYVY4 YZVR_$  $c`e`%h`fJUSVT^ VeYV\Vc_V] WYVZ_eWARZ_$  $UZIT fcdM_eYVyc`e`7%MTJfdZ_SVZ_XT_TVRJW$  $SV_VReYeYVI]`R_ WRZ_RJf_Zg ZE YZUZIT fcdV$  $hRdfaaJV^ V_eVUSJ R_ eVc`_VLeYRe`WYVSRd$  $SRZg `VeYV:_UZR_d13V_X R_"*) &ZH YRe hRd$  $WHSJZHVURdRcVd JehRdRTZZZXWUdJWZ RXV^ W$  $eYVyH WLhYZY^ Rd\VUeYVWRc`WEVVdJWZ$ 

EYZLac`TVdLYRUeh` WodeYVcTYRCRIeVZdzZdZ @\_VhRdeYVacVU^Z\_R\_TV`WeVVcfcR]h`dJUŽ 4YZVhRdS`c\_R\_UX&h fa Z\_eYVT]`dU`cSZe `WeYVYRIZV\_URL`c]RcXVR%ZIf]efcR]VdHReVŽEYZL daReZR]\_Rcc`h\_VddhRdVWg`fdSS]Ve`Tf]efcR]Y`ł



^ `XV\_ZREZ\_ŽEYVAV d R] c``edh VAV ARAVC' VU Z\_ eVV Rdj eh V\_eZeY TV\_ef g Z\_ cVa`\_dVe` eVV Z\_Uf de ZR]ZREZ\_ R\_Uf cSR\_ZREZ\_ `VeYVT f\_egiŁ R\_UeYY YRgV]We eVZc ^ Rc\`\_ eVVZVR`W4 YZV eVRe dz] ac vgRZde`UB Ž2]eY f XY eVV d R] [ZWZd \_`h RWc^ `VW]\]`cVL\_f]]Z VUSj eVV V UZRał ac`acZeZ\_ `VVIf]ef cVLZe dz] ac`gZVd R y^ `dP] cVd kgW W kc eVV (ZeVe`]VXEZ\_ZV eVVZ d TZA a`dZ eZ\_Ž2]d TYRRIE kCZET ZI eVV a RecZIZL\_]`XZT eVRe Z\_daZ kd eVVZ RZ\_Rg` VeYVyH VZe Zb cR\_df TY Rd2\_R> RC RD e gV\_R\_U> R\_f V [CZIF DRU k116ZSV eYV d TZAJ actieZIV d`VWR\_VJZV hY dVYVXV^`\_j ckded`\_WA^Zj eZkdR\_U]Z\_\dR^`\_XXc`f acŽEYkdV U^ kdzT\_Vah`c\dhVčVVie`]]VLLR\_UZzhRdcZU`W DR\_eZX eYReZzhRdRTZj`VkM]ReZgVdLcReYVceYR\_ Z\_UZgZLfRJcŽEYVT\_eZ\_fZj`VeYRe ecRLZZ\_TR\_ SVdW\_Z\_eYV d TZAJ YZcRCTYj R\_UyI]RctZi %eYRe X gkc\_aV a]VdURJ ie iURJ UNRJZ XZZ eX wRef ckd XZgVRchvTZ TchRaVe`eYVZ RZ\_Rj`WcLvZ eZi eYVcfcRjzf aaVdT]RctRfcR`Wd TZAJ `cUv4LR\_Z'RXV eYRedW^ de`d cgzgVZ\_d^V V`WeYVcd TZAJ UZAVIF]i eXdeYRehZJ SVUZIIF dbUJRekc`\_Ž

:\_eYV"\*'!df\_UceYVZ~fV\_TV`WeYV4fSR\_ CVg`]feZ\_R\_URdRcVRTeZ\_e`VT\_`^ZTdeRX \_ReZ\_ŁR\_Z`RXZ\_Rcj`Wc1TZR]TYR\_XVSWR\_e` ~`fcZtYŽ5VabZeVZedcVg`]feZ\_Rgi\_]R\_XfRXvLeYZd ^`gV^V\_eUZU\_`eScVR\hZeY4YZ[VdTf]efcR] ^ ReeZL `caReeVc\_Ž:ehRdeYVZ'RXV`WRyTYR\_XV Z\_`dVC%ZEYVV`aYRCZdVaVReVUjj a]RIVU`\_ eYV 4 YZVR\_ TYRRIEVC ` WEVV dyg` | f eZ\_ Z\_UZIREVd R\_ f\_UVcdeR\_UZ\_X`WeYVZ\_deZefeZ\_R]ecRUZeZ\_ŽEYV a`]ZEZIR] Uj\_R^ZILY`hVgVLCRUZIR]ZKU ViaVIeR eZ\_d`WRTYR\_XVeYReeV\_UVUe`SVViaVcZV\_TVU Rde/VcWRZKReZ\_`WRfe`aZR`dLReVc\_RezeVjLRd R^`ceR] eYcVReŽ:\_ S`eY TROMELeYV d'TZR]`dUkc hRdTR]]VUZ\_e`bfVdeZ\_R\_UeYVdTZR]eV`a` RITY/VREVUŽ3VIRF dV ` WEYVOV dYRCVU VI a VOZV\_TVOL ZUV\_eZejeV\_UUUe`SVf\_UVcde``U^`cVRdRh`c\ Z\_ac`XcVdlR\_U]VdlRdRecRUZZ\_Ž3feeYVVVefcV hRdf\_TVceRZ\_ŁeYcVReV\_Z\_XR\_UTYR eZH]``\Z\_XŽ EYZdWRce/ReZV\_6Zjh`f]USVd?aaWac`gZVU eVV[fde2/TReZ\_WceYV^2ZERcjTfaRdRhRj`W dvIvdeRS ZHZ\_X`dvZŽ

# H + 9 G + 5 H 9 G C I @

Bc '@Uhlb 5a Yf]WUb Wc i blfm gYYa g hc ' \Uj Y VYYb a Uf\_YX Ug a i W 'Ug 7 \]'Y' Vmk \UhA Ubi Y `5bhcb]c '; UffYhOB WU `g ]hg Î GUhY! WYbhf]Wa Uhf]I Ï " EYZI TV\_eRZi `W eYVDReVZ\_ VRIY `WAVd TIVdEVVAc' deR.V\_Sj 4 YZJR\_d TZAġ ZII]` dJj ]Z \UhZeYeYVZ RZ\_Rġ `Wd.VXŽ: e YRdSW\_dZLZ: \_ZIR]jLeYRevYZe` q Zdeff X/ecZX/eV&^ acZ Rg dIY^`] Rd9 Zè g R\_U 8 V XRaYj ESVIRF dVeYVXF ZIZ\_XZJRZdd gVcVZ\*.g `gVcRe4cz@ gHh YZY ZIV VcIZMUSj eYVDRe4/R\_U \_`ea`af]Rcd gVcVZ\*.gHh YZY ZIV VcIZMUZ\_acZ H TZa]VSj eYVV\_eCV\_ReZ\_%b8 RcT%LUV]R 9 f VcRt. "\*\*\*\*E#"'/Ž@\_ e`eYVUV^R\_UVca`af]Rcd gVd VZ\*.gi }eYVRie`W`UVc\_Zij Z\_hYZY 4 YZV hRd S`c\_lhRdfaVcZ`a`dVUeYVRVkC^RzZ\_`VVRZ\_R d`gVcVZX\_giLR\_U eYVZ`a`ceR\_TV`VeYVeVcZe`g R\_UZedVV\_eZkdeV\_UVUe`eR\VacVTVUV\_TV`gvceYV hZhVd`WZEXV\_dŽEYZtacVjXfcVdeYVdTZRjgRtff^ eYReDeReVRTeggZt`YRdd`V&V\_T\_TVRJVLŽ

:\_ [fdeRWh jVRdLSVXZ\_Z\_XhZeYeYVV]VTeZ\_ `W2]VdR\_U2R\_UeVV" \* #%1" \* #&cWVc^ dR\_UeVV\_  $T_eZ_fZ_XhZeYeVV$  and  $X_gVc_Ve^WSi$  WSi WALf\_eZieVA`af]Rc7c`\_eLeVVDeReVZ`RXZ\_RgieVRe hRde`acVgR2jeYc`fXY`feeYVehV\_e2XeYTV\_efg YRUSVT ^ VV\_eeV\_TYVLŽ: \_ eYZthY` [VaVZ ULeYV TYZWOWWOV\_TVa`ZeWcdTZAjihRdeYVDeReVZ ZedUZXWKV\_eXfZktŽ:ehRdeYVV\_XZ\_V`VZ\_UfderZR}  $\mathbb{Z}R=\mathbb{Z}_{\mathbb{Z}}\mathbb{Z}$ eYVZ ZERe`c`Wa'TZR cWWc^Ž:ehRdeYVDeReVRd eVRIYV&Lf\_ZfvZ\_XR\_UY^^`XV\_ZkZ\_XeYVTf\_eqj eYc`fXYdIY``]Z\_X1R\_U^ZZERcj\_dkgZIVŁR\_UeYV 7ZET ŁEYVVI TYVbf VŁCVACKU Z XEYV^ VI TOREZ T f\_eqŽ2S`gVR]]LeYVDeReVd ^ S`]ZkVUVkcd TZkj eYVV XRXV V e`WITZR TIRdhdR Ua` ZZZIR WETVEZ EYZdd ^ S` [ZT łZ' RXZ\_Rcj h`c[UR]]`hVUT \_~ZTed e`SVZ\_deZefeZ\_RZXVLLhYZdecVacVdV\_eZ\_XeYV ac`XcVdbgVViaR\_dZ\_`WUV``TcRIjZ4`^SZ\_ZX deRSZZEj R\_U~VIZSZZEjŁeYV4YZVR\_DEREV^ R\_RXVU e`ac\d\cgVeYV`[UV]Z\dhYZ\deScZ\_XZ\_XeYV]\\dV  $hZ_X aRee ZdZ_e e VV^RZ_de VR^ZE YZda^ZE ZZR$  $\underline{Z}$  eVXReZ\_ $\underline{k}$  UeVVd  $\underline{T}$   $\underline{Z}$  eVXReZ\_ eVReW] hU ZŁWć^ WeYVa` ZZIR T cV WYVDEREVZ RXZ RjŽ E` af eZeR\_`eYVchR +h YÎCHUhY gc i  $\ddot{l}$  cZ7 \]Y WUbVYHU\_YbUgUaYHUd\cfZfh\YYldYfl! YbWY'cZgcWU`'bhY[fUhcb"

 $EYV VI eV_dZ_ `WeV DReVZ RZ_Rj hRd RII$  $T^aR_ZUSj R_VI aR_dZ_ `WeVV af S]ZT da YV&Z$  $D TZ ej eYC hZ eM WZ_e Raf S]ZT da RIV^ VL REVUSj$  $eYV DREVLV S dRIZ_X_ `e`_ ]j eVVa`]Z ZIR a ReZd$  $R_U eVV af S]ZT RU^Z_Z te ReZ_ Sf e Rd VL T REZ_L$  :\_ eYV |Rde UVIRUVd `WeYV eh V\_eZleY TV\_ef g eYVcVhRdRScVR\hZeYeYVa`]ZeZIR]T\_decfTeZ\_ `WRafS]ZTZ`RXZ\_RcjŁhYZTYhRdUZda]RTVUSjR acZeReVZ RXZ\_RgŽEYZdyacZeReXkReZ\_%hRdRjd R a` [ZEZIR] T\_decf TeŽ: WWAC^ Vc]j eYVV^ aYRCZ: YRU SW\_`\_ DeReVZ\_eVcgV\_eZ\_ e` ViaR\_UeVVafS]ZT daYV&VL\_`h ZehRdeYV^Rc\VeViaV&Z/\_TVeYRe SVIR^ V V\_eeV\_TYVLL^ R\Z\_X eYV Z\_UZeZLF R eYV TV\_eeR|}Xf\_eVZ\_eYV\_Vh\_Z^RZZ\_RcjŽ2\_aRcRU\_iZR ac`TVdLcVR]]jLSVTRfdVZeUVacZgVUa`]ZEZTd`WeYV  $Z^{*}RXZ_R_{j}f_U/caZ_Z_X_{d}^{*}W_{ed}R_{e}Z_Z_{e}VafS]Z_{f}$ cVR^ UZU\_`eUZRaaVRŁ`WY`fcdV,Zee``\`\_ UZVWZł V\_eWc^ dŽ2dARce\$`WeYZdCVa`cedY`hdŁY`hVefv&L eYZlecR dWc^ ReZ\_\_\_`WeYVafS]ZTdaYVcVZlRWWWeZX aVa]VdViaV2ZTV`W22WZ\_dTZ4jŽ2 \ZU`W y^ Rc\VeZ RXZ Rg %&Rd SW\_ Z de Ef eVULac gZl  $Z_Xa^{h}WWI^{h} = 2 dWc Z_UZZIFRWWU^{h}$ UVIZZZZ ł^ R.Z.X.R. Uckła` dzszzej Ż2 jey`f Xy eyzd deZ`f]fdWcZ\_UZeZLfRJZReZ\_ZIXV\_VReZ\_XRhVRJeY `WUZEVICIZE; Z\_d`TZR; ]ZWLY`hVgVeLeYVU^Z\_R\_e Z RXZ Rcj XZgVdWh Tlf VdRde`Y`h d`TZVej dY`f]U SVaVcTVZevUR\_UViaVcZV\_TVUŽ: WevVcVeV\_UV\_TZVcl SVIR^ VV & TYULEY&VT f USVRUEV&VT dl bfV\_TVdWcYf^R\_UvgVj`a^V\_eZAczeReVZ\_UzgZuf} R]dh`f]U\_`e`\_]j SVU\acZevU`WeyReafS]ZTc\R]^ eYReac`gZNdRWdf^ V\cdvelZ\_XUZWWcV\_TVdR\_UR WTR] a`Z\_eWceW\_Vh UZgVcdZjŁSfeeYVj h`f]U R]d SVZ]]{Vbf ZaaVUe`TY``dVR\_UcVR]ZkVeYVej aV `W/ZW/eYV/hZYVUe`]VRUŽ

### I BF9CC @ 98 8=@A A 5 G

EYVaReeVc\_`VUT\_eZ\_fZej R\_U dfaefdvZ\_eVV S 4YZJVR\_a`]ZEZIR] Z RVZ\_Rcj dRZMdR\_f^SVc`W Y UZJV^RELR``\_XeVV eVVT^a]Vi dV[ReZ\_dVZa Z

$$\begin{split} & YZte j eYReYZ_Xtdfa`_eYVa`dtSZZej`VWZtdUtchYZte j eYReYZ_Xtdfa`_eYVa`dtSZZej`WZtdUtch$$
 $SVZ_ektZ_dXtURdWRc`VT_~Ztež:_S`eYTRdtL$  $f_T_dcdrZ_VUdS[VTeZzej h`f]UTEVReVeYV~``U$  $eYRedS^ VEXUVgVg'eYZ_XZ_TYR dR_UR_RETYjŽ$  $2TT dtZ_XjLdyWT_VETZ_R_UdvjWTV_d cdrZedW^$ e`SVeYVacZTVe`SVaRZUVceYVdVTfdzj`WdUteŽ $EYZtYZte cZIR]SRT\Xc`f_UZtdvZ_WETVUSj_eYV$  $gVj_cVbfZV^V_eti`VtdyWT_ec`]eYReZ_UZzTRj$  $ZReZ_LfcSR_JZWR_U eYVUZTZaJZ_ZX`WJRS`fc$  $R_Ua`]ZeZtdZ`a`dULZ_eYVetV_eXeYTV_efgL`_$  $aVcd_R]dS[VTeZzejZ$ 

@\_VUZIV^ ^ RR-ZANdhZey eyVdacVRU`VRd TZR Z'RXZ\_Rg eYReXgVdXcVReVchVZXYee`eYVUVdZCVe` ySV`\_VdyVXZEYVcZV`VerVacZeReVh`dU^R\Vd aVa[VWW]RXCVReVc\_WUVCRXV\_fZ\_Vy.%LRUVCRXV eYReZddáddUSf eReeYVdR^ VeZ VYVZXYeV USj eYVa`hVc]Vdd\_VddZ\_UZc;ZLfR]dWWJZ\_eYVWAV^WeYV yd TZR] ^ RIYZ\_VZi\_ dWXZ\_Xe` RV/kc^ eYV dv/gVdL eYV/T^VZ\_e`T\_~ZTeRXRZ\_R\_URXRZ\_hZeYeYV y\_RefcR] ]Rhd‰WdVkŽEYVj hR\_ee`y]VeeYVZc YRZCU h\_%LSfeeYVj RCVTYVT\VUSj eYVecRf^ ReZT ^ V^ ` qi ` WeYVaRdeŽ2e eYVj dR^ VeZ VRd eYVj h`f]U]ZVe`y]ZvevZc`h\_]ZvevZc`h\_KvevVj cv V SVc  $eYReeYVUV2ZVVVcVXVU^{f_UVc^{T_U}} f_UVc^{T_U}dVcR_U$ WRUde T\_~ZTeŽC i hc ZZYUf c Zh Ya gY j Ygžc Z h\Y`X]gcfXYf`h\Y]f`gi V'YWjj ]hma ][ \h[ ]j Y` f]gY<sup>-</sup>hcž ]bX]j ]Xi U`g<sup>-</sup>X]gWd`]bY<sup>-</sup>h Ya gY`j Yg<sup>-</sup>  $UbX^{*}[i Y^{U}[U]bghh Y^{I}[fU]b^{*}cZh Y]f^{*}ck b^{*}$ XYg]fYg"

2 dvT\_UUZW^ RT\_Tkc\_deYVakdZeV\_eWkc `WIYR dŽEYZIZIR\_Z a` ceR\_eckil fcTVkk ^ RZ i eRZ\_Z X`dv&LSfeRid R\_Z aVUZ V\_ee` cvT ^ i a` dEZ\_ `WeYVyH WŽEYVeER ^ RET VI aVZV/TV `Wil TZ ia` ]ZZIR] T\_~ZTe ]VU 4 YZWR\_de` ]`hkc RgVZ `WEZV/TV`gkc eYVUZZZ\_dZ\_eYVZc d`TZR] `dvZEYVWRc`WMZZZ ARTET\_~ZTed^ RUVEYVZ `h\_ YZTe` g` RyWr Zj\_dvTkV94cd ^ VeYZ X\_` ee` SVeR]\UURS` feŽEYZI deReVZj\_ ^ RUVZea` dES]Ve` ackikgVeYVZ YVZEUUZ RX/`WH VLeYV4 YZWR\_d4c SfeReeYVacZIV`W\_VfecRIZIREZ\_, Z\_`eYvCh`dtiL Sj\_V^ aej Z\_XeYVyH V6Z RX/`WEdT\_eV\_eZEYZI dW^ de` SVeYVckdF]e`WgeYVacUZTa`dEZ\_`W a`]ZZIR] RTe`cde` RXCWLhZeY`feR\_j acZ c RZZ\_X `WUZWEV\_ea`Z\_ed`WgZh%b4`ccWRL#!!''LS%/Ž H ZeY feRU fSeLeYVyUV `TdRIj` `WRXW V\_6‰ YRISW\_ R \Y WREFdV `WeYVecR\_dZ\_ ac TVdŽ BcbYh Y Yggž ]Zh Y ZYUF c ZVc bÛJWi ]g dfc! YWYX ]bhc h Y Z hi fYž]hWci `X fc V XYa c W fUWnc Z[hgj ]HU`]mvYWUi gY ]hbYWYgg]IUHYgU bUffck fl bWc blfcj Yfg]U\*LXYÚb]hc b c Zk \Uh ]g Î dc gg]V'YÏ "

2 eYZUUZV ^ RZleyReeYVacU ^ Z R\_TV` VR acZeReVZ RXZ\_RcjeV\_Ude ViRjeZ\_UZeZUFRjRfe\_ł `^j hYZVf\_UVc^Z\_ZXT]]VTeZeVRTeZ\_ŽHYVcVRd eYVafS|ZTZ RXZ Rg hRdSRdVLVgV\_ZVV\_)j eRI ZejjŁ`\_ eYVZUR`Wa`af]RcdgVeVZX\_ej R\_UeYV UNZSVOREV ac`UFTeZ\_`WolTZR]`dUVeLeyVacZeReV Z RXZ Roj ZdCVA RIZ XT ||VT&ZVCM/WUV&VC^ Z ReZ\_ Sj dj dev^ZT dyWeVXf ]ReZ\_ŽH, Y`a Uf\_Yhž; Ug`U We YWH Y a U bUfnž a U Yg h YUg Yf h dYfWY]j Y h Y W U`Yb[ Yg c Z]bX]j ]Xi U`]nU! h¦cbžVi hk ]h ci hdfcj ]X]b[ ]bX]j ]Xi U`g'k ]h Ub ]a U[Y c Zgc WYhn' E YVd TZR] h`dURaa VRd e`SVR^V&Vdvez\_XVcz\_UzezLfR]RTez\_Ž@cdreYV&L R\_RefoR]`dUkće`hYZIYZeZi\_VTVdRgie`RURaeŽ :\_UZeZLFR]dTR\_UWW\_UeYVZcZ\_eVcVdedWkgV\_ejjR\_U VARS ZEY RIZE\_TVAL A EY `eYVadeYVSVeeVace` Radiva eVV Ž3feeYZlRXXXVReZ\_`V&cZgReVZ\_eVCVdedU Vd \_`eRUUfae`RafS]ZT^ReeWZ>`deZ'a`ceR\_e|jŁ ZeU Vd\_`eRUUfae` RT ||VTeZeVRTe`c`cyd'S|VTe‰ hZey eyvRSZZzje`aRceZIZaReVZ\_eYVT\_decfTeZ\_ `WeyVol TZR]`d.WZ

:\_gZth`WeYVeV\_UV\_TZkdcWWkcVUe`ŁZeYRde` SVRd/WhYVEYVC4YZVR\_dTZKejYRdRgRZJdVał  $dd_eReZ_ WZdMVZd_eReZ_ WZdMVZd_eReZ_ W$ d TZK RTEFR] j a VC^ VREVUS j eYVRSdV\_TV VRd TZR UZ V\_dZ\_OEYVEVZdVgZV\_TVeYReyTZgZ d TZkj %  $RdR_Rfe_^^ fdRIec_ZeYVdTZR_acTVdtLYRd$ SW\_ drefVch VR Z\_ 4 YZVŽE YZ d Z d XXdeVU Sj eYVa`hVc`WeYVyhVZXYe`WeYV\_ZXYe%R\_UeYV ZJV\_eZ;TReZ\_`WeYVafS]ZTdaYVeVhZeYeYVDeReVŽ EYc`fXY`feZedYZde`qL4YZ[WR\_d`TZAkj dW`de` YRgVSW\_T\_deZefeVU^`cVRdRac`UfTe`VDeReV RTéZ\_eYR\_Rdd^VeYZ\_XZ\_Zed`h\_cZXYeŽ?`c UVdeYVTf\_eqjdcVTV\_eUVgVj`a^V\_edW^e YRgV decV\_XeYV\_VU ZeŽE YZd T f [U h V] SV`hZ\_X e`RTcZCZL`WeYVZ`RXZ\_RcjcZZ\_TReZ\_deYc`fXY hYZIY Rol TZAGI JVRc\_de` cVT X\_ZAV ZechJVŽAH YRe 4 Rde ozruzeluzex\_`dvuRdRXV\_VcRjeV\_UV\_Tj^ R\Vd

 :e`\_]j cV^ RZ\_de`\_`eVeYReeYZIVc`dZ\_`WT`] ]VTeZgVZ RXZ\_RXd YRd WWWTed`\_ eYVUV^`TcReZT `d.VcŽ: WeYVcVhVcV\_`Z RXV`WyhVLeYVaV a]V%u hYReacZ\_TZa]V^WT]]VTeZgVd [ZLRzZg R\_UhZ]T f ]U SVZ\_g`\Ue ScZ\_XTZZKV\_de XVeYVcV:WeYVd TZZ] `d.Vch`c\d]Z.VR\_Rfe^ReZT^RIYZ\_VLZcVdaVI eZgV^Wa`]ZZTR]UVTZZ\_dLeYV\_hYReU`hVhR\_e UV^`TcRIj\_WcO

# 7 < 5 DH9F'

# K 9žH≰ 9'7 < =@95 B G 'H≰ 9'9A DHMB; 'C : '5 '7 C @@97 HJ 9' =89B HHM



:e YRd SVT ^ VUZIVIF Je e` daVR ` WR 4 YZJVE ZUV\_& g` Rd d ^ VeYZ X dyJVWgZUV\_eŽE YZI TC\Re\d ac`S]V` dWc eYVZ RXd eYRe Vg\g`\_V^ R.\d`W eYV` dyg\dR\_U` VeYVZ: cVJReZ\_drZadh ZeY ` eY\cdŽ :\_VgZES]jHUWa V^ ` eZ\_dRVdzCvUŽ2dUZIF dZ\_ RS` f e4 YZJVR\_URS` f eyH VLeYV4 YZJVR\_d6SVT ^ \d T ^ a]ZIR&U R\_U a\cd\_RZ&VLLZE SVZ\_d e` Xc`h YVRe\UŽAV a]V da\R.` W4 YZJVRd ^ VeYZ X.eYRe ^ R.\deYV` f\_T ^ WceS]VR\_UZcZES]VŽ

EYVRZ `WYZITYRaekćZle`UKITCSVeYVUj\_R`ł ZtłakćtkácZ\_dR\_URackVIZKeZ\_deYReUVj\_VhYRe Ze^VR\_de`SVR4YZWR\_e`UJjŽEYVd`S[VTeYRd e`SVRUUCKHKUWV^^ ^ R\_j R\_X]VZZTT d.Z\_XJjŁ UZWWCV\_eV^aZZIR]^VeY`UŁS`eY bf RJZKEZEVR\_U bf R\_cZREZEVLYREVSW\_ Raa]ZUČEYV^ RZ\_RZ^ZI e`RdTVceRZ\_eYVZ`RXVdaVa]VYRgV`W4YZVLeYV V`eZ\_deYVdVRc`fdvLR\_UeYVdg]VR\_UT\_eV\_e`W UZATFdvZ\_RS`feeVVTf\_eg\_R\_UZedTYRcRTeVZ

E` eYZIV\_ULR\_ZZER] 5 ZIIF dtZ\_8 c`faddefUj hRdTRocZU`fe[`Z\_ejj hZey eYV7RIF]ej`VD`TZ]! `Xj`VVAVVF\_ZejvCoEj`VV4YZJvZ8 c`fa UZIIF dtZ\_d hVCVZZEREVULdRocZX`WMiZEY eVVbfVdtZ\_yHYRe U VCZe^VR\_e`SV4YZJvR\_O%adWRaaV\_UZ"/ZEYV defUj hRdT\_UFTEVU`\_RSR2TdR`a]VdvX`V\_eVU Sj d TZIVT\_`^ZTdecRetR\_R\_UZeYVJaVUVACC^ZV eYVRXRd`WZJVIF]ejZ\_eYVUZIIF dtZ\_RS`fe4YZJv ZeRd cVgVRJVUVVA UZWWCV\_TVdZ\_eYVRetRIY^V\_ed V acVdtVZ

EYVÁVZ\_UZIREZ\_dac`gZUVUEVVSRHZIVVCRdvT\_U

aYRW WYVbfRJÆREZVÆL UŽ\_T ]]FS`&RZ\_hÆY eYV&&MRETYUVaRee V\_e WYV> T4R\_627\d RW\_TJEh`c\hRdU\_V`\_Xc`faZ&&a&ReZ\_`W aY`e`XRaYdfdZXeYVXfZWUXc`faUZIFdZ\_`c WIFdXc`fa ^ VeY`U ]`XJŽDR`aJZXWceYZdhRd Sj deRef ^ ŁRXVR\_UdvIŁd`aaJV`V\_eVUSj Xc`fad Z\_dXZ\_d`WYV\_`œYR\_UdfeYŽEYVT\_eV\_e`W eYVUZIFdZ\_dhRddefTefdVURc`f\_UeYVdaVIZJT }VJUdZ\_hYZY4YZJNR\_JZWZdVaVZZ\_TVLŁdTYRd h`c\LeYVWY`ZJŁa`JZZTeLJVZFcLeVJVZZZ\_R\_U cMZZ\_1dWRaaV\_UZI#Z

 $EYV eYZU deVa h Rde`gR]Z.ReV eYVdV ej a`]`XXd R_U eYVZ UZWWEV_eFReZ_dZ_RcVacVd`egVf a]V`WeYVa`af]ReZ_Lf dZ_XeVVd`egVj ^ VeY`U ]`XjZ EYVZ`a`erR_e_R_UT_ec`gVcdFr]Ztf Vdh VeVZ_l T ca`dreVUZ_e`Rdj deV^ReZTdVZd`WefVdEZ_dVVc eYV_ReZ_R] d`egVj T_UFTeVUSj F? 5 ALhY`dV } VJLh`c\hRdTrczZU`feSj EZ`VCVdRcTY1dW RaaV_UZIVd&R_U'/Ž$ 

:\_ eVVddV\_eZdLeYVUZWWCV\_edefUZdac`UfTVU ^fefR]jjT\_dZdeV\_ecVdf]edŽEYZdTYRaeVchZj\_`e UVdTcZSVeYVcVdf]ed`WWRIY`\_VLSfehZj]dvEVVeY eYVZ:T^^`\_}\_UZ\_XZĔYZI^VR\_deYReUReRW/^ UZWWEV\_edfcTVeLS`eYbfR]ZERezgVR\_UbfR\_eZERezgV R\_USReNU`\_dR`a]Vd`WZWWEV\_e\Z\_U4LYReVSW\_ Z\_eXXReNUZ\_e`RdZ\_X]VR\_RjjdEZEYVU2gVcdEj`W dfcTVdXZgVdUVaeYe`eYV}\_UZ\_XZZ:eRjd`^VR\_dL Y`hVgVaLeYReeYVj\_WUe`SVRaac`RTYVU hZeY TRfeZ\_Ž

EYVT\_TJfdZ\_dR:VSR:MU`\_R\_Rjd&:VWgVdjł eYZ\_XeYReTR:V`fe`V&YVUZTfdZ\_dR\_U\_`e`\_ R\_j aRceZIF]Rc`aZ\_Z\_ŽHYV:V`aZ\_Z\_dR:Vbf`eVUL eYZIZIVV:ch`cVRd\_d+e`Z]fdc:ReVeYVZtfVdUVR]e hZEYLR\_Ue`dr`hd^V`V&YVefc\_d`V&YVR:VfdvU e`UZTIFdd:eYV:V^Re&VcdZ\_VgVjURj]ZWZ

 $EYV_RcRezeverReW[]`hdZlUzeZUUZ_e`eYdW d&adŽ7ZdejjLeYVdVZlRUXCRZaeZ_`VeYVZ`a]RfdZ$  $SZZej RecRIYZ_Xe`eYVZ`RXV`VhYReZUy4YZNR_%$  $R_U e`Zed_RcRezevZZDVT_UjLVgVcjUBj ViaVcZ$  $V_TVclReVURh_fa`_Z_R_Reev`ae e`Via]RZ$  $eYZŽEYZUJjLeYVZ`RXVd`VV4YZNR_d`TZSSZZej$  $V_T f_eVcUURVUVCRZSVU hZeY dWXV_TVe`eYV$  $V`aejZ_X`WeYZET`^``_Xc`f_UŽ$ 

## H ≤ 9 = 8 95 °C : '5 °7 < = @95 B = 8 9B H = M < 5 G 6 97 C A 9 = A D @5 I G = 6 @9

EYVEVZIR WWJZX`Wf\_VRdVR\_UWfdeReZ\_ Z hYReaVa]Vdy RS`fe4YZVR\_UZdZV/eGjŽ yHYRedYRaaVZXe 4YZVOKey9`h U hVdW `fcdMgvdDkey@fc^ZVUWWZXdRS`feeYV~RS%e y4YZVZ eYVda`eJZX6%key4YZVR\_dT\_VKdU%ReV R``\_XcVTV\_e\_VhdaRaVcYVRUJZ vdR\_UeEJvdZ S``\dY`a hZ\_U hdŽK \Yb`dYcd`Y`gdYU\_` UVci h7\]`Y`h Ym UfY`XJgWc bWffhYXž Ug` h\ci [\`h\Ymk YfY``cc\_]b[`Uhih.Ya gY`j Yg` ]b`U`a ]ffcf`UbX`bchfYWc[b]n]b[`k \Uhih.Ym gUk "

 $2 det{S} V' d' h d' `deaV a] VU _`e}_UZe`SgI `f det{Ree}V&VZIR_j eYZ_XTYRRIE}VZEIR] j 4 YZVR et{ReuV}_VdVRIY a Vcd _`dZV_eZj L`cet{Re4}YZVRd RT f_eg ZletVVi a cvdtZ_`VRT ]]VIEZVZV_eZj Ž 6RIY Z_UZZIF R'd cVIREZ_dYZa h ZEY etVT f_eg$ 

#### @/.}ä½

@oz ÚzäCÚzäq ‱lúz²æö OzÝä¶‱i²qz Ú∕æPq∉"ä¶Úqz‰&∉"äæzäfic®2O?äqz²æœÂa @oxÍd≀z∉"äݶmaq¶æ¶ïææ€"æœΩe áCÅzÚgz²æ9′zÝÈ

ä	@ozafi o @OZafi aqz² a aaadýattaj zatta ² qaz alji lági Ýatta Ýatta qato OZZÝaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
ä	ˈæᠯ∕ǎq‰æ̆ @æ∯áÝOæö o $\Omega$ æcz áh o $@C$ æqz² ææäÝæ∯q $\Omega$ o ææææívǽ ( $\phi$
ä	$\label{eq:approximation} \begin{tabular}{lllllllllllllllllllllllllllllllllll$
ä	Ł-jŁ <del>аныныныныныныныныныныныныныныныныныны</del> р
ä	@

>¶ïÚgznäB1Ł; älOas¶≊Oãa⊳ïÚnzonaĭþþ½Ê

 $\begin{array}{c} R \cup Z d Z \mathcal{V} \leftarrow \mathcal{E} g \quad Z d Z \cup f S \mathcal{E} Z H Y Re Z d Y Raa V_Z X \\ e \quad 4 Y Z \mathcal{V} O E Y Z d Z d R b f V \mathcal{E} Z d \mathcal{V} \mathcal{Z} X R \quad V f a ] R \\ \mathcal{E} Z \quad W c \quad d \land V \mathcal{E} Y Z \end{pmatrix} \mathcal{E} Y Re Y R d S \mathcal{V} f \land V f _ W ? Z \mathcal{P} \mathcal{Z} \\ 3 f e \mathcal{E} Z d f \land V \uparrow _ f _ \mathcal{V} \mathcal{R} \mathcal{V} \land R d d \land R j U \mathcal{X} \mathcal{W} \mathcal{E} J \mathcal{V} \mathcal{E} \\ 3 f e \mathcal{E} Y \mathcal{E} d Z _ d R U U f S e d U \mathcal{X} \mathcal{W} \mathcal{E} v e a ] \mathcal{V} c \mathcal{E} d f ] R \\ \mathcal{E} \mathcal{V} \sim \mathcal{V} E \mathcal{E} \mathcal{V} \mathcal{Z} \mathcal{U} a \mathcal{V} \mathcal{Z} / T \mathcal{V} R U \mathcal{V} a \mathcal{V} \mathcal{E} \mathcal{Z} - d \land \mathcal{V} \mathcal{U} \mathcal{Y} \mathcal{V} \\ R U Z d Z \mathcal{V} \quad \mathcal{E} d Z \end{array}$ 

K<5H=GCIFJ5BH5; 9DC=BHB

H YReaV a]VdJ RS`f e4 YZVZIZ dáRcRS]VW' eYVZ RXdeYY YRgV`WYV dJgvdR\_UeYVZ:a]RIV Z\_4YZJR\_d TZ4jŽ2\_URdeYY ]``\Re4YZVW' eYVdR\_Ua`Z\_e`WYVZ:UZWWV\_ea`dZZ\_dR\_UVI aVZJ\_TVdeYJ dW e`SVdWZ\_XZeW' RUZHR\_TVŽ H.Y.7 \]YUb [XYbH]mbc "cb[ YfgYYa ghc VY' Ub`cVj ]ci g`cbYž`VYWU gY`dYcd`Y`Xc`bch gdYU\_`Ug`dcggYggcfg`cZh\Uh ]XYbH]miVi hi Zca `h\Y`ci hgIXYž gYY]b[`]hUg`gca Yh,]b[` Zcf`ch\Yf`dYcd`Y`UbX`ch\Yf`Ha Yg" EYVEVRV eYCWgZha`Z\_edW' hYZIY4YZVR\_UZdZV\_eZj RVUZIIF dMLŽ

†EYVVJZEVgZvha`Z\_e+hYV\_RdvURS`fe4YZvL aV a]VvO'^ eYVYZXVcdeRERZ ^VUZEVjj VdES]ZY ]Z ZedR\_Ua`dEZ\_dŽ:eZdRa`Z\_e`VgZvh eYRedvUd 4YZVVO'^ eVV`fe2UVR\_UVO'^RS`gVŽ

Î=XYbh|migUj |hU`ği VYWžf|| \B`=Xcbhĭi h.]b\_ h\YfY]ğUbm[XYbh]mi'=bU`chcZkUng` =`]\_YVY]b[ 7\]YUb"=ĵiYVYYbUVYhc gdYbX'ha YUVfcUXUgkY``"=ši WeaZcfh UVY'k]h\VY]b[ 7\]YUb"=kci X'dfcVUV'm VY'WeaZcffUVYUg'kY``]Z=kYfY'9b[ ]g\cf >UdUbYgYžVi h]hỹchY'kUmh]b[ g'kcf\_ci hž mci kYfY'Vcfb'h\YfyÅ Ĭ flYaUYža]!YX'U[Y'[fci dži fVUbž\][\@, Ł

 $\begin{array}{c} 4 YZVZddW_W' \wedge eYVa`Z_e`WgZh`Wd \wedge V_V \\ hY` ^ ZXYeYRgVSW_W' ^ Rj Tf_eq ŽEYVVJZV \\ daVR ` W4 YZV W' ^ eYV gR_eXW a`Z_e`VEYVZ: \\ djWZ' RXVRdRT d` `a` JZR_TJRdŽ8]`SRJZRZ_ \\ ac`gZUVdeYV hZYRa`Z_e`VT ^ aRZd_ŽEYVJ \\ eYf ddWeYV ^ dMgvdRd dR_UZ_XRS`gV eYV`S[VTe SVZ_X[f UXUŽEYV4 YZVR_ZV_e6g HZ_d ^ VTRAAL ZlgZh VURdR\ZU`W_eR_XV ^ VeeYReZeZL_VIVd \\ dkj e` UV&RY`_VdMjW6/^ Ž \end{array}$ 

3f eeYZldfaVcZcZg U Vd\_`edW^ W/^ RSV/ZWV eYReeYY \\_`h hYReZlSV&Wc4YZ/VZ.\_eYVa`dZ eZ\_deYY dR/VLeYVYZXYVcdedRRU \_`edW^ e` ]B T]RZ' e` R]VRUVCdYZa c` ]VŽH YReeYY dWXLcReYVL Zle` YZXY/ZXYe RUZWWCV\_TVŽH YV\_ eYY RUVCHEYV T\_UZZ\_d`WeYVZcURZj ]ZgVLeYV YZXYVc decRefL RIT dLZ\_Xe` eYVcf cgyi }\_UZ\_XUWW]aRe`WRT^ł ^ f\_Zj ` WiZ\_ Vdh YZIY eYY ZJV\_eZjWh ZeY 4 YZV  $R_U$  ` Wh YZIY eYY WJ ac` f UŽH YV\_ eYY T ^ V e` T\_dZJ/ceYV4 YZV` VZ\_YV& AUT ^ ^ `\_ dV\_dH\_ eYY WJ RZ/\_ R\_URVT& ZRJŽE YVZ ZJV\_eZ TREZ\_ ZL\_` eh ZeY VgV jS` Uj` d4 YZJVLSf eh ZeY eYRe` WeYV hZ\_V dŽE YZ JXc` f a TR\_\_` e` c U` Vd\_` eh ZHY e` ]VX EZ ZAV Zeda` ceRZe` VR T f\_egi ` WhZ\_V dS j ^ R.Z\_XZE Raa]ZTS]Ve` R] ŽE YZ dV gVR da Ree` VZed dJWZ RXVR IR\_V ZEVŽ: eU` Vd\_` edWZed f a VZ cZj RIeYRe` VRX gVc\_Z XT] ReH Sf e^ VeYj R IR UZ HZ\_TI eZ\_ R\_UR IR YZXVc^ ` cR] bf RZ jŽ

† EYVgZha`Z\_e`V&YVa``c+ReeYV`eYvcVi eV VLa``c Xc`fadcVT X\_ZVR]Z ZeR\_UdZfReV eV dJgvdfeZUZESfeSV/hŽEYYj TReeYV dJgvd RdgZTeZ d`WiT]fdZ\_Ž@\_eYReSREELeYVZUR`W RT ^ `\_ZUV\_eZj hZeY eYV`eYvdU`Vd\_`eTRoj T\_gZTeZ\_WceYV`ŽEYYj dW4YZJVR\_ZUV\_eZjRd Sc`\V\_U`h\_Z\_e`T]RdHVŽ

Î H. Uhiğ k \ Uhik YNY `]\_Y 'b 7 \ ]Y" H.Y dccf glUmk ]h h Y dccfÅ /h YfY UfY h fYY X]ZYf! Ybh7 \ ]Yg<sup>T</sup> fA UYža ]l YX'U[Y [fci dži fVUbž`ck 'Q9, Ł

EYVa``cdvR\`VSVZ\_X4YZyR\_RdRUVdZ\_j eYRe YV deYV Z\_ŽD TZG ZlaVETVZgVURddReZHR\_UZd Wc^ d`WiTfdZ\_RdZdeZf eZ\_RJZAVUŽ2TT dZ\_X e` eYVd gyJŁZ\_WNELEYV^RZ\_T^a]RZ\_e`WeYV ]`hVc deRRZdeYReLUVdbZeVR] eYVRaaVRcR\_TV`W TYR\_XVZ\_4YZyLeYZ\_XdYRgVTRczUU`\_ [fde eYV d?`VŽ7`ceYZdARd\_LhYV\_eYJ\_UV\_j eYVViZeV\_TV `VR\_j 4YZyR\_VdW\_TVLeYY\_RVVRc^`dVgWV^V\_e eYR\_^V SVcd`WeYVcXcfadŽ

### Î=XcbŇi\_bck k \Uhh\Y'dcg]hj Y'WUfUWWf[ |gh]WgUfYžVYWUi gY'bch\]b[ Iğ́ [c]b[ f][ \h Ufci bX`\YfY"=Ĩ)Y`\UZU'a ]bX'hc [ Yhci hhc Ubch\Yf We'i bhfm'Ï

fAU`Yža]] YX`U[Y`[fcidžifVUbžaYX]ia!`ck`C9; Ł

 $\label{eq:constraint} \begin{array}{l} & \left[ EYVgZha`Z_e`WeYV^ZUJWZ_T^VUdverteed \\ :eZH^`__XeYVdveYReeYVYZXYVdeJVgVd`WIV_eZH \\ & TRZ_hZY4YZVREVe`SVWf_UŽEYV^ZUJVIJRdd \\ & VRVdW/eYY_ZUJVIJRdd \\ & VRVdW/eYY_SV_ZZ:ed^VV^SVdWWJeYY_SV_ZUJVIJRdd \\ & VRVdW/eYY_SUJ^Z:ed^VV^SVdWWJeYY_SV_ZU_VEV \\ & SfeeYVZ:h`ddU_`eU^fTYe`~VdY`feeYV \\ & YZW_ZVR_ZUV_eZJZ \\ \end{array}$ 

## ÎK \ UhY`gYž`YhŷggYYÅ žk Y`7 \ ]`YUbg'UfY` [ fYUh'c\_ Yfg'Ï fl Ya U'Yža ]l YX'U[ Y`[ fci dži fVUbž]bhYfa YX]UhY`

G9; Ł

 $EYV^{Z}U_{VZ}T^{V}VdVTe^{d}TR_{d}VR_{R}d4YZ_{I}$   $VR_{d}Sfee^{V}_{J}YR_{g}Vec^{T}S_{V}d_{J}Z_{Xh}YRee^{V}Re^{V}R_{d}Z_{Z}$   $2e^{A}d_{S}VZ_{X}4YZ_{VR}T^{V}U_{I}e^{e}RTR^{d}Z^{T}$   $d_{V}d^{V}WYf^{T}cR_{U}d^{V}V^{V}KCVda^{2}eZ_{X}eZ_{I}$   $f^{A}YZZ_{V}VW_{I}Z_{X}W_{J}T_{Z}Z_{Z}Z_{I}e^{R}dfCV^{V}W$   $acZ_{V}ZZ_{d}VeYReZ_{V}eZ_{J}e^{E}SVT^{V}U^{I}acC^{I}$   $d_{g}VZER_{Z}XRT^{A}aRReZ_{V}gZ_{h}LR_{U}d^{V}VZ^{V}U$   $RiV_{A}SZT^{V}W_{I}Z_{A}CR_{J}ZW^{I}e^{2}MCR_{V}N^{2}C^{I}$   $4^{A}e^{A}aeWcAVdgZ_{R}dR_{U}^{2}W_{L}^{2}Wc^{2}ML^{2}C^{I}W$ 

EYV^ZUJVTJRdUZdIF dZ\_dckýkij RWWJZX`W UZd cZV\_eReZ\_ŽEYVJ TR\_`eckácků/\_eeVV dvjsků RdR\_VJZeVESVIRF dvěrZdZtT\_ddR\_elj cVTVLZXVV^ eVV ESFe\_`cU eVVJ hR\_ee`SVVTJFUVLEd ^ VI eYZ XeYRedW^ dVZXVeV\_ZXJj a`ddSJVZAV aJVZ\_ eYZddcRef ^ TR\_`eR\_UU \_`ehZtY e`SV`f cdLV JZV`eYVcXc`f adŽ3fehYReeYVJ hR\_ee`SVJ`\_X e`R\_URIefRJj U SVJ`\_Xe`LeVV4 YZVeYReY`JUd `f eeYVac`^ZU^`W`UVc\_ZjEZdd ^ VeYZ XeYVJ }\_UJvdtR\_UJvdtaJRf dSJVZDVVCZZTZ\*ZhPJ `f eŽEYVJ RecZSf eV eYVZc VKZZ Xd e`eYV`dvjsvE SVIRF dveYVJ TR\_`eLZtBr\_TVeYV`dvjsvE Ze eYV}\_Xc ReRTFJacZZ:\_eYV4 YZV`VT`^^`\_ dv\_dvETZZTYZ Zd`Zi`\_jj a`ddSJVZVJV`f ReVcf aVZ.d. `c VTJFUVLŽ

#### =B < 9F=+98 7 C A A C B C9B C9

 $\begin{array}{c} 4 YZVZd\_`e [fde`\_VTf_eqjZ:e YRdf_W]UU\\ YZde`cZIR]j Z\_^f]eZa]V\_RccReZgVdcV]ReVUSjUZV\\ WEV_e RTe`cd_VRTYV`a YRZKZ_XaRceZIf]RcRatVTed`$ `gVc`eYVcd1=RccReZeL#!!"/ZEYVdefUZdTRccZUU` $`feVCeYZdCVa`cecVgVR]eYVacVd/_TV`WVfcUZV\\ WEV_eZRVU\_RccReZgVdZ_aVa]VdURZj deWTY+eYV$  $_RZ_R]^ZeRcj_RccReZgVLeYVTZZT1_ReZ_R]_Rd$  $cReZgVLeYVa`af]RcVT1fcZ__RccReZgVR_UeYVV_1$ 



ecvacy\_vfcZR] [RXfRc\_RccRe2gvlZ\_afS]ZTUZEIFdZ\_ RS`fe4YZVe`UR] eXv3VgvcZ\_dRcVcV7cVReVUL`\_]j e`YRgVeYVZ:TcVUZSZZEj bfVdz\_VUZ\_dR\_ejjZEYV3V \_RccRe2gvdRcVefc\_Z\_XZ\_e`4YZ/VR\_y^ jeYc1/Z

EYV\_RcRezgydSVZ\_Xbf V&Z\_VUclyReVe eYVYZł e cZIR] R\_Ua`]ZZIR] 4 YZIVŽE YVT f\_ecj cłackół/ekU Z\_ eYV ZdR]^`de R]h Bj dRT^^ f\_Zij X g%c\_VU R\_UXf ZJVU e h Rdd`d.VcSj VZEVČK \Uh]g'VY! ]b[`\Y`X`i d`hc`ei Ygf]c bž h Ybž ]g`H c Z: X.` k \Yh Yf`h ]g`c fXYf`]g`[ c c Xž UbX`k \Yh Yf` h Y`Y`]h g` UfY`WUdUV`Y`c Z dfc Xi W[b[`]h' E YVdV U f Sed RWWE R] Wf c g\cdZ\_d`V4 YZVR\_ ZJV\_ezj UkfIcZSVLId^ & VZ VdZ\_T^SZ\_RZ\_R\_U d^ VeZ VdZ\_ZI ]ReZ\_LR\_U eYY\_R]h Bj dV\_eVZ, R d SedR\_ezi ]`cd`WC4VZSZejZ

H,Y`bUHcbU`!a]`]HJfmbUffUHj Y EYZI^ R\_ZWHdZeM/WRdR\_RecRegV`WcZZ\_dŽ:e R:ZN:HRdd ^ VeYZ\_XcM/WgZU/eLZ\_R\_j UZIIFdZ\_

ÎKY'UfY'U'ge WyYhmik ∥h∖ ZYk 'VcbXg'cZWe'a a i b]hm' =Zmci 'Xc'VUX'm ]b'h∖Y'a Uf\_Yhž mci 'UfY'gff]ddYX' j]fhi U`m'VUfY''':U]`i fYg'UfY'Yl dYf]YbWYX'Ug ZUi 'hgž UbX`bchUgʻZU]]b[gʻ]b`h\Y`gnghYa"`: cf`h\gʻfYUgcbž ZU]ifYgʻHU\_Y`hc`h\Y`dgnW\c`c[]ghỹg`UbX`bchhc`h\Y` gfYYhï

9i [Yb]c 'H͡fcb]ž&\$\$%"

`WAYVRITVAAURIT f\_e`WAYRe4YZVZZEAUT f\_ed eYVRIZ\_ddR\V\_Sj eYVT f\_eg dWf\_UVdRXZ\_de eYVDaR\_ZY^`\_RTYjZEYZIZIH YV&VAYV`CZZ\_R\_U ^ VRf cV`WARez eZA REVe`SVWf\_UZ7c`^ eYZd dRczZ\_Xa`Z\_dLeYV\_ReZ\_R]AZERg \_RcRezgVX Vd `\_e`eR\VZ\_eYV`eYVchRdWfXYeSj eYVT f\_eg hZeYZed\_VZXS`f cdŽ

H YRe Zibf VátZ\_VUZ\_eYZi\_RcRezgVZiZclgVá SR2Zi+eVVV&Zi^ R\_UaRez eZi^ `WeVVWf\_UVcd Zi\_`eTcVUZS]VŽ

ÎFYU`mj YfmcXXÅ k Yfj Y [ ch6YfbUfXc CÑ ][ [ ]bgžUbX ]hhi fbg`ci hik UhGUb A Ufff k Ug'lk Y Zci bXYf"6YfbUfXc CÑ ][ [ ]bg`k Ug hcc``UhY'''<Y`k Ug'bYj Yf'lk YfY'' =1k ]b\_ ik Uh\ ]g` VY]b[ Vcfb`ci hg]XY k YX`c W\_žg\U``k Y`gUnž ]g`U'j Yfm7 \]YUb W UfUWhf[g]JWÅ Ï

fl Ya U`Yža ]| YX`U[ Y`[ fci dži fVUbž\][ \`C9; Ł

$$\label{eq:constraint} \begin{split} & EYV\_ReZ\_R_{1}^{1} \wedge ZZER_{2}^{2} = RcReSgVYRdVR_{1}V_Zee \\ & UZICVLZeSVIRTOVEYVCVZd\_` ecfodeh` ceV_{1} V_{2}Z_V_TV \\ & VcZZEYZCUZCIIFOUZ_T_1FUVChZEVEVVCFOLZZ_eVReZehRcdZ_gV_eVUVcCM_VZ_eVcVdeVU^` ezgVZZ \\ & eYReZehRcdZ_gV_eVUVcCM_VZ_eVcVdeVU^` ezgVZZ \end{split}$$

Î < [ġrc fmgUng k Y UfY VfUj YžÚ \ hYfgÅ h\Uh k Yfj Y VYYb k ]bbYfgÅ Vi h=Xc blki\_bc k ž gca Yfja Yg mci k cbXYf UVci hk \Uhğ VYYb k f]fhYb" Mci ñY fYUX]b[ UbX ZJVVg UfY X[gdi hYX UbX h\YmgUnic bY h\]b[ h\Yb Ubc h\YfÅ h\Uhğ k \Yb h\YXci Vfg gfUffÅ 6YVUi gY h\YfYfg gi ddc gYX hc VY h\]g \Yfcž 6YfbUfXc C Ñ ][ [ ]bgÅ Vi h=XcbNii\_bc k Å =ĵÑ Y fYUX gYj YfU`c h\Yf h\]b[ g'h\UhgUm\Y k UgbNiu\Yfc Ï fA]| YXU[ Y [ fci dži fVUbža YX]i a ! ck @; Ł

EYV\_REZ\_R]ZU/e2;TReZ\_eYReeAZcl\_RecRezgeV dW\de`ac`gZU/ZclSVT ^ Z\_X\MRX2J\ZEYVf\_c\]Z RSZZEj `\V&YV ^ ZZERcj RTT f\_e ^ R.\diZe YRdU e` ZU/e23J\hzeYZ

 $\hat{I} = \langle Uj Y b N \hat{N} i [ c h U b m \rangle ]ghc finc Z7 \rangle ] Y h U h = U b X h U h a U_Y g a Y g U m H U_Y a m \ U h c Z$ 

Ic '5 fhi fc DfUhcf'6YfbUfXc 'C Ñ' ][ [ ]bgÑÅ VY!
WUi gY h YmÑY i bfYU'Å h YmÑY a UXY! i d '
ghcf]Yg'h YmÚ``nci i d k ]h k \Yb nci ÑY'
ga U```UbX'HU\_Y'nci ']b k ]h Å UbX'h UhỹthY'
fhi h 'Ï

fAUYža ]] YX'U[Y'[fcidžifVUbž`ck'Q9; Ł

4 czezzań `WeyV yzde`czn`ł^Żącegi \_Rocłeżgy zdł \_`eV\_eyf czładeżni ze zdreży RT\\_`h]VUXV^V\_e`WR ]RT\+

ÎH,Y'dfcV'Ya ']g'hUhžVYVVUi gY kY`\Uj YbŇi [chUbni\]ghcfnžkY`\Uj YbŇiå kY'UfYbŇiå kYÑJY'[chbch]b['hc']XYbhZnik]h`Ug'cif ckb'Ï

fl Ya U'Yža ]] YX'U[ Y'[ fci dži fVUbž\][ \'C9; Ł

H<sub>i</sub>Y'Wj JWbUhcbU`bUffUhj Y

 $\begin{array}{l} & \hbox{EYZI}_RcRegVZITfccV_e`_j Z_RVRX^V_eVUL\\ Z_T_TjfdgVVC^Ž:edVd4YZVR_YZb`cjRdeYRe `VRaVa]VhYZYYRdSfZeRTzgZXVUdTZcjR_U VS`UZUeYZIZ_eVZ_deZfcZ_d`VeYVCVafS]ZIŽ 2dR_RcRegVZeT_VTcdhZeYRa`]ZZTR]Z_eVcacVieRZ_`V_UVAV_UV_TVŽ \\ \end{array}$ 

Î=ZYY îh Uh7 \]Y jb îh UhdUfhcZ \]glv fmk Ug Z ```cZdYcdYk \c k YfYk ck °Q Ygli fY cZUXa ]fUlfcbQÅ k ]h [ Yhi d UbX [ cžk ]h Xfj Y" Hi [ \ dYcdY" HYFYdi V]WWUaY Ucb[ UbX [ fUXi U``mîh YmglUfhYXhcVY! WeaY gli d]XÅ žg]``nž`]\_Y gebg cZÅ žîh cgY ZJh Yf Ú[ i fYg îh Uhîh Y dfYg]XYblg UfY'Ï fl Ya UYža] YXU[Y] fci dži fVUbž]bhYfa YXJUhY Q9. L

EYVTZgZI\_RZ\_RJ\_RCREZVZIV\_T f\_eVURI ^`deViTJfdZyJjZ\_eYVUZIIfdZ\_d`VAYV^ZUJV R\_UfaaVcdeRHZZeZIRd ce`VJVRc\_VUJVXV\_URS`fe eYVT f\_egiLhYZYYRdeYVU^`TCREZThVJVRCVDREV Rd`\_V`VZed\Vjce`\_VZEYZL\_RccREZVCf^dfaeYV Z`RXvcj`VVAV^ViTCREZTZgZZREZ\_`VVAVehV\_ł eZeYTV\_efcj+TZg1Z\_Ufdeg1UV^`TCRIjŽ

 $\hat{I}H_{Y}YUfY'[ccXh_b[g']b'7]YUb']ghcfm$ 

UgʻVY]b[ 'UʻXYgʻfYžUʻWć `YWfj Yʻ\cdY'h\Uhi]gʻU`acghi

U`k Ungʻh∖k UfhYX''Ï

ÎKYNj̃Y`bYjYf`aUXY`]hžUbX`h\g`a][\h`YUX`ig hc`gigdYWhih\UhÎ]hï`]gU`amh\žUb`]bjYbh|cbžUgkY``

>cf[Y'9XkUfXgž%--"

#### hccÅHU\_YihYidYf]cXicZfUX]WU``[cjYfb! a YbhgžZcf]bgHUbWY'Ï flYaUYža]IYXU[Y`[fcidžifVUbž]bhYfaYX]UhY` G9; Ł

$$\begin{split} & \text{EYZ}[\_\text{RcRegVYRdSVT} \land VZ a] \text{R} dS] VLY h VgVd.\\ & \text{SVIR} dV eV YZe g Z SRMU `_ h \text{R} d \text{T} f e d ` e \tilde{Z} \\ & :e U Vd_`e R]`h RT \_eZ f`f dac XVddZ\_e SV \\ & e RIVUW \land e V`cZ Z d U h_e e e V ac VdV e \tilde{Z} F YRe \\ & \text{TZ} \_ `]`_X k V Z e d R_R U_` c U e ` d V TZ K V d \\ & `c e YRe Z U f d c Z h h`c `Z F YZ l_R c R Z V Z l [f de R$$
 $<math>\land V` g \tilde{Z} \end{split}$ 

EYVdf UZdd^ h eYReeYV] d' WRUZSZZG d' W WRUSj \_RcRzzydSRdU`\_ YZE g ZIRd TZEVL Z d^VTRML hZY R aVCIVá $Z_$  `WYV^ZZER X gVc\_^V\_e aVZU1"\*(Sł"\*)\*/RdeYVV\_U`W TZZT4YZŽ

ÎK \ Yb =k Ug U [ ]f žVYZc fY D]bc W Ylžth YfY fYU`mk Ug U ZYY ]b[ cZ]XYbl]lmt Mc i b[ dYcd Y \ UX`a i W`a cfY ]XYU ]ga žhccžUbX` [XYbl]ÚYX`a i W`a cfY k ]h 'h Y We i bhfm UbX'h Y '7 \ ]YUb ÛU[ "'7 \ ]Y 'k Ug '7 \ ]YZUbX` h YfY k Ug U`chcZdf]XY'Ï fl Ya UYža ]l YX`U[ Y [ fci dži fVUbž\][ \ `Q9, L

H\Y`bUffUhj Y`cZdcdi`Uf`Yl Wiglcb

Î A mXUX la X a Y l\ Uh7 Uf c g = Vz < Yn k Ug cbY cZh Y V][ [Yghgk ]bY mci WUb ]a U[]bY 'Ï fA UYža ]l YX U[Y] fci dži fVUbž ck C9; Ł

$$\begin{split} & EYZ [\_RcR & EZV \ S`UZ(d_`eRYZ) cZR \ ZV) e E \\ & Sf eRT [RZ' Ž YV_R & Z_R]Z' `We Va`af ]Rc_R \\ & e \\ & E \\ & V \ R_Z W \\ & E \\ & Z \\ & M \\ & E \\ & M \\ & E \\ & M \\ & E \\ & M \\ & E \\ & M \\ & M \\ & E \\ & M$$

 $\hat{I}5bXk \setminus Y = k Ugk U_b[VUW = gUXzk]h$ 



gc a i W k YU'h cb a mf[[ \h\UbXž\i [ Y a ]bYfU`XYdcg][gžUbX cb h Y ch Yfg]XYU [ fYUhVci bX`Ygg gYUžUbX]hg bchYbci [ \Å =gUnžk \mXc 7 \]YUbgžk \mXc =UgU7 \]! YUbž\Uj Y lc [ c \i b[ fn8l fA UYža ]] YXU[ Y [ fci dži fVUbž ck 'Q9, Ł

H, Y <sup>·</sup> bUffUhj Y <sup>·</sup> c Z h Y <sup>·</sup> YbhYdfYbYi f]U<sup>··</sup> ′U[ i Uf

EYZIZIeVV^`decVIV\_e\_RcRezgVLR\_UZeZiecVReVU Z`\_ZIR]jj RdR\_Rcc`XR\_e}TeZ\_`cRdRhZfYeYRe \_VgVcTR`VeefVŽ

EYV^ j eY`WeYV[RXFRcZdUVdRZSVURdeYV1]RZ eYRe 4 YZJVh RdeYV=ReZ\_2^ VZIR\_RgR\_eXRdV`W ^`UVc\_ZejŽEYZdXRgVeYVT f\_eej]VRUVcdYZadeRefd R\_U dveZeRaRceW/^Zed\_VZXYS`f cdŽ

ÎHY k Umh Y VUb\_]b[ gYWc f XYj Y c dYXž mc i \_bc k 3 =hc c\_ =bhYfbYhWUggYg ]b B Yi ! ei fbÅ K Y 7 \]YUbg UfY Ua Un|b[ mk Y<sup>\*\*\*</sup> fY[ UfXYX UVfc UX" FYU`nžh Y `Yj Y`c ZYXi ! WUhc b ]b 7 \]Y ]g Yl hYa Ym\][ \ 'Ï fA UYža ]] YX U[ Y:[ fci dži fVUbž\][ \ Q9, Ł

EYVUZETF dZ\_eR\VdR\_Z^\_\_ZTUZER\_TVW/^ eYV

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2\_UUZZZ]fdZ\_^ V\_ecVd\_ReVdeYc`fXYaVa]Vd cV^ Rc\d+

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2]] Wfc\_RockezgVdYRgVSW\_UZERCUZeVULSfe

h` cdeRWWIEW ZIEVZ RW` W4 YZ/RdRYZE cZIR R\_UZ\_deZf eZ\_R] Wc^ ` WZgZT` dWŽ2]d RWWIEW RVeYVd TZI Xc f adh YZIY eVdV\_RcReZeVdIcW ZAU hZeY TcNeZ\_X eYZI` dVc+d ]UZcdLa` ]ZZZ2\_dR\_U Sf dZ\_Vdf` V\_Ž3` eY eYVT f\_eqj decRf ^ ReZTa` ]ZZ TR] M aVZ/TVdR\_U eYVTYR\_Xd eYRe YRgV eR.V\_ a]RIVZ\_URZj [ZWYRgVf\_Uc^ Z\_W eYV\_RcReZeV eYRe dWd eYV 4 YZ/R\_aVIf [ZcZgj Z\_ eYVYZE cZIR] R\_U Z\_deZef eZ\_R] T\_eZ\_f Zej ` WyX` U` dWc%Z K \Uhig ]b`Xci Vhzh Ybz]gth Y [XYU'h Uhh Y` Wc i blfmig ]b`UV]Hblg`Uj Y U dYW` ]Uf UV]`! ]mžUa ci bHb[ 1c U bUh]c bU`W UfUWHf [g]/Vz Ic WYUhY U`\Ufa cb]ci gʻgc WYmi'

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EYVZUR`W4YZYL`WW&^Z\_XaRe`WR\_`dU& T\_UFTZEV@Z\_eVXReZ\_`\_RW@Z\_X`WWbfRZEj R\_Ud]ZLRZEjŁYRd]`deT&UZSZZEjŁR\_UaVa]V&/U e`dRTe\_WREZEVJj hYV\_d^Z\_UVU`WEZHYj YRd eYZIZURSVT`^VZa]RfdS]VO

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EYY eV\_U e`SV`gVc&&R\_U^RVŽEYY RV YRgZ dackdV\_eVUR^`\_XeYVYZXVcVLTReZ\_R ]VgVdR\_UeV\_Ue`SV]`\_Xe`eYVYZXVcdeRef^Ž EYY RVVVf\_UhZeYd^VhYReXXReVcVXbfV\_Tj R``\_X^`cVRTegV4ReY`]ZOŽEYY RV/ZVj e`SV ac`WdtZ\_R]d`cd/WV^a]`jVVŽEYY YRgVRYZXY `aZ\_Z`VWYZc`h\_TRARSZZZCHR\_UeYY RVT\_ł }UV\_eeYReeYV hZ]\_`e]`dVeYVZcV`a]`j^V\_eR\_U eYReeYVZc}\_R\_TZEJ dEFREZ\_hZ]SVSVevcZ\_VGFcVZ EYVZc`a`[ZEJR] ResEFUVZTZEZTZ\_REFcVR\_UeYV VacVddfaa`ceWcUV^`TRIJŽ

EYZLX: fa SV/ZLÓV EYRELSJ R\_U JRXVL EYV TYR\_XLOEYREYREVGR.V\_a]RIVZ\_4YZV`GVCVIV\_e j VRcd YRgVSW\_SV\_VJ TZA] R\_U YRGV YRU R TJVR: UZEVTEZ\_ŽH YV\_ EYY T\_dZLVC EYV VT\_`^jL EYY WY EYY YRGVU\_VHVJ] `fe `VZE R\_U RV hVJ] UZA` dVUE hRLUEYVVT\_`^ ZTd EV^ ŽE YY REVYZXYJ d TZSSJVZ\_XV\_VRJLR\_U HVJ] UZA` dVU e hRLUE`EYVGŽE YY EYZ \ aV aJVTR\_SVEET EVZ AV aJVHY` REVac` fUE`SV4 YZVR\_WJ EYY REV aRe`VRGVG JRXV^`CJ XC` faLRDEYY EYZ \ eYRE ^`deaVa]VTYVZZYgRffVddZ'ZRce`eYVZc`h\_Ž EYYjeV\_Ue`YRgVR]`\_XeZ`VY`dZc\_R\_UeYY UVj\_VeYV`dvjgVdSjeYVZca]R\_dŽ

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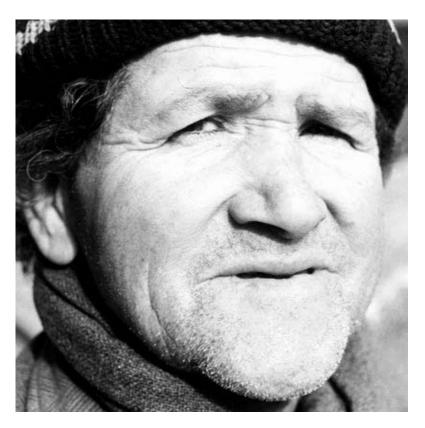
AV a]VhY`RVf\_dCVRS`fe4YZVeYZ\eYReZe ZUZWIF]ee`d3 hYReeYV4YZVZ`LV`eZj Zle`U3jŽ EYVZ:ReeZfUVe`hRtU14YZVZI`\_V`VVF\_VKZ\_ R\_UUZZJfdZ\_^V\_eZEYYJ RVZTJZWE`eR\VR \_VReeZfVgZh`WYR\_XKdZ\_eVVhBj 4YZVR\_d\_`h WWJRS`feeYVZ:ZV\_eZjZ3j R\_U]RXVLeYY eYZ\ eYRe^`CVYRdSW\_]`deYR\_XZZUSj eYVTYR\_XKd eYReYRgVd/R\V\_4YZVZ\_cVTV\_ejVRcdZEYZdXc`fa ^R\VdfaS)´´`WAYVR`a]VŽ

AV a]V $\underline{Z}$  eYZLXc fa R $\underline{V} \wedge R\underline{Z}$ ]j W R]VLhZY eVTY\_ZIR]Lac WdZ\_R] R\_Uf\_ZgVdZj VLFTRZ\_Ž EYY eV\_U e SV]\_X e eYVZ eV VLReV d TZ ł VT\_`^ZT de Ref ^ R\_U e ]ZgVZ\_DR\_eZX ŽEYY WJ eYJ YRgV]`de fe`\_SR]R\_TVW'^ eVVT\_`^ZT d deV ŽEYY R $\underline{V}$ UZHRZJ W hZY eVZc }\_R\_TZR] ac deVTedR\_UTF cv\_eVRc\_ZXLVgV\_e' f XY eVJ RV\_`eR``\_XeVVh`cde aRZLŽEYY R $\underline{V}$  eT\_ł } UV\_eRS`fe \WaZ\_XeVZc V a]`j^V\_eŽEYY R $\underline{V}$ 4 ReY [ZT`\_]j Z\_R`VLR deYJ U\_`edR\VaRceZ `cXR\_ZXUh`cdYZČ

D TZEJ j cláz Z XLEYY U \_`eYREVR\_ RIEGOVAR I Zj JZW ZEYVER deYZIZL\_`eR\_Z a`ceR\_ecWWV\_TV a`Z\_e Vic eYV ŽEYY RV glvj T\_glvdR\_e hZEY ^`Ulc\_e``]dŽEYY eYZ\ eYRe eYVTYR\_Xld\_`h X Z\_X`\_Z eYVT f\_eg RVJWLZ\_X\_`hYklžEYY U \_`eWW] aRe`VWRSc`RUT ^ ^ f\_Zj `VGRIf VE RdeYY SVJZGVeYRe eYVZdRV\_`ehZMj dYRVLŽ EYY eYZ\ eYRe`eYVcaV aJVRV\_`eX/\_VRJ]j e` SV ecf deVLŽEYVZ: a`JZZIR] gZhdT glc eYVhY`JV daVRef ^ ESfeeYY YRgVRdZXYeeV\_UV\_Tj e`ZV\_I eZJVhZY eYVTV\_eXIcZXYeŽ

; fcid". 8 kgWcbhYbhYX:#5 b[fmWk]`YUb AV a]VhY`RVR\_Xj RS`fe4YZ/VeYZ\_\Ze^R.Vd \_`dV\_dVe`eR\ RS`feeYV4YZ/VR\_ZLV\_eZjŽEYVj T]VRcjj U\_`eWW]aRce`WcUB; d4YZ/VZHYV\_eYVj eYZ\_\RS`fe4YZ/VeYVj WWJR\_XgjŽEYVZCZ RXV`W 4YZ/VR\_ZLV\_eZg ZLRdt TZEVUhZeYTYRRREVcdReYVc eYR\_hZeYYZde`g`cZ\_dEGfeZ\_dZEYZdXc`fa^R.Vd fa S! ~`VWEVCR`a]VZ

AVa]VhY`RVR\_Xg`RS`fe4YZVSV]`\_Xe`



eYV]`hVcdTZłVT\_`^ZTdecRef^ŽEYVdVRcV YfdMhZgVdR\_Uh`c\VcdReeYVS`ee`^``WeYV Z\_T^VdIR]VŽEYVjRcVYVRgZjcdacddV\_eVUZ\_eYV Tf\_ecjdZUŽEYVjWRJ]SVchW\_VgR\_XVjZR]dR\_U \_`\_łSVJZgVcdŽEYVjYRgV]ZeqVVUfTReZ\_RJTRaZER] `cWR^ZZRcZejhZeY^`UVc\_e``]dŽ

:\_ XV\_VAP,LeYY SV/Z&VeYVTf\_eg YRd\_`e TYR\_XU R\_U eYR&UVAZEV RaaVRR\_TV&VgVj ł eYZ\_XYRdeBJ VU eYV dR VŽDFTY TYR\_XdRdeVJ U aVCTVZgVeYJ UZRaac`gV`VŽEYJ WVJeYJ YRgV TJVRdj ]`de`feW/^ U&JT a^ V\_edZ eYVVT\_`^ZT d deV^ŽEYY RV\_`e Re R] T\_}UV\_e`WWAZX eYVZ [`SdŽEYVZ: UVIZZ\_ł^RZ\_XU Vd\_`e]``\ SY`\_UeYVaVdV\_eŽEYJ RVf\_d TZSJVR\_UeV\_U e`hZeYURh Z\_e`eYVW^ ZjŽEYJ REVZ\_e`JVR\_e R\_U ]ZeqVZ\_eVCVEVZ aRczZARcZ\_XZ\_d TZGjŽ EYY eYZ\_\aV aJVRV\_`ee`SVecfdeVZEYJ U \_`eSVZ&VeReeYJ SV`\_Xe`R]RXV^`d]T^ł ^f\_ZjLR\_UWNJ dReYVCZI ]REVZ

AV a]VZ\_eYZIX: faeYZ\_\eUJ; dh`d]UZIYRUV. e`f\_UV.deR\_UeYR\_eYVZ:XR\_UNAEYV.dZEYVj WWJ eYReVgV\_edR:VaR.dzZ.XeV^ Sj R\_UeYReeY`dVhZeY a`hVceR\_VRLgR\_eRXV`V&YV^Z\_a`]ZZI:deYVj R:V UZRWWRAU R\_UR:VVZEYV.cf\_dXZeVC:U`cU\_`e S`eYV.ce`g`eVZEYVj U\_`efd`R]jj ZJV\_eZiVhZeY

## ÎK \Uh Xc Ygʻ]ha YUbži]bʻWi hi fU`hYfa gžhcʻVYʻ $7 \ VUb Uh h Y VY[b]b[ cZh Y h Ybm Ufgh Wb!$ hifn8°K \Uhigh\YfY°b Wcaacb'Uacb[ WUfUWfYfg $\sum Y h Y c Z W k c f Y h k c h f g h h Y U b i U Y$ cZFiad]/h\Y`UXmik \c`eiYiYg`id`hc`VimUb` CaUfWhc VfUWYYh'h Y ghi XYbhUhh Y I bli YfgXUX $XY^{-}U^{-}$ : fc bhYfU<sup>-</sup>k \c |XYbh|UYg'k|h h $Y^{-}A$ Udi W.Y<sup>-</sup> dYcd Y/h\Y`\]d!\cddYf`]b`h\Y`dccf`bYk `g Vi fV/ h\Y`XYX]WUhYX`ZcchVU```ZJb/h\Y`mcib[`Xch'Wca` VigbYggaUb`k \c`fYUXg`7*Ud]HU*``aU[Un]bY`cf`h\Y

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9 RdeYVT f\_eq XRZ\_VU^ `cVeYR\_ZeYRd]`deSj eYVdVTYR\_XVdL`cgZVgVdROEYVR\_dhVcZdS]f\_eŽ 2c`f\_Ueh` eYZLd`W&da`\_UV\_edSVJZgVeYReeYV Tf\_eqiZdh`cdV`WXXEYZdRaacVIZReZ\_RWWTedeYV TeVUZSZZEj `VRT ^ ^ `\_ZUV\_6ZEjERdeRS]V#dY`hdŽ EYVZ a R d SZZ RERIYZ Xe eYV4 YZVR Z.V. ł ezej Zd]Z\_\WhZeYeYVWWJZ\_XeYReTYR\_X/YRdSW\_ SRUWceYVT f\_eqŽ

HYj U eY dV hY eYZ \ TYR\_XV YRd SW\_ UVecZ V\_eR] e` eYVT f\_eqj ]`dVT \_} UV\_TVZ\_ eYV ZNR`VR4YZVR\_ZV\_eZ; R\_UWV]^``dVUVeRIYVU  $V_{X}^{A} = U_{X}^{A} = U_{X$ 

gYUgcbU``ZJfa k c f\_Yf k \c fi g\Yg hc Ub]g\ \Yf ZJfa ' k cf\_gc Ug bchhc a gg \Yf ZJj ci f Y gc Ud cdYfU3 =b hYfa gcZ XYbhhmžUa cghbch b[ /bch b[ YhhYf  $bhYfa gcZhYWca a cbdUWYgcZ7 \YUbbYggZ^{Y}Y$ VY]b[ `X]ZÍXYbhcf`ibUggYfh]j Y"`H\Y`cb`mh\]b[ `h\Ym \Uj Y`lb`Wca a cb`lg`U`bYk `W`hi fU``Ybj lfcba Ybh' ]b YUW cZh Ya žYj Yb HJ\_b[ \*1 ghh Y ZYUh fYg gc \* Vf]YûmbchYXžh\YfY'UfY'hfUWYg'cZh\Y'[fYUhWi'h fU`` WW.Ub[YgcZfYWYbhXYWUXYg'Ï

6YfbUfXc 'Gi VYfWUgYUi l ž&\$\$%"

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d^f]U\_`eSVRUgVdMjRWWR&U[fdeSVRFdVZeZd YRc^VUSjTYR\_XZŽ9Zde`g`dr`hdViR`a]Vd`W&VV `aa`dZ&Z

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EYVac`S]V`U`Vd\_`edW^ e`SVTYR\_XVZ\_Zł dMMSfehYReZed&RdZ`edWWMed`\_eVVUZWWCV\_e RdaVTed`WURZj jZMLRdaVa]VaVcTVZgVeVV`ŁRdV Z\_dvaRdS]V&V^ eYVaReYeYVT f\_ecj RdRhY`]VZd dW\_e`SVeRXZ\_XZ6YWUigYhYfY`]gbc`gYbgY`cZ h`Y`Z`hifYžWUb[Yg]b`hc`XUmĨg`Y1 dYf]YbWY` hYbX`hc`VYZY`hUgʻUb`Yfc`glcb`c`Z]XYbh]miUbX` gYWif]mi'

> `de aV a]VSV/Z&VeRe eYVTYR\_X&I YRV\_` T]VRcUZVTeZ\_L`ceYReeYY YRgV\_` cVR] d`SdR\_TV SVTR\*dvf]eZ\_ReVj V&vgV\_` cVR] d`SdR\_TV SVTR\*dvf]eZ\_ReVj V&vgV\_` cVR] d`SdR\_TV R\_UeYZHRWWTedeYVZ:ReeZet UVe hRud4 YZVZEY dv hY`WVJf\_d\*cVR\_UR\_Xj RS`fe4 YZVeY`dvhY` U`fSeeYVV1ZEV\_TV`VR\_j T^^`\_4YZVR\_ZVV\_1 eZg] RCVeYVgVgi aV a]VhY`SV/Z&VeRee2VeYcf de `WYR\_XVYRd\_`e`\_]j SW\_f\_V&g`fdS]Ve`eYV`L SfeeYReZeYRd\_`T]VRcUZVTeZ\_`df]eZ\_ReVjLYRd ]V&VeYZ\_XdRdeYV\_hV&Z

EY`dVhY`RcVac`fU`W4YZVdWe`URj`d  $TYR_X/dRdT_c^2 C^2 Z_V/dC^2 C_V/aVTeReZ_$ eYReLe` eYV^ ŁUVj\_VdhYRe 4 YZjV ZZŽE YVj RcV  $VT_{^{T}} MZ_{^{T}} RVZ_{^{T}}  d TZK g R\_U Zed gR f Vd eYV g eYZ \ `WeYV Wef cV R\_UeYy dWeYZ\_XdX&z\_XSVeeVcWceYV ŽEY dV hY`WW]f\_dfcVRS`fe4YZ/VYRgVRLRaeWUe`eYV  $UV^{R}\_Ud^{W'}^{UVc}\_ZjLRcV_^{eecR}_ZZ_RJZtedR_U$ RVYZXY jj Z\_UZZLF ReVULSfeeYVcVf JecLS`eYaVd d\_RjR\_UdTZRjŁjVRgVeYV ZjReVRdvŽEYVjeYZ\_\ eYReTYR\_XVZ\_eYVT f\_egi YRdSW\_UZEVTeZ\_]VddŽ EYY WY T\_WAW ŽEY dVhY RVR\_X j RS`fe 4 YZVWW] eYVj\_YRgV]`de`feLS`eY\_VT\_`^ZTR]j  $R_UZ_eYZ_dTZR_dYZ_dZ_dZ_dZ_eYY_eYZ_eYRe$ WcaVa]V]ZVeVV ZehRdR]hRjdeVVd? VŽHYRe eYy hR\_eVUVW^ TYR\_XVhRdRhRj `fe`VW1T]fł

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H Yj U d ^ VaV a]VdWSV\_V edZ eYVTYR\_Xd hYZV eYVdU \_`e0EYVdVRCV d ^ V `S[VTe&V cWd\_dŽEY dVhY RcVac f U`W4YZVRVSVeekc VLf TReVU R\_U SVeekc `WWeYR\_eVVTc&ZTR] Xc f adŽ 3f e eYZdZL \_`e eVVhY ]VR\_dh VŽEY dVhY RcV f\_d cV RS`f e 4 YZV RTef R]j YRgV T\_dZVRS]V VLf TReZ\_R] TRaZER] R\_U RgVRXV VRc\_Z XdŽE YV \_`\_IVT\_`^ ZT Rda VTed`Wd TZR] Z\_eVXReZ\_ RCV R]d R\_Z a`eR\_eVWE'cZ\_eYVdVaVcTvaeZ\_dZH.Y` `c gg c ZWc bÚXYbVY`]b U'7 \]YUb ]XYbH]mi]g' gffcb[`m Uggc WJUHX`k ]h`h Y`ZYY`]b[`fh Uh gc WJU`fY`Uhc bg ]dg UbX`h Y`]bghli hc bg' h Uhgi gfU]b`h Ya žgi W. Ugʻdc `JhVgž gc WJU`` cf[Ub]nUhc bg`UbX`h Y`ZJa ]mž UfY`k YU\_''

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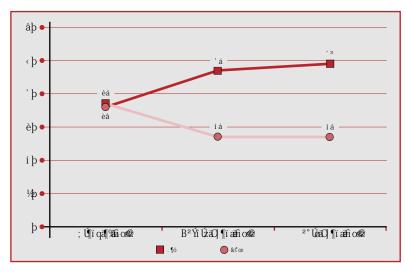
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EY dvhY Rvf\_drVR\_UR\_Xg RS`fe4YZvWW eYZIRZ VIR\_UeYZIZIh YReUZHZ XfZhvdev Vo/^ aV a]VhY Rvac`fU`W4YZNŽ

AV a]VhY`RCVdTVáeZTR]RS`feR4YZ[VR\_ZLV\_eZej

 $\begin{aligned} & \mathsf{RVR} d \ e^{\mathsf{V}} \ \ \ \mathsf{Vd}^{\diamond} e^{\mathsf{A}} \ \ \mathsf{C}^{\dagger} \ \ \mathsf{j} \ \ \mathsf{T}_{\mathsf{gZ}} \ \mathsf{TUUe} \ \mathsf{Ree} \ \mathsf{e}^{\mathsf{V}} \\ & \mathsf{VR}^{\diamond} \ \ \mathsf{Zj} \ \ \mathsf{ZIZ} \ \ \mathsf{TZZ} \ \ \mathsf{TZZ} \ \mathsf{R} \ \mathsf{d} \ \mathsf{f} \ \mathsf{CIV}^{\diamond} \ \mathsf{Vac}^{\diamond} \ \mathsf{S}^{\mathsf{V}} \ \ \mathsf{d}^{\mathsf{Z}} \\ & \mathsf{h}^{\mathsf{V}} \ \ \mathsf{I}^{\mathsf{A}} \ \mathsf{Ree}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \\ & \mathsf{CR} \ \ \mathsf{Xj} \ \ \mathsf{RS}^{\diamond} \ \ \mathsf{f} \ \mathsf{e}^{\mathsf{A}} \ \mathsf{YZV} \ \ \mathsf{d}^{\mathsf{A}} \ \mathsf{RV}^{\mathsf{A}} \ \mathsf{RVf} \ \ \mathsf{d}^{\mathsf{A}} \\ & \mathsf{CR} \ \ \mathsf{Xj} \ \ \mathsf{RS}^{\diamond} \ \ \mathsf{f} \ \mathsf{e}^{\mathsf{A}} \ \mathsf{YZV} \ \ \mathsf{L}^{\diamond} \ \ \mathsf{e}^{\mathsf{A}} \\ & \mathsf{RVR} \ \mathsf{CR} \ \mathsf{L}^{\mathsf{A}} \\ & \mathsf{RVR} \ \mathsf{CR} \ \mathsf{R}^{\mathsf{A}} \ \mathsf{R}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \\ & \mathsf{RVR} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{R}^{\mathsf{A}} \ \mathsf{R}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \\ & \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \\ & \mathsf{R}^{\mathsf{A}} \ \mathsf{L}^{\mathsf{A}} \$ 

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R\_UŁZ\_ a RoeZIF ] ReLeYV ej a V`Wa TZASZZZEj cWa ] et  $\underline{Z}XW^{\prime} = WW Reezer UWZ5^{-} bX^{-}cZWU i gU^{-}hm$ gYYa ghc UflgY. hig a dcggVYhc gUmh UhU WaacbbUhcbU`]XYbh]mYl]ghgžVYWUigY 7\]YUbUhhh XYgUbXfYUhcbg\]dggYYa hc dfcjY'h\Y'WcbhfUfm"

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ac`Uf`TezgV`c4ReY`]ZĬZEYVeze]Vd`WRY``fdVddBydd d'TYRd4*YZJVR\_d'IZRSZJegL@fcVT\_`^ZIZ\_WZZCEg*  $R_U:d4YZJVR4ReY`]ZITf_ecjORtVX`UV{R`a]Vd$ `WeYZĬZ

EYVF?5A#!!"DfcgyjUReRXgVR\_ZUR`W Y`h4YZJVR\_ddWeYV`dv]gvd\_`hŽ

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7ZadejjLevV4YZ/VR\_TYRARTENAC`cdTZR]ReeZefUV ZddW\_RdR\_Z`^fdeS]VVMTeR\_U\_`eRdd^VeYZ\_X  $\begin{array}{l} YZe cZRZDVT\_UJJLhYV\_4YZVR\_dR_RJ dVeYVZc \\ \_ReZ\_ddTZR] aVcd\_RJZej eYVj daVR `Vý:% u \\ y^ Z_WoyhV% uy fcdYZEYVj ReV_`eZV_eZYVZ_XL \\ eYV_LhZeYRdTZR] `dVcR_UYZE cJLSfehZeYeYV \\ 4YZVR_aVcd\_RJZej R_UeYV4YZVR_hRJ `WeVJRE \\ ZXe` `eYVcdZ \\ \end{array}$ 

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ä	> Åz² qæt <b>éæi</b> €" z tÝ <del>аннинниннинниннинниннин</del>		â aaaaaa	
ä	ŁĆ <sup>ę</sup> z Ćłiąd <sup>j</sup> ² <sup>-</sup> z ² rij ¶¶ ŭz Ćłi ä <del>nna ana ana ana ana ana ana ana ana ana</del>		< anna	iiiiiiiiiii/p

> ¶ĩ lýz näk O-ĩ <br/> zö ri lớz näh 2 â â à B 1 Ł; <br/>  $\Rightarrow$ ĩ lớz nă þþhá ) Oź q<br/>a  $\mathbb{P}^2$  ä Oź Y<br/>á ä ä Ú O  $\Rightarrow$  O a C<br/>  $\mathbb{P}^2$ 

:\_eVVUZVWEV\_e\_RacRezzvEL}gVVWRefcVd`V4YZjvR\_ URZj jZVV/VEX4

C bY U[U]bghh Y c h Yf EYV4 YZW\_Rozef UVZIUVIKSVURIh RJZVR\_U RXXVIIZV4

Î 7 \ JYUbg UfY dfJW mUhih Y VYghc Zha Yg k \ Yb JhWea Yghc ``Jj Jb[ ``JZY YUW XUm a cghmÅ 5 ZJYbX glUflg [ c ]b[ U[ U]bghme i VY\ ]bX me i f VUW Å Ï fA UYza ]I YX U[ Y [ fei dži fVUbž ck @, Ł

@\_VdfcTV`WT\_VZTeZ\_dTZR]cVJReZ\_dZd V\_gjŁeYVUZWTfJej`WRT\\_`hJVLXZ\_XeYVgRffV `WeYV`eYVchZeY`feWWJZ\_XeYRehYRe`\_VMJW YRdZdUvgRffVUŽEYV4YZVR\_fcXVe`UZTRVUZeeYV `eYVcZlRhFj`VS`JdeVZ\_XdMVWdeVVŽ3feeYZd ZdU\_VZ\_UZVTeJjŁeYc`fXY^`T\VcjŁYf^`fcRd RhVRa`\_+

Î 5bX k \YbYj Yf îh YfYŷ U'a Įg\Udž ZU UXm h]dg cj Yfž Yj YfnVcXm Ui [\g Q i ZUk g ]b h Y [fci dQH Ym]\_Y U Ui [\U`f][\bž k \Yb ]hŷ gca YVcXmY gYlŷ a ĮgZ fli bY'Ï fA ]I YX U[Y [fci dži fVUbž ck îc ]bhYfa YXJUH Q9, Ł

CbY'k]l\\cihi\Y'ch\Yf D1ZR]cMReZ\_ddW^e SV^Rc\UUSjRcV[RezeV 
$$\label{eq:starting} \begin{split} & |R| \land WXZac TZj L \land WXZgZ XR_U eR Z_XRdR \land Rd \\ & ekc \land WXV_Vc dzj R_UXRezef UZj 6] aRX UV4 YZJ & \\ & uy4 YZJ Vdch RcU% \land VR_Z XR \land VRXV `_V Z_YZd \\ & e g LR_U eYV WZf cVe ckef c_Wg f cdZ_UZj JZWL \\ & RVaRce `WYVCR` VTYRCREVCZEZ+cf S[VTezzzj TR_YRgV_` T_} UV_e V a VTEREZ_cZE YV cVT X_ZZ_UFV`c Y a VU & cdW dYRU e XzgZE YV JRT `W cVTZac TZj ZIV a VcZ/TWU RdRSVect RLeYV hZYA \\ & Y [UZ_X` VR[f de ch Rd + ] \\ \end{split}$$

ÎKY`\UjY'h kU]hZtfgcaYVcXmhrX]Y` VYZtfY'kY'hY``'h YaÅk\UhU'[fYUhZY``ck` \Y'kUg"DUV`cBYfiXU'[ch`\]gfYVé[b]hcb` UVfcUXÅBck'9`JUg:][iYfcUÅ/kYÑY`Ub` ib[fUhYZ```chÏ fAUYZa][YX`U]Y'[fcidžifVUbž`ck'@, Ł

#### Ch\Yf ZJWYg

:\_  $e^{V}UZIF dtZ_dRS`f e^{4}YZ_VR_d TZA] Reset UV-L$  $cWWCV_TVhRd^RUVe`WAJdvRaaVRdR_TV-dR_UT_l$  $TVR]^V_eZ_e^{V}VhR_j aV a]VacVdV_e^{V}Ue^{V}V_dM_gVdZ$  $2d R cVdF ]eLUR_j le`lUR_VgV_ed R_U Reset UV-d RcV$  $dTdf eZ_Z&VU Vc e^{V}Z_e^{V}e^{Z}_`c eff e^{A}V_j T_l$  $TVR]ZCV[ReZ_dMZadRcVdZUe`SVVV]]`VVfj a`TcZjL$  $d e^{VRe}4YZ_VR_dRV`S]Z&VUe`SVTF_Z_XR_U$  $^Ztef deVM_RdeV_j dW_e`f_T gvch VRe YRdSW_$  $T_TVR]VU+$ 

Î Gc WU``nž=ł\]b\_ k Y7 \]YUbg UfY \mdc! W]hYg" H Y k \c Y l\]b[ cZWci d YgžcZk \Uh dYcd Y k]``gUnždi h]b[ cb a Ug\_g'Ï

fi Ya U'Yža ]] YX'U[ Y'[ fci dži fVUbž\][ \'C9; Ł

 $EYVeV\_UV\_Tj e`UZHZ`f]RevZidRZUe`ckf]eZ\_cV]Rez\_dVZideYReRcVSRdvU`_^Zf\_UVcdeR\_UZ_XZ`$  $EYVUZWTf]ej`VcVTX_ZKZ_X`_VcMJVR_U`SeRZ_H$  $Z_X cVTX_ZEZ_W/^`eYVcdckf]edZ_UZHE`ceVU$  $T^^f_ZRez_ŽEYZHAZ]SVV(a]`cVUWceYVc$  $Z_ARce &Ž$ 

#### @Yggh\Ub ch\Yfg

EYV deVcV giaZIR, 4 YZJVR\_ZI^R \U`feSjR WWJZ\_X`WZ\_WCZ cZgjZEYV UZEIF deZ\_d Vg`\VR\_ f\_cVRJZAUZU/cZgjR\_URT\_decRZ\_VUR\_UUZ^Z} ZhVUa`eV\_cZg]+

Î K YMY U k Ung VY ]hì]b[ ˈlà Ya Å k YMJY U k Ung [ ch Ygg UVci hi g là Ub Yj YfmVc Xmi YgY"K YUk Ungžnei \_bck Å k YÑYUgc! fUbgUbX h Uhỹch Yhci VYk |h i gÅ H Y gUa YUg'k |h ZchVUžk YÑ U'k UngVY Ugc!fUbg'Ï fA || YXU[Y] fci dži fVUbža YX|i a !ck 'Q9; Ł

 $EYVWWJZ_X`VZ_WVZ_CZ6jZd_`eT_}_Uve`cM$  $]ReZ_dVZadR``_X4YZJVR_deYV`dMgVdŽ:e^RZ_j$  $RCZMdV0/^T^aRcZ1_dhZeYVC0ZX__VZXYS`fcdŽ$  $EYZdWWJZ_X`VZ_eAc_ReZ_RJZ_WCZC26jVdHS]ZdYVd$  $RYZdRCTYZIR]dIR]VZ2cXV_6Z_VdRVdVV_RdeYVcfaVi$  $cZc`eYV&LAVcfgZR_dR_U3`]ZgZR_dRdZ_WCZc24+$ 

ÎH Ymỹ Y [ cha cfY W YY\_ ih Ub i g" H Uhỹ k \mih YmVYUhi g" H Ymỹ Y [ cha cfY dYfgcbU] m" K Y W[b[ Y VYZcfY h Ya Å = WUbhñgUbX 5 f[ Ybh]bYg" K \mVUbhi=gUbX h Ya 3 GYWU gY h YmgUmih ]b[ g=k cbħigUnž UbX k YñY h Y Î W ] Yb]ncg ĭ Xa |bi hj Y cZ Î 7 \]YUbI i gYXX[ga [gg]j Ym\$Å =a YUbžk Y gYY ci fgY j Yg Ug h Y Î W ]Yb]ncg Ĭ Å žUbX k Y cc\_ Xck b cb h Y 6c ]j [Ubgžk \c UfY Yj Yb k YYb]Yf h Ub i g'Ĭ

fAU'Yža]] YX'U[Y'[fcidžifVUbž]]bhYfaYX]UhY'C9; Ł

#### =bg][ b]ÚWUbWY

$$\begin{split} & EYV eV{d} de`VeVV LZIIf dZ_hRdeYRe4YZ_VR_d\\ & W_{le} \ Z_dZ_Z_TR_eLf_UZdeZ_XfZHVU \ Z_Rj h`ceYl \\ & hYZV`c \ If \ ]ef \ cR]j \ Z_eVCVdEZ_XhRjZ:_UZWVCV_TV \\ & R_UR \ ]RIV`W \ R_VUTYRRIEVCZdeZdeT \ ]`f \ cdR_U \\ & ~Rg`f \ cdR_VhYReTYRRIEVCZVA YZ_VR_d+ \end{split}$$

Î=łh |b\_ k Y Xc U```\Uj Y gca Yh |b[ ]b Wea ! a cbžUbX mci WUb gYY |hf]| \h\YfY. k YÑY [ fYnî MYgžXUf\_ We ci fg U``h Y łļa Yž |hĝ', Y h Y 7 \]YUb i b]Z fa žk Y XfYggXfUV mžYj ! YfnVcXm]b [ fYnžXUf\_ We ci fgžV UW Å h Uhĝ' k \mk YÑY [ cca m]bghYUX cZW YYfZ 'Ï fl Ya UYža ]I YX U[ Y [ fci dži fVUbž]bhYfa YX]UhY Q9, Ł

EYVWWJZ\_X`W\_`eSVZ\_XUZWWCV\_eZReVUZ\_R\_j h`œYhYZJVhBj YRd\_f^Vc`fdT\_\_`eReZ\_dŽ:e cVJRevde`aVa]Vd`h\_UZJVTF]ej Z\_RTTvaeZ\_XUZW WCV\_TVAŽEYVZ\_RXV`WT^^f\_Zej dW\_Rda`dEzegV V\_eRZJdRY`^`XV\_VZej eYReSR\_ZEhVdUZWWCV\_TVŽ7VRc `WT\_~ZTea]BjdR\_Z`a`œR\_ec`JVYV&Ž



5::=FA=B; H 9'9L 7 9DH B

$$\begin{split} & EYVUZIIF dtZ_dUZUR d ckykr RUZWKV_e_` \\ & eZ_` `W4YZW_dY h VgVd.`_Ve/ReT_ecRUZ d e V ^ RZ_de VR` gZhŽ:eeM]d`WRa`d Z gVLT_ł \\ & eXV_eZU_eZJ_ERT^ ^ f_Zj Z_YRc^`_j hZY \\ & X`UdTZA ck/ReZ_dVZ d d ]ZLRZ j LY chZRZ j LY chZZ j LY chZRZ j LY chZRZ j LY chZZ  LY chZZ j LY chZZ$$

#### Gc`]XUf]hm

4 YZNR\_ddR\_USj eYVZc`h\_ŽE YZIRtHveZ\_hRd YVRU`\_]j Z\_eYVUZIIF dtZ\_d`WeYVa``čZeZiT\_ł }\_VU e`ŁR\_U bF VdzZ\_VU SjŁeV/ Rj`\_VŽEYVAV ZIR^V^`g`VVT^^f\_Zj cVda`\_dvde`UZRteV4Ł YRUeZ VdR\_UT\_eZ\_XV\_TZAŽ6gvdj S`Uj TR\_cVIR] d^VZ\_dR\_TV`Wu V`a]Rdj d`]ZLRZdj Z\_cVda`\_dv e`R\_VReeYbF R\_VLRTTZU/e`cZ]\_VdtZH YReZUh Vje `\_^`deZleYReeYZIZIeYVd`]ZLRZdj`Vu Va]VhY` YRgV\_`eYZ\_XŽE YVgRJF V`WeYZHVja SVZ\_XcVT Xi \_ZXVLLh YReec`f S]VdaV a]VZIeYReZeZIRS\_`c^RJL VieR\_V fde`URZj`]ZW4



Î@\_Y'h cgY`\i [Y'[fYUhfU]bg'k Y`\UX'Z:f ]bgHUbWY/k Y U``fU`]YX fci bX h Yb"MYgžVi h h Uhỹtk \Uh=a YUbžgca Yh ]b[ V][ `\Ug'hc` \UddYb VYZ:fY'dYcd YÅ ch Yfk ]gY'k YÑY' bchÅ žch Yfk ]gY'k Y WUbNtVY Vch YfYX'k ]h` dYcd Y'k \c'UfY']b U VUX gdch'Gca Yh ]b[ Yl hfYa Y`\Ug'hc`\UddYb VYZ:fY'k YÑ`[ Yh ]bj c J YX'Ï

fA]] YX'U[Y'[fci dži fVUbža YX]ia !`ck 'C9; Ł

#### <cgd]hU`]hm

4 YZ/VR\_dR:Vd\*TZ7S]VLRWW16Z\_ReVR\_UhVjT^} Z\_Xe`hR:UdgZEE`cd`cV&2X\_Vcd+

Î K YÑY j YfmZ]YbX`nžYgdYWU``mk ]h` dYcd Y k \c Wea Y \YfY Zca UVfcUX''5bX` [Zh`YmUg\_gca Yh]b[ k Y] ]j Y h Ya U[ccX` Ubgk Yf''H Uhğgca Yh]b[ k YÑ Y [ch j Yfm Z]YbX`nžUZYW]cbUhY'Ï fA]I YX`U[Y] fci dži fVUbža YX]i a !`ck @; Ł

$$\label{eq:linear} \begin{split} &2_f \left[ \text{ekZ}\ c^{\ \ } \text{e}_{\text{Z}} \text{VZd}f \ d_V \text{TeVL}Y \ h \ \text{kyc}+\text{VZeY/c} \\ &d^{\ \ } VSV_V \ e^{\ \ } \text{E}_{\text{Z}} SV_Z \ Xd \ f \ \text{X'eL} \ c \ e^{\text{Y}Zd} \ \text{VZY}_U \ U_Z \ \text{Vd} \\ & \ \ \text{Rhd} \ d_{\text{V}} \ e^{\ \ } V_e \ \ \text{VeV} \ \text{VeV} \ \text{VeV} \ \text{XZ}_V \ \text{VZ}_Z \ \text{$$

<UfX<sup>·</sup>k c f\_

:\_ eYVUZEIF ddZ\_d`WeYVa``ck Xc`f act\_cNrUZ \_VdtWcYRdUh`c\R\_URaacVIZReZ\_``WZed gRfV RVRTV\_ecR] eYV^VZE` eYV^LeYV6VScZ\_X^VR\_ł Z\_XLWdtVcZUV\_eZej R\_U^R\_VZe'a`ddS]Ve`YRgVR UZEIF ddZ\_Z\_eKc^d`VyH WZEYVUZR]`XfVRS`f e 4 YZJVR\_dR\_Uh`c\cWXK6YVdR\_Z`RYZ\_Rej eYRedWd eYVd`TZRJZ\_eXXReZ\_``WeYVa``cRdSVZ\_XWcXVU Sj YRCLLUZIZAJZ\_VUJRS`f c+

Î H. YmÑY Ú ( ) hY fgžih Ymk cf\_ ih Y]f k Unici hcZ h ]b[ gÅ /bchU`žVi ha cghi fA ]l YX U[ Y] fci dži fVUbža YX]i a !ck C9; Ł

:\_eYVZ RXZ\_Rg`YWRUh`c\hV}\_UeYVgRfKd `V&Vd\_RJUZX\_ZgLac`XXddR\_U\_RZ\_RJT^^f \_ZgŽEYVa``cdzJdVT X\_ZXVeYV^dNgVdeYV&Z:\_ eYV^ZUJVIJRdMLeYVZ RXZ\_RgZdZ ZRŽ3feZ\_ eYZTRVZzZL\_`eRJJVT^aRdZ\_X ZzZdeY`dVhY` cVRJj U`h`c\eYRedeR\_U`fe+

Î 7 \ J'YUbg'UfY'hYff]V`m`Unn'lÏ fl Ya U'Yža ]! YX'U[ Y'[ fci dži fVUbž]bhYfa YX]UhY' Q9; Ł

#### DUfhm

2\_`eYVc R`SZGRIV\_TV eYRe cf\_d eYc f XY eYV UZEIF dZ\_d`WaV a]VW/^ a``cR\_UZ\_eVc^ VUZEV dVTeZ\_d`WaTZ(ej ZeleYV`\_VSVehW\_ ^Vcj ^ R.} Z\_XR\_UVi ecRogRAR\_TVLTV/VSCReZ\_R\_UVI TVdŽ7RTVU hZey eYVCZX f c`WRZj JZWZ:eZdcRZLIA YZ/NR\_ddXV `fe`aa`cef\_ZZZde`]Ve X, eYV\_eYZ:cVacVdDU ZV\_eEg T ^ Vd`feŽE YZIVV\_1]`gZ\_XdLV`V&YVZcdZd \_`eaRce`WRZj JZWLY`h VgV&R\_UeYVI ecRogRAR\_TV Ze V\_eRZjd^ R\_VdURj le iURj VIZEV\_TVVgV\_YRUVČZ ARcej Z\_XdW^ dZ\_dVaRCFSJVW/^ XfZe+

Î; YhXck b h 'h Y Z bXUg OH a dcfUfm ci hXccf fYglUi fUbhgk \YfY bUhcbU`XUm ]g WY YVfUhYXQH YnÑ VY dUW YX°H ]g cb[ k YY\_YbXzh Y fcUXgk]``VY 'Ua a YX° H YfYfg bc a cbYmUfci bXzVi h7 \]YUbgž h ]g ]g k \Uh=Ni [ Yhh]b[ Uhz`]\_Y U [ ccX ha Yz h Ym']\_Y h Yb'cmh Ya gY j Ygzh YnÑ gdYbX h Y]f UghdYgcžU'k \c Y a cbh Ng k cfh ]b U XUnÅ UbX h Yb h YnÑ [ c Ufci bX a cUb]b[ " K cbNih Yn8 H Uhg h Y ZUWz UZYfk UfXg h Ym

[c'UfcibX'Wcad'U]b]b['Ï flYaU'Yža]lYX'U[Y'[fcidžifVUbž]bhYfaYX]UhY' G9; Ł

 $:eYRdSW_dW_eYReeYVZUR`V4YZVRdRT^{1} ^{`}_dV_dV`V5V]^_XZX2gZXcZVe^RWWZX`W$ ZV\_e2g\_YRd]`deT&UZ5Z2gZEYVfd'R]V1a]R\_REZ\_ WceYZdZ1eYRe4YZVZ1\_`eRT^^f\_ZgLSVIRfdV eYReZ1\_`eeYVhRJ4YZVR\_dRVZ

EYZELOW de SVeef V`W4YZVe UBJŽERSJV\* dr`hdeYRe aV aJVddyWWdeW eV\_Ude SVbfZeV YZXY hYV\_ eVJ T ^ aRtVeYV dygvdhZeY eYVZ\_ł YRSZER\_ed`W\_VZXYS`fcZ\_XT f\_ecZdŽ

2TT d.Z\_Xe`eYVF?5A#!!" Df cgyj£Y h Vgv& eYZIXV\_VA] eV\_UV\_Tj ^ Rt\dT \_dZ.VATS]VUZXWAV\_TI VAŽH`^ V\_ eV\_Ue`T ^ aReVeYVZ:T ^ aRecZ ed]Vdd VAg`f dS]j hZEY`f cdZ.VadeYR\_ ^ V\_U Ž> V\_ ^ R.V ^ `dVa`dZ52gVRdJAdt V\_edhYV\_Z:T ^ Vde`RdaVTed 
$$\label{eq:response} \begin{split} & \text{TYRfgZZizT_RZ_RZi^+ScRgVcj} \ R\_U \\ & \text{aRez ezt } \tilde{Z}_eVzlT^a \text{aRrezgVvgR} \ ReZ_LRUf \ ] ed \\ & \text{YRgVR^RC_VU} \ \tilde{Z}_eVzlT^a \text{aRrezgVvgR} \ ReZ_LRUf \ ] ed \\ & \text{YRgVR^RC_VU} \ \tilde{Z}_eVz \ RV^W \ YZVR_d \\ & \text{eYR_eV} \ \tilde{Z}_eVzlT \ RV^Z \ RV^W \ YZVR_d \\ & \text{eYR_eV} \ \tilde{Z}_eVzlT \ RV^Z \ RV^W \ YZVR_d \\ & \text{eYR_eV} \ ZVUgZh \ d \ YZVR_d \ RV \\ & \text{SvevcRdvWRUHTYRfgZZizT_RZ_RZETRaVTed.} \\ & \text{StevcRdvWRUHTYRfgZZizT_RZ_RZETRaVTed.} \\ & \text{StevCRdvWRUHTYRfgZZizT_RZETRaVTed.} \\ & \text{StevCRdvWRUHTYRfgZ} \ eYVZ_YRSZER_ed^W \\ & \_VZXSS^f cZ_XT_f_eZiZE_VVYZXH^V \ VZA^F \ YZXY \\ & \underline{VZXSS^f cZ_XT_f_eZiZE_VVYZXH^V \ VZA^F \ YZXY \\ & \underline{VZ}eVT_f_eg \ ZIML^V \ VR_h \ YZMENT_2 \ eWed \ YZMC_d \\ & \text{RVSGgVc}R_U^- \ CVaRez \ eZZ \ Z \\ \end{aligned}$$

:WAYV`aZZ\_dT\_TVcZX4YZJVR\_dfaVtZcZej `gVc\_VZXYS`fcZXTf\_ecZdZ\_eYVeRS]V\*bfVd eZ\_dRcVeR\V\_Ze`RTTf\_etRd\_eYVeZTZUV/TR\_ SVT^aZJVLŽ

EY dhY RVac`fU`W4Y4VRV^`dVJZVJj eYR\_ `eYvc`Xc`fade`RVvc^ eYRe4Y4JVR\_dRvvcfavkZc e`eYVZ\_VZXS`fcdZ\_ eYVRvRdT\_dZVvVZ3j T\_eRHELeY`dVhY`RvVcVdaVTegyJj f\_dfcVR\_U R\_Xgi RS`fe4Y4VLhY4VeYJ XV\_VRJJj eV\_Ue` dJ eYRe\_VZXS`fcZ\_XTf\_ezZdRvvcfavkZd:YRgV UZWKV\_eFReVUgZhd+4Y4VR\_dRvVSvEevcZ\_ eYV TYRfgZ\_ZH2TRVRd1SdRgvcj R\_UaRecZeZt`/ R\_U h`cdvZ\_eYvdTZA]RvRd1]Rj R\_UdM}dv/Z

### 7 C B 7 @ G€ B

H YRe V V&Xd W^ R] eYVRS gVZI eYRELZ: f a cgłź h Y 7 \]YUb [XYbh]mi]g bc hWYX]VY UbX Xc Yg bc hdfc Xi WY U gYbgY c ZVY cb[ ! ]b[ "AV a]V dRIY eYZIT \_]If dZ\_ `\_ eYVSRdZi W eYVZ: If ccV\_e V a VZZ TVL: Vh YZIY eh` ej aVdRV aRceZIF]Rc]j Z a` ceR\_e+ eYVZ: a VCIVaeZ\_d RS`fe eYV WWME R\_U UZEVIEZ\_ `VVVIV\_e TYR\_XddZ\_ eYV T f\_eqiLS` eY VC eYVT f\_eqj RdRhY`]VR\_U VC eYV` a Vcd\_R]jLR\_U eYVZ: a VCIVaeZ\_dRS`fe eYV ej aV`Vd TZSZZej eYRe acVgRZdR` `\_X4 YZ/VR\_dŽ Gi a VZZ\_TVdZ\_ eYVV RVRdRV a VCIVZeVU RdT\_ł } c^ Z\_X eYV UVXcW` VZ\_eVXReZ\_` c VI T]f dZ\_Z\_ d TZkjŽH YRedW^ de` SVRedRV VZleVVa]Rf dSZZej

`WeYV4YZJWR\_ZUV\_eZejR\_UeYfdhYReZe^VR\_de` SVaRce`WZeŽ

8 [gVY`]YZ ]b 7 \]`YUb`]XYbh]mi ]gʻh YʻdfY! gYfj Yʻc Zh\c gYʻk \c 'Webg]XYfʻh Ya gYʻj Ygʻ Yl Wi XYX`c fʻdfYʻi X]WYX`Vmih YʻZefa 'c Z h Y]f`ge WJU`fY`Uhcbg\]dgʻʻ6mWebhfUghžh\c gY` k \c 'h ]b\_ 'h Uhih YʻZefa 'c Zh\Y]f`ge WJU`fY! `Uhcbg\]dgʻXc YgʻYbUV`Yʻh Ya 'hc ']bhY[ fUhY` ge WJU`miUfY`U`ge 'VY`]Yj Yfgʻ]b'h Yʻ7 \]`YUb` ]XYbh]mžUbX'dfci X`c Z]h'

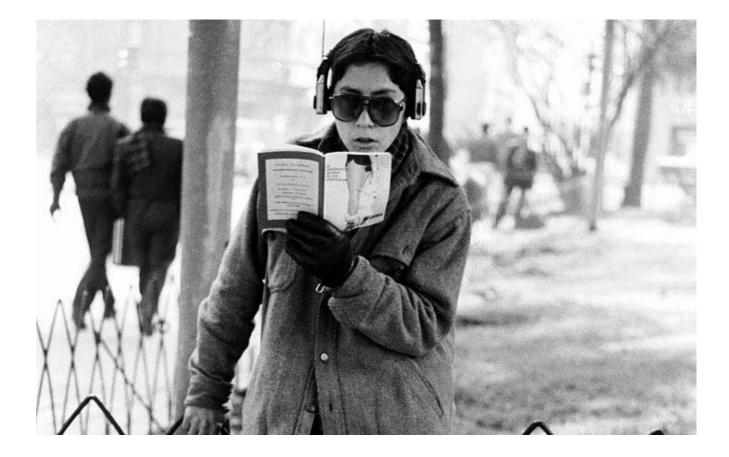
 $EYVZUMR `WR 4 YZWR_ZUV_eEg YRd_`eT^{1}$ a]VEVj UZERaa VRCVU VV^ eVV aCVU ^ZR\_ed TZR

Z RZ\_RjŽ2deVVRjZćUXđRžaZ\_dYhULZZ V\_T f\_ekčURdR\_ZVRjŽVZeUVd\_`e^R\_ZVVEZdVJW RdRcVRJZj Z\_VgVjURjJZVLeVV\_eYZdZVRJUVd\_`e TVRdVe`SVUVđERSJVLSfeZddYZAVU`\_e`RaJR\_V hYVEVZeZL\_`ed`S[VTee`eVVekde`WVIaVEZ/TVŽ

EYZITR\_YRaaV\_Z\_dh`hBjdŽ2 aRde eYRe ZI eY`fXYee`SVX\_VWcX`ULR\_UZIeYfdf\_gV231 RSJVL^Bj SVZLNRJZVUŽ@ceYV4YZVR\_VdV\_TV^Bj SVda`\V\_`VM2EY acZUVRdd^Vh`\_UXMJeYZ\_X eYRe VIZdd`fedLWeYV\_`c^BjdaRIVR\_UeZ\_V`W URZj JZNL`c`fedLWdTZRjcVReZ\_dYZad RXRZ\_L SYj`\_UR\_j gV23TREZ\_Sj VIaVEZ/TVŽ

 $\begin{array}{l} & \label{eq:constraint} EYV URR U \_`e ckgvR] R_j Wch RU]``\ZX \\ & \mbox{ZMRZ}\_`W4 YZVŽEYVCVZI\_`dX_`VR_Vh \\ & \mbox{4 YZVeYReh Z]} RczgV`_VUBLh YVeYVcda`_eR_V \\ & \mbox{1}fdj `c eYc f XY UVJSVReV d TZA] REZ _ZH YfY` \\ & \mbox{gbc `\cdY'Zc f'U'bYk 'Z hi fY'h UhWUb 'hfUb! \\ & \mbox{gWbX h} Y'a d'Ui gV]`[mic Z7 \]'YUb '[XYbH]mi \\ & \mbox{h} XUm' \\ \end{array}$ 

EYVTEZZEL WAYZVROR ZUREYRETR ZOLZVR  $dV_dV W V_X X_X W de SVaf e Z T_e M e Z e Z d$ `eeYVdR^ VeYZ XRdR ZLV eZej gRIff^ŽUV eZeXd  $R_U \operatorname{ReeRIY}^{\wedge} V_{ed} \operatorname{RVR} dY Z dZ X \setminus R V Z J d\Gamma a V Z E Y V$ T\_}XfcReZ\_ZflRjhRjdTYR\_XZ\_XVgV\_hYV\_eYV SROWIREV ders VZ2 e a Roezer f Rc ez VeLd ^ Vazziva SVT ^ V^ ` dVZ' a` ceR\_e h YZV ` eVvcd UZRaa VRŽ :\_4YZWLeYV\RWZUdTaV`WXU\_eZZVdR\_UReeRIYI ^ V\_edZdTYR\_XZ\_XŽEYVZ\_YV6ZeVUT\_}XfcReZ\_Zd \_`ea]RfdZ5]VRdRT^^`\_dWXeV\_eŽ@eYVcdWXeV\_ed dv RZ\_Z\_eRTeLR]eY fXY\_`ef\_RWWTeVLŽ2eReZ V hYV\_\_ReZ\_RJReeRIY^ V\_edRcVhVR\V\_Z\_XLcVJZXZ\_  $R_U eYVW 2j RVeVZX R_Vh^VZ_JXR_U$ W\_TeZ\_Ž2dhZ]SVdW\_ŁY`hVgVŁeYVj YRgV\_`e SW\_RS|Ve`d`aa]j eYVejaV`VSV(`\_XZ\_XeYReeYV ZUNR `W4YZWUZUŽCVJZZZ\_ R\_UWR^Zjj RcV^ `cV Rdt TZREWUHZEYZ\_UZEZLFRJZEREZ\_aYV\_`^ V\_ReYR\_ hZeY\_VhWc^d`Wd TZR ZLV\_eZejŽF\_acVTVUV\_eVU ejaVd`WdTZR] ReeRTY^V\_eRcVR]d`V^VcXZ\_XL Y`hVgVZEYVW]`hZ\_XTYRaeVcdhZ]UvdTcZSVeYV dYRaVLdT aVR U Z ZRZ d`WeYVdVac`TVddVd`W ZV\_ezj dvTdvReZ\_Ž



# 7<5B; 9G<sup>-</sup> B<sup>-</sup>7I @H F5@DFC 8I 7H€ B.<sup>-</sup> bYk <sup>--</sup>Ub[ i U[ YgžbYk <sup>--</sup>UbXgWUdY



## H≰9<sup>·</sup>B9K <sup>·</sup>7CB8<del>+</del>HCBG<sup>·</sup>C: <sup>·</sup>7I @HF5@DFC8I7HCB



6RcjZćTYRaekdokgZh UU ^ V VeYVhB, dT ] [VTeZgVZ RZ\_RZKIZ 4YZV YRgVTYR\_XUŽEYV ^ `de dRZ/e }\_UZ\_XLR\_Rj dU Z\_UKRZLhRdeYRe eYVZJNR`VRT ^ ^ `\_ 4YZVR\_ZJV.eZj YRUSW\_ UMalj Vc UUŽEYVeRLZZ\_RJZJNR`VEYZIZJV.eZj dW de YRgVSVT ^ V Sd ]VeVhYV\_dkERKZ\_deeYV dKRZj `WhYRe 4YZJNR\_dViaVEZ/TVZ\_URZj ]ZWŽ ? VZEYVceYReT ]]VTeZgVZ RZ\_Rj \_ `c`eYvcZYVd Z&U chackdV\_REZ\_dLdTY RdeY dV`VeYVIR\*ZjL cMZZ\_ R\_UEYVDERELYRgVeYVa`h Vce'V S`Uj R yH VZZJVE eYY\_RV\_`e UZRaaVRZ\_XŽEYV`]U Z RXdd cgZgVR\_UZ\_rV\_TVE/VhB, aV a]VdW eYV\_Vh ]R\_UEIRAVŽ

 $= \mathbb{Z}_{V} \setminus \mathbb{Q}_{dj} \stackrel{\text{def}}{=} \mathbb{Z}_{X} \mathbb{Z}_{2} \quad \mathbb{Z}_{2} \mathbb{Z}_{2} \quad \mathbb{Z}_{2} \stackrel{\text{def}}{=} \mathbb{Z}_{2} \stackrel$ 

a`h\&W] eeRLÆZ\_d\_SfeRjd Sj Z\_Y&ÆAUSfdV\_d R\_UZ\_VæÆŽ:\_R\_j \&V\_d\_eY\&VZd\_` \dIRaV\&'^ eYVaRdeŽAV a]VSVRcRh\Z&Ye`\Wia\&Z/T\LeY\Z `h\_`c`eY\dLeYReRWWWEdY`h eY\j d\\eYVa&d\/e R\_U\WU\&YV\&E &ZEY\Zc&RLZ\_X`\&YVdEFReZ\_L Y`h\&V&LhZ]RhRidSVSRMU`\_eYVa&d\/eŽ

 $4 YR_XVT^{VZ_UXWZ_X} dVdd^{VZ} a^{R}_TVZ_EYZITYRaeVchZ] UVITeZVeVVdvdef Tef cZ_X^{VVV} XV_VR_VR_Vh^{c} e^{PETf} ]ef cVZIaRe^{Vef} fTYZ_X ^_ eYVZ^{aRTe}_e^{-}[j^{VZ}ARTe^{-}]j^{VZ}ARTE^{-}]j^{VZ}ARTE^$ 

dec`\_XS`\_UZ\_XVJV`V\_eZ\_eYVT\_dTZfd\_Vdt`W yHVLeYV4YZJVR\_d%ZEYVZ\_V&^ReZ\_acVdV\_eVU YVCVdr`hdeYReeYVc`]V`Wa`]ZEZTdZ\_eYVac`UFTi eZ\_`VUF]efcVYRdTYR\_XVUZEYVcVJReZ\_dVZaSVi ehW\_eYVa`]ZEZTRJZ`RXZ\_Rcj\_R\_UaVaJVdURZjj ]ZEVIZEUVeVJ`aZ\_XZ\_\_VhhRjdŽ

Df Schlof V\_e TYRaekch dr'h Y'h eY actiezt vil  $R_U Z' RXZ RZA' WJZWZ d'TZAj RV vg' ]gZ XL$ h YvéY véSVIRf dv\_h } VJUA' VHF ]ef cR] ac' UF TeZ\_ d'TY Relev VgZZ\_ RV' a V\_Z Xf aL' cSVIRf dv'd ^ V \_`c^ R] Rab Vied' Wi TZA] JZW d'TY RdT\_d^ aeZ\_ RV eR Z X`\_ R\_Vh Z'a' ceR\_TVL' cSVIRf dv'eY\_ZT U/ R\_UdR vSVZ Xa'h včW Jj cV\_vh VLL' cSVIRf dv' `WeY VZ\_TC RCW udack RUR\_UTV\_eR JZj `WUF TReZ\_L h YZTY ZI RIbf ZZ\_XR\_Vh c' JVZ\_TF Jef cR] ac' UF TI eZ\_Ž4 YRaekch kL' R\_U(UKR hZY eV vkV/ véXZ X eV\_UdZ\_4 YZ/W\_TF Jef cKŽ

#### ; @C65@AN5HCB

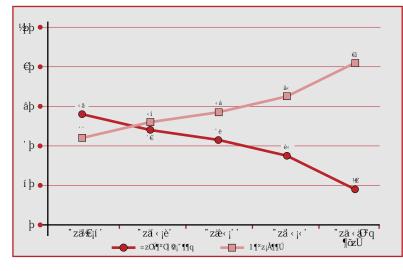
EYV} cdeR\_U^ `de`SgZ f dTYRcRTeVcZbZT`WeYV  $_Vh dEf ReZ_ZdX_SRZReZ_ZJVe eVVTf ]ef dR$  $UZ^{\prime}V_{d}Z_{-}^{h}V^{\prime}V_{d}X_{Z}X^{f}e^{U}$ YRdSW\_ ZeelVdefUZUŽD^ VT^ ^ V\_eRe`cddWZed WWWTeRdRyY^^`XV ZZ X% \\_VLSfe`eYVcdRcXfV eYReeYVolVac`TVoldVdU \_`eRUUfae`Rf\_ZVvc^ yX|`SR|TF|efcV%LJVcR|eYReeYVfSZbfZij`V4`TR 4 ]R c > T5 \_ R]UdRc f \_ UeVh d]Ud XX/dedR  $XV_VR_Y^*$   $XV_ZR_Z_ 18R_T_4R_T_ZZ_**!$ , @ce2kL"\*\*\*, > Rce3/4 3RcSVc`L"\*\*)/Ž:\_ WATEL VRIY d'TZK ac`TVdtVdLT ^ SZ\_VdR\_U dV dXR\_ZKVd eYVIf ]ef cR V/V V\_ecITZEIf ]ReZ\_XRc`f\_UeYVh`dJU  $\underline{Z}$   $\underline{Z}$   $\underline{d}^{1}h_{d}$   $\underline{d}VIZ$  ThR  $\underline{Z}$   $\underline{Z}$   $\underline{d}^{1}h_{d}$   $\underline{d}VIZ$  ThR  $\underline{Z}$   $\underline{Z}$   $\underline{d}^{1}h_{d}$   $\underline{d}VIZ$   $\underline{Z}$   $\underline{d}^{1}h_{d}$   $\underline{d}VIZ$   $\underline{d}V$   $\underline{d}$   $\underline{d}VIZ$   $\underline{d}V$   `acZReVUR\_Uy\_ReZ\_RJZKVU%Z2dF?5A1#!!"/ YRddr h\_ŁeYZdeV\_Ude YVZXYeV\_ UZęvładzij hZeYZ\_ VRIYT f\_eg Ž@\_VViR^ a]VZ\_4YZVZleYVX/VR eZ\_XRaZ\_eYVfdV`V&RdZT^`UVc\_ZkReZ\_e``]d+ VcdL^`SZVeV[VaY\_VdR\_UeYV:\_eVc\_VeŽ2d} Xf cV # dY`hdL) #"``WeVda`\_UV\_ed RXVU`gVc && dePeV eYReeYVj RcVR]^`de`cT^a]VeVjj f\_VR^ZZRchZeY eYVdV^`UVc\_Z\_decf^V\_edŽEYVXRadR^`\_XRXV Xc`fadRcVdezZZXLhZeY&' `Wj`f\_XaVa]V RXVUSVehW\_") RU#%TIRZZXe`SVVRZcji`c gvoj WRY ZZRICh ZEY eYV Ž

4 YZW<sub>2</sub> d TZkj Zł dzJ eV dkeZ<sub>2</sub>X Wc ^ de aV a]Vd\_`c^ R] JZWŽ3f e eVZc Vi aVZV\_TVZł\_` ]`\_XkT\_}Ue eYZŽ7Z\_R\_TZR TZM dR\_U`eVkc h`dlhZWf aYVRGR dRvRd aRe`W4V\_RzZ\_R dzf RzZ\_Ž:\_UWLŁ#(´´`W4^ dVZ ekgZhVU Sj F? 5 A dReWUeYRe eVV^`deZ a`ceR\_eZ\_fV\_TV `\_eVZc JZWdhRdyh YReZdX Z\_X`\_Z eVVh`dUXw hYZV% dZUZe hRd yh YReZdX Z\_X`\_Z eVVh`dUXw hYZV% dZUZe hRd yh YReZdX Z\_X`\_Z eVVh`dUXw h`dUSVZ\_O.Wi YZWdac`S]V`hRd`\_TVZddVI]fł dZ\_W7^ eVVh`dL4eVV`aV\_Z\_X`WzdS`dVkd\_`h dW^ de`SVTEVReZXEVV`aa`dZvUZWIf]ejŽ9`h TR\_eYVJZ\_Vd`WZ\_TIf dZ\_R\_UVITIf dZ\_eYRe^Rc\ eYVS`f\_URZd`WI TZKj SVerRIVLO

#### F989:=B=B; H≰9B5H€B5@GH5H9

2 d/T\_U^ VXRecV\_UL`aa`d/Ue`e/V} cdeLZde/V dv `UMIZX`WeYV\_ReZ\_RI DeRevŽEYZdecR dVd ^ ReZ\_Zdac`gZXR] eVV^ `dVhdV\_TYZ\_XSVIRf dV TF | of cVZ\_4YZVYRdSW\_Ra` | ZEZTR| RWRAC dZ\_TV : UVAV UV TVŽEYZdh Rde`f TYVU fa`Z ARce# `WeYZICVa`ceŽ:\_4YZJVLa`]ZeZTR]T\_decfTeZ\_`W R\_ReZ\_R|ZV\_eE;ZdZ\_eVachZ\_VUhZeYRTf]efdR WWW.de+eYVT\_dVTdReZ\_`VRR\_ReZ\_RJYZde`qi R\_U eYVecR\_d^ZtbZ\_`VR\_Raac`gVU\_ReZ\_R]Tf]efcVŽ 5 fcZ\_XeYV\_Z\_VeW\_eY R\_U ehV\_eZeY TV\_efcZkeL  $DereV VUf TReZ_R R_U Tf ] ef dR a` ] ZZ dL R]` _X$ hZeY YZEE cZTR] VgV\_ed d'TY Rd eYV ARIZZT HRc eYRe TeVReVU R y\_ReZ\_R]%7]Z' RevLh VeV eYV ^ RZ  $^VIYR_Z^{T} dVcZ_dZ_{T} dZ_RZ_X^VIZR_dcdcdV_{1}$ eReZ\_d`WeYV\_ReZ\_Ž\_eYZdhRjŁeYVDeReVTeVReVU T]]VTezeVedRUZZ\_dR\_U^ V^ `cZdeYReYVJaVU\_`e `\_]j e`f\_ZjVeYVaVa]V1RdRacZ\_TZa]V`Wa`]ZZ TR] JVXZZ RIj / Sfee` Z\_T ca`dReVZe1RdRya]VSd‰  $\underline{Z}$ e eYVU ^  $\underline{Z}$ Re $\underline{Z}$  d deV  $\underline{Z}$ EYVUkeV a V e W eYZi yDeReViTV\_ecZi%di TZkij YRd SW\_ UcRcbZIR]jj ^`UZ; VU Sj\_V ]ZSVCR] Xc`heY decReVXZKŽD TZ ł VT\_`^ZT^`UVc\_ZREZ\_YRdSW\_RTT^aR\_ZUUSj DeRevolution have uncoment of the traditional of th ac`UfTeZ\_ŽEYV^R\_RXk2R|c`|VRd2X\_VUe`eYV  $DeReVZdhVR (V_ZXZedVV_TeZ_RdeVVd^{S})/ZT$ chác với \_ erezev ` Weyv d' TZR] ` d.Wž ARCRU' i ZIR] ji Ł eYZdyVT\_`^ZIZd%gZdh`V&YVDeReVZddecV\_XeYV\_ł  $\underline{Z}$  X eYV UV  $\underline{R}$  U Wc d TZR  $\underline{Z}$  eVX  $\underline{R}$   $\underline{Z}$ . ` eYVc h`ddLeYVUVIZV`WeYVDeReVR\_UeYVdvff]eR\_e

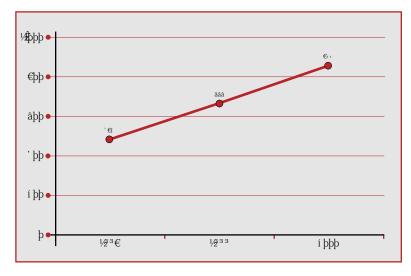




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#### \$'%B=ł äè

#### fi¶ – Åï æ ÚžiÅz Úži⁄pnþþä? o@ 🕫 átáÇz Ýæ- OæqÈ



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f acf cXV^ WeVV^ Rc\VeVT \_`^ j RcVX $g_Z$ XTf ]ef cV R\_Vh Z a`ceR\_TVŽ

#### 5 ÎA 5 F? 9HCC 7 = 9H/I

H YV\_ eVV ^ Rc\Ve SVT ^ Vd eYV ` cXR\_ZkZ\_X acZ\_TZa]V` Vd TZA]  $ZVLZeZd_` e`_]j eYVT f_ecj d$ VT\_`^j eYRe TYR\_XkdLSf e Zed Tf ]ef cVRdh V][Ž: e Zd\_` e R]h Bj d VM]j RaacVIZReVU eYRe eYVRU acZ\_ ` VY^ Rc\Ve]` XZI%V\_eRZdR Tf ]ef cR] ac` [VIeRdh V][Ž E` eYV Vi eV\_e eYRe Ze ccR\_dWc^ d eYV acRIeZTVd R\_U cVacVdV\_eReZ\_d` Wd TZAG LeVV ^ Rc\Ve]Bj d eYVXc`f\_Uh`c\WcRyTF]efcR]^`UV}%Zied^RZ TYRERE&CZEZTOW^de`SVeYVTV\_ecRZj`WeYVZ\_UZ gZLFR]R\_UL^`CVUZVTejjLRaReeZfF]RcT\_TV&eZ\_ `WeYVZ\_UZgZLFR]RdR\_Rfe`\_`^`fcLcReZ\_R]R\_U Zi]RE&URTe`CZEYZZZAR`WaVa]VXfZUXdeYV^VeY1 `U`]`XZTR]Raac`RTY`W\_VT]RedZTR]VT\_`^ZEHR\_U cWUY\_VdhYReTR\_SV^VR\_eSj\_eYVT^^`\_]ZW `WdTZXejZ

 $:= eYZIT = eVIeLTf | ef dR | h^c < eR Vd^{-} T^a | VeVI$  $j_{\rm L} = 10^{-1} \, {\rm Mc}^{-1} \, {\rm d}^{-1} \, {\rm d}^{$ eZ\_LLZEVcdZTReZ\_R\_UaV\_VecReZ\_`VXX`UdR\_U dvgZIVdVcRdvdeYVT\_ecRdeSVehW\_yYZXYTf]efcv‰ RUV Roll TF lef cl/165 Veh WeYV} VRoed RU VZ dfcVR\_UV\_ekkeRZ\_^Ve`WWKZ\_XdŽ2 hZVdR\_XV  $WT = dR X UB RCV_ h T_d VU VRS Z X$ ZUZEZUFRIde TOUREVRTFIefor YRSZERe WC eYV 1 dMgVdRdeYVZcaVcd\_RjeRdeVdUZteReVŽ6Rd RTTVdd e`eYVdV`aa`cef\_ZZdUZ`Z\_ZhVdeYVacVdTcZaeZeV Rf eY cZej `WaRcV\_edR\_UTYf cTYVdR\_URjeVcdeYVZc ecRUZEZ\_R|c`|VLW/^ VR^Z|i ITV\_ecVUcVTcVReZ\_e` dIY``] VUFTREZ\_R\_UdVTe`dR|TF]efdVa`[ZIZdLZ\_ eYVTeVReZ\_R\_UeeR\_d^ZebZ\_`VRCT^^`\_de`eV `WIF | ef cVŽEV | VezzZ\_``WWkd R d'WIZV\_e Vi R^ a | V `WeYZETT\_eZ\_f`fd~`h`WZ\_`gRezgVLWARX^V\_eRgi y~RchVcheyRezlchWazXRhR `]UecRUZZ\_dR\_U VRS]ZX4YZWR de`dYRCVZ f\_WR^ZZRcViaVcZL V\_TVdR\_UZ`RXZ\_VUZXWKV\_eh`d]UdŽ

#### H≰ 9<sup>°</sup>A 98=5 °: =@H9F

 $2 \text{ Wf eeY eV_UV_TJ ZIWc d TZA T ^ f_ZReZ_$ e` eR\_Va]RIVeYc f XY eYV^ WZEZ? Vh Z\_Wc^ReZ\_ eVTY\_`]`XJ R\_UeYVacU ^ Z\_R\_TV` WAYVR UZ I gZ d'R] h`dUYRgVTYR\_XUeYVy^ V\_eTJ ^ Rad%6dWSj 4 YZVR\_de` T]RdZfVR\_U`dVcd TZA cMZEjZ

@hZ\_XaRczIf [Rc]j e`eV[VgZtZ\_LeYVVZtRXc`hł Z\_XdV\_dReZ\_`VgZtef R] cVR]ZejŁhZeY daRezR] [Z`Zed 1Z\_dZU/z´f edZU/ dW^Z\_X e` VRU/RhBj R\_U eZ V Y`cZk`\_d1RA8VcZSWV&V eV[VeT aZ\_XZ@\_ eYV`\_V YR\_ULeYVT ^ af eVcZkVUViaR\_dZ\_`VvdaRIVR]]`hd T ^ ^ f\_ZIReZ\_ hZeY aV a]VhY`ReV\_`e aYj dZ IR]jj acdd/eŽEYZtZITYR\_XZ\_X\_`e`\_]j URj łe`łURj d`TZej T\_eRIeSf eR]d eYVZUR`VeYVaf S]ZTdaRIVL hYZTYZEISVZ\_Xd/a]RIVUSj`eYVcWc^d`W VUZA eZ\_Ž> VR\_hYZVLd`TZEj eZ`VZEISVZ\_XVRX^V\_eNU Z\_e`dvJWT\_\_eRZ\_WU VaZdUVAŽEYV^f]eZaJZZaj`W Z\_eVcackeZgVTUVdR\_U eYV daWU hZeY hYZIYZł Wc^ReZ\_R\_Ud\_^S`]dTZCTF]ReVReVYREV\_Z\_XeYV `Sd]VCTV\_TV`WaRde Vra VCZ/TVdR\_U VdeRSJZMZ\_X Rd ce`WRFeZdeZTackdV\_dERdvbfV\_TV`WRTedf\_T\_ł \_\_VTeVUSjR\_j YZde`cZTR]cVJReZ\_dYZaŽ

 $\label{eq:cvar} CVAf]RcT ^ af eVeL^ `SZVeV]VaY _VR_U: eVel$  $_Vef dRXVZ_UZIReVdR_RSZZ6j e` h` c\ Z_ ycVR] eZ_ VM_$  $eR_dIV_UZ_X_ReZ_R] VV _eXddŽ$ 

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AVCYRadeYV^ `dedecZZXWRefcV`W4YZVR\_d ł TZAG e UR ZIZEdoRaZUZ UZEZUFRZAREZ \_Ž4YZVR\_d REVEV UZ Xei SCVR eYVd TZR Z \dR UeeRUZZ R YRSZECIEYRE YRGV S`EY T\_decRZ\_VU R\_U ac`eVTeVU eYV^ŽEYZdyT^Z\_X`fe%ZdaRce`WRac`TVdd`W V R\_TZAREZ\_ eYRe V\_RS VdZ UZeZUFR de` Sc`RUV\_ eYVZcY`cZk`\_dLZ\_TcVRdVeYVZcRSZZZj`e`aRceZIZaReV Z\_d TZkg R\_Uaf of VolyWolkRZ\_RdeYy dW} eŽ :e^R, Z,g`]gVeYVcWVc^f]ReZ\_`Wd TZR, S`\_Ud `dŁRd`WaW\_YRaaV\_dŁZe^RjeR\VR\_Rd17ZRjefc\_Ž :\_UZ&ZUFRZKReZ\_RdRdTZRTT\_Tvaedv^fTU\_`eSV T\_VKdNUhZeYeYV^`dR]TReVX`qj``VdM]}dY\_Vdd`c eYVa` ZZR`\_V`WZRWWEZ\_Ž\_dY` cetZeU`Vd\_`e dW eVRed TZR Z UZeZLF R Z REZ Z Zed WZelh YRe ZELVECUZIXS`\_UEL`WELTZRE dE |ZURGZEFR\_UTRF6Z\_X aV a]Ve` hZeYUdRh W/^ af S]ZTRWWKZdŽ>  $cVZ_{1}$ UVaV\_UV\_eR\_Ud/W RUVZ\_UZZIFRdTR\_}\_U\_Vh  $R_UUZWWCV_eVVc^{1} d Wd ZRZELZ_Vh T^{1} ^{1}$ daRIVČA`\_dZNZ\_XeYZŁeYVTZETf^deR\_TVdeYRe d`WW\_XZgVoZtVe`y\_WRezgVZ\_UZgZLfR]Zh%hZ] YRgVe SVR RjdU ReVZ

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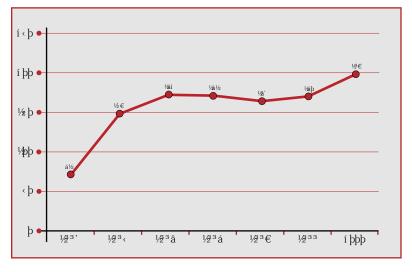
:\_UZ&UFRJZR&Z\_ZIAVG`]F&Z\_ZZX&VVdTZR] S`\_USVIRFdV`VVEd]Z\ hZ&Y &VVdTZR]UZW&VZ &R&Z\_ac`TVdŽ\_d&RU`V&YVWhdTZR]UZW&VZ WETVdeYRefdVUe`VIZ&ERVRCXVR&VERdFJ`VRTe`cd R\_U`V&RFfVR\_USVJZVVJd&V`dTR\_\_`hSVZ.V\_&Z }VUŽEYV&VRVUZW&V\_eyh`c]Ud`VVZVV&hYZY ^R\dZeYRdUV&ZUZ&UFRJde`}\_Ud^VT^^`\_ `dVcfa`\_hYZIY`e`SRV@VVZ:VIZ&V\_TVŽ

:\_d`Wc`Rdd`TZR]yf\_Zej%TR\_\_`]`\_X\cSVSRdvU `\_ RdZ\_XJVV&YZLeYVbfVdeZ\_`WY`hd`TZR]Z\_eVi \$'%B=1 ä @ @ ÕÝ(¶ ² ǎŹzáźå²z ĺ∄/źpþþä? o@) @ AÝ



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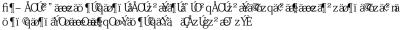
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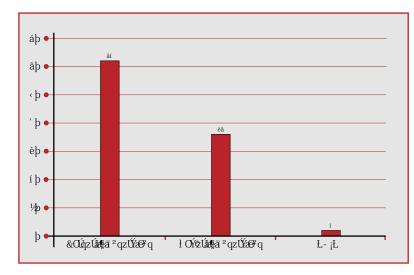


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XREZ\_TR\_SVSfZjeZdSVT ^ Z\_X^` cVf cXV\_& ŽEYV d TZR, WScZTh`f]U YRgV e`SVT\_defTeVU W/^ dMcVU^` & gReZ\_d.dZ'ZRc Via V ZZ\_TVd`W/ VR\_ł Z\_XR\_U dZ'ZRc Raac`RTYVde`RT&Z\_ŽAJRZ\_J j.ŁeYZd ^ f de Z\_g`JgV WCd KRTYZ\_XTFJef cR] ^ VR f cV Ž3f e eYV Z\_UZGZ f RJZR Z\_ R\_U UZWWCV\_& BEZ\_ ac`TVdd Z1^ R.Z\_XZe YR U/c e`cVda`\_U e`eYV TYRJ V\_XV `Wd TZR] Z\_eVXR EZ\_Ž7f ceYVc^` cVL eYV d ł TRJ VU yW\_T&Z\_R] UZWWCV\_& BEZ\_%ac`TVdd XGVd cZW e` ` eYVc UZWTFJ & ZKŽ

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d dev drå e Zel\_`h hV] f\_Ukde``U erre ervVT ł \_`^ ZTd dev`YRdSVT ^ VcVR=ZVJ RF e`\_`^ f dŽ D ^ VerZ X d2 ZRc Zel YRaaV\_Z X Z\_ erva`]ZEZRŁ ]VAR R\_UVUFTREZ\_R d dev dŽE YVJ REVSVT ^ Z X ^ `cV dv/WerWerV\_ERLVRIY`VerV^ `aVREZ X RI T d Z X e`Zed`h\_Z ekc\_R y]`XZI%Z4`\_dLVAREZ\_ `Vyd dev^]`XZI%ZerRe`VerVVT\_`^j WcZ dR\_TVL

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Î H.Y. WIW a głUbW g c Z h Y. ZY c Z a c XYfb a Ub \Uj Y VYYb gc dfc Z i bXmW Ub[YX]b h Y]f gc WU UbX W h fU Ugd YW gz h Uhk Y WUb gd YU\_c Z U bYk U[Y c Z i a Ub \gr fm BYk k Ung UfY c d Ybz h Yf?! Z fYz Z f h Y dYfZ Wic b UbX h Y Z fh Yf Yl hYbgc b c ZW h fY" H YgY k Ung \Uj Y VYYb dfYd UfYX Vmh Y Ybc fa c i g [fck h c Z bUh fU z i a Ub UbX gc WU gWYbW gz VmhYW b]WU dfc [fYggz UbX UXj UbWYg]b XYj Y c d]b[ UbX c f[Ub]nb[ a YUbg k \YfYVma Yb WUb Wc a a i b]WUhY k ]h c bY Ubc h Yf" < YbWY h Y dr hdy h UZWIF je Ze ZdWca ` JZZ de` Rjekc` cTYR] ]V\_XVeYRe d deV R\_UWcZe e` SV`aV\_WJ fa e` aRceZIZaReZ\_ Sj` eYkc of Sd deV d R\_UUZWWeV\_e d TZR] RIÈ coŽ 2 TT f\_e YRde` SVeR.V\_` VeYZ dUZW WEV\_676; Z\_LR\_UZ\_d ^ VTROM dAX V\_eReZ\_L`W ^ f ]6Za]VyMV\_TEZ\_R] ]` XZ d% eYRe TF e cZXYe RIc`dd 4 YZ/W\_d TZX dj L dZ\_TVeYy YRgVR UZWTe Z`aRTe `\_ TF ]ef d2] TEXREZ\_ŽE YV VIZEV\_TV` W\_f ^ Vc`f d ^ `d' c]VdHI]`dVU deV deV\_UZWWEV\_e U` ^ RZ\_d `WI a VCZ/TVR\_Ue` Z\_YZSZeeVVTEVREZ\_`WF`]]VI eZgVZ RZZ RZZ ZARCe'` VEYZ dAX V\_eREZ\_`W V a ZZIR] Z\_Wc^REZ\_RS` f e eYZ dAX V\_eREZ\_`W V a VCZ/TVR\_Uc davdV\_eREZ\_dŽ

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gWybWygʻk \ JW. 'UfY 'WU`YX YI UWi [fYUhmXYj Y`cd' W/h/WU``1 X[a Ybh/h\Y`a cfY`fYWYbhidgmW(c`c[]WU`` ghi X[Ygʻa c fYʻd fc Zci bX`mYld`U]b`\i a Ub`UWhji [lm/ \]eftcf]WU``efti X]Ygʻa U\_Y`]ha i W. YUgʻYf`hc`eYY`h\]b[ gʻ ]bh\Y]faiHUVYUbXYjcìhcbUfmUgdYWpžWighcagi UbXigU[YgUfYVYWca]b[acfYUbXacfYibZcfa/ |bXi ghf|U`hUhc bži fVUb|nUhc bžUbX ch\Yf WUi gYg k∖]W\`dfcachY`Wcaaib]mi`]j]b[`WfYUhY`U`aUgg! WihifYZfca k \JW UfY Vcfb bYk k Ung cZh b\_b[ž UWhb[`UbX`a U\_]b[`igY`cZ`Y]gifY"`H\Y`]bWfYUgY`cZ Wca a YfWY VYłk YYb h\Y j Uf]ci g bUh]cbg UbX \i ! a Ub [ fci dgcdYbga cfY k ]XY mhc U``h\Y hfYUg fYg cZXJZZYfYbhWjj]]hUhcbgUbXih\ig`]hYYWm`]hYžh\YfY XYj Y`cdg'U`a cfY`i b]j YfgU``Zcfa `cZ\i a Ub`W' h fYž k \JW VYHYf dfca chYg UbX Yl dfYgeYg h Y i b]mcZ h\Y`\i a Ub`fUWY`hc`h\Y`XY[ fYY`h\Uh]h`dfYgYfj Yg` h\Y dUfhWi Uf UgdYWgcZh\Y XZYfYbhWj []hUhcbg'I

; Ui X]i a Yhgd Yg DUghc fU`7 c bgh]h h]c bž% \*) "

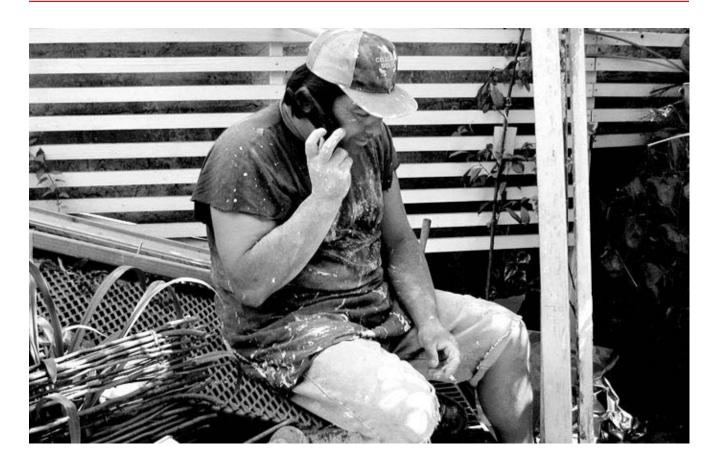
eYVSd2\_UŽ> R\_j`VeYV]RX&T ^ aR\_Zd1dTY Rd4`TR4`]R> ZIC d WR\_U5ZLVj/RVV/XXWU Z y^ R\_fWRf dZ X&R\_U^ R\\ZXRSd2\_UZ RX/ dEYVc eYR\_ ^ R&ZA X`UŽH YZVycVR%S[VTed RVac`UTVUSVZ\_UeYVdIV\_VLZ\_eYVdeVkdZeZi eYVySd2\_UhR%@YReT f\_eth<]VZL#!!"/Ž2dhZ] d^ cej SVdW\_L]RS`fc ZISVT ^ ZXR dvT\_URj W\_TEZ\_ hYZVT\_d^ aeZ\_LhZYZdZ RXdR\_U ac` ^ ZMd`VR\_yZVR] ZW&ZIXV\_VRZ\_XRdeR\_XV y]ZYe\_VdT VSVZ\_XZEYZIZEYVdR1\_WceYVI`d Z \digZda`\_d cdYZa R\_UaRec`\_RXV eYReeYVT d a`d&Vh`dUYRJSW\_WSZ\_XhZY eYVh`dU`W Tf]ef cdŽ2dRcvf]eL^ R\VEZ\_Xe` ZIZ\_TCRZZJj R d deV ReZTT\_defTelR\_RSdeRTe`\_VISfe\_`\_VeYV ]VdTa`hVM] VCeYR4`VRTF]ef cd] ^ VdRXZ

@eYVcTYR\_XKdZ\_eYVVT\_`^ZTac`TVkH\_dTYRd eYVygZafRZARZ\_%W`\_YjSjV/Tec`\_ZTecR\_d WkdLa`Z\_eZ\_eYVR^VUZVTeZ\_ŽEYVXc`heY`W ygZafR]^`\_Yj%Z2YJZXYedeYVZ\_TCARdZ\_XjjRSdeRTe \_Ref cV`W1TZR] cMRZ\_dYZadŽEVJVgZdZ\_R\_U eYV :\_ekc\_VeRcV`eYVc`VIR`a]Vd`WeYVVgR\_VCIV\_TV`W Z\_eVcaVcd\_R] cMRZ\_dYZadŽAV a]V^ZXYeReeV^ae e`f dV^ReVZR] d^S`]dLhYZIYZIhYReT\_d^Vc X`UdRVLe`^R\_VFa VceYZUV^ReVZRZARZ\_Ž 5ZN^S`UZ^VedW^de`SVZ\_VgZRS]VhYV\_dTZR] T^^f\_ZREZ\_ZIT\_UFTEVUSjeVV^VUZZ`dy  $\begin{aligned} & eYReeYVac&gRZ_XIF ]ef cVZIR]RXVj Z RXUU^Z Z \\ _R&U`_VZIRCKUj e`YZeReeYVIYR_XdRWW6Z_X \\ & aVa]VdVaVcZ_TcdR_UT ]]V16gVZ RZ_RZdR_U \\ & eR_dVc^Z_XeYVafS]ZTdaYVcVZ_RZ_RZdR_U \\ & eR_dVc^Z_XeYVafS]ZTdaYVcVZ_RZ_RZdR_U \\ & eYReRUL `dC%eYZdcJ_ZXUcTcZSVdeYVZ aRTe \\ & eYReRUL `dC%eYZdcJ_ZXUcTcZSVdeYVZ aRTe \\ & eYReRUL `gZfR]R_UZ_Vc^RZ_eVTY_`]`XZdRV \\ & YRGZ_X`_eYVhR_aVa]VT_gVcdZS`gVR]LeYZd \\ & ac`TcddZITYR_XZ_XeYVejaV`WRaac`RTYeYReZd \\ & gRZUR_UWWW6ZeVZ_a`]ZZOŽ \end{aligned}$ 

EYVEV UV TZICIE hRUCIZ UZZI FRZEZ ŁUZW WKV\_eZReZ\_R\_UUV^ReVeZRZKReZ\_RcV[fded^V\_W eYV\_VhT\_UZEZ\_d`WIf ]ef cVŽEYVcVRcV`eVVcgVq Z'a`ceRe`\_VeLoFTYRdeYVeVIVeTaZX`WahRIV  $R_UeZ VR_UeYVeVef | eR_e_Rec hZ_X Wr eZk _d$ e`eYVZ^ VUZReVacVdVeŽ2]]eYZIYRdeYVWWWTe `WZ\_TCVRCZ\_XeYVT\_eZ\_XV\_Tj `Wd TZR] cVRZejŽ : `eYVch`ddLeYV dRXV`WhYRe Zlya`ddS]V‰ ViaR\_Ude`d`TYRUXXCWeYReeYVCVZd\_`hRj`W R eZIZaReZ Xh YRe Zlac`SRS VŽ=hilg'i bXYf'h YgY' WebXlhcbgcZWebhb[YbWmUbXibWfftU]bhm  $hUh7 \ YUbgUfY \ Uj b hc a U_YgYbgYcZ$ h\Y]fXUmhc!XUmYldYf[YbWYg':e^ R eYfdSV  $f_d cacZZ_X eYReLZcVda VI6ZeV W1 TZ VT_^ ^ ZT$ decRef ^ ŁaV a]VeYZ \ eYVh ` c]UZd]VddZ eVj[ZXS]V \_`h eYR\_Z\_eYVaRdeŽ

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## 7 I @H F9žK C F? 5B8 H 997 C BC A M



### 7I @H F9 5B8 97 C BC A = 7 89J 9@C DA 9BH

 $\label{eq:product} $$ TCR_{2} \times dV_{2} V_{2} V$ 

@\_VhRj e`Raac`RIYeVdfS[VTeZte`T\_dL\c eVVT ^ a]\i d\RZ\_dYZaS\khW\_Tf]efd\R\_UeV VT\_`^ jŽAf S]ZTUZIIF dZ\_ZIVM]`VWWVZ\_TVde WT\_`^ ZT Z`aVZRJZI^ %Lah ZEY VgVg Zdf V SVZ\_X a]RIVU Z\_R\_VT\_`^ ZT TRAX gi LSf e R^` dVSR] R\_TVU gZh dr`f]U SV dRdMceVUL`\_VeYRe]``\d SVj`\_U eYV RaaVR2\_TVd`VVIRaZRJZe VT\_`^ Zd R\_UU Vd\_`e T\_VKdV eYV Uj\_R^ Zd`WeYV Rd \Ve h ZEY y\_Ref dR] ]Rh d%Z@\_]j h YV\_ eYZI R] e` WWbf V\_e T\_~ReZ\_` VVd TZR] aYV\_`^ V\_R h ZEY \_Ref dR]`\_Vd Zd V a` dVU TR\_eYVT\_ecZsf eZ\_` W IF ]ef dR] ac`U FTeZ\_e` ^ ReVZR] ac`UF TeZ\_SV dVT X\_ZXVZCVT X\_ZZZ x eYV TF ]ef dR] UZ`V\_dZ\_ `WeYV VT\_`^j ^ VR\_d RTTVaeZ\_X eYRe eYV]ReVc ZIR d TZR] T\_decf Te R\_U\_`ed ^ V\_Ref dR]`dVXZ 
$$\begin{split} & 2dA^{R}_{I} ZI^{I} * \% a^{2} e^{1} fe_{Z}^{I} YZ def U^{V} VeV \\ & YZ def g^{V}_{I} VIRaZ e^{1} Zh^{L} Ly^{R}_{I} d^{I} T_{_{}}^{^{}} j L R d R d^{I} VL \\ & Z d f S^{V}_{V} VX U Z_{YZ} d^{I} ZR d^{I} R e^{1} VL \\ & Z d f S^{V}_{V} VX U Z_{YZ} d^{I} ZR d^{I} R e^{1} VL \\ & e^{V}_{Vac}^{^{}} T V d^{I} V dc^{^{}} U T e^{2}_{_{}}^{^{}} ce^{1} R e^{1} VU e^{1} \\ & e^{V}_{Vac}^{^{}} T V d^{I} V dc^{^{}} U T e^{2}_{_{}}^{^{}} ce^{1} R e^{1} VU e^{1} \\ & e^{V}_{Vac}^{^{}} T V d^{I} V dc^{^{}} U T e^{1} a^{I} ZI Z_{e}^{^{}} e^{1} V de^{1} \\ & e^{V}_{Vac}^{^{}} T V de^{1} V dc^{^{}} U T e^{1} a^{1} ZI Z_{e}^{^{}} e^{1} V de^{1} \\ & e^{V}_{Vac}^{^{}} d^{I} V dz Z_{e}^{^{}} VX V t e^{1} a^{1} Z d^{I} \\ & e^{V}_{Vac}^{^{}} d^{I} V dz Z_{e}^{^{}} VX V t e^{1} a^{1} V de^{1} \\ & e^{V}_{Vac}^{^{}} d^{I} V dz Z_{e}^{^{}} VX U de^{1} e^{1} VV t e^{1} a^{1} \\ & e^{V}_{Vac}^{^{}} d^{I} V dz Z_{e}^{^{}} VZ d t Z d t d^{I} U R da Z e^{1} Z d^{I} \\ & e^{1}_{Vac}^{^{}} d^{I} V dz U^{I} d^{I} Z d^{I} Z d^{I} Z d^{I} Z d^{I} Z d^{I} Z d^{I} Z d^{I} Z d^{I} \\ & V T_{a}^{^{}} a^{I} U d^{I} Z$$

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e`]\&R\_TVZ\_eVVWIV`WUZWWEV\_TVdR\_UT\_~ZTed R\_U RaacVIZTeZ\_ Wc eYVSV\_V} ed`VVT`aV&TeZ\_ R\_U`WAVdaVTeWc deR\_URUUR\_UZ\_deZef eZ\_dŽEYV dR`VY`]UdWc eYVT\_ecZsf eZ\_^RUVe`RTf\_ecj`d VT\_`^ZTUVEYT`a^V\_eSj`eYVdeV\_XeY`chVR\_Vdd `VZedh`c\VeYZTER\_VEYZT`V&Vdd\_R]Z\_ZEZEEZV`c R\_VEYZT`VWF deVZEjZEYZIVJF]ef dR]TJZ\_REW%ZET`\_V `VeYVWETE`cd eYRecVcF]eVUZ\_4YZVSVZ\_Xa]RIVU \_Z\_eY`fe`W&&Tf\_ecZdeYZIjVRcZ\_R\_Z\_UM``W VT\_`^ZTV&WU^Ž

EYV\_Vh aYRV`WRaZRJZY ZIRJeWZ\_XeYReZ} eVeUVaV\_UV\_TVSVehW\_eYVVT\_`^j R\_UTF]ef eVZ H YZVeYVX}SRJZREZ\_`VZ\_We' ReZ\_R\_U}\_R\_ł TZR]~`heL`VT\_df^aeZ\_aReeVc\_dR\_UTF]ef eR] X`UELZITEVREZ\_XR\_Vh T\_eVie R] Rc`f\_U eYV h`c]ULTF]ef eR] TEVREZ\_T\_eZfVde`SVacZ^Rdł Zj R\_REZ\_R] RWRZZ:e ZIVRUZ\_X\_Vh TYR]/V\_Xd Rd'X]`SR] ac`TVEMERVZ\_eVc\_RZXU R\_U 4 YZVR\_ d`TZAġ RTT dZ\_Xj SVT^Vd^`cVT^a]VIŽ9`h TR\_dV\_dVSV^RUV`WgVcjURJ ]ZWZ\_d`TZAġ hYV\_ ZEZdi gf]\_VESJVe`faYVRgR]dZ\_h`c]U^RCVeEQ\_ eYVEVTZETF^dR\_TVEZESVT^VEYVEVCVE4 YZVR\_d `YRgVR\_VIaVEZ/TV`WITZAġ`cR\_ZUVR`VEYV d`TZRIhY]VZ

5fcZXcVIV\_ejVRcdLac`S]V^dhZeYV^a]`jł ^ V\_e YRgV R]eVolU eVV ^ VR\_ $Z_X$  ` Wh ` c\ R\_U Zed Z'a`ceR\_TVZ\_aV'a]VdURZji ]ZgVdŽEYVeh`T\_ł Tváeddr f]U\_`eSVT\_VvávUŁY hvávZEYV]vávJ  $R_Ubf R_Z$  `W^ a]  $i ^ V_e R CVU e C^ Z_V S e YV$ ac`a`œZ\_`WeYVa`af]ReZ\_eYReZIVT\_`^ZR]j RIGZYLR\_UeYV\_TVSj eYVZcVRc\_Z\_XdR\_UT\_ecRTe ġaVdR\_UeYVcVf |eR\_edTZR| ac`eVTeZ\_ŽH`c\Ł `\_\_eYV`eYVcYRULZIRhR; WcaVa[Ve`UV}\_V eYV dygvdZ\_dyReZ\_e`Vievc\_Rj\_RefdVR\_UeYVZc ZV\_eZ; R\_UUZX\_Z; RdZ\_UZ;ZLFR]dŽ eZdeVfdTdfTZR We ev driven Rev\_ val R\_U driver ZRez\_ `Vev  $\mathbb{Z}$  UZ22LF R] R\_UZ21RVV\_UR^ V\_eR] acZ\_TZ2]V W1 TZR] VeYZTeLhYVeYVc4YcZteZR\_`c]RjŽ6gV\_eY`fXYTVe eRZ\_ecRLZeZ\_dLW/^ eYV3ZS]Ve` > Rti LYRgVdW\_  $\ensuremath{\texttt{Ze}Rd}{\mathbb{R}}\_\ensuremath{\texttt{R}}[\ensuremath{\texttt{Z}}\_\ensuremath{\texttt{Le}}\ensuremath{\texttt{Y}}\ensuremath{\texttt{C}}\ensuremath{\texttt{V}}\ensuremath{\texttt{Z}}\_\ensuremath{\texttt{R}}\ensuremath{\texttt{Z}}\_\ensuremath{\texttt{Le}}\ensuremath{\texttt{Y}}\ensuremath{\texttt{C}}\ensuremath{\texttt{V}}\ensuremath{\texttt{S}}\ensuremath{\texttt{L}}\ensuremath{\texttt{S}}\ensuremath{\texttt{C}}\ensuremath{\texttt{S}}\ensuremath{\texttt{C}}\ensuremath{\texttt{S}}\ensuremath{\texttt{C}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensuremath{\texttt{R}}\ensuremath{\texttt{Ze}}\ensuremath{\texttt{R}}\ensurem$ TV\_ecR]Zej Z\_aVa]VdURZjj ]ZejVdŽ

 $EYV^{VR} \underline{Z} XR \underline{U} eeRL \underline{Z} ^{Vh^{c}} \underline{C} ^{h} dW$ e`SVZ\_UfSeŽ2dR\_X/^WNTE cdR:VCdYRaZ\_XZcd c`]VLS` eYZ\_eYVac`UFTZ\_ `W1TZig`d^ ReV5Zi hVR]eYR\_UZ\_eYVVCXZ\_X`VZ\_UZgZIFR]ZV\_eZg`R\_U eYVdTZR]S`\_UŽEYVCVeZ\_X`VZ\_UZgZIFR]ZV\_eZg`R\_U eYVdTZR]S`\_UŽEYVCVeZ\_V\_UTZdR:V^ `de^ Re\VU Z\_eYVTf\_ecZdReeYVVCVAY\_e`VeYVeXIY\_`]`XZIR c\g`]feZ\_R\_UeYVa`dd7`dZR\_`CXR\_ZREZ\_ `W ac`UFTeZ\_Ž:\_CVTV\_ejVRcdLR\_f^SVc`VNFeY`cd YRgVV`aYRCHXU eYVCVTYR\_XddZ\_eYV\_RefcV`W h`cLYZXJZXGZ\_XeYVZcT\_dbfV\_TVdVceYV`cXR \_ZREZ\_ `W1TZdj R\_UeYVTYRRIeVc`VZ\_UZgZIFR]d 1DV\_\_VeL"\*\*), 3Rf^R\_L"\*\*)SZ

:\_ 4 YZVLeYVac`TVdIYRdSW\_ d`hVŽ7`c^`de  $V^{2}ZZdh`d`ZIR_UhZ]T_eZfVe`SVRgZeR]aRce$ `WURZj ViaVZV\_TVŽ?`\_VeYV/VdLeYV^VR\_ZX`W h`d`RdR}VJU`VdTZZ;dVRZ\_dZITYR\_XZXV&V RdhVJ]19`aV\_YB\_L#!!"/Ž @56CIF'89F9; I@5H€B

:\_  $dVIV_e j$  VRcL eYVdV YRd SW\_ R  $dZ_Z$  TR\_e TYR\_XVZ\_  $eYV \land VR_ZX \land Wh `c` R_UZ_ ]RS`fd$  $TRaZER] <math>dV[ReZ_dZ_ T \land aR_ZdZ: eZd_`e`_]j eYV$ Xc`f\_U d ]Vd` W[RS`fc  $dV[ReZ_deYRe YRgVSW_$ RWWAVLES feeYV d TZ TF]ef dR] dRIVR hV]ZEYVW]`hZ\_XR\_Rj  $dEUVERZSV dTYR_XdZ_ ]RS`fc]VA$  $ZIREZ_ R_U eYV dF]eR_eZ_TAVRVZ_ [`SZ_dVTf cZjE$  $SWXEVT_dZVCZ_X dfS[VTeZgV aVETVaeZ_d` VEYV$  $]RS`fd ^ Rc\VedZf ReZ_Z$ 

CW\c^ de` |RS`fc|RhdZ eVV"\*)! dac` UFT\UR dRUZIR dYZłaZ\_ 4 YZWR\_ d TZR YZZE je ZE YVOWIC^ d Z\_T]fUVU^ R[`cTYR\_Xkde` eYVd; deV^ `WZZZ\_XR\_U UZA ZdRłe ełVcf jvdX gvc\_Z Xh c Z XRIezezzad R\_UT ||VTezeVSRXRZZXLe` eYVc` |VR\_Udef Tl efcV`Wf\_Z\_dLR\_Ue`d`TZR]dVTfcZejZ\_deZefeZ\_dŽ H YV&VRd eYV acVgZ f d [VXZdReZ\_ YRU VRg; f cVU `aV\_IV\_UVV`a]`j^V\_eT\_edRTedLeVV\_Vh]Rhd a RIVU eV a`dRg T\_edRTed`\_ eVV dR^ VW eZ\_XZ  $E YV RcXf^ V_e Wc UVcVXf ReZ X V^ a]^j^ V_e$ T\_eeRTedhRdeYReT^aR\_Zkd\_WUVUe`Z`ac`gV eYVZcT ^ aVezZeV\_VetLR\_UeYReeYZth`f]U]VRUe` XcVReVc[`STcVReZ\_ŽEYVcVZd\_`T\_dV\_dfdRS`fe eYV`feT^V`WeYVdV^VRefcVdŽD^VdWeYV^Rd eYVSRHZIWceYVVT\_`^ ZTXc`heY`WeYV]ReeUVIRUV `WeYVehV\_eZleYTV\_efqiŽ@eYVcdefUZldL]Z.VeYRe`W  $E^{\ } \ R_R U > Re^{2} A k^ WeV: eVc_R Z_R = RS^ fc$  $@cXR_ZREZ_1:=@L"***/LRCV^ CVTCEZRZ$ 

@\_VT\_d\bf V\_TV`\WeVVy\_V ]ZS\CR] CW\C^% W ]RS`fcCV]ReZ\_dU\CZg\U\CV^ eYV\Cc`c`\WYZ\_\Z\_X eYReU\C\XF]ReZ\_h`f]Ud\ZZ\hRX\dV\ce\^a`d\cj  $R_U_`_lT_ecRleh`c\\CdR_UeYReeYVXRaS\ChW_$  $eV\CVR_Ua\C^<math>R_V_eh`c\\Cdh`f]U_Rc`h RdR$ 

Î 5 ```]b`U``ž h\Y``Ugh XYWUXY`\UgʻVYYb`U`j Yfm XmbUa ]WcbY`Zcf`&V`WYUhcbždfcXi Whj ]miUbX` fYU``k U[ YgÅ '7\]Y`bck`\UgʻUVci f`Uk gʻh\UhUfY` fY[ UfXYX`UgʻUXj UbWYX`Vmik cfX`gʻUbXUfXgžUbX h\Y`XYfY[i`Uh¦cb`UbX`ÛY]]V]]mih\Ym\UjY`Vfci[\h UfY`ibXciVhYX`mUacb[`h\Y`aU]b`fYUgcbgZcf`h\Y` We'ibhfmĨŷ[ccX`YWebca]WdYfZcfaUbWY`]b`h\Y`Ugh XYWUXY'Ï

:YfbUbXc 7c`ca U'UbX'DUhf]Wc Fc'Ugž&\$\$\$"

c\df]eŽ:\_ eYV^ R\_f WR1ef cZ\_X dvTe`eLe` eR\V[fde `\_VVIR`a]VLXc`ddhRXVdaRZUe`eV`a`dRq`deRWW  $\underline{Z}$  "\*\*' hVeV&\* ]`hVeVR\_ eY dVaRUe h`e\} VcdhZeY`aV\_IV\_UVUT\_ecRTedŽEYVcMT\_UVWWTe hRdR\_Z\_TeVReVZ\_`\_łT\_eeRTeh`e\VeeŽ3VehW\_ "\*\*%R\_U"\*\*' ŁhYZTY hVčVj VRcd` Wate`\_XXc` heYŁ eVV\_f^SVc`W\_`\_łT\_eeRTehRXVUV`a]`jWdZ\_ Z\_UfdegiLT\_defTeZ\_R\_Udv@ZTvdZ\_eYV4YZvR\_ acZereV dVTe c Z TcVRcNU W/^ "Z  $\tilde{Z}$  e "Z  $\tilde{Z}$  WeYVe`eR]LRIT\_f\_eZ\_XWcYR[WVR]\_Vh\_[`SdŽEYV eeV\_UdW^ de`SVT\_eZ\_fZ\_XŽ:=@ VdeZ^ ReVddfXt XVdee/Reh`c\VdhZeY`feT\_edRTed`chZeYeV`ł a`dRcjT\_edRTedRTTf\_eSVehW\_eYV^WcRS`fe  $\mathcal{K}$  `WR] hRXIaR ZX[`SdZ\_eVT f\_eqŽEh` eYZUd`WeYVdVYReV\_`T\_eeRTe`WR\_j\Z\_UŽEYV dvdf ]ed`WeYV42D6? #!!! df cgVf S`dveYvdV}\_U Z\_Xd`feLdY`hZ\_XeYRe#\$Ž\$~~`WhRXVVRc\_VcdL`c RS`feR^Z]Z\_aVa]VLYRU\_`T\_ecRIeŽ

 $2e eYV d? VeZ VLeYVT \_eeSf eZ \_ `W Zic`l V_eVacZMdZ TEVRMU ^ Rc\VUjj Z5 f cZ_XeYRed? V aVZ U" ***%I" **' LyeYVac`a`ceZ _ `WiRXVRc_l Vdh Z&Y`aV_lV_UVUT \_eeRledZ ^ Zic`V_eVacZMd Z eYVZ Uf decZNLT _ def TeZ _ R_U dvcgZV d/Te`cd c`d/Vd/^ " SŽ ~ e` "(Ž ~ `VeYVe`eR]Lh YcVRdZ ^ `Uvc_V_eVacZMdeYVac`a`ceZ _ `WiRXVRc_l Vdh ZeY`aV_lV_UVUT _eeRledWj Vd/^ (%Z ~ e` '%Z ~ %w=@L" ***/ŽE Yf dZ d/Tf cZj`VW^ a`Gj`c _`_lT_eeRleh`c\Z XLdW de`YRgVZ TEVRMUZ R] ac`UT TeZ _ d/Te`cH ZeYT _d/Df V_T/d_`e`_j WcZ_T ^ VdSf eRJd Wch`c\Vcd bf R]Zj`VVZWZ$ 

Gc WJU`']bYei U`]lm\Ug']bWYUgYX bc hc b`m VYWUi gY`c ZWUb[Yg']b']bWca Y`X]gfr]Vi ! hc bž Vi hVYWUi gY`h.Y`c gg`c Z'c V`gYWi f]lmi UZYWg gc a Y'dUffgc Zgc WYhmZUf a cfY'h.Ub' ch.Yfg" Eh` Z\_UZZT R]dh ZeY dZ ZRc VLF TREZ\_ R\_UZ\_T ^ V]VgYd^ RJ SVgVcj UZWWCV\_elj a]RIVU e` T aVhZeY]RS`f c^ Rc\VeUVCVAf]RZ\_Ž eZIYVCV eYReeVV\_Vh c` ]V`WAVDRAVZIaRceZff [Rc]j Tcf TZAJŽ



AckgZfdjLetV^RZ\_W\_TZ\_`WetVdTZQDEREW hRd\_`ed ^fTYe`cUZdezZfeVZ\_T ^VRde`ac`ł gZLVac`eVTeZ\_RXRZ\_deZ\_dVTfcZej`WV`a]`j^V\_eŽ HYReetVDEREWetV\_dRhRdRdTZQcVa`\_dSZZej Z\_Tf^SV\_efa`\_ZeYRd\_`hSVT ^VetVViTJfdZeV cVda`\_dSZZej`WetVZ\_UZezLfR]14 RdeVJL#!!#/Ž

 $2 dR ddf ]e`VeYVy]ZSVER]ZR eZ_{WV}IS`fcd/]R$  $eZ_deYVeVZIReV_UV_Tj e`dWh`c\VedafcVj Z$  $eVc^d`VeYVac`UFTegZij`VeYVy]SS`fcVRTe`c%Z$  $eYVeVegZIV`VeYVVT_`^ZTejdeV^ŽEYVyejdeV^%Zd$  $T_dZVeVUaReR^`f_eddeYRe^VRefdede`ac`eVTe$  $h`c\VedeV_Ue`SV dW_RdUvetefTegV`W dVeŽ$  $EYZeVgVedR]ZIT_eeReje`e`eYVeteReVyj`VW f^R_$  $UVgVj`a^V_ethYZIY RUg`TReVeLSj T_eeRetLeYRe$  $Yf^R_SVZ_Xd eA`f]USV eYV RIegVaReeZTZaR_ed$  $Z_R_U RIEFR]SV_VjTZReZd`VeYV d`TZRJac`TvetZ$  $EYVWJ]`hZ_XeVTeZ_dR_RjdVeYVcVRJESZd`VeYZd$ 

## D9F79DH€BGC: H≰997CBCA=7 GMGH9A 5B8 KCF?=B; @=9

EYVT\_TJfdZ\_d`W#VbfRJZ#252VdfUZdTRczZU `feSjF?5AVceYZdCVa`ceRvS`c\_V`feSjeYV cvdf]ed`V#YV#!!"DfcgyJŽ7Zde`VR]LeYvCvZdeYV aVcTVacZ\_4YZvR\_dYRgV`W#VVT\_`^ZTddv^Ž EISJV""UAZTedR^`ceRRc^Z\_XdEfReZ\_LRd+(1 cZhcgY]bhYfjJYkYX\UfvcifUXjYfgYZYY'! ]b[gftZ]bgYWif]mz`cgg`UbX`Ub[YfLUVcih h\Y`YVcbca]WgnghYa"

#### @/.}ä/2/2

Hoxyozill ‱zation († 1877) a z Yadź Ozgańan († 1817) a zwazation († 1818) kara († 1818) kara a zakazation († 18 Yóy az – Dzy Az Uyz² a z Yati

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ä	;¶Ý¢ <b>€z:ðsz@"Ýnÿ</b> ¶²Šqz²gzn <b>ÿz²æĕÝ©∕í– nåÅÚqz <del>ännnunnunnunnunnunnunnunn</del>ni è</b>
ä	$L \text{-} \text{i} L \text{-} \text{i} R \P^2 z  aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa$
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>¶ï ÚgznáB1L; äl Ox¶²OQa>ï Údzonái þþ½Ê

#### @/.łä½

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$$\begin{split} & \mathbb{Z}_{\mathcal{A}} \stackrel{\text{eYdV}_{\mathcal{A}} = \mathbb{Z}_{\mathcal{A}} \\ & \mathbb{Z}_{\mathcal{A}} \stackrel{\text{eYdV}_{\mathcal{A}} = \mathbb{Z}_{\mathcal{A}} \\ & \mathbb{Z}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \mathbb{S}_{d} \\ & \mathbb{R}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \mathbb{S}_{\mathcal{A}} \\ & \mathbb{R}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \mathbb{Z}_{\mathcal{A}} \\ & \mathbb{R}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \mathbb{Z}_{\mathcal{A}} \\ & \mathbb{R}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \mathbb{R}_{\mathcal{A}} \\ & \mathbb{R}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \\ & \mathbb{R}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \\ & \mathbb{R}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \\ & \mathbb{R}_{\mathcal{A}} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \\ & \mathbb{R}^{d} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \\ & \mathbb{R}^{d} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \quad & \mathbb{R}^{d} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \\ & \mathbb{R}^{d} \stackrel{\text{eYRe}}{=} \mathbb{R}^{d} \quad & \mathbb{R}^{d} \stackrel{\text$$

E` def c\_L]Rdej Le` eYV ^ VR\_Z.X ReeRIYVU e` h`c\ ReeYVaddd/\_eeZ` VLeYVcf cgyj ckf ]eddr`h eYRe #(´``WaV a]VWW] Ze` SVeYVZc h`c\ eYRe SZ\_UdeYV Ze` 4YZyR\_ d`TZej ŽEYZd dw`de` T\_}c^ eYVZ` ackdtZ\_ eYRe h`c\ RdR ^ VR\_d`W d`TZEjZREZ\_ ZdZ a`ceR\_e`\_jj Wc R ^ Z`cZej`W 4YZyR\_dŽ:\_ eYVR5d/\_TV`WT ^ aRdrS]VURH ZeZd Z`a`ddS]Ve`dJ hYveYvceYZdd TZEjZZZXc]VhRd ^`dVZ`a`ceR\_eZ\_VRcjZcavZUdŽ:\_ R\_j VgV\_eL e`UJj`dh`c\a]RIVZd\_`e`Wf cedB\_UZ\_XZ`a`ceR\_TV RdRdfcUV`W1TZEj VavZ2/TVŽEYVTV\_ecRjZej`W h`c\ RdeYVJZ\_\SVehW\_Tf]efcVR\_UeYVVT\_``j Tf]USVT`^Z\_XZ\_e` bfVebZ\_Ž

3j T\_ecRebhZeYaVcZUdhYV\_eVvVhVvVa`hVd VM TJRd1^`gV`V\_ecLZeZl\_`]`\_XvcZ\_eVvh`c\t a]RUVeYReZ\_UZgZlfR]deV\_Ue`UVgV]`a eVvZcZ`RXV `Wd TZdj`c R\_j ZJVR] Z`RXV`WeYVyH V%ZEYZd U`Vd\_`e^VR\_eYReh`c\Zl]`dZX^VR\_ZXLSfe eYReZeZlRIbfZZ\_XRUZWWCV\_e`\_VeYReLReacVdV\_eL ZlTYRCRI&VZXVUSj RdvE`VW^SZgR]V\_TVČZ>Re $\frac{3}{2}$ 9`aV\_YRJ\_1#!!"/dr`hdeYRedTYUZV^ RdRV Wf\_UeYcfXYfeeYV]`\_XR\_UgRZUYZb`q`W h``d\Ž3f eh``d\hRdRhRj deYV]Z\SV: $hV_^R$ R eVZZ] ac`UTTZ\_R\_UeYVac`UTTZ\_`WV VR\_Z,XŽ H``d\R\_U]ZWhVZ\_eVachZ\_VUSVIRf dV;Wch``d\ VaLeYV`\_]j d`TZR] V&^ eYReeYVZXYee`]ZWT f]U eR\VhRdeYVZXYee`h`cVLd^VeYZ,XR\_R]`X f de` hYReac`aVaj cZXYedRVV&Sf dZ\_Vdf`V\_%a4 ReV[L #!!#/Ž eZleYZITV\_eR]Zj eYReZISVZ\_XTR]]VUZ\_e` bf VdZ\_Sj eYVEYZU:\_Uf deZR] CVg`]f eZ\_LeYV ac`daVIed`VeYV;\\_`h]VLXVd`TZdj%R\_UeYVIf]} ef dP] TYR\_XXdeYVAcac`TVdtVdV\_eRZŽ

@\_V`WANAVTYR\_XXdZdRdd TZRANU hZey eVVcZdV

`VIT\_d^ VcTf]ef dŽH YRe ZIYRaaV\_Z, XLRI 3Rfł ^R\_1"\*\*\*S/af edZHZIyRXRUFR]Sf ef\_de`aaRS]V erR\_dZZ\_W/^ RQc`UFTVcd TZAj`e`RQC\_d^ Vc d`TZAj`, W/^ Rd TZAj`XFZJVUSj eYVh`c\VeYZTe` `\_VX gVc\_UUSj eYVRVdeYVeZTd`VIT\_d^ aeZ\_%Z EYZEZRXV\_VR]eV\_UV\_Tj eYReZddRoeZ\_Xe`SVdV/ Z\_4 YZVRdhV]Z7`c^R\_j 4 YZVR\_dLT\_d^ aeZ\_ TR\_SVT^ VRd^ VR\_ZXMJ Rdh`c\hRdZEYV\_Vie TYRaeVchZ] Via)`cVhYReT\_d^ aeZ\_TR\_^VR\_ WceYVd TZRJ ViaVEZ/TVdR\_UT]]VIeZVCAcVd/eft eZ\_d`V4 YZVR\_df\_UVceYVd/TZETf^ dR\_TVZ



## H + 9 7 C B G A 9 F 7 I @ H F 9



## H = 0 F = 0 C = 7 C = 0 A = 0 H = 0 B = 0

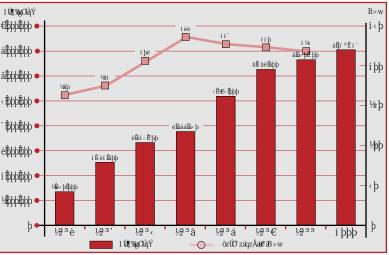
D ^ Vh2]} UZê`UUê dWT \_d^ adZ\_ eVRêVU RdaRee`WêVV\_Vh hBj `Wac UTZ\_XTF Jef  $dZ^{0}$ \_TV Tf Jef dZff\_UVde`UZ\_ eVVSc RUdV dVReRTYVUê ZeZ\_ eYZICVa` dLY hVgVL eVVVTR\_SV\_`Uf Se RS`f eeYVc`JVZea]Bj dZ\_ e`UBj dd TZéj Ž7 c^ R\_j 4 YZJVR\_d:Wcbgi a dH]cb`\UgʻU`g][ b]ÚVUbWY` gla ]`Uf`lc`hUhk \]W`k cf\_`\UX`VYZ:fYZUgʻ h`Y`d\ng]WU``WfngHU``JnUh]cb`cZ]bX]j ]Xi U`` JXYbh]mi UbX`UgʻU`bYk ž a UhYf]U``a Ub]! Z'gfUh]cb`cZh`Y`gcWU``VcbX''4`\_d^ aeZ\_ Zi TYR\_XZ\_XTF Jef cVSVIRf dVZeZi df aa]j Z\_X\_Vh ^ ReVZR]dVVceYVV\_RIe^V\_e`WeVVd/WgZf dgZt`eff VdLSf e R]d\_SVIRf dVZeZI XV\_VREZ\_XRT ]]VT&ZV Z RXZ\_Rj `Wd TZGjŽAV a]VR:VdIR:TVj RhR:V`W eVVdVTYR\_XX:LY`hVgVŽ

EYVZ a`  $ceR_TV`W'_d'^a acZ_RtRIF [d cl] Rie$  $UVCZgVdW/^R_f^SVc`WRIE` ccŽ@_VZIZJV_ccZ VU$  $Sj R_R_eYc`a`]`XZIR]`SchcgReZ_15`fX]RdR_U$  $: drVch``UL''**'/Ž>ReVCZG] X`UdRV_VIVdRcj$  $_`e`_]j Wc`d'ScZeV_TVLSfeR]d e` XZgVgZIS]V$  $R_U delS]VWc^ e` eYVTReVX cZd'eYRe decf Tef cV$  $URZj JZWZ_eYVT^^f_ZjZ`VIF] ef cVZIcVARUJU$  $RdRT]]VIcZgVd deV^`W'VR_ZX&LT_d^ acZ_$  $IR_SVdW_RdRhBj`W'S[VIcZJVZ_XR_U d/RcZ_X$  $eYV^ŽER.VLWcZ_deR_TVLeYVT_T]f cZ_deYReTR_$  SVUGAL\_W/~RdfaVc/Rc/Ved/aaZ\_Xezaž:e ckgkRjdhYZY ac Uf TedRW/Zj T\_dL/kd\_VIkdZ eZdR\_UhYZY jf i f cZdLeYVW/Zj dVRZ\_XYRSZeL eYVZ a`ceR\_TVZeReeRIY/de`WUZ\_ZdU^VedZT d TZEJZRZ\_\_R\_UeYVeZ VY cZk \_Ze`aVRE/de`Ž EYVCR^VeYZ\_XYRaaV\_dhZeYT]`eV/dSfjZ\_XŽEYV TY ZVdaV a]V^R/VRV\_`e`\_jjZ\_UZREZV V&/VZc Z\_T^VdR\_UeYVc/bfZV^Ved`VeYVZch`c\a]RIVŽ EYYJ RJ XZgVIjf Vde`eYVZ a`ceR\_TVeYJ ReeRIY e`eYVZCZ RX/R\_UeYVc/T\_X\_ZZ\_eYJ VfaVIeV/^ `eYvcZEYVR\_eYc`a`]`XZR] Raac RIY cky/RJcEYV\_L eYReZ\_UZZIF RJdhYVEY/cT\_dIZ f dj`ceRIZEJEF d/ T\_d^VcX`Ude`TJRHZY/R\_UcR\_\RhY`]VcR\_X/ `VURZj\_VfaVZVTVČZ

EYV dVT \_ U dvRd \_ Wc YZXY/ZXY6Z XT \_d ^ ał eZ \_ RdRWć^ ` Wff ] ef dR] TcVReZ \_ YRde` U h ZY eYV Z TcVRdZ XZ a` ceR\_TV` Wf ^ S` ] dR\_U dX\_ dZ : \_ TcVRdZ X] i ŁeYV Sf j Z X` WX` Ud R\_U dvgZVd Zd SVT ^ Z X R gR]f V Z ZcM/WdReYVć eYR\_ R h Rj ` Wef aa] j Z X d ^ V h R\_ eŽ 7` c ^ R\_ j aV a] V LeYV dRZMNEZ \_ ` ]`\_Xkć T \_dZed ^ VcV j Z ^ WeZ X R\_WUZ 7cVbf V\_ej i LeYV gR]f V` WR eYZ X JZd\_` e Z h YRe Ze Zi` c U VE Sf e Z h YRe Ze dZ Z V dŽ: e Zd R h Rj ` WRIYZ gZ X dM/VcNRJZREZ \_ ` c` WdV\_UZ X dZ R]de` ` eYvdR\_U d ^ S` JZZ X d TZR c/ReZ\_ I dYZa dŽE YVcVcf ] e ZleYRELe` RUV?cWLT \_d ^ aeZ\_ ZLUV^ ReVZRJZNU+eYV^ ReVZR] ac` UF Te T f\_edWc ] VdHeYR\_ eYV dX Z TRZ\_Ž

:\_ 4 YZ/VERT dZ\_Xe eYVbf RJZREZ Vdf UZdTRH cZU`feSjF?5AWceYZłCVa`œłd TZRJT\_gVcR eZ\_eV\_Ude`fc\_VRZJ e`UVdTcZaeZ\_dLJZłdR\_U RaacVIZREZ\_d`VniYReeYVaRœZTZaR\_edYRZVS`fXYdŁ Z\_eV\_Ue`SfjŁ`chR\_eVUe`SfjSfeTfJU\_čZ`.\_ `eYVch`dHZzeeV\_Ude`cVgJgVRc`f\_UT\_d^ ał eZ\_RłaZVUe``cVXXX\_VZ`edd TZRJTYRRTRVcZł cV-VTEVUZ\_VgVgURJJR\_XFRXLhYZTY`VAV\_fdvd RSjX\_VZJNRJ`VNiYReeYVdTZRJS`\_Udv`fJUSV RdRTcZeVZ\_WcTcZZTZZZXZXyT\_d^ VcZf`%R\_U

ÊþþÊþþ • èÊeí < Êþþ èÊþþþÊþþ • í Ê èí Êàþþ í ÊþþþÊþþ • %ê-∢þ₿þþ ¹∕⋬þþþ₿þþ ● þ**●** 1⁄2³è 1/23' 1/23 1 ܶ%ägŒq́qÝ >¶ï lýzna⊳ (7a0) ¶äfi o⊖-]zlá¶%aa ¶––zlýznai þþ½Ê v^RevZRZA %LeeVVT\_daZF fdT\_d\* aeZ\_RU `deV\_eReZ\_eYReRcVYV/Ue`acVerZ{\_`hŽ5VdaZeV eYZd\_VRezeVT\_\_`eReZ\_LRbfR\_eZeRezeVZ\_TcVRdV TR TVRC SVZV 62 VULROTR eRIZE Raac gRŽ @\_V^ R\_ZWARZ\_`WeYZdZdeYVdf deRZ\_VUXc`heY



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T\_d^aeZ\_RIRd TZAJ VI a V ZV\_TVR\_UV\_U h Ze hZeY RgAZU^ VR\_Z\_XZ EYV gAT Volé`\_T\_d^aeZ\_UVaV\_Ud`\_eV \Z\_U`W\_WU daV a]VYRgVZ@SgZ f dj LZe TR\_`e YRgVeYVd? V^ VR\_Z\_XVC eY dv def XXJZ Xe d d gZgVRd Wc eY dv hY`RV de2d; Wh ZeY eYVZ a`dZ eZ\_Z2 dh ZJ SV dW\_L^`de cda`\_UV\_ed W^ eYV ]`h Vc decRef^TJRZ`eYRe Z\_RXd`WT\_d^aeZ\_ RVRJZ/\_e`eYV Z2\_UTV eYZ\_Jj ZedW^ dRXxCd ZgV e`decVddeYVacU^Z\_R\_TV`WT\_d^aeZ\_hYV\_

`WTCNUZeTRUfdV1}XfcV(/ŽEYVeVdZ\_SVehW

h`d.dR\_URTeZ\_ddY`hdY`hUZWTf]eZeZde`RTTVae

`\_VZ\_Wfc4YZWZ\_d]ZzVZ\_a`gvcgjŽ:eYRde`SV cVT X\_ZXULeY`fXYLeYReeVVT f\_egjčdZ\_VbfRZzXd RVdvehZeYZ\_1R\_UV/RIVSReVUSj/RyT\_d^ \c If]efc%ZEYVa``cU\_\_`e]ZzVZ\_RUZWWCV\_eh`c]U W/^eYVhVR]eYjŽ4`\_TcVeVeY`fXYa`gvcg\_^R

$$\label{eq:linear} \begin{split} \widehat{I} &A &mh Yc fm \c h Uh c b Y c Z h Y Y UWYg c Z h Y \\ X W Uh c fg \d \b 7 \] Y \Ug VYYb U d c Z i b X W \\ h fU \W Ub Yz Ub Z gh X b h Y k UmYa d \Ugg \Ug \\ \end{split}$$

g、JAHYX Uk UmiZica We `YWMj Y UWHcb UbX hck UfXg Webgiadhjcb Ugh Y VUggZicf Vi ]X]b[ ]XYbh]h]YgUbX gYWif]b[ ]fYWe[b]hcb'Ï

>cf[Y`@UffU‡bž&\$\$%"



SVLZeZd\_`eR\_`S[VT&zgVVNMESfeRdZefReZ\_UV}\_VU Sj d`TZkejŽ4`\_dNbfV\_ejjLVgVcjeYZ\_XUVaV\_Ud`\_

eYVTF Jef dRJ WAR Vh`c\hZeYZ\_hYZTY a`gVcgi Zd JRSVJJVU Rd dTYŽE Yc`f XY eVJVgZZ\_LRUgVcsZZ\_X R\_U`eYVc^ VUZRUVgZTVdLZ TJf UZ\_XeYVVI a VCZ/TV `WJZgZ\_XZ\_RSZXTZgiLeYVyT\_d^ Vcd TZAgi %XRd RTCZEZTRIZ\_fV\_TV`\_eYVhBj 4 YZJVR\_dLR\_UVdaVI TZRIJj eVVa``c eYV^dvJgVdLUVj\_VhYReZe^ VR\_d e`ySVa``CZZ

EYV bf  $R_{ZR} = V df UZ d dY h eYR yT d^ Vd$  $Zh \% Zh V V V V \dot{e} g V h V / Z Xack df c V -$  $\underline{Z}$  UZ  $\underline{Z}$   $\underline{L}$   $\underline{R}$   $\underline{d}$   $\underline{Z}$   $\underline{e}$   $\underline{V}$   $\underline{Z}$   $\underline{e}$   $\underline{k}$   $\hat{k}$   \UURS`feeYVejaV`WaReZURATeZ\_eYVjXeW/^ SfjZ\_XRac`UfTeL%\$~ `WeVda`\_UV\_eddeReVeYRe ZeZlRhFj`WyeeVFeZ\_XeVV^dygVe7ZiWrFeZH74FeZ\_ ReyXteZ\_XeYVeYZ\_Xd: hR\_e%ZdRUUUe` eYZŁZe  $\label{eq:linear} $$ TR_SVdR2UeYReWc) ! " `WeVda`_UV_edtT_d^ ! $$$  $Z_XZdRhR$  `WeRezUVZ\_XRUVOZEYZda`dezeV RaacVIZReZ\_Raa]ZddZ\_^fTYeYVdR^VhRje `eYVcdT\_df^aeZ\_ŽDZL`fe`W'!cVda`\_UV\_ed eYZ \ eYRe aV a]VSf j eYZ XdySVIRf dVeYVj \_WU eYV %LaR\_U`\_]j eh`Z`RXZ\_VeYRe eYVj U`Zeye` dr`h`WWZiWeYZdeV\_UV\_TjZdT\_}c^WLhYjU aV a]V\_`eWc^f]ReVR\_UT ^ Ve`eVc^dhZeYeYZd dezantez\_0

## 5 HMDC @C; MC: 7 C B GI A 9FG

 $EYV dYRaZ_X`YRYT_d^{A}VcdTZkj%ZdZ_UZIR$  $eZgV`YR dRaZJ dV cXR_ZREZ_`YkYVT_UZZ_d`W$  $T^^f_Zj]ZWŽ_eYZddTZkj`YkYZ_XT_d^a$  $eZ_Lh YRe ej aV`VYT_d^VcdRV4YZYR_dDEYV$  $d`cgYJT_eRZ_dR_f^SVc`YT_d^acZ_lcVJReVU$  $gRZSS]Vd1 dW RaaV_UZ_(/ eYRe ac`gZ, W^ReVZR]$  $VkCR ej a`]`XJŽ7fcXc`fad`VkVch`_UV_edTR_SV$ UZKZ XFZhVUŽ

#### H& 9 B 998M 7 C B GI A 9Fž C F Î = 7 C B GI A 9 HC GI FJ = J 9Ï

EYVEVZIR WYZEJ UZEVTE JZ \ SVEN W\_ eYV hBj aV a]VT\_d^VR\_U eYVZcd TZ łVT\_`^ZT JVEVJŽ EYV]REXXde Xcfa`VZ\_UZEZLFR]d1%#″/REVVEV^ eYV]`hVcdecRef^LR\_UeYVZcT\_d^aeZ\_ZUZEZV\_ ViTJf dZEVJ Sj\_WUŽ3j R\_U]REXXLeYVJ\_VEVCYREV ^`\_VJ e`daREVLVEV\_eY^f XY eYVJ h`c\`\_Jj e`

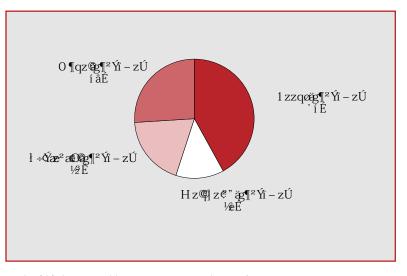
7 C B GI A -B; ∶ C F K 9@@ 69-B; žC F Î = 7 C B! GI A 9 HC A 5?9 @= 9 69 H9 FÏ

EYZIZdeYVď R]VdeXcfaL[fde" \$~`VK]dVah`\_ł UV\_edLR\_UZed^V SVadh`c\YRUReT\_d^ZX Z\_bfVde`VRSVeeVc]ZWabjVŽEYVdVR-VZ\_UZeZJFR]d W/^eYV]`hVcZ\_T^VXcfadhY`ecjeZgVab eYVZ: ^ `UVde VR:\_ZXdZ d'R] Z ac gV V\_edł R cWVZXdRe d.R\_Vh eV/VgZZ\_łeYRe Z T&RdV eYVZ: WY ZXd'deR\_URU`VJZgZXŽEYVJ hZ]RhRJ decj e `SeRZ R\_VfecRZT ^ Ve dR]ZVeYVZ:RdzZReZ\_d. hYZIY eYVJ af cdf VVR:\_VdeJ Sfe\_`e`Sdvd2gVJŽ D ^ VeZ VdLeYVdV decV\_f `fdT\_df VdX e`R dr`aaZXTV\_ecVe`dWZVeYV&RVR.j SRXRZ\_d. R\_UeYVJ RCVYRaaj ZVeYVJ TR\_Xkéd ^ VeYZXWc RX `UacZIVŽ2 ]RXVac`a`ceZ\_`VeYZEVc`fa RcV ^ V\_W7 eYV]`hVcdeRef ^ hZeYYVRgj WY Zj cV da`\_dSZZEZCŽ=ZVeYV^ V SVcd`VeYV} cdeXc`faL eYVJ eV\_Ue`WWJeYReeYVJ YRgVSW\_JVASVZ\_USj ]ZWR\_UYRgV\_`TF]efcR]T\_df aeZ\_ŽEYVJ eV\_U e`VR:\_d ^ VhYRe^`cVeYR\_eYV`LY`hVgV&R\_U

H so 9L = CH9B H so @ 7 C B CI A 9F ž C F Î = 7 C B ! CI A 9 H C A 5 ? 9 A M C9@ 69H 9F Ï

@\_VZ\_}gV`WeYVcVda`\_UV\_edRcVZ\_dVTfcVT\_}  $d^{A} V d Z E Y V R V f d R i a V a V W A e Y V Z U V$ decRef ^ hY RcVgVg T\_TVc\_WhZeY `SeRZZX af SZTOVT X\_ZZ\_ `WeYVZcd TZR deRef dŽ7` ceYV` Ł T\_df^aeZ\_ZlacZ'RzZj RhRj`Vstc[VTeZ\_XeYV^ł dMg\dŽy9 RgZ\_X%ZclaRce `WeYVZchRj `WySVZ\_X%Z EYZdZhYjeYY TRVd ^ fTYRS`feeYVZcaYjdZ TR Raa VRcR\_TV, eVVZchV]ISVZ\_XUVaV\_Ud`\_ eYZd Viewc\_RIZ RXXŽEYV/h`f]U]ZVe`hVRcScR\_UVU T]`eYZ\_XLegi`fe\_VhWRAYZ\_ac`UfTedR\_UXV\_Va  $R_{i} de eYV dMgVd RaReeZ6i ZeV_eZR T_dr^ Vd$ `fXYee`SVZ\_Ra`d&Z\_e`WJ]`heYc`fXYeYVZc UVOZEV e` UZCHZ\_XFZEY eYV dygVoZEYV fd R]j  $VRc_hV]ERCVZ_RX`U\}_R_TZR] a`dEZ_ER_U$ WW/eYReeYV/ReVhZ\_VcdŽ?`\_VeYV/ddLeYV/`VeV\_ TR\_`eRWAUeYVAV]fifcZdR\_URdVVATVUe`Sfj TYVRaljiŁhYZTY ^ R.VdeYV Z dVTf cV, eYVZc VX d dW^ e` e` eeWZEYVeVc^ yWZeV\_eZR%T\_df^ Vc Zdfd/Ue`f\_U/d/ZVe/V/Z\SVehW\_Z/VeZejRU  $T_d^{aeZ} + yReZ_X$ SVT ^ VdRdZ\_ eReZV\_1 eZ; VdySVZ\_XZZEY dVhY dVZV\_eZej ZdSRdVU`\_  $T_dR_eT^{A} = T^{A} = R_{Z_{1}}^{A} = dh_{Z_{1}}^{A} =$  $T_dIZ f d WhYRe aV a]V^ZXYe eYZ \ WeYV Ž$ 6ZeYVcRSVeeVd`WWVZXYS`fc`cRa``cY`fdVY`]U \_VieU`chZ]dZCVUZefcSZ\_XUfSedŽF\_dfcV`W eYVZCZIV eZejŁT deR elj UVWV UZ XRXRZ de`fedZUV acVdfcVdLT\_df^Vdc`VdYZdejaVIR\_`eVgV\_}\_U CWAXZ eYVZC VR ZZCŽ

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> ¶i lýz näkláz Å Oź qa<br/>¶²äese aj Oź Ýá ¶%äese ab 1 Ł; al Oz ¶²O ão i lóz onai þ<br/>þ ½ É

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2 WWK jj YZXY ac`a`ceZ\_Ł# ~``WeYVe`eRJLSV]`\_X e`eYVXcfa`WZ\_UZeZLfR]dhY`^ZXYeSVeVc^U y^`UV|%T`\_d`^Vcd`WeYVejaVWR^ZZRcW/^ RugVæZZ\_XŽ:\_`eVvch`dutaVa]VhZeYRdec`\_X RkdeYkeZTeRdeVLgVcj T\_Tkc\_WhZeYeVVZcaYjdZR RaaVRcR TVIhY ZVe dec ]] R UhZU hłdY a Z dr`aaZ\_XTV\_eeVdR\_USfj\_SdR\_UVUT]`eYZ\_XZ7c`^ eYZddR Ua`ZeLeYVj eYZ\eYReeYV`aa`cef\_ZZdd WcT\_d^ aeZ\_ YRgVTYR XVU Wc eYVSVeeVZ3j  $R_U$  RXVLeYVaV a VZ eYZXC fa RV^ V SVcd W eYV^ VUZ ^ łYZXY decRef ^ hY TJVRcjj WW eYReeYVj RVhZ\_VcdR\_URVVMjjcvRjZvURdZ\_UZeZUFRjdŽ EYVZcd/JVT\_}UV\_TVZfT^SZ\_WhZeYR\_Z\_eVetvele Z\_d'TZR|ZWZ@\_|jZ\_eYZdXc`faZdRYZ&Y[VgV]`W Tf |ef cR| T\_d^ aeZ\_Wf\_UŽ2 |eY f XY eYVcVdf |ed Z\_UZIREVRT\_ddeV\_eac`}]VLeY\_fXYLeYVddkV\_VeYV Xc`fad'XXkdedeYReeYVy^`UVjT\_d^V& ZXYe RTef Riji UZeZLVZ e`eh`ejaVeZ@\_VZdeYVRTef Ri  $T_d^{\Lambda}$   $T_{M}$   $T_{M}$   $T_{M}$ V^S`UZUZ\_eYVZ`RXZ\_Rg``WeYZtT\_d`^Vcd`TZL VájŽEYV eYVcej aVZV\_eZ VdhZY eYZtyZVR[‰\_]j  $RdR_RdaZReZ_Z4`_df^ aeZ_Zd\_`h_e`YRgVR$ dec`\_XRdaZReZ\_R]T\_\_`eReZ\_ŽAV a]Vh`f]U]ZV  $\dot{e} dd S V dV \gamma^ UM T_d^ VLS fe Z dVZc$ RTef R Via VZ/TVeYY RV^`cV ZV/W ZEV\_&R/%  $T_d^{\Lambda} Vade c_SVeh W_eYVUVaZeRS V^{UV} R_U$ eYVCVRZZZA VEYVZC ZZVOŽ

EYVZ a` ceR\_TVeYRe RkdeYkeZtdZdSVXZ\_ZXe` eRV`\_Z\_4YZVR\_dURZ; ZEVdYRdRjcVRU; SW\_ ^ V\_eZ\_WŽERS]V"%dY`hdY`h V\_`c^``fdj Z`ł a` ced` VRVdeYVeZTT\_df^ VcX`UdYRgVZ TcVRdVU 1'% ~/`g\ceYVIRdeUVIRUŽ5ZaV dZXhZeygRlfV UV}\_ZZ\_dZ\_UZeZLFRjddvZkVfa`\_eYVViedReRXR\_dL eYVT ^ ^ `\_a]RIV`c eYV df SejV e` c\ac\dv\_e eYV dMWeYc`fXYR\_RdeYVeZTZ`RXVŽER\ZXeYZde` Zed) XZIR T\_TIf dZ\_LInWci X'VY'gUX'hUhU' dYfgcbÑg V]c [fUd\mhYbXg hc VY fYU`]nYX Ug U gminUhcb cZh Y Y c " 2e eYV V eV VL eYVZ\_UZeZLFR] ZYZL`cYVc]ZWdej ]VLeYVac`[VTeVU  $Z^{*}$  RXV ` WYZ1 ` c YVc dej ]VŽ2\_U eYZ1acVIV  $Z_{V}$ TV `VEYVZ' RXVLR RVdeYVEZT | R XF RXV dReYVc eVR R gVSR]  $^{T}VLT f$ ]U Via]RZ hYj aV a]V}\_UZed YRUe Roz Revh YRez YRaaV Z Xe evv +h Y Webgi a Yf W h fY lg U k c fX Ygg UYgh YhW Yl dYf]YbWY"

 $EYV dec`_X R deYV \& T T ^ a`_V e`VVT _ df ^ a \\ eZ _ Zl`_V`V eYV ^ RZ_ VM e` cdf_U c ^ ZZ X e YV \\ ZJR ` WYYZX' If ] ef c % Z ac Zl_`h ac`Uf TUU`_ R$  $^ R dd dIR]VLZe Zl R_ ` d Z R g R le eYRe R_j`_V IR_$  $V VI f e Z 6 g X b R c % o 7 c_ï_U k L" ***/ ac`g ZJ d$ 

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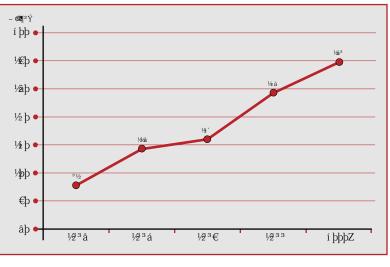
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EYVETIVEN VM aaZXIV\_eVELVEZVELZ eV } cebZ\_deR\_TVLW/^ RaREV i +ZeZIRacZeVeVeRIVL hYVEV dVcR\_UT\_ec`]RVRedf cVLLeYRe`aVeReVe RdRafS]ZT daRIVZ:\_ `eYVch`dteLRafS]ZT daRIV ZIT\_dEEf eVUVcRdyVIEVLdX\* V\_eVuafS]ZTZ\_ RIEFR] WRIELCH^ aaZXIV\_ecVdcVdV^S]V^\_VR\_`eYVc gVcj T]`dVj R\_UUZWC`\_]j Sj eYVafcTYREZX a`hVeLeRdeVdR\_UYRSZed`VeY dVhY`fdVeVVŽ EYV & f ]e ZIRUZ ZfeZ\_`WUZgVaZgiŁR\_U eYZi \_`h dW^de`SVR ad&bf ZZEV Wc a]RIVdhY &V aV a]VT\_X&& & ZEYV^R] eVf ddW^de`dV-VTe `\_V & UR^ V\_eR] TYR\_X& h Y Î di V`]W']g bck ` a UXY'i d`c ZgdY WU û i V`]Wgi" EY & VZIR\_ yR TYZa VJRX `Waf S]ZT daRIVE% 2 d. ZZL "\*\*'/L VRIY R\_Z\_W c^R] R& `^ VREZ\_`WaV a] V h ZEY dZ ZJRC ]ZW dg ]V Z

EYVUZEVCZZTREZ\_R\_UCIX^V\_eReZ\_`WEYV af S ZT da YVCV Zd cVcF JeZ X ł R U eYZd Zd R dVT U aRcRU i ł Z\_RUMZ ZREZ\_`WARCZA ZE YZ ł Złh YRe  $UZbZ_XfZhVdeVV^R]W^{\prime} eVVfcSR_VaVcZV_TVZ$ 2^ V\_U |Rddef U 1#!!!/ TYRced eYZddYZAZH YRe RC dV Rd R\_Z ZEREZ\_ WEYV dVR TZE YRd V\_UVU faSjSVZ\_XLZ\_eYVT]]VTeZeVZ\_RzZ\_RzjŁeYVZ.VR  $TZijZ:eZdR_ReeV$  are  $dVT_defTefdSR_JZWZ_$ RdfSfcSR\_TV eeV+eYVeRdeVV/ceYVf\_\\_h\_RU dfcacZZZ\_XLeYVSVRfgi `WZXYeR\_UdYRUhLeYV a]VRdR\_eL^ VR\_UVZ\_Xdec`]]ŽEYVdY`aaZ\_XTV\_ecV cVda`\_UdZ\_aRcee`eYVdVfcSR\_UV^R\_UdŽ3feeYZd `S[VTezgVf]eZ\*ReVjj T]RchVdhzeYdvTfczej\_WUdL eYVV\_UcVf ]eSVZXRV/c^ `WaTZR] ^ ZZXeYRe Zd ]eVOUL^ `\_Ze CULZ]f ^ Z ReVUR\_UR ZEXVŽ EYVRS` cozeV ReeV ae ScZ\_XdR dvT\_UTYR\_XVe` ]ZXYe+V\_T f\_eVcd h ZEY eYV UZWWEV\_e `eYVeLeYV der XV&RVCVARVUSjRardVVVVAVaVV `\_WZi\_UWUŁeYVdY`aaZ\_XTV\_ecVdW^ de` YRgV SW\_eRZ^d^RUVVceYVTZejUhV]V&URX/cV/cdł TZRIT\_eRTeSfeWARCKMI`WeYV@eYWŽ:eZdT^ZX e`SVRdaRIVeYReL]ZVeYVaRdRXkdR\_URcIRUNd`W eYV` JUTV eV` WIR eRX ŁdYcd Y'WUb'i gY'hc' ÎVY hc | Yh\Yfi k |h\ci hh\Y f|g\_g cZÎUWhb |  $RT_dR_e deVR^{\Lambda} WaV a VL^WAVZ XR_USVZ X$ 

 $\label{eq:started} \begin{array}{l} dW_{LSf} ehZeY feeYVUR_X& VSVZ_XS` eYVEVUSj\\ SVXXZ_XLRXXCVdIgVedRWIEa`]ZZIR] ac`aRXR_UR`c\\ d^Vj`feYVIJUZHfCSR_TVŽDW_Z_eYZI]ZXYeLeYV\\ ^R]] TeVRevdRafS]ZTdaRIVLSfeRdR^VEVa]RIV`W\\ aRdRXVŽ\\ \end{array}$ 

 $\label{eq:second} \begin{array}{l} 3 \ eV \ eV \ UV \ TZdZ \ alj \ ReR \ dVc^RZ \ VeV \ af \ S]Z \ dY \ VZZ \ Z \ Z \ Z \ VZZ \ Z \ VZZ$ 

> ZXYe \_`e eYV ^ R] SV R cZef R] ac` TVdd eYRe T\_dVTdRevdRUEVR^ `WeYVyHV%Q4VceRZ]jLT\_ł  $d^{aeZ}_{aeZ}$  a VRev dRdR } VU W [] VI 28 V 2 V eZ j Ž 7RdYZ ŁhZey ZedUj R^ ZId` WUZWWEV OZROZ R U ZV\_6Z\_TReZ\_ŁZteYVSVdt\\_`h\_ VtR^a]V`WeYV ZWC^RLeV eREEVZW EREZCHEYREUKZEVW/^T\_ł  $d^{aeZ}_{Z3feeYW} \sim ZYeSV d^{VZ}X^{O}$ DY`aaZXTV\_ecVd\_`e`\_]j cVacVdV\_eRdVVTegVL YZKRETYZIR ` d.W.Z\_X` WWKERZ\_ d ^ S` [ZTX ` UdeYRe YV/a aVcaVef ReVR UcV Vh aRceZIF |RcacRTeZIVdR U cháchál\_eReZ\_d`Wa TZkéjŽEYVj RcVRjď R\ZU`W Webzev TVeV `\_j eYRe V\_RS]Vd Zed a ReeZIZaR\_ed e` WWJ aRce `WRT^^f\_ZijŽEYZdZdaVcYRadhYRe aVa[VLUWaUh\_LdvR]j hR\_e+e`eR\VaRceZ Rozef R eYRe [VedeYV UVA] j eYVZc Z UZez If RZejŁ hYZdeT^^V`deZXRT]]VTeZeVZV\_eZejŽ:eZd eYVTYVScReZ\_`WRyHV%LSfeRaRceZIf]RcyHV‰ eYReZL\_`eSRdVU`\_T]]VI6ZvRI6Z\_Ž:eZlaVcYRad eYZdejaV~VafS]ZT1^ ~ CVdaVTeRe`ceYR\_RTe`dL^ ~ CV TOZZT eYR\_ a RoeZZaR\_d eYRe Zt eYV d'S[VTe`WeYV yafS]ZT%ZNRe`URJŽ



# Hk9<sup>°</sup>DC @H₽7 5@65 G<del>c</del>G<sup>°</sup>C : <sup>−</sup>Hk9<sup>°</sup>ÎK9<sup>°</sup>I



## K 95? DC @++7 5@=89BH+ =7 5HC B

 $2dacVgZ fdTYRaeVcddr`hVLLT_dr`aeZ_ZdeV_UZ_Xe`dfaa]R_eh`c`RdeYVTV_edf]ViaVcZ_TV`WdTZf]Z_edcRieZ_Ž2 dZ`ZfRcTYR_XVTf]USV f_UVc`hF]Z_a`]ZZTdŽ9Zde`cZfR]]jLya`]ZZTdhRdeYVTf]efdf]TV`V_e`W4YZvR_dTZfg'%a8RcdvE_L #!!"'ZehRdeYc`fXYa`]ZZTdeYRe4YZvR_dVVcXU^V_Ue`VZ_XdWceYVZ_UZjVaVcZ_TVdR_UeYVZcdał cddV_eRz_d`VdTZfg'RdRhY`]VZYReTV_edfZjZfR] a`UZfZTCJPVREVVFfUZ łgZffR]^UZFAR_UdaVUZ_TR]jedf]ac`UFTeZ_ZEYVdVRV_`ecYaZTA`]ZZTdAVFedV~de`YRgVTYR_XVL cRYAZTA`]ZZTdAVFAU^ACAVAL$ 

af S]ZT daRIVŽ3WKVT\_dZWZ\_XY`h eYVaf S]ZT daYVKVYRdSW\_TYR\_XUSj eVJVgZZ\_Ł`\_Vdr`f]U Rd\e`hYReVieV\_ea`]ZEZTdYRdT\_eczSfeVUe`eYV Tf]efcR]T\_decfTeZ\_`W4YZWR\_dTZkejŽ

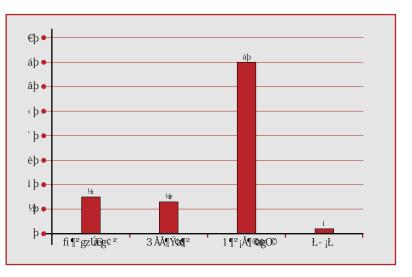
A` ] $\mathbf{Z}\mathbf{Z}\mathbf{I}\mathbf{d}_{h}$  h dW de` SV]VdUZ a` ceR\_eVc eVV acRI&ZVdR\_U c/ac/dV\_eReZ\_d` V/ $\mathbf{Z}$  d' TZ/ej Ž: ed UVI]Z\_VTR\_SVdW\_Z\_eVV]` h UV/cW` Va` ] $\mathbf{Z}\mathbf{Z}\mathbf{R}$  $\mathbf{Z}V_{e}\mathbf{Z}_{h}$  TReZ\_c/eVV]` h UV/cW` Va` ] $\mathbf{Z}\mathbf{Z}\mathbf{R}$  $\mathbf{Z}V_{e}\mathbf{Z}_{h}$  TReZ\_c/eVV]VUSj eYVc/dF]ed` VeYVF? 5 A #! ! " d' ceVjŽ; f de " # j VRcd RAKC UV` ` TCRIj h Rd c/de` c/UL TZZKV\_d ReV c/` Rc\RS]j U/eRIYUU V0'^ a` ] $\mathbf{Z}\mathbf{Z}\mathbf{C}\mathbf{Z}_{h}$  Y/ $\mathbf{Q}\mathbf{R}_{h}$  d ReV [Vd1 h Z]Z\_X eYR\_ SW/cVe a`  $\mathbf{d}\mathbf{Z}_{h}$  eYV d/gvd1 R]`\_X eVV]V46/cZY/e R  $\mathbf{Z}\mathbf{L}\mathbf{R}_{h}$  U j`f\_XaVa]VRV<VfTRLee`dXZdeVcWcg@ZX R\_ULZ\_XV\_VRILe`aRceZIZaReVZ\_ZdeZefeZ\_R] a`]ZZZdŽ

E` eVde eYV} cde Yja`eYVdZLeYV]`h [VgV] `W a  $\mathbb{Z} = \mathbb{Z}  hRd^RUVe`ac`}[VeY`dVhY`dRha`]ZZZdRdR ZeVXOR a Roe` VeVVZcZV\_oZjŽ3j ZUZeZU RjdhZeY Rol [ZU a`]ZEZTR ZUV eZej RolV^VR e olda` UV ed hY  $ZV_{e}Z$  WhZ Ra  $dZ_{R}$  R Xe WW RIZER\_UHY`S`eYg`eVUZ\_eYVacVdRV\_eZRJV/VII eZ\_d`WR\_fRq #!!! R\_UZ\_eV\_UUe` g`eVZ\_eYV aRc[ZR^ V\_eRcj V[VIeZ\_di5 VIV SVc#!!"/Ž@\_eYZd UV ZZ ŁR^ ` CVUV R UZ X` \_ VeYR eYV^ VCV RWAC^ REZ\_ `WR a` ZEZIR] `c ZUV |`XZIR] deR\_TVL Îdc`]hJWU'Ï fYgdcbXYbhg'UWWcibhYX'Zcf'bc' a cfYihUb & 1 cZhYgUa dY"@eYVccVa`\_ł UV edley dvhy UZU `eS`ey UVIRCVRa` ZZZR a`dEZ\_R\_UdeReVeYV/YRUg`eVUR\_UZ\_eV\_UVUe`Ł RV]RSV]]VUy\_`\_ła`]ZZR]%LR\_URIT f\_eWc(! " `WeWda`\_UV\_eeŽ

yA` JÆZIR%&Vda`\_UV\_ed R:V UZac`a` œZ\_ReVj Wf\_UR``\_XaV a]VhZeY YZXVc ]V&Vdf TR eZ\_W^ eYVf aaVcdeRef^ R\_ULaRœZIf ]Rcj LeVV ^ VUZf^łYZXY deRef^, ^ V\_RXU`gVc %& R\_U aV a]VW^ DR\_eZX ŽEYVdVT\_UXc`f a T\_eRZ\_dR ]RcXVac`a`œZ\_`VZ\_UZgZLf R]dW^ eVV]`h VcdeR ef^ hZeYZ\_T^ a]VEVdVT\_URg`VLf TReZ\_Lh`^ V\_ R\_Uj`f\_XaV a]VRXVUSVehW\_") R\_U S%LR\_U aV a]V]ZZ\_XZ\_TZEXd`eYVceYR\_DR\_eZX Ž

 $EYV ya` ] \textbf{ZZIR} \% \&c` fa TR_ SV U \textbf{ZZIVU SVEh W_} cVda`_UV_edZIV_e2JVZ_XhZeY AcVdZIV_e=RX dLeVV$  $4`_TVdeRIZ_ 1X gVc_ZXT R] \textbf{ZZ} _ / R_Ua` d \textbf{ZZ}_d$  $cR_XZ_X V o^ eVVTV_ecVe` eVV] W \textbf{Z}`_ eVV`_V$  $YR_ULR_U eV` dVZIV_e2JVZ_XhZeY; `Rof <math>\frac{3}{4}$  = Rg  $\frac{3}{4}$  1eVV^Rj`c` W LR\_e JX 'LeV`aa` d \textbf{ZZ}\_ R\_U eVV cZXYe e` TV\_ecVicZXY dL`\_ eV` eVV ZH YV\_ eYZ IZ U\_VLZ: eR\_daZVdeYReeYV y4`\_TVdeRIZ\_% c` fa ^ R\_Vdfa " &` VVYV dR`a] VR\_U eYV y` aa` d \textbf{ZZ}\_ % " S` ŽEYV y\_`\_la` ] \textbf{ZZIR} % c` fa L] VeZSV da VReVLL T^acZMd(! ~` VKR] 4 YZ VR\_dZ\_eV cZZMA VZ

 $\label{eq:constraint} 2ddVARLdeYVdVT_UYja`eYVdXLeYV]`h ]VgVJ ``Wa`]ZEZIRJ aRceZIZaReZ_ R``_Xj`f_XaVa]VL eh` eV_UV_TZdTR_SVZLV_eZ_VLZEYV} cceZleYRe j`f_XaVa]VRXVUSVehW_") R_U#%U Z_UVU$ 



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UZA JB, R^ fTYh VR\Vca`JZZTRJZV\_GZj eYR\_`eYVc RXV Xc`fadŽEYVeV dW^ de`SVR ^ Rc\VU a`JZZ TRJ UVIZV\_GZ TRZ\_ R``\_XeY`dV hY`T fJU SV T\_dZVeVU aRce`VeYVyceR\_dZZ\_ XV\_VCRZ\_%Z3j T\_ecReLeY`dV hY`\\_Vh eYV acVI"\*(\$4YZ/VZ eYVZcj`feY`c RU`JVETV\_TV dW^ e`YRgVR dec`\_ł XXca`JZZTRJZV\_GZjŽEYV dVT\_UeV\_UV\_TjZLeYReL R``\_XeYV ya`JZZTRJ%oVch`\_UV\_ecLj`f\_XaV aJV ZVV\_GZYV^`cVhZY eYV`aa`dZZ\_Ž

ERSJV") SVJ`h dr`hdY`h Rezef Uvde`Uvi ^`Tortj UZWWCR``\_XeYVeYeW Xc`fadŽH YZV eYV XcWre Sf]\`WeY`dVhY`ZUV\_eZjVhZeY eYV 4`\_TvoertZ'\_ dfaa`ce eYV Uv^`ToreZt djdev`Ł Rj^`deYRJWWeY`dvT]`dve`eYV`aa`dEZ\_eYZ\_\ R\_RfeY`cZERZR\_CXZ'VTR\_d^VEZ`VdSVSveeveZ 2XRZ\_Łckda`\_UV\_edhY`ReVJZeJVT\_Tvc\_VhZeY a`JZZTdeV\_Ue`SVJVdT ^^ZeeVUe`Uv^`TortJZ y?`\_ła`JZZTR%okda`\_UV\_edTR\_\_`eSVZUV\_eZ VU hZeYy\_`\_łUv`TorezMaYa`hVgVZ\_\_WaterVjdr`h XcWre4cT ^^Ze^V\_ee`eYVUv`ToreZtcXZ\_VeYR\_ `aa`dZZ\_daveVdZ

 $EYVAVUZWWAV_TVARAVT]VRAVE hYV_eYVATS[VTe$  $Ztla`]ZZTALSfeeYYJTR_SVAW_Z_`eYVARARE`Ž$  $2dRaVT_UVIR^a]VLeR_VReeZfUVAte eYVTYR_XAd$  $aW_Z_4YZIVŽEYVXARe^R[`cZgi1)(~/`Waa`dZ$  $eZ_R_Uy_`_la`]ZZTR%aVa`_UV_edSV]ZgVeYRe$  $eYVAVTYR_XADRAV]VRUZ_X_`hYVAVR_UeYReeYZ_Xd$  $YRgVcV^RZ_VURDEVY_hVAVZEYV dev_XeY`VAVV$  @/ }ä/á

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Z.V. & TREZ\_RV\_`e & Z&A] ^ RekktŽEYY ^ VR\_ eYReeYVa`]ZZIR] T UVła`h \k RdeYVV a ktdZ\_`W a`af]Rc d g\&ZX\_ej ł Raa \Rade`SVZ\_eV][ZXS]Ve` [f de eYcW`f e`VWgVg`"! TZXV\_dŽ:e dW^ d c\R d\_RS]Ve`d aa`dVeYRe`\_]j eYZl^Z\_`cZj c\&Rtd a`]ZZIdRdaRe`VhiYReXgVd^ VR\_Z\_Xe`VgVg`UB] V a \kZV\_TVR\_U RdeYV daYVkV h YkV eYVZ Z.VR`W 4 YZV Złe`SV dYRa VLŽC h Yfk [gYž]ha i gh VY` Uggi a YX`h Uhdc`]HVg`Xc Yg`]hhY`hc`g\UdY` h Y`]bX]j [Xi U``UbX`bUhcbU``]XYbh]micZh Y` ch\Yf`+Si`cZfYgdcbXYbIg"

EYVZcVJVgR\_TV`Vva`]ZeZTdLf\_UVcde``URdRUVi ZSVEREVT\_defTeZ\_\_\_\_WeYVdTZR\_\_\_dVeLdW\_de` SV Z\_VU é TZERV ď Z\_RSZZEj é RTeT [[VT6ZEV]jŽ EYVZ'a`ceR\_TV`Wa`]ZZTdZdZdZ\_gVcdVjj cVjReVUe` eYVy\_Ref cRIZEREZ\_%WA TZAGŽ WEYVVI ZEEZX d.V.c Zty Ref dR% R Uf TYR XARS Why YRe Zda` ZEZTOWO :\_UWUŁCYÓWRCTYZ\_e`eYVa`]ZEZIR] ReeZef UVd`WYZ}ł UCV\_R\_URU ]VCIV\_edZ\_UZIReVcleyReeYVZc\_VXReZeV WWZ\_XdRS`fea`]ZEZTdRCVXV\_VR]jj Rdd TZREVUhZEY RaVćTVáeZ\_eYReeYVZc`h\_RTeZ\_dRcVZ\_VWWTeZeV  $12^{\text{Rd}RL''**}(, > R_kZL''**(/ZJ`f_XaV a]Vd'W$ WCW/^RTX\_ZZZVUZZTdUSVTRfdVeYV/hZEYe` TYR\_XVeYVVIZeZ\_XdeReV`VRXWRZdSfeWWJa`hVdjVdd e`U`d`ŽHYV\_eYVZcUVdZvd]\VRU\_`hYV&VLeYVj eV Ue` dvRIeSj dv[VIeZ Xa` ZZZdŽ5 VdaZZ Xa` ZZZd ZdRhRj`W R\Z\_XfaWceYVZcWfdedReZ\_RehYRe eYVjdWRdeYVZ\_WWWI6ZeV\_Vdd`VeYVZc`h\_RI6Z\_dŽ  $EYZISC RU = C^{d}R - UZX WeYV add Zfd$ CVa`œidYcd`Yk]``cb`mYlYfWgYWfhyYbg\]d k \Yb h Ym \Uj Y h Y gY ZW bÚXYbW UbX gYZYghYYa hc ZYY h\Uhh\Y|f UWhcbg WUb a U\_Y'U'X]ZZYfYbWY"

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9 ZXY VJVTeZ\_ efc\_`fed RcV`VAV\_ foNU Rd R\_ RcXf^V\_ee`oh`heYRe 4 YZjvR\_UV^`TeRTj Zd Z\_ d f\_UYVRjeYŽ

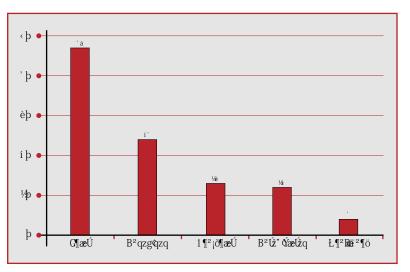
 $\begin{array}{l} 6] VIeZ\_dTf] USV XZZX X CAREAC h VZXYee ``$  $yAXWU^ ``WIY`ZIV%Z eVVT]] VIeZeVZ RZZ RcjZ$ 2TT dZXe` eYV CAF] ed`V&YVF? 5 A #!!" dfd $gy[LR]^``de YR]WVR[] CAb`_UV_ed RCV h YRe hZ]$  SVTRAX cZAU YAVRdyg`eAdžE YAVZ\_UZ9ZLFRd g`eAUZ\_;R\_fRg #!!! R\_UhVAVZ\_eV\_e`\_ efc\_ZX `feRARZ\_Z\_5 VIV^ SVc#!!"Ž2eeAV`eYAVI eAV V RVy\_`\_łg`eAdMaeY`dVhY`UZU\_`eg`eVR\_UYRU \_`Z\_eV\_eZ\_`WUZ\_XdŽ

HY`REVEVVIVIÈ dENCEYVZC^RZ\_TYRETENCZEZT Zela`]ZZIR]ŽEYVyg`eVc%Zc`faZ\_T]fUvd"!!!~`W eY dV hY ZV\_eZJVa`]ZZTR]jL hY VeYvc hZY eV `aa`dZZ\_`ceYV4`\_TVeRTZ\_Ž3jT\_eRHL`\_]j ##"`VY\_`\_ła`]ZZTR%dv&:\_UV\_edRvaRe`VeYv VJVTe`dRVZ:\_`eYvc h`dULaRezTZREZ\_Z\_VJVII eZ\_dZlaRe`VRa`]ZZTR]ZV\_eZjLcVARUJV&I`VZed ZV]`XZTR]`cZV\_eReZ\_Ž@VeY`dV hY`drRvS`eY RecZSf eVd1a`]ZZTR]a`dZZ\_ZXR\_UVJVTe`dSJ aRd eZTZREZ\_łZETR\_SVdZUeYREUV^`TRTJZIRT^ł a`\_V\_e`VeYVZZV\_eZjZ2\_UZ\_UVULeYY\_XV\_VRJ]j VJ acVdTRdec`\_XT^^ZE^V ee`UV^`TRTJŽ

 $2 XchZXaca`a`ceZ_`VUZEXV_dH% ~ Z_eVV \\ \#! ! " aRc]ZR^ V_eRcj V/IeZ_d^R_ZXWEd^V_ZU \\ `VWAKcgReZ_ZD)^VU eYZISj_`eefc_ZX`feZ_ \\ V/VIeZ_dieh`^Z]Z_ 4 YZVR_dRVV_`eV_c`]/VIEZ_dieh`^Z]Z_ 8 CHZZ/E eVVcSj RIEESV jace eVcEZX i' & eV^fdR_U da`ZVUSR]`edR_U #$! eV`fdR_U \\ S]R_\`_VHZ_S`eVTRACHY RVVI acVCHZXEVZc RZZ_RZ_W'^eVV4 YZVR_a`ZEZR jd eV^Z$ 

2\_`eYvcdZ\_Z\_TR\_ecVcf]e\_WUde`SV^V\_eZ\_VU+ eYV]Z\_ZeVUZ\_fV\_TVeYReVT\_`^ZTVRTe`cddW^ e` YRgV`\_VJVTe`cR] Reczef UVdZH YZJV%&``Vg`eVcdRtV aV a]VhY`SVJZgVeYVj YRgV]`de`feSj eYVVT ł

\$'%B=1 ä4 1@ga¶ÚO@aaŶ¶" @äÇÅz Lýz²aĐ" z ÝÈ



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 $\label{eq:linear_line$ 

## 

 $EYVZ_Wc^{A}RZ_R_R_i dWd^{A}WdedeYReUV^{T}I$   $dRij YRd^{}_j j Z ZWUZ a^{} cR_TVRdRT_dZf eZV$   $acZ_TZa_VVWeYVT j VEZVZ RZ_R_i Z2_UeYVVZi$   $WceYVc_VZI_VVc_eYZI_ReYZU^{V}WYV4YZ_VR_d$   $d^{} cgy WdZUeYy UZJ_{eTR}VhYRej aV^{VX}gi$   $Vc_^VeeYY YRULR_U'')^{''} dZUeYy h^{}j USV$   $T_eVeRZYR_RfeYcZRZ_dXZ^{VZA}^{A} aRZi_h$   $hZeY URERW^{2} 2cXV_eZ_R_VgV_Z eYV^{Z}ke^{V}W$   $eYReTf_ei dTZi faYVReR_i dZeR_i Z4V^{} i W j T^{2} ZeVUe^{V}$   $UV^{T}ZR_i J 0$ 

 $4ZEKV_d$  Receff Uvde h Rduda ) Zezddw e SV Uvevc^ Z\_W\_ ed ^ f TYSj R\_j RSderle ZURRdSj eYVZ: VgVg UB V a V ZV\_TVŽ: e Raa V Rde SV Y V VL Z\_ eYVZ: URZj d TZR] adrie ZV V LeYRea V a V f\_UVX eYVZ: T X\_ZEGV R\_U RWWEG V y RaacV\_e ZV V YZa‰ Z\_ a ) ZezTR] RWWZ Z 4 `\_d ZU c Y h a V a V J V C\_ hYReyWWU^``WIY`ZIV%6VR\_dŽEYZtlacZ\_TZa]V ZŁ`WI`f cdNLRaZjRc`WW^`TCRIj, TZENKV\_dYZa Zd VIVETZHUSj TY`` dZ XR UUVTZLZ XR'` XUZWA V\_e`aeZ\_dŽAdRZVVC eYZdyVXVU^``VVIY`ZIV%Lo Y`hVgV£XV\_VR]j`gVdj``\deYVVR1eeYRe^R\_j`W eYV`aeZ\_dYRgVSW\_UVIZUUVRCZ\_RL/gR\_TVR\_U R]`\_XhR; RhR; W/^ eYVTZEZKVŽ:\_TcVRdZXjjŁZe Zd\_`\_ła`]ZEZIR] WETVOłEYV]`TR|R UZ EVE REZ\_R ya`hVcdeYReSV%iæYReUVeVc^Z\_VeYVTY`ZVdWc d TZkáj d Uvýlj a ^ V\_eŽ4ZEKV\_d y]VRc\_%eYRe eYV d TZR] dZef ReZ\_dW^de`SVR\_`dU/cVdeRS]ZM/USj  $RWhL^{s}dh YZY eYY YRdV_{UVIZZ}^{h} R_ZX$ a`hVŽ:\_`eYVch`dJdLeYVReeZefUVd`W1ZeZkV\_d dW^ e` SVZ\_~fV\_TVUSj eYVaVcTVaeZ\_ eYVj YRgV `WeYVZCRSZZEje`^R.VRUZWWCV\_TVe`eYVhRjeYV Tf\_eqiZdXZ\_XŽ@\_VZ\_UZIRe`c`WeyZdZdeYVWW/Z\_X `Wa`hVdVddVddŽ

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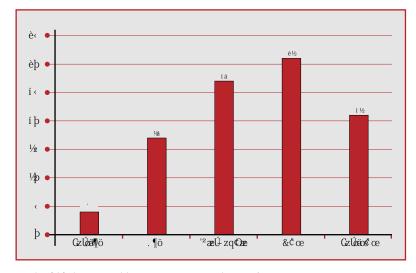
@∕.łāþ ;¶©©@C36⊱Ŷær²gzmäÅzlýgz²æ0″zÝðO″lźz⊄″öö ©enaaezð¶@¶ö⊄″äÝæĐer–z²æY

>¶ï ÚgznaB1Ł; al Ove¶²O®≥ï Údzonai þþ½Ê

2\_eZZARZ\_XeVVT\_TJfdZ\_LZETR\_SVdZUeYRe 4 YZJNR\_deV\_Ue`dYREVRdec`\_XWWJZ\_X`Wa`h VcJVdd \_VdZE YZdcVdf]eZdUVcZgVUVG'^ R\_RUUZEgVZ\_UVi SRUU`\_ WfcgRzZS]VdLRddr`h\_Z\_dCS]V#!Ž2d eYVWJ]`hZ\_XTYRecCgVRJdL`\_VZ\_}gVcVda`\_UV\_ed WWJ^ REXZ\_RJZKUR\_UdT`c\_VUZ\_VgVcj`\_\_V`VeYV Vfc`aeZ\_d^ V\_eZ\_VLER\_UYRJWVeYVR?`a]VWJJd Ze`eYVdh`faaVcSR\_Ud`VeYVZ\_UVIŽ

CVda`\_UV\_edhZeYRdec`\_XVWJZ\_X`Wa`hVdjVdd \_VddeV\_Ue`SVJ`\_Xe`eYVJ`hVcdecRef^ŁhZeY`fe UZdeZ\_TeZ\_ `VVRXV`c dvfZA`hVdjVdd\_VddZdeYV

\$'%B=1 ä/e '²qz÷ä¶%åŶözÚ@ÝÝäÇÅzÚgz²æÖ'zÝÈ



 $df S[VI52gVV aV22/TV`VeVVa``dLR_UZET_dZedd Z_WVJZ_X_`e[f deV a]`ZeVUR_UVIT]fUVUVT_`^ZI TR]jjLSf eR]d Yf^ZZEVUR_UdT c_VLZA`hVd/Vdd __VddZ` a]ZdR]RI\`Ved/VVT_}UV_TVR_U`Vedf de Z_`eVVcdZ2S`gVR]LZe^VR_dR]RI\`WT_}UV_TVR_U`Vedf de Z_`eVVcdZ2S`gVR]LZe^VR_dR]RI\`WT_}UV_TV Z_`_Vd RSZZej e`TYR_XV eVVUZVTeZ_`W_Vd`h_]ZW`c RWWTe UVgV]`a^V_edZ_eVVT f_ecjZ 4`_dVbf V_eljLaV a]V`VeYZlej aVeV_Ue`ckeVRe W/^ eVVa`]ZZIR daVVdZ$ 

2\_Z a` cdR\_eT\_TJf dZ\_etNeTR\_SVUGh\_W/ etZiZierNeh Y`a cfY`dck Yf Ygg dYcd Y ZYY`z h Y`a cfY``]\_Ymh YmUfY hc h ]b\_h Uhdc`]fJWg` lg`dc]bhYgg`UbX`hc`dfcZ'gg`]bX[ZYfYbWY`hc` h Y`dc`]hJWU``fY[]a Y" EYZiZiS`c\_V`feSj etV W]`hZ\_XT cd/ReZ\_+etV^`čVa`h Ve]VddaV a]V WJZ\_etVZcUZj [ZgVdetV^`čVa`h Ve]VddaV a]V WJZ\_etVZcUZj [ZgVdetV^`čVa`h Ve]VddaV a]V WJZ\_etVZcUZj [ZgVdetV^`čVa`h Ve]VddaV a]V acVgZ f d CVa`ce 1F? 5 AL #! !! R/Z\_cVReZ\_e` yd TZA] TRaZEN?ZEYV cVdf ]cd etV\_Z\_UZR&U etNe aV a]VhY`eV\_Ue`ecf ceR\_URdf TZRVhZeY`etVd XV\_VGN]j aRceZIZR&V^`čVZ\_af S]ZTRWR&cZEYV\_ Rd\_`hLZeTR\_SV dZU etNe dTZA] ViaVZV\_TVR\_U a`]ZeZIR] RTeZ\_RcVf df R]jj ]Z\_\UJZVeh`dZVd`W

2\_j`Sdkgkck&ZhZ\_XeYVURR`\_eYVhVR\_Vdd `Wa`]ZZIR] ZJV\_&Z TREZ\_ R\_UeYVVieV\_ee`hYZIY aV a]VWJ] a`hVc]Vdd ZlS`f\_Ue`YRgV dec`\_X UfSedRS`feeYVdX\_Z TR\_TVeYRea`]ZZIdTR\_YRgV Wc^ R\_j 4YZJVR\_dŽ:eU`Vd\_`edW^ e`SVZ\_eYV a`]ZZIR] daYVcVeYReeYJ ^ ZXYe}\_UeYVcvdffcTVd eYY\_WUe``cXR\_ZXVR\_UXgV^ VR\_ZXe`eYVZ cV]REZ\_dYZa hZEY d`TZkjZEYVhZJVdacVRUWJZ\_X `Wa`hVc]Vdtd XXVdedeYReeYJ U\_\_`eaVcTVgV a`]ZZIR] a`hVcRdYVJaVAJZ\_VYR\_TZ\_XeYVd`TZA TRaRSZZEZ/deYReaV a]V\_WUe`SVT ^ VdxJVkVJZR\_e RXV\_ed`cyd`S[VTa%oVU/gJ]`a^ V\_eZ\_4YZJVŽ

EYVEVIR\_SV\_`UfSeeYRe4YZ/W\_UV``TRIj YRdSW\_g&g d'TIVdHM]Z\_eYVh`c\`WZ\_dEZfeZ\_R] T\_d]ZLRZ\_ŽeYRdSW\_[VddV\_dEZgVLY`h\g&de eYVd'S[VIEZgVLIf]efd]UZ`V\_dZ\_`V&YVecR\_dEZ\_ ac`TVddŽ@\_V^ZXYeVgV\_R\hYVEYVcZeZdTZEZKV\_d hY`YRgVSVT^VUVERIYVU &V^ a`]ZEZTZ9Rd eYVa`]ZEZIR]d\_deV^\_`e dReYVchZeYURh\_ W^ TZEXV\_dD>ZXYe\_`eZddV/WKWVV\_EZ]Uj\_R^ZdSV XV\_VCRZ\_XeYVWVJZ\_Xd`VZ`a`eV\_TVR\_UViTIfdZ\_ UZda]RJVUSjd^R\_j4YZ/WE\_dD



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4 `f]UeYV Rdf VUZER\_UeJ\&ZZ\_aReZf ]Rd ]j Ld aa]j eVVZZ\_Z TR\_TVeYRea `ZZZZZ TARZZ Xj ]RT\dDEV\&ZZ\_RIETR]j dW de aVAVC d&AG `V&YVW\_TEZ\_d\_`c^ R]j Rdf TZRAUhZEY a `ZZZŽ > `dVeYR\_a`]ZZTR dAWTVALZEZL\_`h eJ\&ZZ\_ Z RXd eYRe ReZIF ]ReV aV a]Vd URZj V aVZZ\_TVŽ :^ RXddW^ e SV]Vdff\_hZJUJ R\_U^ `dVdUFTi eZgVeYR\_h`dUhYV\_ZET ^Vde UVCRZSZ XRWW1 eZgVVI aVZZ\_TVdR\_UT \_gYZXaV a]VdV` eZ\_dŽ 2]] WC^ d`Wf TZS] dJREZ\_dZA RAV\_`h aVC^ VRAU Sj R\_ yZ RXVTF]ef d%hYZYZIXZZZ XcZV e R\_ V\_`c^ `fdLR]eY fXY ~WZZ XLRcdJ `VT]]VTEZV Z RXZZZH YReZIER\Z Xa]RIVZIRyZZF RJ T\_ł def TEZ\_`WARZEJ SVchW\_eYVZ RXZRJ R\_U eYV cNRJŽ=ZV eYV a` JÆZIRJ Z.W ]`XZd` V&YV a Rett. eM/VgZZ\_\_`h dW^ de` ac` gZLV4 YZJNR\_dh ZeY eYV \Vj deYVj f dVe` Z\_eVcackeeYVZc VI a VZZ/ TVŽEV/VgZ dZ\_ZdeYf dSVT^ Z\_XR Tcf TZGJ e``]` V&M/W Schd gReZ\_ŽE Yc` f XY ZeL4 YZJNR\_d TZGj TR\_cV-VIe`\_ Zed/VŽE YVCVZIR` a]VVgZLV\_TVLeYV\_LeYReeM/VgZZ\_ Zda]R\_Z\_XR gZER] c`]VZ\_eYV]ZW` WI TZG Ž

 $2_f^SVc^WRZ_2^VCZR_RfeY^CQYRZVI$  $]ZYeWeYV^aa^cef_ZZCR_UcZNCRthTZRWDhZY$  $eNVgZZ_Z_RZ_2^VCZR18RTFA4R_TJZ_Z"**!,$  $=R_UZ."**#, > Reg243RSVc~L"**)/R_UZ_4YZV$  $14ReRj_L#!!!, 7f_V_kRJZRL#!!!/Ž:eac`gZNct$  $4YZVR_dhZY^`cb`WAVZcTf]ef_cR]T_d^aeZ_Ž$  $EYZIRbVIehZ]SVRUCVdMUZ_ARce%Ž$   $EYVTV\_ecR] a]RIV`TTf aZUSj eYVel/VgZZ\_dvé$  $Z\_^R_j 4YZ/VR_Y^VVdSVRcdhZe_Vdde ZedZ aRTe$  $`_ eYVhRj VgVcjURj d`TZSSZZcj Zl`cXR_Z&VUR_U$  $Vf aVCZ/TVUŽ4`_dvbf V_elj LeYVCVZIRT_Tvc_eYRe$  $eYVXc`hZ_Xdx^V_eReZ_`VVel/VgZZ_``WWCZ_Xd$  $R_UT_df^ aeZ_^ZXYe]VRU e`Vc`dZ_``Wd`TZRj$  $cV]ReZ_dYZad R_UZ`c eYVTf]ef cRj VMC^Vh`c\`W$  $_ReZ_R]ZWŽ$ 

HYVEVeYVa`eVeZRZ Z'aRTe`\_aVcd\_R\_cVR eZ\_dYZadZdT\_TVc\_VLŁeh`RdaVTed\_WUe`SV  $UZdeZ_XfZdYVU\check{Z}@=eYV`_VYR_ULZeZda`ddS]V$  $eYRe eYV oZV Z T_d^ aeZ_{L^{h}} Z ToVRoZ Xj$ Z\_UZ&ZLFRJZKU R\_U dXX^ V\_eVUL ^ Rj YRgV SW\_ UR^RXZ\_Xe`aVcd\_R]VXZ\_UdYZad`caRceZIZaReZ\_  $\underline{Z} \ CXR_{\underline{Z}} = \underline{Z}  [VTeLeY`f XYŽ@\_eYV`eYVELeYVEVZIZWE^ReZ\_ e`d\`h hYReRdec`\_Xad\dV\_TVeYVeVVeZZZ\_d\e ZdZ VR^Zj ZWZEYZdRIefR]j dW^d ZVj e YReV SW\_RWATECZ\_eYVTfccV\_eeV\_UV\_Tj\_WcaVa]V e`hZeyUdRhZ\_e`eYVWR^ZjjŽ@\_VaZ/TV`WUReR RgRZIRS]VT\_TVc\_deYV]`TReZ\_`V&VVgZEZ\_dvedZ\_ eYVY^ VŽ3VehW "\*\*' R U"\*\*\* eVVZcadvdV TV  $\underline{Z} eVV]\underline{Z}\underline{Z}X\underline{Z}\underline{Z}X\underline{C}^{^{-}}UV1]\underline{Z}UUd\underline{X}\underline{Z}T\underline{R}ej$ eYVfaaVcdeRef^ R\_UdjZXYejj Z\_eYVZ\_eVc^ VUZReV `\_\_VLhYZdecV^RZZXdeRS[VZ\_eVV]`hVcdecRef^Ž 5 fcZ\_XeYReaVcZULeYVaVcTV\_eRXV`WaaVcdcR ef ^ Y` ^ VdhZey Rev VgZZ\_ Z ey V^ RZ SVLc`` ^  $\underline{Z}$  TeVReMUV&\* ) ! " e` \*! " ,  $\underline{Z}$   $\underline{Z}$  eVe\* VUReVeV1 e`ceLeYVac`a`ceZ\_Z\_TeVReMUWY^'#" e`'\*",  $R_UZ_eV)^h c de Re Ze c d V W ^ & " e & " Z$ :eTf]USVdRUeYReeYV]`Tfd`WLeZ`RIjRSdcSd eYV af S ZT Z' RXXŽ=ReV&LeY` f XYLeYV` aa` deV eV\_UV\_Tj hZ]SVdW\_+Sj cVacVdV\_eZ\_XZ\_eZ\_RIjŁ ev/vgZZ\_\_ac`XR^ ^ VdTcVReVR\_Z]fdZ\_ `WefeYZ 3feZe`\_]j RTYZgVdeYZdyecfeYVWWT&%Sj ^ R\Z\_X eYVacZeReVaf S ZŽ

 $EV_V [gzZ_ Zldz] R_ Z a `cR_ e V_V V_ e Z e V$  $d TZSZZ `VM YZNR_ VA ZZ ČZ E VVac` a `cz_ `W$  $aV a]VhReIYZ_Xac`XR^ \ VdhZY eVZ VA ZZ ČRe$  $TVcHZ_ eZ Vd`VVR YRdcV RZ VU dVRU ReRS`fe$  $)! " dZ_TV"**' ŽZTT dZ_Xe` eVV"*** 4? EG$  $a`]]L' ' " `WVch`_UV_edZ eVVf aa VcdeRef ^ R_U$  $) $" `VeY dVZ_eVZ_eC VUZeVR_U]`h VcdeReR$  dz]]U eYZŽ2 d2 ZPc eV\_UV\_Tj ZdcVgVR]VUSj eYV F?5Ad\*cgVjŽ2dRVRY Zj REzzzgiŁhReIYZ\_XeVVgZ dZ\_e`XVeYVc1&! ~ `V4Xda`\_UV\_ed'T ^ VddVT\_U `\_]j e`eR]\Z\_X`gVcVRY Zj ac`S]V^d1&! ~ Z

2dcVXRLdeYVdvT\_UeYVdxLeyReRdZ\_XIVafS|ZT  $YRdUZZ_eVXdReVUZ_e^{-}_f^{C} ddVX^{V}eVU^{-}VdL$ eYVTV ecRZi `WVhdSf ]]Vz dZ S`eY eYVd aa]j  $R_UeYVT_d^{aeZ_{WeyVgZZ_{ac}} XdR^{A_ZX}$ dY f USV YZXY ZXYeVUŽE YV acZ cZej XZeV e eYV\_VhdTf]UYRgVR\_`c^RegeVVVVV\_e1yZed d^VeYZ\_Xj`f [fdeYRgVe`hReTY%LSfeeYZdUVd \_`eacVgV\_eZeSVZ\_XRa`hVcVM d`TZRZ\_eVXcReZ\_  $^VIYR_Zh Z2 \ZU \WT ^ f_Zj \%Zh TevrevU+$ gZuh Vcd WWJ eYRe eYVj REVZ\_T ^ aR\_j hZeY eY fł dR\_Ud`WeYVcdReeYVdR^VYfdLd/RcZ\_XRdvé `W^VdRXVdŽ2\_UeYVdYRvZX`WZ^RXVd]VRUde`  $eVVTeVReZ_ WT^{^} ^ = eVVVeZ_ Za eR_e$ Where the the terms of terms of terms e`hYZIY aV a]VRœZIf]ReVhYRe eYVj YRgVdW\_Ž BYkg'dfc[fUa a Yg'UfY'h\Y'a cghdcdi 'Uf' fl) 1 łžUbX h YmUfY U`gc h Y c bYg h Uhh Y `Uf[Yghidfcdcfh]cbicZfYgdcbXYbhgifl&uEi X]gW gg k ]h ch Yf dYcd Y"

$$\begin{split} & E YV \text{We erre UZHF} dZ \_ `\text{W} efc_d` _ yh \text{B}d \\ ` W \text{WZ} & \text{Werz} \text{X}dT f ] U \underline{Z} \text{UZR} \text{Vere Z} \text{RX} dac \\ & U & \underline{Z} \text{ReV} d & \text{Vh YRe `gkc } R & \text{X} \text{F} \text{RX} \\ & \underline{Z} \text{ReV} d & \text{Vh YRe `gkc } R & \text{X} \text{F} \text{RX} \\ & \underline{Z} \text{ReV} d & \text{Vh YRe `gkc } R & \text{X} \text{RX} \\ & \underline{Z} \text{ReV} d & \text{Vh YRe `gkc } R & \text{X} \text{RX} \\ & \underline{Z} \text{ReV} d & \text{Vh YRe `gkc } R & \text{X} \text{RX} \\ & \underline{Z} \text{ReV} d & \text{Vh YRe `gkc } R & \text{X} \text{RX} \\ & \underline{Z} \text{ReV} d & \text{Vh YRe `gkc } R & \text{X} \text{RX} \\ & \underline{Z} \text{R} \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} \\ & \underline{Z} \text{R} \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} \\ & \underline{Z} \text{R} \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} \\ & \underline{Z} \text{R} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} \\ & \underline{Z} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} \\ & \underline{Z} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} \\ & \underline{Z} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} \text{R} & \text{V} & \text{V} \text{R} & \text{V} \text{R} & \text{V}$$

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aV a]VRœZIF]Revh YReeYVJ YRgVdW\_ŁY`h \g\&Rd Z\_UZIRevdeYRe Z`RX\dRv\_`eT\_d^ \UaRdZgVjZ :\_ \KUZRevdeYRe Z`RX\dRv\_`eT\_d^ \UaRdZgVjZ :\_ \KUZRevdeYRe Z`RX\dRv\_`eT\_d^ \UaRdZgVjZ Z\_UZgZIFR]dT\_ccReeeYVZ.`h\_gZh`V&YZ\_Xd\_`e `\_]j hZeY`eYVc VI aVZZ/TVd dW\_`\_eYV\_Vhd. SfeR]d hZeY eYV`aZ\_Z\_dRZvUSj`eYvc aV a]VŽ EYVd/UZIIF dZ\_dRS`fe\_ReZ\_R]R\_Uh`d[U\_Vhd IR\_dZ`f]RevdYRvUeYZ \Z\_XRS`fehR]d`VVZZX e`XXeYvc, Z\_`eYvch`dLLSS`fehReZIX`UR\_U SRLEJVZZZ RevR\_UZJVZZ RevLSVRFeZM\R\_UfXjj Z\_d TZeJ]ZWZ9`h \g\cSR\_R]eVvUZIIF dZ\_Ld^ V UX&W`WJRS`dReZ\_ZX\ac UFTeZ\_`VRyT^^`\_  $dV_d\% dR Vda |RIVZ: eTR_ `eSVUZ' ZdZ | dZU eYReeV/VZZZ_ ^R_Zaf |ReVdafS|ZT`aZZ_ `ceYRe ZZUVdec`jZX4YZ/VE_dTf |ef dR YRSZREŽE YV/VL1 ZXc` |VZ ZdeR ZX` Z UZj |ZWZ UFV deYVc e`ZdRSZZ eT ^SZ VaVd _RZ VUUZWKV_6ZA eZ_ `VZ ed R UZ/TV hZY R_ Z eVX eZ VV/TeZ_Z 3j R]`hZ XaVd _RZ VU ac`XR^ ^ Vd/VEZ_ Ze T _eZS fevde`gZh Vd Z UZZ R RZ _ L hYZ V Re eYV dR VeZ VZ T __VTed eYV hZY RZ _R RUX SR T ^ f_ZRZ _ `hdŽEYZ HSZ R j dVU _`hZ$ 

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:eYRdSW\_eYc`fXYeYVacVddLeYV\_dRLZLR\_U \_`heVVgZZ\_eYRe4YZVR\_dW/^UZXWEV\_ecVXZ\_d R\_Uac`gZ\_TVdYRgVSW\_RS]Ve`dYRcVViaVcZV\_TVdL  $f_{z}Z$  XeYVa` ZZR ZNR  $WRZ _ Ze$  RWMZ X WSV/\_XZ\_XŽEV/VgZZ\_Z\_aRceZIf]RcYRdT\_ecZSfeVUL  $hZey ZedycVRZh % Zed^ RdlaV_VecReZ_R_UZedZ_{}$ TeVReZ\_XTV\_eeRJZA^ R\_UXV XePaYZR T gVeRXVLe eYVy\_ReZ\_RZREZ\_%W172R acREZIVZDZ TVeYV "\*)! dLY` h \g\dLX]` SRZKPZ\_ YRdSW\_ USZZ\_XR ^ R[`cecR\_dWc^ ReZ\_Z\_eYVeVJVgZtZ\_Z\_UFdeqiŽ  $EYVTeVReZ_ `VeeR_d_ReZ_R|T_X|`^ Verevel R_U$ eYVX)`SRJZReZ\_`VRFUZ}gZfRJac`UFTeZ\_ŁT^ł SZ\_WhZeYRUXXW W^^ XK\_ZREZ\_ŁYREVXEV\_ cZWe`eYWWRceYRe\_ReZ\_RJZW\_eZejZdfTlf^SZ\_X e`W&VZX\_Z\_~fV\_TVdŽEYVacVdV\_eCVa`cedR\VdR UZWWCV\_egZh+eYVUZbZ\_TcZ\_SVehW\_eYVY^V Xc`h\_R\_UeVVRZV\_Zd\_`eRUNbfReVe`UVdTcZSV e`URj`d`Tf]efcR] ac`Uf`TeZ\_Ž2d\_`eVU VRc]ZkŁ eYVeV\_dZ\_SVehW\_eYVX)`SR]R\_UeYV]`TR]Zd ddf | eZ\_XZ\_ eVRaac` acZeZ\_ R\_U ddZX\_Z TReZ\_ `Wo]^S`]ZTX`UdSj\_]`TR] Tf]efcVoŽEV]VozZZ\_Zd \_`ViTVaeZ\_Ž

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3cZWVV\_eZ\_drfjUSV^RUVVeYVhRj\_ReZ\_ł R] TY/VScReZ\_dRcVTYR\_\_V]/UeYc f XY eYV^ VURZ Edruzz\_R]jLeVV\_Rz\_dXcVReczfR]didTYRdeVV ") DVaeV SVcR\_UeVV> ZZERG ARCRUV YRgVSW\_ \_`e[fdeRT^^V`dReZ\_`WeYVyHV%SfeR]d  $R_{a} = a^{C} R_{d} R_$ VITVAUVI edgRXR\_TVIf\_df]Z\_ValleYReyTVJVSdReZ\_d

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`WeYVHV%JR\_]VRUe`Sja]RIZ\_XT\_ec`]d`\_ aRceZIZaReZ\_ŽE`URJŁeYVTV/VScReZ\_`WeYVyHV‰ YRddyZANUehRud^VUZRWAGZAZOŻEYV\_RaZ\_ XReYVcdRc`f\_UeYVeV/VgZZZ\_dveZEYVV^S/V ReZT ac`XoR^ ^ VZdeYVEVJVe<sup>2</sup>\_ 1EVJVeY \_/ŁhYZIY XV\_VcR]]j RIYZvgVdV\_`c^`fdcRoZ\_Xd1Z\_#!!!Ł  $dR \ Z \ X eV \ R \ V C \ R \ TYR \ V \ EV \ Z \ X$ dVTeZ\_RTYZEVU&Ž aVCTV eRXVa`Z edŽDZ ZRC W\_TeZ\_dRcVaVcVvc^ VUSj da`cedVgV\_eddfTYRd eYV}iefcVd`WeYV\_ReZ\_R]W eSR] eVR^ŽEYVdV ^ VLIRdaVTeRT]VdYZ\_eReeYVTYR\_XVZ\_ec`Uf TVUSj eV/VgZZ\_Ž=ZVeYVecRUZZ\_R] WdeZgZZdLZe Vi Rjed R\_ViedRdLZ\_RcjViaV2Z\_TV`W\_ReZ\_Rjf\_ZejŽ3fe eV/VéZZ\_ZIRS/Ve`^f]eZa]j dZX\_ZTR\_eVéV\_edR\_U dacVRUeYVV``eZ\_R]ViaV2Z/TV`\_R^RdddIR]VŽ

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hYZY Vývj`\_VaRceZZaRevde`d^VUVXcWO:eZd \_`h e` eYV dTcW\_Ł Raa RcV\_ejjŁeYRe R] TZeZkV\_d efc\_e`]VRc\_RS`feZdfVd`VVT^^`\_Z\_eVeXdeŽ:e Tf]USVdZUeYReeVVgZZ\_ZITeVReZXRWcf^ WE TZZKY\_ UNSREVE ^ VUZREVU Sj eYVZ' RXVd` VEYV eVJVgZZ\_\_VhdŽ3fehYReyT^^`\_h`dU%aZXYe

ZeSVfdYVZ\_XZ\_O:\_ 4 YZYŁRdZ\_`eYVcTf\_ezXdŁ ZeZdckR/ZkU eYRee/VgZZ\_ZdYVjaZ\_Xe`T\_defTe eYZIT^^`\_`fej``\SjdkeZ\_XeYVafS]ZTRW\_URL eYVXR^Vh`c\hZeYZ\_hYZYaVa]VVC^f]ReVeYVZc a`]ZZIR] UVIZZ\_dR\_U[fUXV^V\_ediyacZ\_Z%&R\_U eYVRee2SfeZ\_`VKXda`\_dSZZej VcZdfVd`VXV\_ł VCR]Z\_eVCVdaYyXR^Z\_X%ZEYVCXff]eZ\_XUj\_R^ZdŁ Y hVgVLRcV\_`ef\_UVde``UŽ

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^`f]Ud`aZZ\_dRS`fe\_ReZ\_R]RWWOdZ\_aRezTf]Rc Wrc^`dVeYR\_\_VhdaRaVd`ceYVdUZ\_UŽHYV aVa]Vda]RIV`WCVdUV\_TVZdT\_dZMCVULeYV dEfRZ\_ZddZXYejjUZWWCV\_eŽHYZV)#´`V&Y`dV dfcgVjVUZ\_DR\_eZRX\_ffc\_e`eYVeVJVgZdZ\_L`\_]j ''´´`V&Y`dV[ZeZXZ\_eYVdXZ\_dUŽ

EYZlafS|ZTdaRIVTf|UL`WTfcdLSV\_`^`CV eYR R RCTYZAVIRX `WafS|ZTOŽ: WATELev/VezZZ ac`XdR^ ^ Z\_X eV\_Ud e` SV YZXY]j dXX^ V\_eVUL  $hZey ac XeR^ \wedge VdWIf dZ X \ daVIZ TRFUZ/TVd$  $1^{\circ}$  c\_Z\_Xd elso a cedd elso ZZ9 h verter Zd dkX^V\_eReZ\_`WeYVyafS]ZI%daYVEVZ\_e`aRceZIf]Rc yaf SZTC%ZTT f\_eVCVU Sj\_eYVTV ecRZej `W VhoŽ  $EYZITV_{ecR}Z_{ij}ZIR_{ij}eVV^{\circ}VZ_{i}a^{\circ}eR_{e}Z_{i}eVR_{ij}$ TZERKY\_d Z\_UZXWKZY\_TV e` a`]ZEZId YRd cVUF TVU eYV ReeV\_eZ\_aRZU e`eYZdSjeVVgZZZ\_ac`XcR^^VdŽ Ac`XR^^ZXZdeV\_UZ Xe`dYZ&RhR, W/^ a`]ZZTd  $e^{hRt}dYf^{R}$  Z  $e^{kt}de^{it} dZdtW^{I}$  Z  $e^{kt}$  ReZ R RWWRZde`U^VdeZT`\_VdR\_UWV^XV\_VdR]ZdfVde` daVIZT`\_VZZeeYVdR^VeZ\_VLY`hVgVLeYVIV edR a RIV` WVhdZdSVZ XcVRWc^ VLŽ4`\_dZVcZ XeYV VgV/`Var`ZZZR UZRWWTeZ ŁZe WUde`SVdecVddWU eYRe\_VhdR\_UUTf^V\_eRgi ac`XR^^VURCVeYV Why fozevid West ~ WestV4YZWR\_dZ\_evlogZhWUSj F? 5 AŽ? Vhdac`XAR^ ^ VdeV\_Ue` SVacWWccVU Sj ^ V\_Ł` [U\c aV a [VŁeYV]` h \c VT\_` ^ ZT ded \t  $ef^{A} R_U eY dV ZZ XZ TZEZ d`f edz V DR_eZEX Ž$  $5 Tf^V_eRg$  ac XR<sup>^ V</sup>L<sup>^</sup> VL<sup>^</sup> VR\_hYZVLRV<sup>^ </sup>CV e`eYVeRdeV`Wa`^V\_ŁRUf]edZ\_eYV^VUZf^}YZXY decRef^ŁR\_UaVa]V]ZęZ\_XZ\_DR\_eARXŽ

EYVacWWV\_TVTJRZ VUZIS`c\_V`feSj T\_ł d^ aeZ\_ŽZTT dZ\_Xe eYV"\*\*\* 4? EG\_ReZ\_R d`cgVjL\*) ~``VaVa]VdJ eYV hRETY\_VhdSf]i ]VEZ\_d`WhY^'& TJRZ e hRETY eVV W'^ SVZ\_Z\_Xe`V\_UŽ2TefR] T\_d^ aeZ\_ d^ hd R dZ ZRc eV\_UV\_TJLRd^ VRF dVUSj eYV ReVRXW Y`fdW^ JU dRZ\_XŽ:\_ eYV TRV`WDR\_eZX LeYZI c`dVW'^ \* a`Z\_edZ\_"\*\*%e`"! a`Z\_edZ\_#!!!Ž :\_`eYVc h`dtLUF cZ\_X #!!! R\_ReVRXV`W") eY`fdR\_UY`fdY' JUd`c %(# eY`fdR\_UaVa]VZ\_ DR\_eZX hRETYU eYV\_VhdVgVj\_ZX eŽYV]VgV] `WT\_d^ aeZ\_ZdZ'ZRCRTc`dtR] d`TZIVT\_`^ZT Xc`fadŽ

 $\label{eq:hardenergy} H YV_eYZIZ_Wc^{*}ReZ_ZIT_dZWUZ_T_[f_1] \\ eZ_hZYeYV_f^{SVc^{*}}WdYgZZ_gZhVdI]RZ^{*}Z_X$ 

e`UZEIF dd\_VhdR\_UUTF^V\_eRg`ac`XR^^V&ZZ TR\_SVdZUeYReeAJV&ZZ\_XV\_VREVdRafS]ZTdaRIV e`hYZIYR] efc\_e`Z\_V&c^eVv^dAJgvdRS`fedfSl [VTed`VXV\_VR]Z\_e&&&ZEYVZ\_V&c^ReZ\_eYReZd ^ZtHZ\_XLeY`fXYLZIhYRedfS[VTed RVUN]ehZeY R\_UY`heYy`RVa&dV\_eVLŽDefUZd`VW&WhTJfV&L RJeY`fXYd^VRVac&gZAUSjeYV]Zde`V&YV"! dfS[VTedeYRecXTVZgVUeYVX&ReV&e\_VhdTgvdRXVZ\_ #!!!ŽEVJV&ZZ\_XgVR]ZeJV^`dVeZ`Ve`yXV\_VR] Z\_e&&d&GS[VTedh#'´´/eYR\_e`da`cedR\_U`eYVc daVTeRecXVgVedh##´´/Ž

2 yaf S]ZT daRIV%Zd`\_VhYdV VgVg S`Uj TR\_ daVR R\_U SVYVRUL dWR\_U SV dW\_ŽEYV d TZG UZGV dZg` VM YZVZd\_`edV-VT&VLY`hVgVd Z\_ eVV eZ`VR\_U edvRe^ V\_eedjVgZZ\_ XgVde` eVV UZWWd V\_ed TZG Xc`fadŽ2TT d.Z\_Xe` eVV4? EG d`cgV cWVcVUe`L^`deaV a]VWJ eYRea`]ZZTRJ aReZdL X gVc\_^ V\_eRfeY`cZZd eVVR^ VUVCTVdR\_USf dZ \_VdVdRV`gVd davdd/eVUŽ3j T\_eRHL^Z\_`dZj Xc`fadLeYVddLV\_ed`V&``c\_VZXS`fcY``ULZj edj[VTefR]dR\_U eVVj`f\_XRVf\_UVddavdv/eVUŽ

2 eYZUTJf VZtac`gZJVUSj aV a]VdRdAdd`V\_e `WVhdac`XR`^VdŽERSJV#&c\gVRJdTcZZZA``W

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<sup>12</sup>g®qz Yáll<sup>2</sup>@äæ∯ Yzaö olfáláðæqäæ0ææzæöö Orgozqalaï] @jäæ@öÓ(¶² & zö Yalú(Ĩ" Ú0- – z YáQí Éeâ€alz¶Å@ÉÉ >¶ï Úgznañ ¶² Yz¶al Ogq°O&nza@2@öÁ(° ²a ï Úzznaiz∄ ³3 É

dkgvor] RohvTæŽDV\_dreZ\_RJZh ŁTV\_ecrJZh Ła`]ZEZ TR] SZRdR\_U dvJVvTV\_d cchZa Rcv TZEvU RdevV^`de \_VvRezevVvR1ved`Vv4 YZvR\_evJvzeZZ\_Ž

## H + 9 - B + 9 F B 9 H 5 B C DDC F H B + M: C F H + 9 D 6 - 7 GD5 7 93

 $2 deYV \# ! ! " H`dU9f^R_5VgV]`a^VeCVi$  $a`cea`Z_eVU`fd_eYV:_eVc_VeYV_ZIR]$  $a`eV_6XI e`RIERdRa`hVcVI] a]ReVc^WcafS]ZT$  $Zdf VZEYVH VS TR_SVf dvUe`ac`UFTVT]]VI6gV$  $`aZ_Z_dR_U^VdRXdLZ`ac`gVafS]ZT RU^Z_ZI$  $eREZ_R_UV_YR_TVTZEXV_`gVcZXVeR_UafS]ZT$  $eR_daRV_TjŽedeVTY_`]`XZIR] SRVYRdeYVa`eV_1$  $6XI e`Z_TCVRV`ccVUFTVeYVUZIVIF]6Xd`W1TZR]$  $aRceZIZARZ_R_Ue`VRIZEREV`cVVceYVcT^a]ZREV$  $eYVcV]REZ_dYZaSVchW_TZEXV_dR_UX`gVc_^VeZ$  $H YRe`aa`cef_ZEXd RVeYVCVVcTTZEXV_dZ_eVV$  $ej aV`W_eVc_VeRTTVdEUVa]`j^VeR_UfdV_`h$  $SVZ_XdW_Z_4YZNO$ 

$$\begin{split} H^{\ }_{d} Lh ZML^{^{\ }}_{d} \sim VaV a ] VRV XRZ \underline{Z} XRTVdt VRIY \\ Ug e^{^{-}_{d}} RZ LcR^{^{-}}_{d} f_{ed}^{^{-}_{d}} VZ Wc^{^{-}_{d}} RZ LR_{U} UdHS ] ZM \end{split}$$

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> ¶g¶jzg¶²¶- ga<sup>ä</sup>ääää</sup>L¶äø¶iä Ýzäæzä²a₂Úźzałź"i®UóÆä ää" Ý 🛙 Å äännen kuunnen JzÝännen kuunnen ¶äännen kuun kuun kuun 🦉 🔊 ääfií ännnnnnnnn annnn ''ännnnnnn â ännnnnnnn þännnnnnn þ ääfi è äinnin muunin 1/2 äinnin mute â äinnin muuni /ainnin muuni /ainnin muuni /⊅þ ääe¶æ**ënnunnunnunnunnun**™ää**nnunnu**ۏ ä**nnunnun**b ä**nnunnun**b

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Z\_X^`cVR\_U^`cVT\_eRTedhZeY`eY\caVa]VLRe \g\cUZ`Z\_ZHZ\_XT deŽH Y\c\RdZ\_]Re\"\*\*&eY\c\ h\c\RS`fe#! ^Z]Z\_:\_e\c\_\efd\cdeY\c\Rt\\_`h d ^ V&! ^ Z]Z\_ Rc`f\_UeYVh`d]UŽ4 YZVYRd\_`e SW\_ ]W&/SWZ\_U+Z\_ ;f\_V"\*\*&eYV&/hV&'"\$# dZevdhZeY eYVŽ7U ^ RZ\_, Sj ;f\_V#!!" eYV&/hV& ' (1#\$)ŽEYV42D6? #!!! d`cgyj V&Z ReVUeYRe  $(\breve{Z}^{\sim} W_{4} Y_{Z} W_{E} Y f dY^{\circ}]UdYRUR_: _ekc_ VeT_{} _{}$ \_VIZ\_ $Z_{2}^{}URIT dZ_{Xe} eVVF? 5 A #! ! " df cgYL " <math>(\breve{Z}^{\sim} W_{4} Y_{Z} W_{E} df dV eVVH VS cWf Rc_{} JZ$ 

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H YfY 'gU Uf[YVi hbchYUg'mei UbhļÚVY bi a VYf cZ=bhYfbYhghYgUbX 'b]hJUhj Ygk \cgY U]a 'g'rc dfc! a chY K YV UVWW ggZcf U```UbX YbUV Y cd]b]cbgUbX' bZcfa Uhcb cZ]bhYfYghc WhhYbghc VY Yl WUb[YX'' H YgY 'b]hJUhj YgUfY \Uj |b[Ub i bYj Yb 'a dUWi'C bY' d]cbYYfb[YZcfhigh YA ]b]gfmcZ9Xi WUhcb '9b UW'g' @b\_gQdfc[fUa a Yžk \cgY Ua V]hci gd Ub \Ugg W WYYXYX 'b WcbbYWhb[i d'- \$i cZh Y GUHY!g Vg! X]hYX'gWcc 'dcdi Uhcbž]bWi X]b[gWcc g]b fYa chY' fi fU``UfYUg''8 Ygd]hY U``'h YgY YZcfhgž \ck Yj Yfzh Y' Î X][]HU`'[UdI']b '7 \]Y'ggh``j Yfmk [XY''

6miUbX `Uf[ Yž Wj ]W=bHYfbYh ]b]hJUhj Yg UfY a cfY `LYmhc dfcj ]XY U Vi `Yh]b Vc UfX `gYfj ]WY h\Ub` cddcfhi b]hYg Zcf ]bHYfUWhcb cf gYfj ]WY dfcj ]gcb'' BcbYh\YYggžh\YfY \Ug VYYb a Ucf dfc[ fYgg ]b ZU! W]HUh]b[ `HUg\_gg W UgHUI dUma Ybhžgc WJU``\ci gb[ ` Udd `JWUhcbg UbX Wcbg a Yf Wca d U]bhg'' H\Y`k Um h\Y =bHYfbYhWUb VY i gYX `]b dfUWhWY hc `[ YbYfUHY` WJ] [W]b\_gUbX YI WUb[ Yga UmVY ]`i ghUhYX Vmik c ` Yl Ua d Yg'

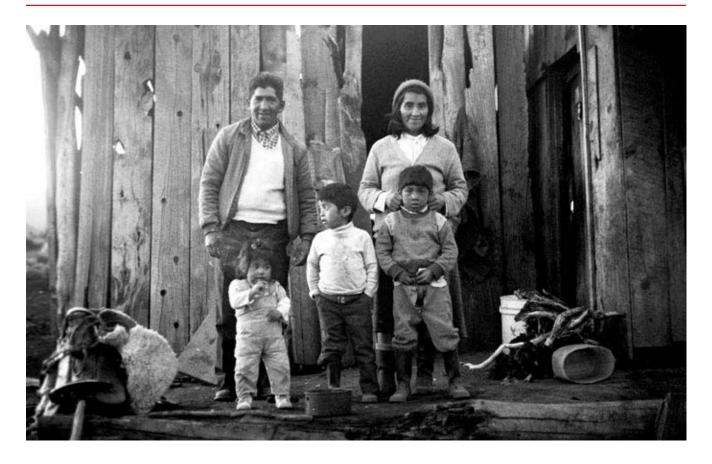
H Y Úgh WUgY 'g'h Uhc Z>i Ub Df fYnž h Y ÚWhci g' bUa Y i gYX 'Umh Y k f]hYf c ZUb 'Y!a U] 'gYbhci hhc fYei Ygh ]bZc fa Uhc b Zc a 'X]ZYfYbh di V `]W UbX df]j UhY!gYWc f c f[ Ub]nUhc bg' C Zh Y &+ 'W bhUWgź cbmÚ Y Ubgk YfYX fY Yj Ubhnž dfc a dhmUbX Z `m' GYj YbhYYb c Zh Ya 'Y]h Yf \UX bc hUbgk YfYX UZH'f U 'Zc ffb][ \hž cf h Y UXXfYggYg di V `]g\YX 'Zc f h Ya ' cb `]bY 'k YfY'k fcb[ "'H Y fYa U]bXYf Ubgk YfYX 'UZH'f U 'cb[ 'XY Unž cf X]X bch [ ]j Y Wc a d YhY fYd `]Yg'' H YfY'k YfY bc 'g][ b]ÚWUbh X]ZYfYbWg Ua cb[ 'h Y' j Uf]ci g mdYg c Z cf[ Ub]nUhc b Wc bg 'hYX 'ftli V `]W gYWc fzdf]j UhY!gYWc fzB; C E ]b 'hYfa g c Zh Y ei U`]mi c Zh Y]f 'Ubgk Yfg'' =b 'UXX]hc bz >i Ub Df fYn k fch' hc ' h Y Y Y a U] UXXfYggYg c Z h Y Wc i bhmỹ %&S dUf ]U! a YbhJfmXYdi hYg C b mb]bY fYd ]YXžk ]h gl fYd ]Yg Uff]j [b[ `k ]h [b U Z/k XUngž lk c U a c bh "UhYf UbX" c bY UZhYf h fYY a c bh g 5 [ U]bžh YfY k YfY bc X]ZYf! YbWYgUa c b[ `dc ]hWU dUfh]YgUgfY[ UfXgh Y e i U ]mi c ZfYgd c bgY"

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HY 9`9bW Yblfc HY YWbHY \UgZ ghYfYX bYk ``[b\_g' bchcb mcb h\YK YV Vi hU`gc žUbX a cghdUfh]W Ufmž ]b h\Y`c WU``i gYf Wca a i b]m"H [gg\ck gh\Uhh\Y'dc! hYbh]U``cZh\Y`=bHYfbYh[gU`gc 'h]YX`]b k ]h 'h\Y mdY cZ gc W[U``fY`Uhcbg\]dg h\Uh[ i [XY`][g i gY"`=b 'h\g WUgYž ]h\Ug VYYb 'gYYb 'h\UhUWWYgg hc 'h\Y`K YV`]gbc hUb' Ui hca UhWdfc Wyggž Vi h]bj c j Yg'h\Y`Uddfcdf]Uhcb' cZU`fUb[ Y`cZg\_]``gUbX`Ub[ i U[ Yg' HY UWéi [g]hcb cZh YgY [gVYgYhVmYl dYWUhcbgź X]ZĹW 'hYg UbX']bgYW f]hYg': cf'h Y gUa Y fYUgcbž]h [g U' [ ccX'WébhYl hZ f'h Y XYj Y cda Ybh cZgcW]U`` WUd]hU``]b Wéa a i b]hYg''=hWUb 'h i g VY WébWi XYX' h Uh =bhYfbYh UWWgg [g U'a UhhYf 'bch 'f gh cZX][ ]hU`` WébbYWhcbg Vi h cZgcW]U``WébbYWhcbg h cc'' H Y' X][ ]hU``]bZUgffi Wh fY [g bchYbci [ \ 'hc WYUhY'gcW]U`` bYłk cf\_g UbX W] [W]bhYfWéi fgY''8][ ]hU``cf 'bchžWéa ! a i b]WUhcb [gg]h``U'gcW]U` d\Ybca Ybcb'flbhYf![fcid'fY`Uhcbg:h\UhXYdYbXg' cb'hmdYg'cZ`Ub[iU[YžYldYWUhcbg'UbX'Weaai! b]WUhcb'ghmYgzZcfag'cZgY[aYbhUhcb'UbX'aih'U' fYWe[b]hcbz'UbX'h\Y'YlYfWgY'cZdckYf''7\]Y'\Ug U'[ccX'X][]HU``]bZUgffiWifYzU'h\ci[\`acfY']g'g]`` bYYXYX''6ihk\UhlgfYU`m'UW\_]b['gh]``UfY'h\Y'gcWU`` UffUb[YaYbg'UbX'aYbHJ``achj'Uhcbg'bYYXYX'Zcf' ]bX]j [XiU``YldYf]YbWYghc'VY'U[[fY[UhYX'UbX'X]g gYa]bUhYX''

# $7 < 5 \text{ DH9F}^{\cdot *}$

## 9H B=7 8=J9FG+M5B8 H 9B9K 7I@HF5@7<5@99B; ! 9G = 3.7 < = 69



## H + 9 = A DC F + 5 B 7 9 C : 'H + 9 = B 8 = 9B C I G D 9 C D @ 9 G = B 'H + 9 . 7<=@95B<sup>-</sup>=A5; =B5FM

=b 'h Y Wc ``YWhj Y ]a U[ ]bUfmic Z7 \ ]`YUbgži h\Y]bX][YbcigdYcd`YgUfYgYYbUgdUfhcZ h\Y`Wi`hifU``ibXYfd]bb]b[`cZbUh]cb\ccXž R\_UeVy\_RoV\_`ecVARdUVURdR\_Z`aVUZ`V\_ee` eYVT f\_eqj dU/gy]`a^ V\_eŽ@\_eYVT\_ecRqiLeYVZc T]RZ dRCV gZhVU a` dEZgV]j R\_U UZETCZ Z\_ReZ\_ RXRZ\_deeVV Zl`aa`dVUŽ2 d`cgVj TRccZVU`feSj R acZAREV`cXR\_ZAREZ\_Z\_8cVREVCDR\_eZRX ac`gZVd ZWC^ ReZ\_e T\_}c^ eYZZŽ\_eYYZZAh WS ~ W f T\_ VIEWUHZEY eYV> Raf TYVaV a]VREVSWZ U DR\_eARX\_cVarLV\_edLeYVVWW.e`VeYV> Raf TYVde` yhZ\_SRI\eYVZc]R\_UdR\_URIYZgVd ^ VRfe`\_`^j

eY dV ZZ XZ eYV IRazer eYZ \ eYReeYV> Raf TYVd RVUZEZ ZRVURAZ deSj 4 YZVR\_dR\_U(\*~U \_`eeYZ\_\eYY\_h`f]Uegie`UZdfRU/Rd\_žLRfX/eVc  $W^{\wedge} \sim Reg Z XRj T_X Raf TYVZWYV hZMVUe$ 1Af S|Z= Vec Ł#! ! " /Ž

:eZdZ\_eVcVdeZ\_Xe`\_`eVeYVSVJZWVW(!‴``W cVda`\_UV\_edZ\_eYZd`aZ\_Z\_dfcgVj\_eYReyZ\_eVcVded eVVgZ]V\_TVZ = R2dRTR\_RLeVV> Raf TVVVRcd ]R\_UNYŽJ VéReeYV dR VeZ VL' S″ dR e/ReZVEVV  $W^{\circ} eYV4 Y_{Z}VR_D Rev ZU[f de Za VR_h Y_{Z}VL))^{"} W hVeV > Raf TYV eVy yh f ]U SV Re eVV SR ZIRUA$ 

} XY6Z\_XWCeYVZc2XYetYZo2XYetYZo2XYetYZo2XYetYZo2XYetYZo2XYetYZo2XYetYZo2XYetYZo2 eYZ\_\eYV> RafTYVdd^f]UYRgVd^VVVXCW^W Rfe`\_`^j hZeYZ\_eYV4YZVR\_DeRevLVieV\_UZ\_Xe VUFTReZ\_L[fdeZTVR\_U`eYVCRVRŽ

EYVF? 5 A #! ! "? ReZ\_R] Df cgyj clýgkRjdgkij dZ\_Z; TR\_eeV\_UV\_TZkilh YZTY df aa`ceeYVZJNReYRe 4 YZJNR\_d TZkij RaacVIZBeVdeYVZ a`ceR\_TV`VZ\_ł UZAV `f dTF jef ckiZERS]V#(Z]f decRevdeYZŽ

AV a]VRV $dX_Z$  TR\_ej ^ VVUth\_ e eVVVd VZ\_ Tf ]ef d?] VVZERXVZ\_ eYV> Vec a ]ZR\_ CVZ\_ 1S' ~ Ver dVZ\_eVcgZhW/R\_UZ\_ eYVCVZ\_ ` W GR]aRCRol 1S# /ŽEYV} Xf ddWceYVCVZ\_ ` W 2df TR\_3RLZ\_eCVdZ\_XjL^ RETY eYV\_RZ\_R] Rgvd RXŽEYVCVZ\_ ` W1 ` bf Z' S` ZleVV \_ VerRe^ ` de ZV\_eZ Vdh ZY eYVZ\_UZX\_ ` f dTf ]ef dd1) ) ~ /Ž

> VR\_hYZNLAYZNR\_dU \_`eSV/Z&V?ReeYVUZN WEV\_TVZ\_U&Y`a^V\_e]V&YSV&hW\_eYVZ:Tf\_egi R\_UZed\_VZXYS`fcdZlUfVe`ZedYRgZ\_XWhVcZ\_UZX @/.łäá

#### >¶ï ÚgznäB1Ł; äl Oeo¶²O®sï Údzønäi þþ½Ê

#### @⁄.łä€

fi c@zāÝāOā- ¶ÚzāOqõO' gz qāg¶ĩ ² đớ<br/>táðæ<br/>Đã äÝā² z ¢ c<br/>d¶ĩÚÝā] z gOi Ýz äæz ÚzāOúzā‰ö z Úã <br/>  ${}^{e}q$ ¢ z² ¶ĩ Ýā<br/>Áz ¶Å@žØz² đơi z ÝÈ

ää "Úz äinnin muunin muu

>¶ï ÚgznäB1Ł; äl Oxo¶²O&≥ï Údzonai þþ½Ê

 $\begin{array}{l} V_{f} daV a ] VZE YVXCVReSf ] \ \ WaZZ_UZRXCVd \\ hZey deRev^V_e d] ZVeYV^_Va^dUZ_eS] V \#) \\ \end{array}$ 

#### H + 9 - B 8 = 9B C I G DC DI @5 H ⊂ B - B 7 < - @9

$$\begin{split} & EYV"**\# A`af ]ReZ_ 4V_df dVdrS]ZhVU eYRe \\ & eYV&Vh V&VR]^ `deR^ Z]Z_ aV a]Vi**) ES) & RXUU `gVc"%Z_ 4YZV hY` UVI]ReVU eYV^ dv]gVde` SV \\ ^ V SVdo` Wc T]`dVe` R_ Z_UZXV_`fdXcf aZ_XL \\ & If ]ef cV` caV a]VZ@V&VdvL*#) E' !ZVV_eZ_VUhZY \\ & eYV> Raf TYV aV a]V d eYReLT f_eZ_XTYZUV_L \\ & d^ V "E#) #L" " aV a]V cV]ReVU `c SV]`_XUU e` \\ & eYRe VeY_ZTXcf aZ`_ e` eR]L*Z`` `VeYVT f_eg`d \\ & a`af]ReZ_ deReVU eYRe eYY_SV]`_XUU e` d^ V \\ & Z_UZXV_`fdaV a]VZ$$

2 [Relcdef U dr'hWelthe eVkVhVV#S%48%]aV a]V] $Z_Z Z Z UZ_V^f d> RafTYVT^{f_Z}$ eZdZ eVd feY`W4YZ/ZEYZIZ\_`eR]`h} Xf ckL T\_dZ\_WZ\_XetReeYkVT^^f\_ZZd\VaRZeVeVZC Tf]efckL]R\_XFRALcVZZ\_ R\_UecRUZZ\_R]hB d`W ]ZWZEYVJ^R\_Vfa & SL&!) d`cR] Y`f dY']Ud Z Y^`X\_V f d> RafTYVT^^f\_ZZdhYkVetV Z UZ\_V^f dTf]efcVZdclac`UTVUUR Sj URZ

 $3VaUVdeYV > RafTYVdLhY Wc^{V} eYV ]RcXVde$  $<math>Z_UZAV_{fd}XcfaZ_4YZAVLeYVCVRCVeYV2j^RcR$  $Z_eYVARc_`ceY`WeYVTf_ecjL^`de`VAY^ ]ZeV$  $Z_2cZIRR_U:bfZbfVSfehY RdZ_YRSZES`eYeVV$  $RjeZa]R_`R_U eYV dReZ_Vd eYV 2 dRIR`VD`dLhY`$  $]ZeVZ_eVV`RcMd`VeYV 2 dRIR`R dRe~RcdZ_eYV$  $CVZZ_`V2_e`WARCHER R_Ud`R]]Xcfad`VBfVI$  $TYFRR_U4`jRZ:_eYVARcdfeYLeYVCVRCVXcfad$  $`WcRhRcMARcR UJR`R RLUXIV UVUW'^ eYV$  `cZXZ\_R] Z\_YRSZER\_ed`WeYVT\_eZ\_V\_eddfeYvc\_ ViecV^ZejŽ:\_ eYVARIZ;TeYvcVZd6RebVc:dR\_U hZeyRa`af]ReZ\_`VNS`feeYcWeV`fcR\_UaVa]V 

## F95 GC9FH€ B 5 B 8 F97 C; B + 1€ B C: 9H & B = 7; FC I DG 5 G DFC 8I 7 9FG C: 7I @H F9

EYV]RV"\*)!ddh eYVSVZ\_ZX`VRXV\_VR ^`gV`V\_e e` c\Rdb\ce eYV \eY\_ZT a\cd\_R]Zg``W 4YZ\Vd Z\_UZ&V\_`f d aV a]\vZEYc f XY R hY`]V gRzXg``W'cXR\_ZREZ\_dLR] \eY\_ZT Xc`f ad SVXR\_ e` R]\ceeYVT f\_eq`e` eYV\_WUe` cVT X\_ZX\eY\Zc V/ZeV\_TVLRTI\aeeYVZcTf]ef cR] TYRRIR\cZEZTdR\_U h`c\ e` hRddR\_RTT ^ `UREZ\_SRdW`\_ eYV T\_ded TEZ\_`VR^f]eZff]ef cR] d TZkġZEYV&VhRd RTYR\_XVZ\_eYV`cZ\_dReZ\_`VWeY\_ZTT]RZ`dT\_ł dZeV\_ehZeY hYRe`YRdYRaaV\_WUZ\_ ^ R\_j aRced`W eYVh`cJUR\_UZ\_=REZ\_2^ VCZRŽ\_UZ&V\_`f daV a]V RV\_`h U/`R\_UZ\_X\_`e[f cbT\_cc`]`gVceYVZcdi d f cTV4d TYRd]R\_USf eR]d eYVcZXYee`T V/ZeZ\_ d TZkġ`\_eVXc`h\_Tf]ef cR] eKc^dZYCZWEf dR \_Vh TYR]V\_XV=eYVTYR]V\_XV`VUZe\cdEjZ

EYV\_Vh RTT^^`UReZ\_SVehW\_4YZVR\_ d`TZAġ R\_UeYVZ\_UZAV\_`fdaVa]VdhRdafee`eYV eVdeZ\_eYVVRdj "\*\*!dLhYV\_eYV6iVIfeZeVdV\_e 4`\_XXddRdve`WJVAR]cWXc^deYReh`f]UYReV YRURa`dEEgVWWMTe`\_ZeVdVeY\_ZfcVJReZ\_dZ\_ 4YZJVŽEYV`S[VTe`WeYVT\_dEEfeZ\_R]cWXc^hRd e`XQEVcVTX\_ZEZ\_LReeYVYZXVde]VAR]VgeVLe` ^f]eZVeY\_ZTZġ R\_UZ\_UZAV\_`fdaVa]Vd cZXYee`  $\begin{aligned} & \operatorname{chc} U \operatorname{TVeV} X_{z} \operatorname{TI} e \operatorname{cVR} U^{A} \operatorname{R} \operatorname{RVeV} X_{z} \operatorname{cdd} f \operatorname{cTVd} \\ & \operatorname{R} U \left| Z W d \operatorname{deV} d \check{z} \operatorname{YZ} R^{A} \vee U^{A} \vee \operatorname{e} \operatorname{Rdc} \left| \operatorname{VIeV} U \right| \right. \\ & 4 \\ & - X \operatorname{VdI} \operatorname{R} U \operatorname{e} \operatorname{YZ} R^{A} \vee U^{A} \vee \operatorname{e} \operatorname{Rdc} \left| \operatorname{VIeV} U \right| \right. \\ & 4 \\ & - X \operatorname{VdI} \operatorname{R} U \operatorname{e} \operatorname{YZ} R^{A} \vee U^{A} \vee \operatorname{e} \operatorname{Rdc} \left[ \operatorname{VIeV} U \right] \right. \\ & 4 \\ & - X \operatorname{VdI} \operatorname{R} U \operatorname{e} \operatorname{YZ} R^{A} \vee \operatorname{R} \mathcal{I} = \operatorname{Rdc} \operatorname{V} \operatorname{R} \operatorname{Rdc} \left[ \operatorname{VIeV} U \right] \right. \\ & 4 \\ & - X \operatorname{VdI} \operatorname{R} U \operatorname{e} \operatorname{Y} \mathcal{I} \times \operatorname{R} \mathcal{I} = \operatorname{R} \operatorname{R} \operatorname{R} \mathcal{I} = \operatorname{R} \operatorname{R} \operatorname{R} \mathcal{I} \\ & 4 \\ & - 2 \\ & -$ 

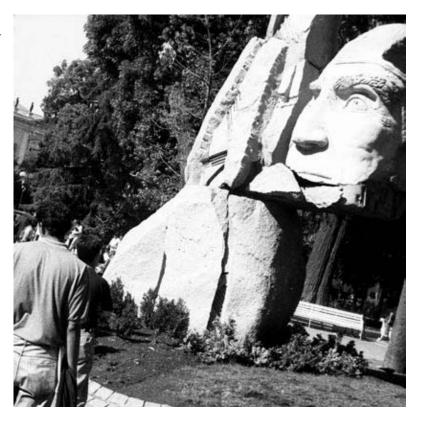
:\_ "\*\*SLY`h VgVL  $e^{V}$ :\_UZV\_`fd 2Te I=Y :\_UXV\_RNh RdaRdM ŽH YZV\_`e V\_ $e^{V}Z_XT_{d}Z$  $e^{Z}_R vT X_ZZ_{Le^{V}Z}U VdXR_e VR_{d}e^{T}de^{T}$ T ^ f\_ZZVLac` $e^{V}Ee^{V}Z_R ULVEVESZY d de^{d}d^{T}$ Wc  $e^{V}Z_V a_R dZ_{Lac}^{-} e^{V}Z_UZV_{T} d^{TF} e^{V}$ R\_UTEVR $e^{V}R_Z de^{T}e^{Z_R}^{-} vTYR_Z^{+} VcUv_{d}^{T}a^{T}$ Z\_Xaf S ZTa` Z\_  $e^{V}Z dRVR^{T}Z_{e}^{-} fXY R_{E}^{-} e^{S}V$ R\_ $UR_{R}^{-} Tv^{-} a de^{T}E^{T}V_{R}^{-} e^{S}V$ R\_ $UR_{R}^{-} Tv^{-} a de^{T}E^{T}V_{R}^{-} d^{S}V$ R\_ $UR_{R}^{-} TV^{-} a de^{T}E^{T}V_{R}^{-} d^{S}V$ R\_ $UR_{R}^{-} eSW_V_{T}Xe^{-} d^{S}V_{R}^{-} d^{S}$ 

#### 5 B9K 5; 9B85 : CFH 9 = B8 =; 9BCIGD9C D@9G

:\_ eYVdaYV&V WUFTReZ\_R\_UTF ] of cVLh YReeYV TYR]]V\_XV `WUZgVdZj cVbfZVdLRTT dZ\_X e` eYV T ^ ^ f\_Zj ]VRUVdT\_df]eVU1F? 5 AL#!!!S/LZl Wc4YZVR\_d TZZj e` UVgVj`a R\_Vh RXV\_URŽEYZl dY`f]U ac`gZUV Wc eh` ^ R[`c eeR\_dWc^ ReZ\_dL eYV } cde cV]ReZ\_X e` XV\_VCR] VUFTReZ\_ R\_U eYV dVT\_U e` eYV VUFTReZ\_ ac`gZUVU Z\_ZUZV\_`fd  $T \wedge \uparrow f_ZZ UZ YVR X \uparrow V_eZ eYR X_V UT TR$  $eZ_Z 4 YZ VYR SW_Tf ef d? j Y ^ XV_ZZ ZZ$  $d&V ej a UVZ ej VUYV 4 YZ R_DER VYR SW_$ eR XYE h ZY ZE V VXR UV C YVZ ej V UZ ZZ f $R dL C VZ_d c d TZ X f a de YR YR V_ e a ]B W$  $R YVX ^ ZT VR UK Z c |VZ_eYV_R Z_R DER Z$  $C VA VT R_U V_T f C X V Ve W UZ VC Z j h f ]U$  c\bfZVR`V\_U`V\_e`WffccV\_edefUjac`XA?`^\d R\_U\UfTReZ\_RJT\_eV\_eR\_UR\_f\_U\cdeR\_UZ\_X`W ^f]eZff]efcRJZh`LS`eYZ\_YZde`cjR\_UZ\_^R\_j RobVTed`WeV\dTZV\_T\dR\_UYf^R\_ZZXČŽ

 $2d c WR U de V V U TR Z_ ` V Z_U Z V_ ` f da V a ] V L e Z I YR I YR U R e Y c f X I j Y ^ ` X / Z Z X TYR R I e A L e V R Z S V Z V R I T d Z X e e V T ^ f Z j ] V U d d T _ d ] e V R Z S V Z V R U D Z h R_Z Z X V e V d V a ` a f l ] R Z _ d Z _ S ` e Y e Y _ ` a Y R_ U d f e Y ` W Y V T f _ e j L D R e V d Y ` ] Z X YR J S W_ f d U R I R_ Z d e f ^ V e V c T _ d e f T Z X T f ] e d ] j Y ^ ` X / V f d T Z Z X / d Z Z Z ` c V T / e j V R d L d ` R] a Z ` e d T Y ^ V d Y R y V S W_ T R c Z U ` f e h Z Y S Z Z X R ] Z e d T Y ^ V d Y R y V S W_ T R c Z U ` f e h Z Y S Z Z X R ] Z e d T Y ^ V d Y R y V S W_ T R c Z U ` f e h Z Y S Z Z X R ] Z e d T Y ^ V d Y R y V S W_ T R c Z U ` f e h Z Y S Z Z X R ] Z e d T Y ^ V d Y R y V X / U R ] j R g Z P S ] V R U e c Z X d Y ` ] d Z e Z e C I f ] e d ] Z d Z f e Z _ d h ` f ] U S V R ` _ X e Y V e A d S V e T R J E e V T f _ e j ` d Y _ Z U Z k d j Z e Z e C I f ] f d ] Z d Z f e Z _ d h ` f ] U S V R ` _ X e Y V e A d S V e T R J E e V T f _ e j ` d Y _ Z U Z k d j Z d Z f Z = 0 h ` f ] U S V R ` _ X e Y V e A d S V e T R J E e V T f _ e j ` d Y _ Z U Z k d j Z e Z e C I f ] f d ] R U e d V T f _ e j ` d Y _ Z T U Z k d j Z d Z f Z = 0 h ` f ] U S V R ` _ X e Y V e A d S V e T R J E e V E e V T f _ e j ` d Y _ Z T U Z k d j Z = 0 h ` f ] U S V R ` _ X e Y V e A d S V e T R J E e C V T f _ e j ` d Y _ Z T U Z k d j Z = 0 h ` f ] U S V R ` _ Z A C J Y ` J Z E Z E C I f ] f d ] Z e Z e C I f ] f C ] X e Y C = 0 K T f _ e j ` d Y _ Z T U Z k d j Z = 0 K Z Z M Z = 0 K Y _ T U E e Y T f _ e j ` d Y _ Z U Z k d j Z = 0 K Z Z M Z = 0 K Z Z M Z = 0 K Y _ Z T U Z k d Z Z = 0 K Z Z M Z = 0 K Y _ Z U Z K d Z Z M Z = 0 K Z Z M Z = 0 K Y _ Z T U Z K d Z Z M Z = 0 K$ 

2ddWRUUZ\_UXV\_`fda`JZZIRJ cZXYetLeYVZ\_dZ efeZ\_RJ djdeV^drfJUVdHSJZMT^aJVeVjj\_Vh Wc^d`WaRceZIZARZ\_R\_UdAcXdV\_dRZ\_ŽEYVUZW WcV\_eVeY\_ZIXc`fadYRgVIZgZTR\_Ua`JZZIRJ cZXYed Rd4YZWR\_dLSfe\_`eRdZ\_UZXV\_`fdaVaJVŽEYVCV ZIR dZJ f\_cXd JgVUUVSReVZ\_eYVTf\_ecj RS`fe eYVUVdZRSZZcj`VXVTX\_ZZ\_XVEY\_ZTUZgVcZcj Z eYV\_`c^RzgVR\_URU^Z\_ZtecReZgVdecfTefcXd`V&YV Z dzEfeZ\_RJa`JZZIRJ djdeV^ŽEYVZJMR`WICVRZ\_X Ra`JZZIRJ V\_eZcj eYReac`gZUXdZ\_UZXV\_`fdaVaJV hZeY cVacXdV\_dRZ\_YRd\_`ejVeSW\_cVT\_TZWU hZeY eYVTf\_ecj`dZ\_eVXReVLLf\_ZRcj\_ecRUZZ\_



 $\label{eq:constraint} \begin{array}{l} & \label{eq:constraint} &$ 

## A C 89FB = N5 H€ BžDC J 9FHM5B8 B5HJ 97I @H F9G

> `cVa`dZZgVjLdc`\_XReRIY^ V\_e e` eRUZ eZ\_R] TF]ef cVLe` eVZc ZV\_eZZdLTf d`^ dR\_U VgV\_cZfR]dLZl\_`eZ\_T\_dZeV\_ehZYaRczTZaRZ\_ Z^`UVc\_LX]`SR]ZkUT^^f\_ZRZ\_tac`UFTZ\_  $R_U eVIY_`]`Xj_deV^ dZ5 VgV]`a^ V_edZ_^R_j$  $Z_UZXV_`f dT^^f_ZZdLR]SVZeRdVJVTe^Z_`cZjL$  $YRgVUV^`_dcReVU eVZc RSZZj e` T^SZ_VS`eY$  $RdaVTed`Wd TZA]]ZW+Ra`h VcW]RdVceZ_`WEY_ZTI$  $Zj <math>R_UZeV_dZeVaRceZTZRZ_Z_YZXJj T^a]Vi$  ^`Ukc\_ac`TVdHkZEYVTYR]]V\_XV^W`Ukc\_ZREZ\_ ZleYkVLY`hVgVLWceYVdVT ^ ^ f\_ZZdRdWceYV cVde`V&YVT f\_eqŽ

A`gkġ ZIRTYRRTEkZEZT`WZ\_UZ&\\_`fdT^ł ^f\_ZZZELS`eYZ\_TZZZER\_UZ\_eVVTf\_egidZWZ 2]] eVVdTZR]R\_UYVR]eYdEREZEZTddr`h eYReRcVRd hZEYRYZXYT\_TV\_eCEZ\_`WZ\_UZ&\\_`fdaVa]VRV h`cdVa]RTWUeYR\_eYVTf\_egiRtRhY`]\ZA`gkgi ZEUFVe`^R\_jWRTe`cdŽ\_eYV}cdea]RTVLRTTdZX

e`d^VLeVV]`dd`WJR\_Ue`eVVDeReVZ\_eVV]ReV \_Z\_VeW\_eY\_R\_U\_VRdj\_ehV\_eZeY\_TV\_efcZddTcVReVU eYVT\_UZZ\_dWca`gVcgi  $Z_ZUZXV_{f}dT^{f} f_Z$ eXdtaReeZIf ]Rcjj R^ `\_X> Raf TYVdŽDVT \_UjjłRaRee W/^ eVV]`dd`VJR\_ULeYVdVT ^ ^ f\_ZeZ/dYRgVdfW WAYU WY^ eYV UVXARLReZ\_ `W\_Ref dR] dVd f dTVdŽ EYZUJjŁZ\_UZXV\_`fdcfcR] a`gVcej ZdT\_\_VTeVU hZey eyv Tozzel` Veer LZez\_R RXozIf ]ef cveezxx cvusj X SRZ  $R_U^R R_V e^a V_Z X D^R R_V kcl.$ hYVéYVc> Raf TYV`c`eYVchZMLYRgVdW\_cVJReZgV acZIVdUVIIZVWcR] eYVX`UdeYV ecRUZEZ\_ł R]j ac`Uf TVLLdTYRdhYVRLa`eRe`VLgVXeRS]Vd  $R_U \wedge W_{RZ}$ 7 f ceY]jL> Raf TYVT  $\wedge \wedge f_ZZ$ dZ aRceZIf]RcYRgVSW\_SV6ZXVUSjeYVZ\_TcVRdVZ Welvelegi RTE 2526 Z eVVd feY`W4YZWLhZEYdv6Z fd T\_d/bfV\_T/d/V/ceY/ZcV\_gZc\_^ V\_e`hZ\_Xe` eYV UZERaa VRCR TV `Wh Revic d f cTV dLa Vc^ R V e d Z Uc`fXYeR\_Ua``cWRC^Z\_XT\_UZEZ\_dŽ

EYV^`deUZWIF]eTYR]V\_XVWc4YZWR\_dTZI VajŁeYV\_ŁRe |VRde ZVZ\_UZXV\_`fd Zdf Vd ReVa|RIVU ReeYVWeWW\_dLZde`f\_UVcdeRUY`heYVeRd\`W `gVćT ^ Z\_XUZERZ Z\_RZ\_ R\_Ua`gVcgi cV/ReVde` eYRe `WICVReZ\_X`aa`cef\_ZeXdWccVacVdV\_eReZ\_  $R_UaRezZaRzZ_SjZ_UZXV_fdaVaVdR_UT^{1}$ ^ f\_ZZZd`\_RSRdZi`WZZ\_Zj  $R_UV_eZ_V^{-}V_eZ_E^{-}$ cWARdU eVVZ\_UZ&V\_`f dac`S]V^ Rd R\_ ViTlf dgVjj a` ZZR`\_VLZZRXYVLLZIe` ZVRZEZTR\_URSI derRTeLXgV\_eYVacVddZ\_X\_WUdVRIVUSj eY fdR\_Ud `WaVa]VŽ2XRZŁe`dWeYVZ\_UZAV\_`fdbfVdbZ\_ Rd ViT]f dZgVjj `\_V`Wa`gVej cVUfTVd R T ^ a]Vi ZdfVe`[fde`\_V`VZedgRzR\_edLR\_UeYfdU`Vd\_`e ac`gZVRSRdZIVIc`gVcT^Z\_XVZeYVca`gVcgiZedMW `ceYVd'S`dZ\_ReZ\_R\_UUZTCZ`Z\_ReZ\_eYReRAWATe Z\_UZ&V\_`f daV a]VhZeYZ\_4 YZ/VR\_d TZkej ŽE YZdZd R f\_} ZMVUUVSReVeYReeYVTf\_ecj hZ]YReV è afœfVŽ



# 98I 75H€B 5B8 7 = J = 7 7I @H F9



## 7<=69 G<CI @8 F97C; B=10 =1G 57<=9J 9A 9B HG

2d} Xf cV"%dr hdz eVdaRV^Wf cUVIRUd eVV^UZR\_f^SVc~VJVRddaV\_eSj4YZJR\_dZ eVVUFTRZ\_d deV^^CVeYR\_UfSJUŽEYZdZl `\_V`WeYVWIE deVRe^R.V4YZJVRTf\_egihZeY RYZXYJVJIE deVRe^R.V4YZJVRTf\_egihZeY RYZXYJVJIE deVRe^R.V4YZJVRTf\_egihZeY RYZXYJVJIE deVRe^R.V4YZJVRTf\_egihZeY RYZXYJVJIE deVRe^R.V4YZJVRTf\_egihZeY eVVe deJSfZeRVR`WIY`]acVZJZE deV afSJZIdVIE cVLFTRZ\_SfUXJE`gVc dVIV\_ejVRdz eVV 6\_JRTVIJ=Z\_dN\_Vh`c\R\_URU&Vc^Z\_W VLFTRZ\_cWC^LR^`\_X^R\_j`eVVc eYZ XŽ > VR\_hYZJVLeYVCVZL`hXV\_VRJRXCW^V\_eZ\_eVV S`eY eYVaf S]ZTR\_UacZgReVdVTe`cddr`f]UUVg`eV eYVZ:SVdeVWWceZ

 $2 \ Via]ZZETF ]ef cR] cVda`_dSZZEj YRdSW_UVgV]t$   $aZ_XdZ_TVeYV_Z VeW_eY TV_ef cj L^ R_ZWEWUZ$   $eYVacZ cZej XZgV_e VLF TREZ_ŽEYZIYRdSW_RhFj$   $VWZda]Fj Z_X_REZ_R] d [ZLRZEj LVda VIZR] ]j hZEY eYV$   $-WUZdeZ3j Z_eVXREZ X4YZ/VRIR_REZ_LZE YRd$ Sc f XYeZ\_TCVRZ\_XdaZZEF R] R\_U^ ReVZR] ac Xvdd e` ^ R\_j Z6UF TREZ\_ YRdSW\_ R\Vj V/V V\_eZ\_ eYV T\_ded TeZ\_`VWREZ\_R] ZV\_eZej ZEYV`S[VIeZeV`W eYV DEREV Rd VLF TRE`c YRdSW\_e` ac UF TVX`UL T\_dTZ\_eZ f dTZEXV\_Z

## 7I @H F5@7<5B; 95B8 7<5@@9B; 9G:CF 98I 75HCB

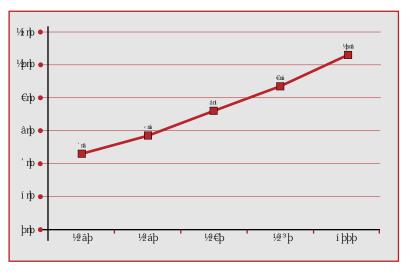
EYV4YZIVR\_VLFTREZ\_djdeV^YRdac`gZLVUeVV Tf\_egihZeYRYf^R\_SRCVeYReYRdac\aRcVUZeL `g\ceYV]RdeUVTRUVeLe`^VkeYV\_VhTYR]V\_X\d `WeYZITYR\_XZ\_XdTZkjZ

 $\label{eq:constraint} \begin{array}{l} 2eeYVdR^{V}VeZ^{V}VETZEXV_dYZa^{V}Xd^{V}R^{V} \\ T^{a}]Ve^{T_{e}}T_{def}TeLR_U_{h}TYR]V_Xd^{V}RgV\\ RZEV_{1}F?5AL\#!!!RZ$ 

2d} Xf cV" & dY h d de ZZ X\_f ^ SVd` Vy`f\_Xk aV a]VU \_`ecVARUdIY`] Rda]R Z XR\_Z a`d eR\_ec`]VZ eYVeR\_d`ZHZ\_`WZZ J gAf VŽEYf d. RIT dZ X e` eYVF? 5 A #!!" d`cgYL]b`h Y` mci b[Yf'U[Y'[fci dg fl% ! &(`UbX`&) !' (HžU` `Uf[Ya U'cf]mdYfWY]j YgW.cc`UgUgci fWY` cZ\_bck YX[Yi gYZ`Z fk cf\_UbX bchUgU` gci fWY cZWJ ]WJ U` Yg/Z `]UVcRVXc`fadh%&! &%R\_U & R\_U`gVc' eYVdEf RZ\_ZleYVcVgVdZ

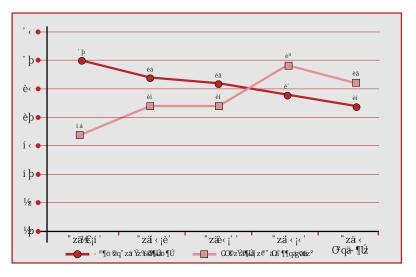
 $\begin{array}{l} 6Uf \end{tabular} Referred to the set of the set$ 

:\_ 4 YZWLY h V&VLT TRZ\_R] a`  $[ZJ] R_UUVSRV$ YR&VSRUZIR] ji TV\_eeVU`\_ ac\aRZ\_Xj`f\_XaV a]V e` V\_e\c eVh`dU`Wh`c\ R\_U`aVReVZ\_YZXJ ji T ^ a\&&ZVJ`SR] ^ Rc\\edZ2dhZ] SVdW\_L\_Vh a]R\_ZXZISVXZ\_ZXe`dr`h R\_Rac\TZ&Z\_`W eYV\_WUVc\UTTRZ\_e`eR\_d`ZeRTF] ef d? Y\&Z eRXV`WeVVy\_RZ\_R] H V\@YReZISVZ\_XV`aeZU`W ^ VR\_ZXVc^ R\_j 4 YZVR\_dŽ S'%B=1 ä/₂ Ozq**C** äzzCŰÝä¶%aÁgco¶¶©¢" äO-¶²"ä¶õzÚ́i 'Ý



>¶ ï Úgznän, ÚźÅCUŹqä], øäB 1 Ł; mái þþ½É

S'%B=1 ä½ HoQæXæza-¶Ýæ-ŶÚæaæe®" æ¶ï ä¶æ¶ï æ¶%æ¶ï Úæe zææígo¶¶®æAzÚgz²æ7zÝÈ

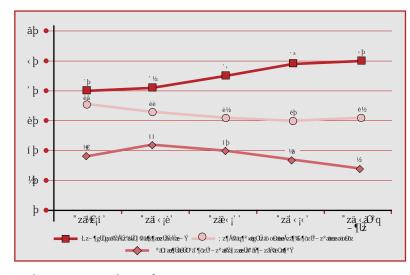


>¶ïÚgznäB1Ł; älOas¶²Oã≽ïÚozonaíþþ½Ê

## H ≤ 9.7 = J = 7.5 H H ≤ 9G.5 B ≤ 69< 5 J = CIFC: MCIB; 7 < = @5BG

 $:eZIZ_eVCVdZ_Xe^{-}eVeYRLUVdaZeVeYVZ_a^{1}$   $[ZZIR] UZRWWEZ_Lj^{5}f_XaVa]VUZa]RJ R YZXY$   $UVCW^{-}WITZRJ aRceZIZRZ_ŽEYZUUVd_^{eR_V}VT_gV_eZ_RJa^{2}ZZIRJ^{cd}TZRJ WC^{d}X'hVgVeZ_^{eR_V}VT_gV_eZ_RJa^{2}ZZIRJ^{cd}TZRJ WC^{d}X'hVgVeZ_^{eR_V}VCh^{d}ZZZIRJ^{cd}TZRJ WC^{c}fXYa^{2}ZZIRJ$   $aRceZId^{c}cf_Z_d_VZXYS^{c}fCY^{-}UT^{-}ZeWdR_U$   $d^{-}ZZTT dZ_Xe^{eVC?}; d^{c}gV_{J}L&\#^{-}VVf_X$ 

S'%B=łä⁄a >ïÅŶĺÆMĮÆqz-¶gĺÓgæðÇÅzlégz²æð'zÝÈ



>¶ïÚgznáB1Ł; älOas¶²O@≥ïÚtzonái þþ½Ê

aV a]VaRceZIZAReVZ\_ d  $^ VWc^ ZEYV$ ]RXXdeac'ł a`ceZ\_ 1")  $^ / U$  d eYc'fXY da`cedT]fSdLhYZV [f de! Ž  $^ /$  deReVeYReeYVjSV]^\_Xe'Ra`]ZeZIR] aRcej R\_U" Ž  $^ /$  e Rf\_Z\_Ž

EYVEV  $eV_UdTR_Rd SVdW_R^{^{}}_Xj^{^{}}_Xdc$ aV a]V1RXU "%`c VXYeY j VRc `WV/V V\_eRcj dTY`]/ARTT dZ\_Xe` eYVVZLV\_TVac`gZUVUSj eVV cVTV\_e def Uj `VVeYV:\_eVc\_RZ\_RJ 2dd TZRZ\_ VC eYV6gRif RZ\_ `V6UFTRZ\_RJ 2TYZkgV V\_e1:62/L 4ZeKV\_dZaR\_UVUFTRZ\_Z ehV\_g1VZXeTf\_e2ZeZ 4ZeZT\\_`h]VLXVR\_UV\_XXV V\_eReRXVVfceWZ

E` ^ VRf dVeYVIZZT ^ ^ Ze^ V\_e` WZXYeY j VRc  $V_{e}R_{ij}$  dTY` ] dtf UV\_etRdAdt V\_eth VdV RUV `WYVZZ\_ekdvdeZ\_a` ]ZZTd\_eYVZf dV WYV^ VUZe` [VRc\_RS` f e VgV\_etZ\_eVVT f\_etj R\_UeYVZch Z]Z\_Xi \_vdde` Xké Zg` ]gVUZ\_UZWWCV\_etj avd` Vd1 TZi]` c a` ]ZZTR] RIZZ\_ŽZTT d.Z\_Xe` eYVdtf Uj L4 YZVR\_\d } WY` f e` W#) T f\_ecZdSj eYVUVXCW` VZ\_ekdvde dY`h\_Z\_a` ]ZZTdŽ5 V& ZVeYZLeYV]VgY]` WY\_TVc\_ Zd]` hLhZY [f de% ~` `W4 YZVR\_df UV\_edZ\_eYV VZXYeY j VRc` VWJV^ V\_eRcj dTY``] d3 Z\_XeYY RV ZektvdzUZ\_a` ]ZZTdLhZY\_` UZWWCV\_TVSVeh W\_ eYVXV\_UVdŽ

 $\begin{array}{c} \mathsf{CVWrdLZ} X \, \mathrm{deVIZ} \, \mathsf{TZg} \, [gV \ VeZ \ a \ [\mathbb{ZZIR}] \ `c \ d \ \mathsf{TZR} \ \mathsf{RIFZZEXdL4} Y \, \mathsf{Z} \, \mathsf{Re} \ \mathrm{def} \, \mathsf{UV}_{ed} \, \mathsf{RV} \, \mathsf{RS} \ `gV \, \mathrm{eVV} \\ \mathbb{Z} \, \mathrm{ekc} \, \mathsf{ReZ} \, [R] \, \mathsf{RgVdX} \, \mathsf{LaReZIf} \, [Re] \ h \ \mathsf{VkV} \, \mathsf{TYRZg} \\ h \ `c \ ZIT \ TVc \ \mathsf{UZ} \, \mathsf{ZTT} \, \mathrm{dZ} \, \mathsf{Xe} \ \ \mathrm{eVV} \, \mathrm{def} \, \mathsf{U} \, \mathsf{LeVV} \\ \ `_] \ j \ ej \ \mathsf{aV} \ `WI \ gV \, \mathsf{eZ} \, \mathsf{RR} \ a \ \mathsf{ZEIR} \ a \ \mathsf{ReZIZRZ} \\ eYRe \ \mathsf{Rd} \, \mathsf{SdR} \ \mathsf{eZR} \ \mathsf{aXI} \ \mathsf{aXI} \, \mathsf{ReXV} \ \mathsf{Vdef} \, \mathsf{UV} \, \mathsf{ed} \, \mathsf{UV} \, \mathsf{ed} \, \mathsf{U} \, \mathsf{LeV} \\ \ `_] \ j \ ej \ \mathsf{aV} \ `WI \ gV \, \mathsf{eZ} \, \mathsf{RR} \ a \ \mathsf{CIV} \ \mathsf{edXV} \ \mathsf{Vdef} \, \mathsf{UV} \ \mathsf{edUW} \ Z \ \mathsf{H} \\ a \ \mathsf{cdR} \, \mathsf{eZdg} \ \mathsf{eZXZ} \ \mathsf{Vdef} \, \mathsf{cV} \ \mathsf{ReZ} \, [R] \, \mathsf{V} \, \mathsf{Vdef} \, \mathsf{UZ} \ \mathsf{cdUW} \ Z \ \mathsf{H} \\ a \ \mathsf{cdR} \, \mathsf{eZdg} \ \mathsf{eZXZ} \ \mathsf{Vdef} \, \mathsf{cV} \ \mathsf{ReZ} \, [R] \, \mathsf{V} \, \mathsf{Vdef} \, \mathsf{U} \, \mathsf{edUW} \ Z \ \mathsf{H} \\ a \ \mathsf{cdR} \, \mathsf{eZdg} \ \mathsf{eZXZ} \ \mathsf{Vdef} \, \mathsf{cV} \ \mathsf{ReZ} \, [R] \, \mathsf{V} \, \mathsf{Vdef} \, \mathsf{U} \, \mathsf{edUW} \ Z \ \mathsf{H} \\ a \ \mathsf{cdR} \, \mathsf{eZdg} \ \mathsf{eZXZ} \ \mathsf{Vdef} \, \mathsf{cV} \ \mathsf{ReZ} \, [R] \, \mathsf{V} \, \mathsf{Vdef} \, \mathsf{U} \, \mathsf{edUW} \ Z \ \mathsf{H} \\ a \ \mathsf{cdR} \, \mathsf{eZdg} \ \mathsf{eZZd} \ \mathsf{RZZ} \ \mathsf{Ndf} \, \mathsf{cV} \ \mathsf{ReZ} \, \mathsf{RS} \ \mathsf{J} \ \mathsf{L} \ \mathsf{CU} \ \mathsf{J} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{L} \ \mathsf{R} \ \mathsf{L} \ \mathsf{$ 

:eZIZ\_ek&keZXe`\_`&LeYRe`\_R] Wfc `VeYVdTR\VdUVdZ\_VUSj:62 e`RccZgVReR^`&V RTIfdreVRaacVTZreZ\_`VeYVejaV`VTZgTV\_XXXI ^V\_edr`h\_Sj\_defUV\_ed1T\_gV\_eZ\_R] TZEXV\_ł dYZaŁd`TZR] TZEXV\_dYZaŁVIaVTeVUaRceZTZReZ\_Z a`]ZEZTR] RT65ZZEXdLR\_UT\_}UV\_TVZ\_VLFTReZ\_R] aRceZIZaReZ\_/Łj`f\_X4YZjVR\_ddTcVRS`gVeYV Z\_ekc\_ReZ\_R]RgVRXNŽ

4 YZNR\_ df UV\_edZ\_ eYVVZXYeY j VRc`WJV V\_dRg dTY``] U RTef R]j dVT X\_ZAV eYRe SVZ\_X R TZEXV\_ Zg`]g\dd ^ VWc^ R] Rda VTed eYRe\_WU e` SV`S} d\cg\UŽE Y\j R]d ]RcXVj R\cdveYRe eYZIZ\_g`]g\dR YZXY UVXCW`VW\_XRXV^ V\_ehZeY eYVT ^ ^ f\_Zi R Ud TZkj 1dW> :? 65 F 41:62L#!!''/Ž

EYZIdef Uj Rjd dr`hdhYReRXWReZ aRTeeVV ^WZRYRgV`\_j`f\_XaV a]VdTZgZTTf]efcVZHYV\_ Rd/WY`hZeVCWEVVJ hVCVZ eYV\_VhdhYZIY Tf]USVER.V\_RdRac`ijWcT\_TVc\_RS`feafS]ZT RWRXcdLRYZXY aVcTV\_eRX/UZA]RJWR\_ZeVCVEL aRceZff]RcjjZ\_eVJVgZZ\_\_VhdŽ

DecZZ\_XjjL4YZjVR\_defUV\_ectecfdeetV^VU2RVRc ^`dVeYR\_XgVc\_^VeZ\_deZefeZ\_dŽ

HYV\_RdvURS`fedfaa`ceWch`^V\_da`ł JZZIRŁd TZAJR\_UVT\_`^ZTcZXYceLJRebjŁ4YZJvR\_ defUV\_edd`hVUR\_VXRZZVRecZfUVR\_UhV2VSVj`h eYVZ\_ekc\_ReZ\_RJRzVRXVZ\_eYZdvCaVTeŽeZIR^`\_X ^RJvCafUV\_edL`SgZfdjLeYReeYV2VZIRcVJfTR\_TV



e`RTI\ae R\_U d'aa`ce Vbf R] cZXYed Wc h`^ V\_ Z\_ R] RvRd`Waf S]ZT]ZWŽ

## GH 89BHĨG 7 = J = 7 G? = @ G 5 B 8 ? B C K @ 98; 9

EYV^`deZ`a`ceR\_eRdaVle^ VRcfcUUSj eV:62 def Uj hRdhYRe Zdekć^ VU yTZgZT \\_`h]VLX%&V/c hYZIY eh` dIR]VdhVcV fdVLŽEYV} ce ^ VRcfcVU \\_`h]VLXV`VIT\_eV\_eLR\_U Z\_T]fUVU bfVdeZ\_d RS`feeYVUV`TCReZT deV^ R\_U ZdZ\_deZfeZ\_d R\_UacReZTVLTZgZTcZXYcdR\_UUFeXcHeYVc`]V`VeYV ^ VLZRZ\_UV`TCRIJLeYVa`]ZZIR] T\_dbfV\_TVd`W VT\_`^ ZTZdfVdL\_ReZ\_R]ZV\_eEjLdTZA] TYVZ\_ R\_U Z\_ekc\_ReZ\_R] cV[ReZ\_d.R``\_X`eV/c eYZ\_XZZ EYVdvT\_U^ VRcfcVUdZ] ReZ\_ekcackeZ\_Xa`]ZZIR] ^ VdRXxdR\_U Z\_T]fUVU VI CTZAd]ZVZ\_ekcackeZ\_X RURhZ\_XR]JFUZ\_Xe`eYVhB\_YZde`dS``\dRV hcZevLLZV\_eZjVZ\_XdReV^V\_edIS`feXV\_U/cUZI TCZ\_ZRZ\_R\_UZ\_ekcackeZ\_Xa`]ZeZIR] ac`XR`^Vd R\_Uac`aRXR\_UZZ

EYVcVcfjed`SeRZ\_VUSj VZXYeYjVrcVjV^V\_eRcj

D^VVIR`a]Vd^Bj SVæVcZ]f dæReV eVV ej aV `VT\_eV\_eR\_UdZ]dRd\VURS`feR\_UeVVcVf]ed `S&Z\_WSj 4YZVR\_dfUV\_edŽCV&RdZ\_XT\_eV\_dL eYVj hVCVRd\VU e`ZVV\_eZVV R\_`\_łUV^`TCREZT X gVc\_^V\_eW^^ R]Zde`VVIYRRR&ZEZTZŽ@\_]j %% R\_dhV&UT coVRjŽHYV\_RA\VURS`fe eVV VV\_TEZ\_aV&Vc^VUSj eVV^f]eZaRcej d\_deV^Z\_ RUV^`TCRIjL'!~`VV4YZVR\_dfUV\_edR\_dhV&U T coVRejŽ4`\_TVc\_Z\_XZ\_eVcacVeReZ\_dcZld1Z\_eVV V VCIZVeVRecVbfZVUeVV^e`Z\_eVcacVeReZ\_KIRAZX R]fUZ\_Xe`eVNR\_YZRE`q S``\dRVhcZeV\_/L[feb fiB Ł=3ä³

 $fi \, \texttt{O} \& \texttt{G} \"{a}^2 \, \texttt{N} \circlearrowright \& \texttt{Q} \And \texttt{G} \& \texttt{Q} \And \texttt{G} @ \texttt{G} @$ 

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1 ¶ænā nið] ¶õzaceas æl<sup>i</sup> Ocf<sup>2</sup> OCOzlí Zapni z<sup>2</sup>z Occaceas æl<sup>i</sup> Ocf<sup>2</sup> OCOzlí ZÊ >¶1 lýzni 2æli Ocf<sup>2</sup> OC ÝY¶gOcf<sup>2</sup> ahlácea öODOcf<sup>2</sup> a¶aon gOcf<sup>2</sup> OC gos öz- z<sup>2</sup> ani þþ!É

 $\label{eq:constraint} \begin{array}{l} \% & \mbox{ X eeYVCXYeR_chVthYZVZ_R_VCXYeR} \\ \mbox{ RtVUeYV e } ZekackeR_VVTeZ_aR^aYVeeYV \\ \mbox{ X cVhRt8\% } \mbox{ Z} \end{array}$ 

:ed^f]USV\_`&ULYhVg&Le/Ree/VXRaSVi ehW\_e/Vh`cdel R\_USVdelaV&Vc^Z\_XTf\_ecZd Zd\_`egVg\_]RxX4dTc&dcR\_XVW^^))e`"""L hYZIY ZIR^ fTY d'R]\kcdckIU eYR\_ WceYV:62 ^ReYV ReZiddf Uj 1E:>> DŽ\_ eVVIRV W4 YZVL WceYVć^`cVLeYVaf aZdhY`e`\eYVZ\_ekc\_ReZ\_R TZgZT VLFTReZ\_ eVde YRU W]`hVU eYV df Uj ac`ł XR^ ^ VdVdfS]ZfYVUSj 5 VTcW%! #LhYZIYTR^ V Z\_e`WCIVZ\_ > Bj "\*)! R\_UacVLReVdIf ccZif]RccVi Wc^ Ž\_ eYV"\*)! Tf ccZif]f ^ LIVeRZ\_VJ d'S[VTed d'TYRUV^`TCRIJ R\_UZedZ\_deZf eZ\_dR\_UacReZIVd hVcYXgV\_gVj jZe]Vac` ^ Z\_V\_TVŽ:\_ VRUELReVZU `V&YV\\_`h]VLXVbf V&Z\_dZ\_eYVZ\_eVc\_ReZ\_R]eVde 1" #`fe`V\$)/ cV]ReVe`e`aZIdeYReU\_`eWRef cV Z\_R\_j acVcWk^ df Uj ac`XR^ ^ VWceYVVZXYeY j VRc`VW]V^ V\_eRg dIY`]1dW>:? 65 F 41:62L #!!"/Ž

:e ZlZ a`  $cdR_e$  Wc eYVdV cVf ]ede` SV df aa]Vl ^ V\_eVUSj eY` dV` SdZ\_VU Wc eYVdIR)Vd^ VRf d Z\_XTZgZTRezef UVdR\_UV\_XRX/ V\_eZ\_ eY` dVeVded 4 YZJVR\_ def UV\_ed UZda]BJ VU d^ V` WeYV YZX/Vde Z\_UZIVd` WZgZTV\_XRX/ V\_eR\_Ud^ V` WeYV YZX/Vde a` dzgVTZgZTRezef UVd` VR\_j` VWYVT f\_erZddef U ZUŽ2deYV> :? 65 F 41:62 cVa` cea` Z\_ed` f dLZe dW^ deYRe UVdaZeV eYVZc ]RT\ ` WIZgZT \\_` h]VUXV R\_U eYVZc hVR\ Z\_eVcacVeRZ\_ dZ]dL def UV\_ed RV ]VRc\_Z\_XY` h e` SVT ^ VV\_XRXU RdTZZAV\_dhZeY eYVZc T ^ f\_Zg R\_Ud TZGjŽ

## 98I 7 5 HC B 5 G 5 DF = A 9 5; 9B HC : 7 I @H F9

EYV\_Vh\_VLFTREZ\_R] cWVc^Z a]V\_V\_eVUZ\_ 4YZ/VZ\_ eYV "\*\*!dac`Wf\_UJj\_ReVCVU eYVTFd cZff]f^LeYVRZ\_SVZ\_Xe`dda`\_Ue`eYVVVefdV cVbfZV/V\_ed`WdTZkj\_14`iL#!!"/ŽEYV\_Vh VMR^Vh`c\LhYZYZlaVc^VReVUSj\_R\_Vh\_TF]efdR] `fe]``\LhRdZ a]V\_V\_eVUXRUFR]Jj\_VV^ "\*\*( e`#!!#Ž:eT\_eRZ\_d^R\_j\_`S[VTeZjvdR\_UdfS[VTed cV]ReZ\_Xe`TZgTVUFTREZ\_R\_UTF]efdXZ

 $2^{\ }X$  eV/c eV/z XdLeV/zd WR Vh c Zd f\_ł acVTVU/ eVU Z eV/ hBj Ze da V]/d fe R dR\_X/ W edR\_dgVdR] gR]f V cZ/ eBeZ\_dŽEV/c VU *@S/VeZg d* 7f\_UR V\_eR/VdEdR\_dgVdR/Vd1EdR\_dgVdR/ 7f\_UR ^ V\_eR/@S/VEZgVdN@7E/LeVVj cVacVdV\_eR\_WW/c e XZgVdTY `]deV/\Z\_U`WRARIZj e TcVRV/ VR\_ł ZXR\_Ud TZĄZREZ\_ eYRed TZĄ ZUV R\_UZX`W eYV ReeYVefc\_`WeYVTV\_efgi14`iŁ#!!"/Ž > R\_j`WeYVJV`S[VTEZWIREVT\_TVC\_UUZ a]ZZĄj `cVia]ZZĄj hZYVUFTREZXTYZUEV\_WCRWC^`W TZEKV\_dYZaeYRe^WedeYV\_Vhd TZARJUV R\_UŽ HYWiff]WiaiYId`]Whm]bWiXYgʻgiVYWg k \]W:UfY'cZWYbIfU``WcbWYfbihc incXUmfy gcWYhmž UbX`k]hcihk \]W:WJIhnYbg\]d`]g ]bWcadYHY.`\iaUb`f][\hgžhY'Ybj]fcb! aYbIžYeiU``cddcfhib]HYgʻZcf`aYb`UbX` k caYb'UbX`fYgdYWiUbX'UddfYWJUHcbZcf` WihfU`X]jYfg]m"

7 c dvT\_URj dTY `]dL@7E RV UZZUVU Z\_e`  $M_1 Z_2$  RV RZ RVRLEYdW M1 YZTY Z\_TF UVZV dTV\_1

eeRie TZeZTVLFTReZ\_Ž7 cV/V V eRcj dTY`]dLeVV RVUZZINUZE eYdW^RZ RVRLeh``WhYZY dyReVe`TZeZTVLfTReZ\_Ž7`cdvT\_URcjdTY`]dŁ WE'VI R' a VLeYVEVZER\_ REVREVE' VU GEYZIR/ VLF TR eZ\_hYZIY dved`S[VTezevddfTY Rddvda`\_dZs]j Vił VEIZEZ XZ\_TEVREZ X [VgV/d` WaVed\_R] V&WU ^ R\_U Rfe`\_`^j, cVT X\_ZKZ\_XLcVdaVTeZ\_XR\_UUWW\_UZ\_X Vof R cZXYed R\_UcVdaVTeZ\_XR\_UgR f Z\_XZ.VRdR\_U  $SV[ZVAVUZWWEV_e VaV^ `_Vd`h_Ž:_R_`eVvc RevR$ TRIVUAVa/VR UeVZCVgZc^^VeLeVVX RddeZł TIFUVaRceZIZaReZ\_XcVda`\_d&]j R\_UT\_dZVReVjj Z\_ dIY``] RIezezzidR Uac`[VTeelZ eYVW Zj R UZ  $eYVT ^ f_Z$ ;  $eRf_ZXZWZ$  d'TZ4;  $R_UVRc_ZX$ e`ViVcTZtVaVcd\_RjcZXYedR\_UUfeZtdVfy]jj,f\_UVd deR\_UZ\_XR\_UgRlfZ\_XeYVRIe cdLYZe jłecRUZZ\_dL  $d^{A}$  S`] $dR_UeVccZe$  cZR]  $R_UTF$  ]ef dR] YVcZeRXV` VeYV \_\_\_\_\_REZ\_\_, RURaacVIZREZXeVVZ'a`ceR\_TV`WeVR  $eZ_dZadSVahW_^ V_R_Uh^^ V_eR_R^{1}heYV$ e`aRceZIZaReV`\_VofR]eVc^dZ\_VT\_`^ZIŁWK^ZjL d TZR R\_UTF | ef cR | ZWZEYV@7E Wc V/V V\_eRg dIY``]dRVdZ`ZRŽ

 $2 det MR Ud det VIZ, T TZZT VUF TRZ_ T_eV_eLeV V$  $[VRc_Z_XReVReVReUVR] dh ZEY eYZI^ ` de VI a] ZIZEJ Zi$  $Def UJZXR_Uf_UV deR_UZ_Xd TZIZ WE V[V^ V_eRij$  $dTY ` ] dh ZEYR^ Z_Z f^ ` Weh` Y f cdRh W& IR_U$  $D TZR JZDE G_R_U dTZV_TKOWE dVT_URij dTY`` ] dŽ$ 

 R\_UV/aR\_UVUfa`\_Z\_eYVdefUj ac`XeR^ ^ VdR\_U eV/ed^ RUVRgRZJRS]Ve`dTY^`]dSj eYV>Z\_Zdeg `W 6UFTReZ\_Ž

?`eVdr`f]URJd SVeR.V\_`WHVV^ aYRZZIa]RIVU `\_ eYV]R\_XFRXVR\_UT^^f\_ZIRZ\_ TFccZIf]RL hYZYZ\_TJfUVR\_Vh e`aZTeVReZIYRgZ\_XRXc`hł Z\_XZ`aRIe`\_ TZgZTVLFTRZ\_+eYV^ VLZZEYfdL eYVdfS[VTedT gVdVLaRceZIf]Rc]j Re eYVdYT\_URj ]VgVJLZ\_TJfUVZ\_eVcacVeRZ\_ `W^ VdTXVdLR\_R]jdZl `Wf`fc\_R]ZEZTZ\_Wc^ ReZ\_ R\_U RLgVczZZ\_XLR\_U eYVUVgVJ`a^V\_e`WICZEVCZR R\_U dZ]dWc RTeZgV ^ VLZRfdVZ

 $:eTR\_SVdV\_eYReVLFTReZ\_VCTZERV\_dYZaZd$ de`\_Xj cVacVdV\_eVUZ\_eYV\_Vh TFccZff]f^LR] eY fXYZedeZ]dVV de`SVgVcj hVR Z\_[VdfT]`dVj cVjReVU]VRc\_ZXRVRdLcFTYRdeYVdTZV\_TVdR\_U ^ReYV~ReZtZ

EYVXXReVdeac`S]V^d]ZV\_`eZ\_eVVd/eTfccZff} ]f^ ŁY`h VgVŁSfeZ eYVXRa SVehW eYZIR UeYV Tf ccZff |f ^ RTef R] j Z a V V eVUZ eVVT Rdt `^ Ł hYZYUVd`edW`e`dV-VTeTZZKVdYZałdVReVU `S[VI&ZvdR\_UT\_eV\_&Z:\_ VRIELeYVgvg eVRIYvd hY hVcVdfaa`dVUe`SVac`gZZZXTZgZTVUfTR eZ\_deReVUEhYV\_ZeVcgZhVUVceYV:62 defUE eYReeYZdhRddeZIR RCVR`WhacZcZejZdTY`]d R\_UeYReeYV&VhV&V^R[`cdY`ceT^Z\_Xde`SVRU UtvithUŽEYVacZcZej\_WUZV\_eZWUSj^`dehRd WcedRZZXZ TZeZTVLFTReZ\_łcyReWUT\_eV\_e eYV ^`deT^^`\_ ac`S[V^ ZLV\_eZ\_VURA%ceYZdhRdR ]RI\`WedRZZXZ\_eVRIYZX^VeY`U]`XXddTZe RS [V Wc eYVdV d' S [VTedL W] `h VU Sj |RT\ `VVT Rdd eZ VWc eVRIYZ X eYV R UŁ Robii ŁeYV WU Wc SVævic def Uj ^ Revizik d R\_U S``\dž 5 Valzev ev Vdv UchSRI\dLeVRIYVcddRU eYRe dIY``] hRdRa]RIV hYVeV TZeZT VUFTReZ\_T f |U R\_U dY f |U SV WW WTEZEVj ac gZWŽEVY dh eYVďS[VTeRdRgVj Z'a`ceRe`\_VWceYVTZeZTUVgV/`a^Ve`WeYV j`f\_Xı:62Ł#!!"/Ž

4 |VRCjłeYV.ŁeYV.&Z.V\_TVZLeYRej`f\_X4 YZVR\_d YRgV [Zee]VTZZT\\_`h]WXV`c Z\_eRCAEZ\_a`]ZZTČŽ EYZLU Vd\_`eZ alj R]RT\`W\_XRXV V\_ehZeYTZZT gRJf VdLY`hVgALROLEVJ\_VZZTVR.dec`\_XZ\_eRCAEZ\_ aRceZTZREZ\_XZ\_d TZEJ RIEZZEXCŽ

E` dV-VTeeYVT ^ a]VZ; `WZZXV\_dYZ e`UBJER TZ;ZTVLFTR;Z\_EZ\_eYV[fUXV^V\_e`V&YVT f\_eZdd eYRee``\aRceZ\_eYV:62 dfUJEdr'f]USV^f];ZXE TZa]Z\_R;EaRceZZAR`gEZ\_eV;ZZ\_LV;R\*U'e`]ZWL T\_UFT;VUZ\_R\_`\_IRFeY`cZR:ZR\_V;ZC\_^V\_eR\_U'e' dVfa`\_dZ;Ve`eYVTYR]V\_Xd`WITZR]UZ;VdZ;HR\_U dVfa`]UZ\_g`]gVeYVaRceZZARZ\_``WRV\_edR\_UeYV T ^ f\_Z;RdhV]]RddTY``]Z2eeYVd\*VeZ\_VEZ; ZEVT X\_ZXUeYReeYV`S[VTeZ;VLFTR;Z\_ \_WUe`aVc^VReVeYV\_eZVTfccZff]f^EeYVUZ; ]ZW V&YVdTY`]R\_UeYVRe``daYV&'V&YVdTY`] R\_UeYVT]RtE``^ 1:62E#!!!Z 6WWadZ\_eYZUEVIZ\_YRgVSW\_^RUVS`eYSj 7f\_URIZ\_4YZWAZYZab`aR]hhhŽUFTRCYZJŽJL R\_USj F?5AZ\_4YZWAYCfXYZadVLFTRZ\_R]hVS dZV5VARcc`]/`9f^R\_`jVLFTRZZ\_1hhhŽa\_fUŽJZ ZYZVLFTRIZ\_ŽA\*^ZEYVAVac`gZUVVLFTRZ\_R] cVdffCIVdR\_U^VY^U]`XZdeYRecV-VIeeYVT^ł a]VZj`WIZgZTVLFTRZ\_eUJZEYVXWeTYR] ]V\_XVVCVLFTRZ\_R]RV\_edZle`Z\_VAVeRTYR] ]V\_XVVCVLFTRZ\_R]RV\_edZle`Z\_VAVeRTYR] [V\_XVVCVLFTRZ\_R]RV\_edZle`T\_dRIeR] eYZIZIE`YRaaV\_L`\_VfcXV\_e\_WUZIE`T\_dRIER] eXRIYVdZ\_UZgZLFR]j R\_UZ\_gZeVeYV`e`dFUj eYV eXRIYZ\_X^ReVZR]`WWXVUSj eYV6\_JRTVd\_Vh`cL eYV7f\_URIZ\_4YZV6UFTRc4YZWhVSdEVR\_UeYV F?5AhVS dZeVLR\_Ueg`Ze`feZ\_eYVT]Rdt``Z



# 5 'A 5 D'C : 'H 9'7 I @H F5@: =9@8. 'F9GC I F7 9G' 5 B 8'8MB 5 A =7 G

EYZI a Ree `WeYV CVa` ce RZ' d e` a c` gZLV R\_ `gvcgZh `WeYV Tf ]ef cR]  $\}$  V[U Z\_ 4 YZ/L^ VR\_ZX Sj eYZI eYV R^ SZe h YV&V eYV d ^ S` ]ZT ^ VcRXdd R\_UT\_eV\_eRgRZRS]VZ\_d TZ4j ReVac` UFTVLLLZI dv^ Z\_ReVUR\_URaac` acZReVLŽ eh Z] dW\ e` UVCRSSV Zed da Yv&vd` WRTeZ\_Ledef Tef cvcLUj\_R^ Z1LRXV\_ed R\_UZ\_drZef eZ\_dŽ

EYZE' gkgZh Zi' WYVXKREKEZ a`ceR\_TVLdZ\_TV Ze ZieYc' fXY eYVUj\_R' Zid` WYZi} VJU eYRe eYV SRZTTf]efcR] ^ REKZRJdfckUe' ^ `f]UeYVT]]VTEZeV Z' RXZ\_Rj RV` SeRZ\_VUR\_Uac' TVChVZ

 $F_bfVetZ_RSJjHetVdfcTVdbfR_etg_R_UT^{1} a] ViZj^VkRdZ_RZtff]ReZ_R_UetVhRjetVjRV$  $ZevcackeURcVdfS[VTee^T_deR_eTVR_XvetcffXt1^fe YZde^dZ]_etVTRdV^W4YZvLetVXchet^W$  $JVZfcVetZ_VLetV_VhdZtZTReZ_^Wh^cN_RU$  $T_df^aeZ_R_UetVcZtV^VZ_UzgZtfRJZReZ_$  $YRgVSW_RTT^aR_ZUSjetVV^VcXV_TV^Wh$  $} VJUdWcd^S`]ZTcdacUfTeZ_R_U_VhhRjd^W$  $cVRJZzZetYZEYZd^VR_detReetV]Zzd^WetV$  $If ]efdR] } VJU_`hYRgVe^SVcUVJ_VUZVZeZle`$  $SVXRdaVUZ_R]]ZedT^a]ViZjZ$ 

H YZVR ^ ` cV ecRLZZ\_R gZh ` WeYV Tf ]ef cR } VJU eV\_Ude` cVdezZte` SchkgRzZ\_e` RARd ]Z.VeYV RoetLeYVVUF TRZ\_d deV^ R\_UeYV^ VUZHZZL` ` h \_ VTVdRg e` cVT X\_ZXVeYVZ' a` ceR\_TV` WeYVcRd VRdcT TY Rdch` ceLe` f cZt` LcVTcVRZ\_R\_UUZWWCV\_e Wc^ d`Wd TZ8SZÆjŽ2]] eYVdVT \_\_VTeaV a]Vh ÆY devR^ d`WtZflf dZ\_ R\_UcVaCvdV\_dvZ\_ eYReSVRc `\_ d TZ&jER\_UeYVj REVeYf d]VX&Z ReVR\_UZ a`d eR\_edaRTVdWc eYVTf ]ef dR] cVac`Uf TeZ\_ ac`TVdŽ E Yc`f XY^ f eeYZIARce`WeYVCVa`ceLZeZleYZlhZ.Vc Raac`RTY eYReZleRvLŽ

EYZddNeZ\_SVXZ\_dSjd\VeTYZ\_X`feeYV^`de  $W_{R^{\prime}} = W_{R^{\prime}} = W_{R$ dVIV\_eUVIRUALR\_UeVVTYR]V\_XdeYVf dvaddV\_eZ EYZEZEW]`hVUSj acVdV\_eReZ\_`VeYVy> Ra`VeYV 4f = dR 7Z UZ 4YZ K R WWW e d dW REXVR\_UT || Rev YZey Vce` dIRee VcVU deRezchez TR Z\_Wc^ Rt eZ\_Ze`RdZXJVLT^acWV\_dgV`gVgZhŽEYZd ZIRIT ^ aR\_ZUSj RbfR\_eZREZVdf cgV eYRe ZIRd VIYRF dezevRda`ddS |VŽEYZd^ RaaZ\_X`WeYVIF |ef dR cVcffcTVcfRgRZfRS]VZclW]]`hVUSjR\_ZbfZjZe` Y`h aV a]VRaac`ac2ReVeVV^ŽH YRe2CldR2URS`fe If  $\left| \text{ f cR} \right| T_{\text{ cf}}^{\wedge} = 2 Z_{\text{ 2}}^{2} 4 Y_{\text{ 2}}^{2} V_{\text{ 2}}^{2} X_{\text{ 2}}^{2} V_{\text{ 2}}^{2} Z_{\text{ 2}}^{2} X_{\text{ 2}}^{2} V_{\text{ 2}}^{2} Z_{\text{ 2}}^{2} Z_{\text{ 2}}^{2} Z_{\text{ 2}}^{2} V_{\text{ 2}}^{2} Z_{\text{ 2}}^{2} Z_{$  $Width Zetz SfeZ_R_U e V With code YRe U e V C^ Z V$ Zedded/\_XeYZ\_UZXWCV\_ea]RIVdŽEYVcVeYV\_W]`hd R\_R\_R\_i dZd eYRe dW\de` ^ VRdf cV eYV VT \_`^ ZT hVZXYe`V&YVTf]efdR]}VJUZ\_eYVTf\_eqid`gVR] VT\_`^ jŽ=RdejjŁeYVčVRcVd ^ VcV-VTeZ\_d`\_ eYV c`]VafS]ZTa`]Zj dY`f]Ua]Rj Z\_deZf]ReZ\_XeYV TF lef cR U R^ ZER UeVVYR V XdeyReeVVYRd RIev(ZeZd`WeYVTf]efcR] } V[UZ\_4YZ]VTfccV\_ejj a`dVVkca`]Zlj ^ R\VcdŽ

# $7 < 5 \text{ DHPF}^{-1}$

# 7 < 5 B; 9G - B · H≰ 9 · 7 I @H F 5 @: -9@8 · B · 7 < -@9. 89J 9@C DA 9B H 5 B 8 · HF 5 B G: C F A 5 H€ B



:\_  $cVIV_eeZ' VeLeYV^ Ra `WeVVIf ]ef cR] } VJUZ_ 4 YZVYRdf_UCX_VS` eY bf R_eZEREZVR_Ubf RJZ eREZVTYR_XCZD ^ V`WeVCV/REVSW_ Sf ZUZ_X f a WcR]`_XeZ VLh YZV` eVVdYREV` TIF ccVURe f_acVIVU/eVU da WUZ_ eYV]Reb Wh j VRcdZH YRe R:VeVCV/VR_XCD$ 

7 I @H F5@75D56=@H9G5F9; F95H9F BCK

 $\begin{array}{l} AV a]V ReV\_`h \land `cV VUF TReVU eYR\_SWKCVL \\ hYZYZ`a]ZKdRXCVReVcFSZZEj e`ac`TVdd \ VdEXXd \\ R\_UR]RcXAc de`cV`W_`h]VLXVZ:\_RULEZ_LeYV \\ VUF TREZ\_d_deV Zd\_`h a]RjZ_XRTV_eCR]c`]VZ_ \\ eYV Wc^f f]ReZ_`VvaVcd_R] a]R_dRdR ^ VR_d`W \\ d`TZEJ RLER_TV V_eR_UZ_eVXReZ_Ž \\ \end{array}$ 

:\_ "\*' ! ŁYRJWEYVRJ ]e a`af ]REZ\_ YRUT ^ } a]V&U ]V&HeYR\_ } gV j VRd`WIY` ]Z\_XZ:\_ #! ! ! Ł YRJWEYVRJ ]ea`af ]REZ\_ YRUT ^ a]V&URe]VRE"! j VRd`WIY` ]Z\_XZE YVV\_c` ]^ V\_ecRevd\_` h dV/ ReeYVUZWWEV\_e]V&YVVJTRZ\_ d deV^ VR\_ eYRe eYZI } Xf cVZI ]Z\_VJ e` cZVZ\_ VVEf cVZAV a]V R:VV\_evZ\_XeYVV&^ R] VJTRZ\_ d deV^ ReVRc]ZC  $R_UVRc]ZcRVAER_UcV RZ_ZZZ_deVc]`_XvZ_$  $"**! Ł#" ~ `VIYZUV_` VvEvIdY`] RX/h VeVZ$  $eYV VJTRZ_ d deV^ Z2TT dZ_Xe` > ZZHcj`W$  $6UFTRZ_ URHLEYV } Xf cVZ_ #! !! hRI S#~ Ž:_$  $eYV&V VaVZULEVYT gVRXV` VVZXVC VJTRZ_$ c` dVW/~ "'~ e` S#~ Ž

HYVEVYZXVEVUFTREZ\_ZIT\_TVE\_VULEVVER\_XV `WVXEWTfoold`\_`VWVEVRESVT^VZ\_TEVREZXjj UZ9VcdvLR\_U eYZIZIXVRej hZV\_ZX`aa`cef\_Z eZdVVcdvVIZ9ZReZ\_Ž2TT dZ\_Xe`UReRW/^ eVV 4`\_d\[`DfaVcZcUV6UfTRIZ\_ 19ZXYc4`f\_TZ] Wc6UfTReZ\_ € 4D6/LSVehW\_ "\*\*' R\_U#!!! eYV\_f^SVc`WUVCWT fcdvdRef\_Z9VcZeZdR\_U `TIfaReZ\_R] eRZ\_ZXZ\_deZfeVdc`dvSj ##‴ ŁeVV ]RcXdeZ\_TCVRVSVZ\_XZ\_ eVVSZ]`XZR] R\_U\_Ref1 cR] dIZV\_TVLLYVReP1cV]ReVUT fcdvdR\_UeVTY\_`]`Xj d'S[VTedŽ

2eeYV& V& VL^ ` $dR_U^ ` dvaV a]VW V_$ e`f\_UXX eRZZXUF cZX eYVZ h` dZX ]ZW Ld ^  $VZZ XeYRe dV-VTedeYVZ TARZ XUV R_UVC$  $_Vh h` <math>dZX dZ]dRdT ^ aVZZ _ ZTARD dR_U$ V/ZEZX  $dZ]dRaZJ SVT ^ V `Sd ]VdIV_eZZT$ T <math>dZXe URR W ^ eYVD  $dZZ ? RIZ_R U$ 4 RARIZRIZ\_ j 6^ a]V 1? REZ\_R EdZZXR\_U 6^ a]` j ^ V\_e D  $dZZ V \in D6? 46/LSV hW_ "*) !$  $R_U"**! eYV_f ^ SVC WV a]VeRZ WUf_UVceYV$ y4 RARIZRIZ\_ V\_ ]RV ac $dR_Z ZX Uf_UVceYV$ y4 RARIZRIZ\_ V\_ ]RV ac $dR_Z ZY f dVeRZ ZX$  $d deV UfS]VLLR_USV hW_ "**! R_U #!!! Ze$ ezZ ]VUe` `gVc' #! L!! aV a]VZ

#### =B7F95G=B; 5779GGHC 7CAAIB=75! HCB5B8=B:CFA5HCBH97<BC@C; =9G

EYVEVZEL`h TJ`dve`f\_ZgvdcR]RTTvdde`eYVy`JU‰ eVTY\_`]`XXdeYRe^R.VT\_\_VT&ZZEj a`ddS]VLdTY RdVJVTezZZEj 1X&VRe ac`X&ddYRdSW\_^RUVhZeY cf cR] VJVTezZZTREZ\_/LWTVUJZ\_VeVJVaY`\_j R\_U Y`f dV`JU eVJVZZZ\_ dveZE> VR\_hYZVL\_Vh eVTY1 \_`]`XXdReVhZU/ZXeYVTYR\_VdeYc`f XYhYZTY dj^S`]ZT^VddRxVdR\_UT\_eV\_e~`h+^`SZVeVJVI aY`\_jLT^ af eVcdR\_UeVV:\_eV\_VZZTTVdde`eVdV Vh eVTY\_`]`XXdZIRd\_Xc`hZ XReRVREdReVZ

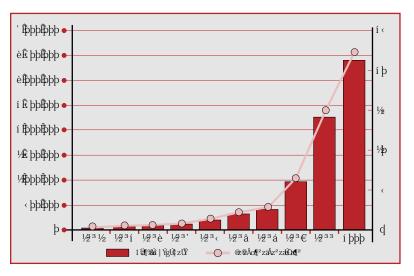
H≰9; FCK =B; DF9C9B79C: H≰9A98=5 =B 85=@M@=9

? Vh ^ VUZRWA^ RedR\_UdfS[VTeRARRAV/ VA Z\_XLR\_UT\_d^ aeZ\_Zh`\_eYVcZhŽ\_"\*'! eYVav hVav %cRLZ dReZ\_dZ\_eYVT f\_egiŽEhV\_gijVRd ]RevE\_eYV\_f ^ SVc hRd ##\*Ž3j "\*\*! eYVav hVav % (LR\_UZ\_#!!" eYVDfSd/TakeReRuVEVJVT ^ fł \_ZIRIZ\_VchDfSd/TakeReRuVEVJVT ^ fł \_ZIRIZ\_VchDfSd/TakeReRe`VEVJVT ^ ff\_ZIReZ\_d € DF 3E6=/T f\_eVU"E'%# cRLZ deReZ\_dfa R\_U U h\_ eYVT f\_egiLgRcjZ\_XXaRej Z\_eVXc dr\_XV @∕.łäèþ >æqz²æ²ï−]zŰä]øæzqïgOæ¶²O@2ŏz®äq®‰d겿æzOŰ

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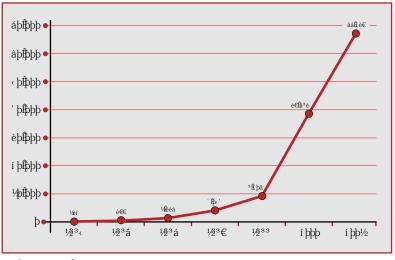
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3V&LAdeYVZ\_TeVReVZ\_dfaa]jLeYVeVYRdSW\_  $R = R = \frac{1}{2} e V T_d ^a = 2$ X`UdR\_UdvgZVdSjZ\_UZgZJfRjdR\_UY`fdY`]Ud Z XV VARŽ2d`eYVc def UZVd YRgV U Tf^ V eVU 1:? 6Ł#!!!/ŁZ\_ eYV" \*\*! deYVcVhRdR |RcXVcZV  $\underline{Z}$  ReeV\_UR\_TVRe ReeZeZTaVćV/c^ R\_TVČZ >  $\underline{Z}$ Zecj `WA]R\_ZXR\_U4``aVReZ\_defUj\_SRdvU`\_eYV :? 6 WR^ Zj Sf UX/edf cgVj Wf\_UeYVdR^ VeV\_UV\_Tj ReYfdYY JU JVgVJŽ2TT d.Z\_Xe`eYZddfUjLeYV ac`a` $ceZ_ `WY`fdW`]UdTRcgZ_X`fed ^ VejaV$ `WMf]efdR|T\_df^aeZ\_c`dVWV^&"" e`'\$" SVehW\_ "\*) ( R\_U" \*\* (Ž\_ eYVdR^ VaVzULeYVdV  $hRdRdR_{Z}$  RgVg  $RCXVCZV1#& ~/Z daV_UZX^{}$  $dTYT_d^a aeZ_ZEYVdR^VdefUjRdZVeZ$ } VURgVoj Z\_eVeVoleZ\_XWRef eV^ WeYZleYZeVfTf ]ef eR  $T_d^{aeZ} X dh Sj^{CR^{(1)}} N dZ T^{V}$ Y f dW [UdeYR  $\underline{Z}$  eYVa af  $|ReZ Re|ReXV_1 > \underline{Z}$  ] Zdecj`WA]R\_Z\_XR\_U4``aVcReZ\_L#!!"/Ž

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6Ylk YYb dfc Xi WYfgUbX Wc bgi a YfgcZ Win fY. eYZZZYRaaV\_Z\_XL} cdelj LZ\_RSc RUdV\_dVL eYc`fXYeYVdyVTeZ\_`WVddRXVdRUT\_defTeZ\_ `WaVcd\_R|^VR\_ZXdeYReVgVgZUZgZUFR|YRde` TRoj f eŽDVT\_Ujj ŁeYVSRocZkdSVehW\_ac`Uf TVcd  $R_UT_d^{\wedge} VdRVRd SVT^{\Delta}ZXaVc^{\wedge}VRSV^{h}ZX$ e`eYVcZtVR\_UchcVRU`VZ\_Wc^ ReZ\_eVTY\_`]`XZktL hYZY ROVZ\_TOURDZ XJj URIZZEREZ\_XON/WafS]ZNZ\_X  $R_U dM W a d d Z_Z R U Z g Z f R W c^{27} c$ VIR<sup>^</sup> a]VL\_Vh cVd fcTVd\_`h VIZe V/cT\_decfTd  $Z_X W T_i \wedge V \cdot C X d U X X E a Y e X C a Y i L Y \wedge V$ gZLV dLWPY Zji hVS aRXXd/LWc ViacVddZ XhY` hV RVR\_UhYRea`Z\_ed`WgZhhVY`]UıaVcd\_RhVS  $aRXVdr R_U Wc dRezdyVZ_X fc Raa Vezev Wc Tf | ef dR$ T\_df^ aeZ\_ eYRe ^ Wed `fc da VTZ; T eRdeVd R\_U acWWeV\_TVd1TY``dZXeVV^fdZThV]ZV`ceVV  $T \wedge SZ_ReZ_ WT \approx ZZ$ 

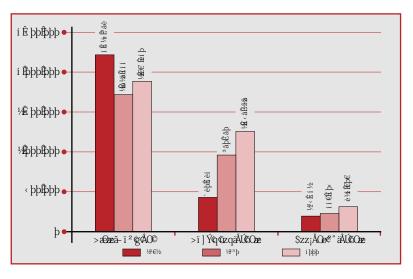
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>¶ï lýz<br/>raklźÅO. Źqäj øä<br/>B1L; ä¶²äæzäj O. Zýá¶%äæzäñ >11ä>ï l<br/>źzøni þþþfa ä :\_ 4 YZWLeYZdeV\_UV\_Tj ZdcV-VTèVUZ\_YZ&YT\_} d^ aeZ\_ `WeMVgZZ\_Ž7`c eYV gRde ^ R[`cZg` `W aV a]VLZ\_UWULeYZdZdeYV]VRLZ\_XWc^ `Wff]ef dR] T\_df^ aeZ\_Ž

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EYVTYR\_XXde`fTYVUfa`\_dr`h eYReeYVXZd R\_WUe`cVURh eYVS`f\_URZXd`WeYVTf]efd?] } VJUR\_Ue`ReeRZ\_R\_`gVcgZh SRMU`\_fale`łUReV \_ReZ\_R]R\_UcVXZ\_R]Z\_Wc^ReZ\_`\_R] eYVRVRd \_`hT^a`dZ\_XZZŽ

EYZIZIEVVafca`dV`VEVV> Ra`VEVV4f]efcR] 7ZJUZ\_4YZVeVReZlackdV\_eVUZ\_eVV\_VeTVRaekZ



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EYV> Ra`WAYV4f]ef dR]  $7ZIJUZ_4YZVRZ`de`$ UMICZSVLdj dAV REXVR\_Ubf R\_eXJVIF]ef dR] RIEZZEJ S`eY\_RZ\_R]j R\_ULdaVIZ\_TR]jLZ\_VRIY dXZ\_Ž EYV`S[VIEZJVZIe`RIIVARZ\_eYVdf aa]j`VVIF]ef dR] X`UdR\_UddogZIVdLY`h eYVJ\_TZIF]REVR\_UeYVZc ^ RZ\_TYRCRIEXCZEZIE eYVUJ\_R`ZT`Wac`UFTEZ\_ R\_U cVac`UFTEZ\_LeYVZ\_dRetefTef cVR\_U d`TZR] gVYZI]Vdf dVU e`TcVReVLUZEN^Z\_REV R\_U RTIVEH eYV`LeYVafS]ZI] R\_U acZgReVId/Te`cZ\_dEEf eZ\_d eYRedf dEZ\_R\_UVdEVc eYV`LR\_UeYVdEREV`VEYV RXV\_edZ\_g`]gVUZ\_eYVUZeVTeac`UFTEZ\_`VVIF]ef dR] X`UEŽ :UV\_eXYZ\_XR\_Uac`TVdtZ\_XeYZdZ\_Wc^ReZ\_LSj ^ VR\_d`VRUVIICZaeZgV^RecZ\_`VVIF]ef d] RIeZeZej Z\_ 4 YZ/Ve/ReTRaef ckdeYVXc`hZ\_XT ^ a]ViZej `WeYV \_Vh T\_UZeZ\_d`Wd TZAej e`UBJŁZdZ\_UZebV\_dS]VZW eYVc/Zde`SVRSRtZdWcf\_UVcdeR\_UZ\_XeYVyIF]ef d3 aYV\_`^ V\_`\_%R\_UZed^ RZ\_]Z\_Vd`VUVgV]`a^ V\_eZ EYV> Ra`WeYV4f]ef d3] 7ZJUZ\_4YZJVZ\_TIfUXd `gVc''&! Z\_UZIRe`cdUVcIIcZSZ\_XTF]ef d3] RIeZeZejZ :eeYfdac`gZUXdV`aZZIR] VgZV\_TVe`dr`h Y`h ^ f]eZIRIVeXUeYVd`S[VIeZeIR\_UY`h ZeeZdZ\_hZeY `eYvc RebVIed`WeV a]Vdd`TZE] cVJReZ\_dYZadR\_U hRjd`WZWZ  $EYV > Ra `WeYV 4f ]ef cR] 7ZJ[U Z_ 4YZ]V R]d$   $ZT ca` cReVel bf R_e e E REE VZ_We' ReZ_RS`fee YV gV$   $U^{RZ} dR_U dZ T^{a} a`_V_e d`WeV' RedZ_X gV_SVI$   $]`hZ'c`^RT^{a} RC REE VA CARE VZ_U ZRe`cd$   $dr`h XC Re YV C X_V ZE ZE YV C CARE TY YR de'f dc VI$   $gVR W ]RC XV X Rad Z_Z We' REZ_R_U z`cd deV' REZ R$   $e Z_t d^{VE} X Ze YR Reh R M Z_V ZE YV U gV a^{V} e$   $`VR_Z e V C RE Z R U z`cd deV' REZ R$  e X U Y Ze V C RE Z R U z`cd deV' REZ R  $a YV_{C} V = e R T f ]U C V V E e YV T_U Z Z R U$   $e V U T Z d`WT_e A^{a} c R t d' T Z E Z R$ 

 $EYV > Ra `VeYV 4f ] ef dt] 7ZJU Z_ 4 YZV ac` l gZVdR_Vh S`Uj `VeJ dtV^ ReZKU\_`h]VUXZ`VZe Zh^ RZ_etZ_VU`gvceZ VR_UT_eZ_f Vde` SVRUVU e` LZeTR_ YVJa e` def Tef dVRdve` Vef ] ef dt] dtRzZteZtL hZeY RJ eVVSV_VJ edeYZdh`f]U`SgZ f dj YRgVVc$ 

eYV`cZV\_eReZ\_`Wa`]ZZZdR\_UacRTeZTVdeYRecfdeRZ\_ eYV^R\_Z\_XR\_UcVTVZgZ\_X`WF]efcVZ

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2]eY f XY XXRe WWArdh XXV RUVe``SelZ\_eYV UReR\_WUVLLeYVT\_dretZ\_edcWWardVUe``SelZ\_fdj ^ VR\_eeYReeYV> Ra T f]U\_`eT\_etZ\_ R] eYVZ\_ł V&^ ReZ\_Z\_ZZER]j V\_gZEXXUZE YZUV Vd\_`eUVerRie V&'^ eYVgR]f V`V&YVcXf] erLSfe Ze ZIR cV^Z\_UVc eYRe eYZl> Ra ZL\_`eR\_VIYRfd&ZeVUXTICZeZ\_`W If ]ef cVZ\_4 YZVLR\_UeYRe WarVich`c\ZL\_WUVU e`TcXReVRS`Uj`VWF]efd7] drezdeZICZ

## =B:CFA5H $\in$ B;5H $\in$ 9F=B;

H,Y:XYg[[b:UbX:Wc`YWhcb:cZhY]bZcfaUhcb ]bWiXYX]b:hY:7i h fU``AUd:cZ7\]YkUgUWca! dYlž]bhYbgjYdfcW/gg`Ughb[:cjYf`U:mYUf'=b:hY ÚghgHJ[YžhYW h fU``ÚYX:Ug'gW kUgXY]a]hYX UbX'gnghYaUhhUhcb]bgfi a YbhgkYfYXYg[[bYX"H;Y gYWcbX'gHJ[YZ:W gYX'cbhYWc`YWhcb'cZbZcfaU! hcb'Zcf]bWigcb]b:hYAUd"@UghnžhY]bZcfaUhcb' Wc`YWhYXkUg'cf[Ub]nYXUbX'dfcW/ggYX"H;YXUhU Zcf7\]YUgU'k\cYUbX'ZcfYUW;fY[]cb'UfY'[]jYb' ]b'U'gdYWU`ZcX!cih'

♣ ħ Y Wei ígY c Zh Y fYgYUfW žWe bHUWhk Uga UXY k ]ħ cj Yf\*) \$ ]bgh]h hc bg]bj c j YX ]b W h fYž]b Vch ` h Y di V ]WUbX df]j UhY gYWe fg' H YgY ]bWi XYX'' ' a ]b]ghf]YgžX]j ]gc bgžgi VgYWYHUf]UhgUbX ch Yf GHUHY UXa ]b]ghfUhj Y Vc X]Ygž (% We a a i bU``Vc X]Yggi W ` Uga i b]WHU]hYgža i b]WHU``UfhgWYbhYgža i b]WHU`` 'VfUf]Ygža i gYi a gWe a ]b[ i bXYf h Y 8 ]fYWWGB XY` 6]V ]c hYWUgž 5 fW, ]j cg mA i gYcg ff]VfUf]Ygž 5 fW ]j Yg UbX A i gYi a gGYfj ]WY Ì 8=65 A Hži b]j Yfg]hYgUbX h Y` 'LYžUbX cj Yf & S df]j UhY!gYWe f c f[ Ub]nUhc bgg W.` Ug WbYa Ugž h YUhYgž We `Y[ Ygž Zei bXUhc bg UbX`gc ` cb''7 c bgIUbhfYWe i fgY k Ug\UX he h Y €hYfbYhUbXž]b` dUfh]W Ufzhe 'h Y A ]b]gfmic Z9Xi WUhc b`7 Ufhe [ fUZ]U` 7 i h fU``XY7 \]Y" 6YgJXYg fYe i Ygłg Zc f XUłU Ug g W ž XJgW gglc bg cf ]bhYfj ]Yk g k YfY \YX k ]h dYcd Y fY[ UfXYX Ug e i U ]ÚYX ]bZc fa Ubłg' H Y fYg hg c Zh YgY ]bZc fa YX h Y Wc bWYd h U `XYg[ b c Zh Y k c f\_]b[ `a Uhf] UbX` [ i ]XYX ]bZc fa Uhjcb![ Uh Yf]b[ `YZc fhg'

₽JZcfa Uhjcbik UgʻVUgʻWU``mWc``YWYYX`]bik cik Ung

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i 5 Wead YHY UW cZXUHU Zef WYfHU b bX WUhefg"

¡HY]a dcggV]]mib WYfHJb WUgYgcZWc``YWfb[ h\Y` gYdUfUhYXUHJbYYXYXZcfIB8Dhc WYUhYbUhjcbU`` ]bX]WJhcfg'

j H.Yi bgnghYa Uh]WbUhi fYcZh.Y]bZcfa Uh]cb'dfc! j]XYX'Vmigca Y`gci fWYg"

# 85H5 GMGH9A 5H=15HC B A 5HF=1

EYVRaac`RIY eRvV\_e`Tf]ef dvYvdvZlR^f]eZ WIVeVU`\_VLR\_UVdceVZddWd\_R\_N\_`dXR\_ZZX R\_Udjdev^RzZZZdecf^V\_ehRdUvdZv\_VZH\_Y` ]a dcfHUbWY`cZh`]g`a Uhf]]\_']g'h`Uh]hdfcj ]XYg` a i`h]d`Y`XYgWf]dhji Y`j Yff]WYg`UbX`WccfX]! bUhYg`Zcf`fYUX]b[`UbX`UbU`ng]gz`[]j ]b[`U` a cfY`Wca d`YhY`cj Yfj ]Yk`cZWi`hi fY`]b` 7 \]Y"

 $\begin{array}{c} {\rm EYV}^{\rm Reo2} \ dW{\rm dL} \ del j \ Le^{\rm UV} \ {\rm ReTReVeV} \ {\rm V} \ {\rm V} \ {\rm H} \\ \ ^{\rm RZ} \ dW{\rm dL} \ del j \ {\rm Le}^{\rm UV} \ {\rm RETReVeV} \ {\rm V} \\ {\rm UZWWEV} \ {\rm eRVR1}^{\rm C} \ {\rm VIF} \ {\rm Jef} \ dR \ {\rm REo2} \ {\rm H} \ {\rm VIE}^{\rm Z} \ {\rm XeV} \\ {\rm UZWWEV} \ {\rm eRVR1}^{\rm C} \ {\rm VIF} \ {\rm Jef} \ dR \ {\rm REo2} \ {\rm Ze} \ {\rm RUZWE} \ {\rm ZeVV} \\ {\rm UZWWEV} \ {\rm eRVR1}^{\rm C} \ {\rm VIF} \ {\rm Jef} \ dR \ {\rm REo2} \ {\rm Ze} \ {\rm RUZWE} \ {\rm ZeVV} \\ {\rm UZWWEV} \ {\rm eRVR1}^{\rm C} \ {\rm VIF} \ {\rm Jef} \ dR \ {\rm REo2} \ {\rm Ze} \ {\rm RUZWE} \ {\rm XeVV} \\ {\rm UZWWEV} \ {\rm eRVR1}^{\rm C} \ {\rm V} \ {\rm V} \ {\rm V} \ {\rm S}^{\rm C} \ {\rm ZeVV} \ {\rm V} \\ {\rm S}^{\rm C} \ {\rm ZeVV} \ {\rm C}^{\rm C} \ {\rm V} \ {\rm C}^{\rm C} \ {\rm ZeVV} \ {\rm C}^{\rm C} \ {\rm ZeVV} \\ {\rm S}^{\rm C} \ {\rm ZeVV} \ {\rm C}^{\rm C} \ {\rm C}^{\rm C} \ {\rm C}^{\rm C} \ {\rm C}^{\rm C} \ {\rm ZeVV} \ {\rm C}^{\rm C} \ {\rm ZeVV} \ {\rm C}^{\rm C} \ {\rm ZeVV} \\ {\rm C}^{\rm C} \ {\rm C}^$ 

 $\label{eq:linear_line$ 

## 5FH-GH+7 8CA5-B

### @hYfUhi fY

:\_ eYVaVcZ U" \*\* ## #! !!  $Laf S ZMZ_X$  f  $eaf eZ_1$ TeVRMUSj "% ~ gVR]  $LReY f XY eYVcVhRd_ `eR T_deR_eeeV_U` gVc eYVaVcZ UZS c` heY hRd& ~ SVeh W_ "**# <math>R_U$ " \*\*%  $LSf e SVeh W_$ "\*\*)  $R_U$ #!!! Zeh Rd [f de # ~ Z:\_ #!!!  $LVceYVc^ `cVL _]j$ #2% #! S``\dh VeVaf S ZHVLERUVTeVRV `WS& 2% Vd 
$$\label{eq:linearized_linear} \begin{split} & \mathsf{W}^{\wedge} \ "*** \ \mathbb{R}_U \ \mathsf{e}^{\mathsf{V}} \mathsf{V} \mathsf{d}^{\mathsf{H}} \mathsf{Ra} \mathsf{Ve}^{\mathsf{b}} \mathsf{L}^{\mathsf{c}} \mathsf{a}^{\mathsf{Z}} \ \mathsf{e}^{\mathsf{V}} \mathsf{a}^{\mathsf{V}} \mathsf{Z}^{\mathsf{U}} \mathsf{Z}^{\mathsf{Z}} \\ & \mathsf{2}_{\mathsf{Z}} \ \mathsf{Z}^{\mathsf{C}} \mathsf{V} \mathsf{R}^{\mathsf{U}} \mathsf{Z}^{\mathsf{U}} \mathsf{Z$$

2ddVRdUdeYVUj\_R^ZT`WZeVRj RIezzj ZedWV eYVEVRV\\_`h\_ e`SV"\* hcZeVrd T\_XedddR\_U S' S``\ WZcdŽEYV^`de ac`^Z\_V\_e ZdeYV7VcZr :\_eVc\_RIZ\_RJUJ=ZSc`1:\_eVc\_ReZ\_RJ3``\7RZ/L hYZYYRdSW\_YYJUZ\_DR\_eZX Wc#" j VRcdSf e dZ\_TVeYV"\*\*!dWZcdYRgVRd dacf\_Xf a Z\_`eYVc e`h\_dR\_UT^^f\_VdcfTYRdGZRUJ>RdCRJ aRR2d R\_UÛfD RŽEYVEVRVRd daVZZJWZcdfTY RdeYV7VZRUJ=ZSc`F dLU 1DVT\_U9 R\_U3``\ 7RZ/R\_UeYV7VZRUJ=ZSc`dZ\_:G2 1G2E17cW 3``\7RZ/LRdhVJ]Rdd^VXZJ' gVced daVZZJ Zde dfS[VTed\_cfTYRdeYV7VZRUJ]=ZSc`UV 2ceV 12ce3``\7RZ/YVJUSj eYV7RIfJej`V2ced`VeYV F\_ZgVcZg``W4YZVŽ

2eackd/\_dt.eVkVRV) \* af S]ZHZ\_XY`f dkdR\_U &&) S``\dr`adZ\_eVVT f\_egiŽ2deVVVJU`f e^ Ra dr`hdt.BS`fe\*! ~``VRJ af S]ZHZ\_XY`f dkdRvZ\_ eYV> Vec`a`]ZER\_CVXZ\_LR\_URdZ`ZRcac`a`ceZ\_ `VvZeJVdRVaf S]ZHVUZ\_eVVTRaZERŽ

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Z dVL ej VRd RZ Z Xe YR eeY VeV\_UV\_Tj e hRdd ^ Rd VeT\_TV\_etReZ\_R\_UZ\_fV\_TVeV vac UT EZ\_ R\_U^ Rd VeZ X: VYZeV Rej h`c dŽD ^ Vaf S Zh Vdd YR gVT ^ Ve XeV & Rd y6 UZe dd: \_UváV\_UZ/eV dw 1Z UVáV\_UV\_eaf S Zh Vdd hZeY R gZh e`d de`dZ X af S Zh Z Xe`Zed`dZ Z R] c`] V R\_U^ RZ XZe ] Vdd ^ Rd VeL UZ gV Z.\_ RUZEZ\_Ld^ VS``dr`ade YRe RV Z UVáV\_UV\_e`VeYV^ R[`c TYRZ d YR gV`dN \_ZXVUZ e`X gVc\_^ V\_d R dZ V UR d'TZ eZ\_d\\_`h\_ Rd Ac`j VTe`dU 7 ^ V\_e` 15 VgY`a^ V\_e Ac`[VTed  $\in$  AC@ 7@/Z\_RSZU e`Z`ac`gVeY VZCT^ a VEZ gV a`dEZ\_Ž

 $DZ_TV'' **! LRgRZG `VX gkc_ VeZZZRZG Vd YRgVd f XYe e`V_T f dXV ckrLZ XZ:_ "**SLWc VR`a]VLeYV7_U ? RIZ_R]UJ]=Zsc j ]R=VIEf dR 1? ReZ_R] 3`` R_UCVRLZ X7f_U/hRdTckreVLL R_UZ #!!! R]`_V`gkcRSZ]Z_aVd dh VcVTYR_l _V]WeYc f XY eYZI` cXR_ZREZ_hZY eYVRZ `W V_T f dXZ_X]Zeddrj TckreZ_R_US`` SfjZ XZ EYVcV RcV R]d Z_ZZRZGVd e`deZ f]ReV ckrLZ XL dTY Rd:_ekc_ReZ_R] 3`` 5 RJZ$ 

5 i X]c ! j ]gi U`

H Y Ui X]c !j ]g U``gYWc f [ fYk `gfc b[ `m VYłk YYb % - UbX% - - "EYZġ łd¢V Wef dV } ]^ dh Wac Uf TWZ 4 YZVL^ `dveYR\_ U f S]V eYV"\*) ! de eR `Vff de" %Ž6gvćj eYZ Xd XXddePRe eYZIZ TARAZIJZ \We eYVa `JZZIR] JSVRJZRZ\_ eYRee `\ a]RIVZ 4 YZVUf cZ XeYVa VZ UŽ:\_ WAŁ 4 YZVR\_ } ]^ `f eaf eh RdRdRJ Z TARZ XZ eVV } gVij Vrc a VZ U"\*) &"\*)\*+" # `VeYV"% Wref dV } ]^ d^ RUVZ eYVU/IRU/h VeVd/WRU eYV\_Ž

DZ\_TV" \*\*! ŁeV DEReV YRI dké f a R gRZAG `W ac`XR` ^ Vd R\_U W\_Ud e` ac` ^ `eV TZ\_V R R\_U gZ.N ŽE YVdV Z\_TJf UV eVV: SVć^ VUZ Ac`XR` ^ V 1" \*\* (/Łh YZIY RZ d e` deZ f]REV ac`UF TeZ\_ `W }]^ d Wc TZ\_V R R\_U eV/VgZZ\_, eYV Ac`XR` R UV 7` ^ V\_e` R] 4 Z\_V UV = RcX ^ VedR[V17VRef cV 7Z^ 4 Z\_V R 5 VgV] a^ V\_e Ac`XR` ^ V1" \*\*\*/Ł h YZIY Z\_ #!!" UZB5 cdU`gVc & S! ^ ZJZ\_ aVd d e` T }}\_R\_TVeYVac`UF TeZ\_ R\_UUZdeZ5 f eZ\_ `W WRef cV}]^ d R\_U eYVAc`XR` RUV5 VRcc`]]` UVJ 2 f UZ gZdF R] CVXZ\_R] 1 CVXZ\_R] 2 f UZ 1 GZ F R] 5 VgV] a^ V\_e Ac`XR` ^ V 1" \*\* (/LUVZX\_VU e` WdeVc R\_U deZ f]REV ac`UF TeZ\_ R\_UUZdeZ5 f eZ\_ `WFUZ 1 gZfF R] ResZET TCVRZ\_dŽ

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 $\label{eq:restriction} \begin{array}{l} AcZgReVIdVTe`cf_ZgVcdZeZdR_U`TTfaReZ_R\\ edRZ_ZXZ_dEEfeVdRc`f_UeYVTf_edj_`h`WWC'''\\ UVXcWTfcdvdZ_TcVReZgVRfUZigZfR]UZTZaJZ_VdL\\ hZeYRTfccV_ee`eR]`V#EVS! defUV_edŽ \end{array}$ 

@\_VZ\_ekt/dbZ\_XUVgVj`a^V\_eztlet/VcZtV`WdY`ce }]^dLhYZTY\_RcVdbRceZ\_Xe`XV\_VcReVet/VzC`h\_ dTcW\_Z\_XgV\_fVd1Wdb2gRd/R\_UVgV\_e`aV\_VcReV eYVT`^^VcTZb]TzCTfZthZethZeYdTcW\_Z\_XdZ\_d^V`W eYVT`f\_eqid^R[`cTZ\_V`RdŽ

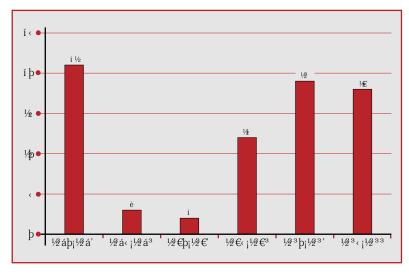
 $2 dVT \_UTYR_XV dW\_Z_eYZHRORZELZ_eVV def Tef dV`WIZ_V R d aa]jŽ:_ "*) * eVdV h VdV ") ! TZ_V RdZ 4 YZV h ZeY Re eR]`V#) <math>HH$ ! ' dNRed. R\_RgVRXV`W&& aVc TZ\_V RŽEV\_j VRcd]ReveLZ "\*\*\*LeYVdV h VdV #&& TZ\_V RŽEV\_j VRcd]ReveLZ `c S#%dNRedaVc TZ\_V RLR\_UeVV\_f ^ SVc` VVZWWA V\_e}]^ dR\_UdRCV\_Z\_XdYRUZ\_TCVRDMZZTT dZ\_X e` :? 6LZ\_ "\*\*\* eYVCV h VdVR\_RgVRXV^VG! LS\*( TZ\_V RdRV/Z\_XdR^`\_eVLhZY RgVRXV^`\_eY]j Rev\_UR\_TV`WE'' ###&\$ gZh VcZ

$$\begin{split} & EYVUj\_R^{*}ZT^{*}WeYV dVTe^{*}c^{*}Zd^{*}Z^{*}WeTVUSj^{*}S) \\ & TZ\_V^{*}R_{2}^{*} ]^{*} dV^{*}ceR_{-}UU^{*}Tf^{*}V_{-}eR_{2}^{*}WetzeR_{2}dR_{-}U \\ & Sj^{*}ZzZezeVdc^{*}TYRd? ReZ\_R_{1}^{*}4Z_{-}V^{*}R5R_{3}H^{*}YZY \\ & SVAR_{-}Z_{-}^{*}**SZ \end{split}$$

## DYfZcfa ]b[ Ufbg

 $\label{eq:constraint} 2 \end{tabular} 2 \end{tabular} XY eV &V ZI_` T_eZ_f`fd dvbf V_TV`W \\ YZE cZR dev ZEZ dt h Y`Z'k `XUHU`Uj U]`UV`Y` \\ fYj YU`U`gfc b[ i dgi f[ Y`]b 7 \]YUb h YUHY` \\ UbX`XfUa U`cj Yfh Y``Ugh%`mYUfg':_ #!!! \\ eV &V kV& eV Rev R_UUR' RWEZR dZ2 df Uj \\ \end{array}$ 

### \$'%B=łãþ ficos©2O°áŠ© Ýäjøäľï¢″ľïz²²⊄−näl⁄??áþ;1½?³³





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af S]ZHVUSj eV> Z\_Zhej`V&UT TReZ\_d^hheen R]^`deehZIVRd^R\_j a]FjdhV&VdHXWUUF cZ\_XeVV }gMjWcaVzZU"\*\*"1"\*\*&RctZ\_"\*("1"\*(&LhZeY e`eRjd`V&&SR\_U")(Lc&daVT&ZeMjZ>`\_Ze`cZ\_X`W \_VhdaRaVctZ\_#!!!jZJUVURe`eRj`V#!(a]Fjd dHXWUZDR eZX`eYNecWZ

H YV&VReeV\_UR\_TVZIT\_TVc\_VUE? 6 Wf\_UeYRe eYVac`a`œZ\_`V&IV a]VX Z\_Xe`eYVeYVReeVZ\_ R\_j X&&V\_^`\_eYc`dV`\_ ReVRXV&/^ "(&aVc "!! eY`f dR\_UZ\_YRSZER\_edZ\_ "\*\*\*&e`%( aVc"!! eY`f dR\_U Z\_YRSZER\_edZ\_ "\*\*\*\*Ž:\_ #!!!!LeYV&V hV&VWf\_Ue`SV" &%gV\_fVdZ\_eYVT f\_eej fdvU ^ RZ\_jj VC eYVReeVL^`cVeYR\_ReYZU`V&YV^Z\_ eYV> Vec`a`]ZER\_CVXZ\_Ž

 $:= "*** LeVV4 Re`XRAA4f]efd]_1Tf]efd]^Ralaz XVI VETZIV TRocZU`feSjeV> Z_Zbej`V6Ufl$  $TReZ_ dVT dVU Re`eR]`V#) ! eVVecVT ^ aR_ZdL$  $"&%a]RJ hcZXYedR_U*#UZVTe`ed_#&&UR_TVedR_U$  $^`dveYR_S!!` eVvcdsVTZRJZbedZ_TJfUZ_X^Z`VL$  $[fXXJVedR_UTY`dVXRaYVedZEYRejVRL#"YZXVc$  $VLfTReZ_ VeBSJZY^ V_ed`WWCVU UVXeWT fcold$  $Z_eYZIRVRŽ$ 

H YV2vac`WebZ\_R] Reff TZReZ\_dRVT\_TVc\_VUL eYV^`deac`^Z\_V\_eZdeYVDZ\_UZRe`UV2Te`ddUV 4 YZV14 YZVR\_2Te`cd`F\_Z\_ $\in$ D 5 2CE 6/Ž:ed RI&&ZZA RCV gRCZU R\_U Z\_T]f UV\_VX & ReZ\_X eYV ac`gZZ\_`VvicV^ZbdVceYVf\_Z\_Sj eYV>ZZd eVcZ\_UV3Z/Vd? RIZ\_R]Vd1>Z\_Zdej`VV? ReZ\_R] Ac`aVcej/LcVacAV\_eZ\_X RIe`cd Re`d`VeV]VgZZ\_ TYR\_Vd R\_U dZ\_Z\_X RXCVV V\_ed h ZeYY`chZER] R\_U^VLZR] Z\_dEf eZ\_dŽ

@WeYVac`XR` ^ VdR\_UW\_UdWceYVaV&V&^ ZXRect.eYV ^ `de ac` ^  $Z_VeZleYVAc`XR` REVRec`$  $:<math>e_ZVR_eV_1E`f c_ZXEYVReeVAc`XR` ^ Vth YZIY$ T ^ Vdf\_UC eYV >  $ZZleg` `W6UFTRZ_ŽF_UC$  $eYZlac`XR` ^ Vtac`WdZ_R] RIEZ X ec`faVd RV$  $V_XRXUe`aV&Vc^ eYZca]Bj dZ_eVVRev4tXj ^ _R$  $cZf ^ dR_URFUE`cf ^ dVc]RcXVRTUZ/TVtacWM$  $RS]j W^ UAcZeWUSRI\Xc`f_UZIZ_TV"**' `gkc$  $&! a]Bj dYRgVSW_ deRXUR_URcZ`ZRc_f ^ SVc$  $`VeYVRevRaacVIZEZ_h`c\dr`adYRgVSW_YVJUt$  $hZeY Re`ef]`VMS`feR^Z]Z_aV a]VReeV_UZXŽ$  Aig]W

 $\label{eq:constraint} > f dZ ZleYVRNR h YdVeYVUNReY`VZ_Wc^R R eZ_Zl^`deRIFeMLReY`f XY eYVWh URERT ]]VIEWU dgvR] R]RXVR^`f_e`WRIEZZI Ž$ 

EYV ^ `de deZZZXU&V EYV ^ `de deZZZXU&V UVI]Z\_V11#8Ž  $\times / Z_d$  &V UVI]Z\_V11#8Ž  $\times / Z_d$  &V UVIZ\_V11#8Ž  $\times / Z_d$  &V 2 d TZRIZ\_UVAC UFTE dd7\_`Xë}T dUV4YZV 14YZVR\_8 dR``aY\_VAC UFTVd 2 dd TZRZ\_/L f\_eZ \*\*\*\* T\_d^ aeZ\_Z eVT f\_eg ReVRXU !Ž `cZZR dT dZXdaVc aVd\_aVc1VRŽ7 c #!!"LeYVV&VIRdeh RdWc\_`^ `dVAR\_!ŽZCZU`` h Y Ufflgf W[ ccXg bXi gff Ygzh g`Ug VYYb` a cghUZYVYYXVmd fUVm 2\_ eVC RTE cYReV SW\_UZZER eVTY\_`] XXdac gZZ XVW RTIVHE ^ f dZ RgRZIS]V\_eYV:eVC RZ cVZ\_`eVCh`dHeYV UVgV a^ Ve`VR\_ZVC^R A R`VE`aVRZ X`\_ S`eYR\_Z UZZLFR R\_UR\_ZUF deZR dIRVZU ZX XVReYR^ Z\_eVZRVZ

$$\begin{split} & E YV_f ^ SVc `Vd _Xd V_eVd U \underline{Z} e YV 4 Y\underline{Z}V\underline{R} \\ : \_eV_{1}Vlif R_{1}Ac `a Vcg ~ CVXdeVc YRdUV1]\underline{Z} VUd Rea ] j \underline{Z} \\ & H YVeVRd \#L S( d _Xdh VeVeVXdeVeVU \underline{Z} e YVa V \underline{Z} U \\ & "*)) } "**" & L`__]j ~ " H \#() ~ h VeV eVXdeVeVU SVeh W_ \\ & "**' } H **) & LRUc ~ a `VS( ~ \underline{Z} \end{split}$$

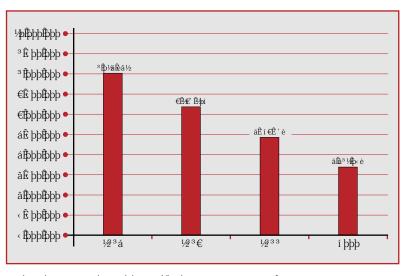
H YVA a REEZ\_V a ReVT\_TV\_VLeV> ZZI eg `V6UFTREZ\_4 Re`XRVA 4f]ef cR] [Zted #L"" Xc f a d:%#(T ^ a` dxdR\_U#2%() ZUZZI f R] a dRI eEZ\_V aZ> f dZI dyReVUVX dVT f cdxd:^ VR\_h YZVL dh eYV]`h V deZ TCVR VZ\_R\_f R] YZXY dv UFTREZ\_ V\_c`]^ V\_e]V gV dSV h W\_"\*\*' R\_U#!!! LeV gV d R] a dV^`V#! Zx" 1" LS" (Z\_#!!! LR dR RZ\_de" L\*S Z\_"\*\*'/T ^ a RZ\_X h ZY Xc`heY`W' #Zs" Wc UR\_TVL & Zx" Wc eYV RevL & Z#" Wc ]Zev R ef cvL S! Z% Wc eYV a Red R\_U"' %Z#" Wc TZ\_V R R\_UR UZ L gZ f R] ReeZ

2]eY fXY RTF deV Z WC^ ReZ \_ RS`fe eYV U ł \_R`ZT`W f dZR] REZZE ZI ]RI\Z XL ]ZV VgV\_ed YRgV T]VRcjj VI aVcZ/TVU R\_ f adf cXV Z\_ cVTV\_e j VRcdŽ@\_VaYV\_`^V\_`\_Z\_ eYV]Re!"! j VRcd YRd SW\_ eYVT ^ Z\_X`W VXH VgV\_ed e eYVT f\_ecjL SVXZ\_Z X hZY C`U DeVh Recd YZE cZT? ReZ\_R] DeRLZ ^ T\_TVce1"\*) \*/ R\_U aVcVc^ R\_TVdSj eVV h`cJUd]VRUZ XXc f ad R U RozZeVd Re^ Rd1 Rf UZ



 $\begin{array}{l} V_{TV}gV_{f} VZEYZIYRdSW_{d} aa]V V_{e}USj eV \\ TCREZ_ `WR TZETFZe`WaV_{RZC}T_TVed1^{f}dT \\ hWdWEZRdR_Ud^{R}Ud^{R}]gV_{f} VEd^{TYRdeVD45L \\ DRR6defUZ > ReVE=R3RefeEJZV^{f}dTSRdR_U \\ d`_Z2 hZVdr_XV`W fdZRdej]VEXV_{d}R_U \\ Z_ `gReZ_{d}RV CACCV_eU Re eVOVa]RIVER_U \\ eYJ RVaCAF^{RS}j dfaa`ceVUSj R]RXVa``]`W \\ \end{array}$ 

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#### @/.}äe³ 10æ¶²0@a-¶²ï – z²aéã0²qä-z–¶Ú09ýmä]øäĺź"¶²

$$\begin{split} & \operatorname{auti} \P^2 \operatorname{Yz} \P \operatorname{Ial} \operatorname{Og} \P^2 \operatorname{Ocalimitation} \\ & \operatorname{aut} \operatorname{Zab} \P^{21} - z^2 \operatorname{A}^{1} \operatorname{Yammanna} \operatorname{aut}^{1$$

>¶ï Úzriáň ¶² Ýz¶äqzä<br/>D ¶²ï – z² a%Ýäl Qg¶² OžÝiá þþ½äfi Oá#" ÚMafi ï <br/> <br/> éeÚ0ãa/2  $^{33}$ Ê

adRT&&Z\_VatLac`WatZ\_RjdR\_UV\_eYfd&rtetZ@\_V VfR`a]V`VeYZdReVeYVC`T\DTY``]dda`\_d`eVU Sj eYV>Z\_Zdeg``V6UfTReZ\_Ž

## J ]gi U`Ufhg

 $\begin{array}{c} @\_VRdaVTe`WaYVUVgVJ`a^V_e`WaYVgZfF]Red\\ \hline Z 4YZVYRdSW_eYVTeVReZ_`WRT^^VETZM$  $TZTFZEYVeVRV_`h"#*ReeXRJVZXdLRUeYVJ$  $a]RJReh`WJUc`]VLac`gZLZX`aa`cef_ZEXdWc$  $S`eY eYVVIYZZEZ_R_UeYVdRJV`WRch`c\dŽ$  H`c\dR\R\d VIYSZUUR\_USc`fXYee`eYVafSi ]ZTSj #() ^ fdvf ^ dŽ2 ]RXV\_f ^ SVc`VeYVdVdvV TZRJZVZ\_eYVVIYSZZ\_`Vvch`c\dd ^ Vac`UFTVU ]`TR]]jL`eYVdSj Z\_e\c\_RZ\_R]j cV\_`h\_VURezdedŽ > R\_j`VveYV`LY`hVgVLYRgVR]d SW\_Via]`cZ\_X \_Vh eV\_UV\_TZdZ\_Rcdd TYRdZ\_dR]REZ\_dTcVReVU Sj j`f\_X4YZvR\_Rcezded eYZIVC^`VvceZdzTTcVI ReZ\_h`c\dfa`\_eYVVIYZZZ\_daRIVf dZ\_XUZVWA V\_e^ReVZR]dR\_UVC^dZAfS]ZTZScRZCdr\_f\_ZTZAR RceTIV\_ecVdf\_ZgVdZg VIeR`fdR]TV\_ecVdR\_U^R]d RVR]d fdVURUVYZZZ\_dARIVŽ

 $EYV_f^ SVc^ WdfUV_edV_c^ ]]UUZ_gZfR]$ Read cVReVUUXCWT f cdvdhRd"  $E^{1} Z_{\#} \\ EVV dvgvLeVV \\ ZZteg^ VCUTTRZ_4 Ree XRVA$  $4f]ef cR] T f_eVU "E(' # aRZ_eVcLS') dff ]ae cd.$  $%" V_XRgvdR_U*' aV a]VchVIZRZZ XZ_URh$  $ZXZ_eVVT f_egZ$ 

:\_ #! ! " LetV7 \_ U UV5 VCRc' ]]` UV]R4f]ef cR j ]Rd2ceVd14f]ef cVR\_U2ced5 VgV]` a^ V\_e 7f\_U  $\in$  7@? 5 2CE/ ac`gZVU #%# ^ Z]Z\_ aVd d Vc eVVgZfR]RceL` c " &` VeYVe eR]ZgVetVUSj eVV 7f\_U\_RZ\_R]jZEYV2cTYZeVTef cVDxcgZV` VeYV > ZZtej` VWfS]ZTH` c\cLECR\_ch` ceR\_UEV[VT ^ 1 ^ f\_ZTRZ\_dTYR\_V]VU" S\$^ Z]Z\_ aVd cZ\_e` eVV UVgV]` a^ V\_e` VeYVgZfR]RcedeYc`f XYZedAfS]ZT 2ce4` aVZZ\_1#!!!/Z

### <Yf]HJ[Y

:\_ 4 YZWLeYV4 `\_dV[` UV> `\_f^ V\_e`d? RIZ } \_R\di? REZ\_R] > `\_f^ V\_ed4 `f\_TZ/ UXZX\_REWU eYV} ate YZde` aZT ^ `\_f^ V\_edZ\_ " \*# +7f VeVUV =`eRZ\_ eYV3¾ 3¾ CVXZ\_Le` acV\_VdUVAZReW  $R_U=`d4R_V]`dZ_CRUZZREV_Le`VVVaa'`VVR_$  $=fZUV2]SRUV2^ ReX dZ_4`acR] <math>R_U4$  YRZIf aR  $Z_2_TfULZ_eYV=`d=RX dCVXZ_Ž$ 

 $\begin{array}{l} 4 YZVdTf \left[ ef dt \right] YVZERXVLZ_T \left[ UZ_X_REZ_RLYZd e cZLafS]ZT_R_U RcTYRV \right]`XZTR ^ `_f^ V_ed R_U \\ _Ref dV dvdvgVdLZd_`h_UV_VUSj = Rh "(Ž#)) L \\ V_RTeVUZ_"*(!Z$ 

2 e e R `W&S! YZE  $\mathcal{Z}T^ `_f^ V \text{e} YREVSW_$  $\mathcal{V}T X_ZAVU Z_ 4 YZV d` WAL eYV ]REXVE _f^ SVcd$  $<math>SVZ_XT__VIEVU hZEY \mathcal{O}/ZZ_ 1" ** / R_U eVV \mathcal{O}ZI$  $hR_j d_1*"/ZEYV X AREVE T_TV_eREZ_dREVWf_U$  $Z_ eVV > Vec a` ]ZER_CVZ_ R_U eVV <math>\mathcal{O}XZ_d`W$   $\begin{array}{l} \label{eq:criterion} \label{eq:criterion} \end{circles} CR a R R B & L = `d = R ` d R U E R R R I ` Z Y & V & R V \\ $$ " & a ] R V & U & R d R TYRV ]` XZ R & Y & Z & Y & A & A \\ R & U & ( \# yk` R d & Z R & C & V & Z & R & V & A & A \\ e^{YV} & Z & e^{YV} & V & e^{`a}` ] & Z R & C & X Z & R & U & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & V & e^{YV} & Z & e^{YV} & e^{YV} & Z & e^{YV} & e^{YV} & Z & e^{YV} & e^{YV} & Z & e^{YV} & e^{YV} & Z & e^{YV} & e^{YV} & Z & e^{YV} & e^{YV} & Z & e^{YV} & e^{YV} & Z & e^{YV} & e^{YV} & Z & e^{YV} &$ 

 $EYV > \underline{Z}Zetg `V6UfTReZ_4 Ree X4RMA4f]efd?$ R[d] [Zted Rei ef] `W% T ^ ^ V `drezgV`c]`TR YV6ZeRXV ^ `\_f ^ V\_edt.Z\_T ca`drez\_X eV dV eYRe T ^ ^ f\_ZeZd eYV dV]gVd dXRU Rd aRce `WeYVZc YV6ZeRXVŽ

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## Gdcfh

Da`ceRdRTf]efd] RT&&& ZXaRe`W&V^ RdtV\_eV. daVT&Re`cRT&& WC^ ZXaRe`W&V^ RdtV\_eV. &Z\_ V\_eZ\_UfdegiH\_UZ&ZTRAReZTZARe`g RT&& dfdRZ\_VUSj eVVda`ceZ\_XRdtTZReZ\_de`hYZTYZed adRT&Z\_Vdda`ced`V\_R\_Uh`^V\_/SV\_\_XZ

5 g'U'a Ugg'gdYWUlc f'Yj Ybhgdc fhig'gi f! dUggYX'c b`m'Vm'WbYa Už Yj Yb'h ci [\`]h \Ug'XYW]bYX']b h Y'UghÚ Y mYUfg':\_ "\*) \*Ł Rg\dRXV^`\_eY]j ReeV\_UR\_TV Re da`œZ\_X \gV\_ed hRd' Ł\*&( a\c'!!! eY`f dR\_UZ\_YRSZER\_edŽ\_ "\*\*# eYV} Xf c\hRd) f) '' ŁSf eSj "\*\*\* Ze YRULč aa\U e` &L) &ZE Y\dV} Xf c\dRV VK YZX\c eYR\_ eY`dV Wc`eY\c ej a\d`WgV\_ed TY Rda]Rj dLc\TZERdR\_U T\_T\ceZ

 $\begin{array}{l} EYVUc`al`WWZ\_ReeV_UR_TVRe`da`ccZ_XVgV_ed\\ Z\_cVTV_ejVRcdTR_SVRTT`f_eVUVcSj`eYVXXVeVc\\ VRV`WRTVctlac`gZUVUSj`eVVZ_ZLARccZIf]Rcjj\\ TRS]VLR_USj`eYVZ_TcVRdVUcfaa]j`W^RctlV_eVcl\\ eRZ^V_eXV_VR[]jZ \end{array}$ 

 $\begin{array}{l} E YZtl UVI] Z V YRd ^ RZ [j RWWTeVU ecRUZZ _ R] \\ ^ Rtd(daVIeRe`c da`cecld`TY RdW eSR] [LSRth.VeSR] [L g`] [VJSR] R_US`i Z XZ7`c_ZIYVda`cecld`TY RdeVV \\ \end{array}$ 

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^ Rce27] RceeLY`T\Vj R\_UXj^\_Rde27dLSj T\_eeRdeL ReeV\_UR\_TVZdZ\_T&Rd2ZXŽ

EYVÆFREZ\_TYR\_XkdhYV\_da`ceRdRaRceZZaR e`g`Rlezzaj ZlR\_RjdVLŽ2TT`dLZ\_Xe`eVV:\_deZf`e` ? RIZ\_RJUVj5 Va`ceVi? ReZ\_RJDa`ced:\_deZf`eV/Ł Wc^Vcjj5:8656CLeYVcVhVcV\*%L!'J;\*' cbfRcV^VecVd`WdaRIVXZgV\_`gVc`e`da`ceZ\_X RlezzzadZ\_4YZVZ\_"\*\*'LhZeYRe`eR]`W(Ł\*& da`cedgV\_fVd`WZXWCV\_eTRaRIZZAČŽ

 $2XZ_{LRT} dZ_{Xe} eV> RaR? RIZ_R UV2d I$   $TZreze LRU1? ReZ_R > Ra `V2dd TZreze Ze V$ #!!! CVa`ce`\_ 9 f ^ R\_ 5 VeV a V\_eZ\_ 4 YZVZ\_ "\*\*\* eVV/hVV\*E%&ch`ced` cXR\_ZREZ\_dT ^ 1 acZZ\_X) L&% ch`cedT fScD) T ^ f\_VJVeV TfS f\_Z\_dR\_US) # Rdd TZREZ\_dVCReREZe V VAA`cedŽ EYVCVZ\_`VZ\_e VXRdeRYRdcVReZeV j chVR\_ZX eYV]RCXCh\_f ^ SVc`Vah`ceZ\_X`cXR\_ZREZ\_dhZY S\* `cXR\_ZREZ\_dVCVZ\_`VERCRARI hZY S% `cXR\_ZREZ\_dAVc"! eY`f cR\_UZ\_YRSZE edZeeVV S`ee` `VeYVCR\_ZXREVeYVCVZ\_d`V2j d/2 R\_U @`9 ZXZ\_dhZY" & R\_U"" ch`ced` cXR\_ZREZ\_daVc "! eY`f cR\_UZ\_YRSZE edZeVI JEZVI

### Hci f|ga

 $EYV_f^SVc^W4YZVR_dX'Z_XRSc^RU_R_U$   $WWZZ_VdgZUZZ_X4YZVXCh^dSdR_eZR]j_Z_eVV$   $"**!d_^RZ_Xe^fcZh^_V_VVAVV^^deU_R^ZT$   $dVTe^cd^WF_jefdR_REZZE_ZEYV_f^SVc^W4YZVR_d$   $XZ_XRSc^RU_c^dVSj_"S(~SVehW_"*)*R_U$   $#!!!EhYZVeVV_f^SVc^WZZE^cdV_eWZ_XeVV$   $Tf_ecj^cdVSj_""**~Z^2]eV^fXYZEZC^a^dUS_V$ 

Î H.Y`WebWYdhcZWi'hi fU``\Yf]HU[Y`U``i XYg`he` h\Y`\]ghef]WU``i bXYfd]bb]b[`cZh\Y`\UV]hgžWighea gz ]XYUgUbX'j U`i Ygh\UhVY`cb[`he`h\Y`\]ghefmicZh\Y Wcaaib]miUbXidfcj]XYih]gWcibhfmk]h`]ggcWU` ib]miKY'UfYik∖UhkY'UfY'VYWuigYihUh∖]ghcfmig k∖Uh]hkUgï

<i a VYfhc A Uh fUbUž&\$\$&"

 $Z_S$  Y TRANDE of Y h ^ R\_j ` VAYVAV[`fc\_Vjd h VCVf\_UVoeRV\_afcVj WcefcZd` af ca` dvdLeYV Xc`heY` WT\_\_VT& ZdTf]efcR] Z` aRTe Zd VgZU\_eŽ

$$\begin{split} & EYV Xc heY cVgVR]VU Sj eYVdV Z_UZRe cd Zd \\ ^ ReTYVU Sj eYV UVgY a^ V_e `VeYV edRyJ `cXR \\ & _ZReZ _ Z_VXRdef Tef cV+Z_ "*)* eYVCV hVEV '*! \\ & edRyJ RXV_TZd Z_ #!!!LeYVCV hVEV "E'!!Z._ eYV \\ & R^ VaVeZ ULeYVT f_eg `dY` eJ TRARIZG XCh W/^ \\ & *S" e` #1(") VdRS [ZH^ V_edZ=Z_VhZMLeYV_f^ SVc `VE` ^ dZ_TEVRAU Sj "S! " R_U eYV_f^ SVc `W \\ & SVUdSj ""S" Z$$

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C f[Ub]nUl]c b UbX gffi Wi fY c Zh Y YXi WU! l]c b gmghYa

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eYVTRd/`WZXYVCVLFTReZ\_ŁeYV^RZ\_UVgV]ł VeYRdSW\_eYVdecfTefdR|TYRXVSc`fXYe eSjeYV"\*)!=Vj@cXi\_ZIR4`\_deZefTZ\_R  $dvER_kR_14 \ dvErec_R = Rh \ bcm$ 46/ŁhYZIY `aV\_WeYVhR, WcXc`hZ\_X eWidvTe`cZg`]gv^VeZeVvcf\_ZX`WeYV ^ŽEYV&VZdeYfdRdjdeV^`W&RUZEZ\_RjVdeRSł V\_ediafS]ZHdMe`c`\_VeLR\_UacZgReVidMe`c hZeYafS]ZIłdvTe`c}\_R\_TZ\_XŁcVacVdV\_eVUSj `\_d/`UVCVTe`cVd14`f\_TZJ`WAcZ\_TZaR]dz GZW4YR TVI) COLLE URD OUV WACZEREV VOLES ZY^ V\_edŽ@VR| YZXYCVCTReZ\_VderSZY^ V\_ed  $\underline{Z}$  #!!!L#&hVeVecRUZZ\_R]f\_ZeVecRUZZ\_R]f\_ZeVecRUZZdR\_U#"& hVeVacZeReVVdeRS ZEY^ V\_edŽ

 $2 \text{ dVT}_U aYV^{^} V_{^} ZleYVUVI]ZVZ eYV$ f^SVc`WZdeZefeZdRUeYVZTeVReVZdefUVe \_f^SVaŽ\_"\*\*! eYVeVhVeV\$!! YZXYVcVufTReZ\_ VdeRS]ZEY^V edhZeYRe`eR]`W#%&E%1) defUVed Z\_ #!!!!LeYV}XfcVdhVcV#%{ R\_U%\$&D,\$!ŽEYV TYR\_XVZ\_eYV\_f^SVc`VVdeRS]ZY^V\_edZd^RZ\_jj Uf Ve`eYVT]`d`cV`W'R\_j 4V\_ec`dUV7`c^ RIZ\_\_  $E^{1}$   $\mathbb{Z}R_{1}E^{1}$   $\mathbb{Z}R_{1}E^{1}$   $\mathbb{Z}R_{1}E^{1}$   $\mathbb{Z}R_{2}Z_{1}X_{4}V_{6}C^{1}$   $\mathbb{Z}R_{1}E^{1}$   @/ łä‹

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### Ht 9'A 98=5

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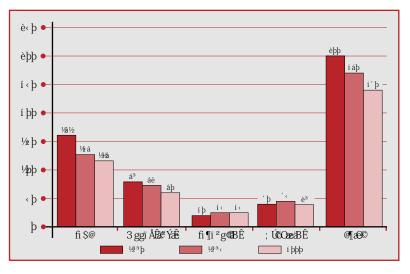
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## FUX]c

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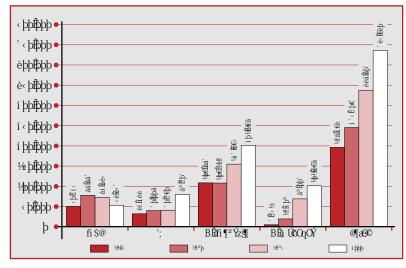
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: "\*\*" eYVeVhVeV" { & { () "} i W eVVaY\_V ]Z\_VdZ\_4YZVŽEV\_jVRcd`\_ŁeYZdTRaRIZj YRU ec\S]VU e` \$L\$' &L \$\* ]Z\_VL^ `cV eYR\_ `\_V aVc Y`fdYY`JUŽH YReYRdYRaaV\_WhZeY^`SZVeVJVI aY`\_j Zł\&V\_^`dvdeZZ\_XŽ:\_ "\*\*&eYWvhWv "\*({{}}\$"%YR\_UdvedŽ7ZeVjVRcd]RevceVV}XfcVhRd  $\frac{1}{2} = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{1}{2} = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{1}{2} + \frac{1}$ }gVaVa]V\_`hYRdR^`SZ[VaY`\_VŽ

EYVZ\_TOURDVZ\_Z\_deR||VUTRaRIZej YRd`SgZfdj RXXXIeVUeYV\_f^SVc`VeVVáY`\_VTR]]d^RVVR\_U eYV\_f^SVc`WZfeVd`W7dZ=bihY'Ufgh\U'ZcZ &\$\$%ZYUW\`7\]`YUb`gdYbhUb`Uj YfU[Y`cZ %%a bihygUa cbh cbh YhYYd\cbY"EYZ Zd gVc ## Y f cdR j VRLZ Tf UZX TRL RZ RXIUZER TVR UZEVC REZ RITRIOŽ

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 $\begin{array}{l} EYV^{S}[VI \overleftarrow{\partial} gV^{WeYZ}]TYRaeVcZIe^{UV}\\ Tf]efdR] ac^{3}]V^{WeYV}Tf\_eejdCVZ\_dL\\ hZeYRgZAhe^{UV}eZVZ_ZVeYVZ_UZWWCV_edecV_XeYd\\ R\_UhVR_VddVdZ\_eYVTf]efdR] \} V[UŽ \\ \end{array}$ 

E`  $eYZIV_ULR4f$ ]ef dR] 5 j\_R` ZI` :\_UN 145:/ R\_UR4f]ef dR] CVd f cTVd:\_UN 14C:/ YRgVSW\_ T\_def TEVUŽEYVaf ca` dV` VeYVdVZIe` ac` gZUVR d\_eYVeZT` gVgZh` VeYVTf]ef dR] } VJUZ\_4YZVL SVRZ\_XZ\_^ ZUeYRe eYVCVRV^ R[` c T\_dedRZed R\_U dA` ceT ^ Z\_XdZ\_ZVC^ ReZ\_LYZE` cZIR] W] ]`hlfa R\_UURRd deV REXRZ\_Ž

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 $\dagger$  DYReV ` WeYV'If ] ef de] } V]U Z\_ eYV e` de] Wc eYV d XZ\_

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DeRezteZIR| TR/TF|Rez\_dh/&VeYV\_TRocZU`fee`  $dR_ \ eV dXZ_ dW cVRIY UZ V_ dZ_ ŽE YV gR fV d$ WcWRIYZUZIRe`chVeVefc\_VUZe`KdTeVdueYV dVZ\_ddT dV ^ ZfdeYV RgVdRXVLUZeZUU Sj eYV ej aZIR UVgZReZ\_/ŽEYVgRJf VdeYf dT\_gVceVUhVcV eYV\_fdVUe``SeRZ\_RgVcRXVdeYReT^a`dVUeYV }\_RJZ\_UVIŽEYVOVTRTIF]RoZ\_d^RUVZea`dd2S]V e T^aRcVgRcZRS]Vd^VRcfcVUZ\_UZXWKcV\_ef\_ZcdZ EYf d h Y W U f h g b h g W U d h f g c k h YdYfZcfa UbWY`cZUbm[]j Yb`fY[]cb`]b`fY`U! hcbhch\YfYgh'Bchcb`mg\ci`Xh\YfUb\_[b[ cZhYfY[]cbgVYWcbgXYfYXžhYfYZcfYžVih hY [ Udg VYhk YYb h Ya Ug k Y " EYVcVf ]ed h VEVEYV\_R\_Rj dVUR\_UeYVdEFReZ\_`V&YVEVXZ\_d Z\_VRIYUZ V\_dZ\_hRdT\_dZV&VU eYVYZXV&RcVI XZ\_ddT ckleYVXXReVcZedTf ]ef cRJ UVgVJ`a^ V\_eŽ

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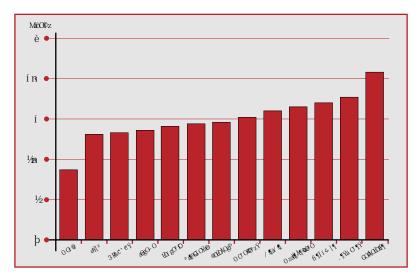
EYZEZ\_UVI UZGZZNOLEYVT f\_ecj`dCVXZ\_dZ\_e`Wfc Xc`fadudW}XfcV#%ZEYVGR]aRRR&LCVXZ\_UZE a] $R_{1}$  deVVYZXVde]VgVd`VUF] ff dR] U\_R`ZI`ŽeZd W]]`hWJSj RXc`fa`VXXZ\_deVRedT dVRS`gVeVV RgVRXV=`d=RX dL4`bfZ S`LeVV> Vec`a`]ZR\_ CVXZ\_L3¾ 3¾ R\_U> RXR]R\_VŽZ eYZU Xc`faL hZeY^VLZA'l]`h dT dVLT^ acZMERRARIIL2\_l e`VXXRHL=R2dfTR\_94L2eRIR`RL@`9 ZXZ\_dR\_U 2j d/2Ž=RdejLeVV> Rf]VCVXZ\_dT dvd]`hVdž

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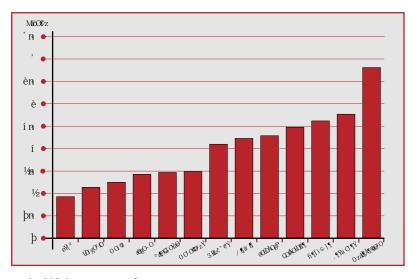
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## 8=A 9BG=C BG<sup>-</sup>C : 'H 9<sup>-</sup>78=

# 9j YbhgʻX]a Ybg|cb EYZtl UZ`V\_dZ\_Z\_T]f UVd eh`Z\_UZTRe`cd+Wdt eZgZZtl R\_UVgV\_edLR\_UTZ\_V`RLeYVRetVR\_U`eYVc dY`hdR\_UaV&Vc^R\_TVchdW}Xf cV#&Z

7 c eYZUZ V\_dZ\_ŁeYV $dXZ_dVRJ$ TJVRcjj Z\_e eYdXZ f adŽ:\_ eYV} cdeZIeYV> Vec a`JZR\_ CV XZ\_ŽEYZIZIVU]`h UUSj =`d=RX dL4`bfZ S`L GRJaRCRA LERCRARTIL3¾ 3¾ R\_U @`9 ZXZ\_dŽ =RebjL> RXRJR\_VL2\_e VRACHL20RTR`RL> RfJVL =R2dRTR\_MAR\_U2j d½ dT cVSV]`h eYVR2VRXŽ

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 $EYV]VRU `VeYV > Vec`a`]ZR_CVZ_`gVc`eYV `eYVedZI]ReXVjj UFVe`eYV_f^SVc`VVIZ_V^RL eYVRevVR_U`eYVc`dr`hdR_UaVeVVc^R_TVEZYV ^`_eYj RgVeRXVZIS' dr`hdR_UaVeVVc^R_TVd aVc''! eY`fdR_UZ_YRSZR_eeLhYZVeVV}XfeVVc eYV_Ve_YZXVeHdT cZ_X cVXZ_ZI]Ved eYR_YR]W eYZh" (/Z$ 

= VRUZ\_XeYVd/T\_UXc fa ZI=`d=RX dLhYZY YRdeYV^`deWd5Z5Z3dR\_UV&Y\_ed+`g\c\$&& Rj VRŽ :ecR\_\dYZXY\deZ\_eYVT f\_ecj Wcc\/ZZ fdWd5Z9RdL ]`TR] TM\ScReZ\_dR\_UW}\Wd5Z9RdEYZTT\_ecRdedL Wc VR `a]VLhZY eYV\_VZXYS`fcZ XcVZ\_L=R2d Rf TR\_3RLhYZY cR\_\d\_VRc eVVS`ee`^ Wc S`eY Z\_UZRe: cdŽEYZIT\_}c^ dR dZX\_Z TR\_e WREf cV`W eYZIUZ V\_dZ\_+eYV^Rc\UR\_U df cacdZZ XXRa d\aRReZ\_XeYVeYZUXc fa Wf^ eYV`eYVccVXZ\_dL Z\_UZReZeV`WeYVcVReZeVj f\_UVCVgVf aVUf aa]j `Wff ]ef cVReYZFS]Ve`eY`cVXZ

5WhcfgX]aYbg]cb

$$\label{eq:linear} \begin{split} & E YZl UZ \ V_{c}Z \ _Z Tf UXd eYCW \ _Z UZRe \ cd+Tf \ ]! \\ & ef cMcMReAURCH TZRZZZG LacRIGZ \ _VcdR Ucdf UV_ed \\ & V_c \ ]] VUZ \ cMReAUR \ f cMchudW \ Xf \ cV\# \ /Z \end{split}$$

7 f c Xc f ad Rev UZ&Z Xf ZhVU+ eV CVZ\_d`W 4`bf Z'S`R\_U2j d/2 ReVZ} acea]RIVLW]`h USj 2 eRR^ RL> RAR]R\_VL@`9 ZXZ\_dCR[aRR84 R\_U =`d=RX dR\_UeYV\_Sj = R2dRTR\_9742\_e`WARHEL ERCRARTI R\_U 3%4 3%4 R\_ULZ\_ eV]`h Ve a]RIVL > Rf]VR\_UeVV> Vec`a`]ZR\_CVXZ\_Ž

EYVcf cacZZ\_X]VRUkchZa`VM`bfZ S`Z\_eYZi UZ`V\_dZ\_ZIRIT f\_eVUVkCSj eYV]RXV\_f^SVc`W aV a]VaRceZIZaReZ\_XZ\_RceZteZTRiezzeZd1hcZeVcd. aRZ\_eVcdL^fdZZR\_dR\_UaVeVkc^Z\_XRced+"!Žs´´` `VeYVe`eR] WceYVhY`]VT f\_ecjŽ

EYV TROV `WEYV > Vec`a`]ZER\_ CVXZ\_ŁhYZIY dR\_\d]ROHZCIONEZZ\_XZHYVCVRCIZ\_RSd]feVeVc^ dZe YRd^ `cVacRI&ZZ\_VCIR\_U`cXR\_ZREZ\_deYR\_R\_ji hYVCVJOULhYV\_eVCIV}XfcVCIRCVhVZXYeVUSj`eYVc gREZES]VoLcTTYRda`af]REZ\_ŁeYVaZTefcVTYR\_XXd XCVRejjZ2\_UZWWCV\_eTROVZIeYRe`W>Rf]VLhY`dV a``ca`d&Z\_ZiVddV\_e&Z]]jUFVe`]`hdefUV\_e \_f^SVddi# $%' / Z_Tf$ ]efcVicV,ReVUVX6WTfcdvZ

9Xi WUHcb`X]a Ybg|cb EYZtZ\_T]fUkteh`Z\_UZRe`cd+VUfTReZ\_R]TgVd RXVR\_U`TTfaReZ\_R]edRZ\_ZX1dW}XfcV#(/Ž

$$\begin{split} & EYV cVdf \ ] eddr h \ eYV cVdZ \_ dUZgZLZ XZ e \ Wfc \\ & Xc \ f adZ 7Zde T ^ V2_e \ VMRdeR R_U > RXR] ] R_VdL \\ & eYV\_ GR] aRR8d R_U ERR8aRI \ Z E YV eYZU Xc \ f a \\ & Z_T] f UVd eYV > Vec \ a \ ] ZeR\_ CVXZ\_L2eRIR \ RL=R \\ & 2dR TR_8AL4 \ bf Z \ S \ L3\% 3\% R_U2j \ d/2Lh YZV \\ & > Rf [VL@ 9 ZXZ_dR_U= \ d=RX \ dcR_ \ ] RdeZ \end{split}$$

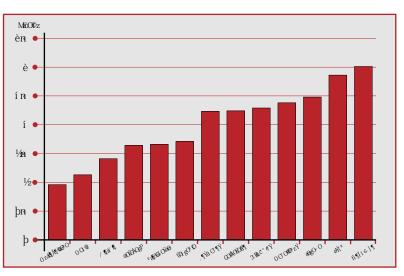
A YX]U<sup>·</sup>X]a Ybg]cb

$$\begin{split} & E YZd UZ \ V_dZ_ \ Z T]f U de YVW] \ h_Z X Z UZR \\ & e` cd _ Vh da Ra V d a V Z UZR d cR U \ dR Z_ d R_U \\ & TRS] Vel V Z Z_ TYR_ V d u dW \ Xf cV #) / Z \end{split}$$

EYVT f\_eqi dd $XZ_dW$ ] Ze Wfc Xc fadZ2eeYVe a ReVGRJaR Red L3¾3¾LeYV> Vec a [ZR\_ CVZ\_ R\_U=`d=RX dŽEYVdVRVW]`hUSj =R 2df TR\_¾R\_U> Rf [VLeYV\_ Sj @ 9ZXZ\_dLER R aRII L4`bf Z S` R\_U2\_e VWR REZ:\_ eYVS`æ`^ Xc fa ReV2dRIR^ RL> RR] R\_VdR\_U2j d $^2Z$ 

EYZIZIEYV} cdeUZ V\_dZ\_WchYZIY eYVT f\_ł eg čdeYcW^ `deYVRgZj a`af]REVUCVZ\_dVRJ Z\_e` eYVdR^ VXc`faŁZ UZIREZ XRT ccVREZ\_SV6hW\_ a`af]REZ\_R\_U^ VUZRUVGY`a^ V\_eZ4`\_gVcdVjŁZ ZdetzZZ\_XEYREEYV6h` cVZ\_d`VEYVVRCd feYT^ V ]REH\_hYV\_T^^`\_\_dV\_dVh`f]Ud`XXdeeYReeYVj h`f]U\_WUR^ `dvREgV^ VUZRJ dEV^ SVIRfd/`W eYVZcgVcj cV^` eV\_VdZ6RIY`VEYV^ YRd[fdedh` cVZ\_R] aVZ UZIRJcLY`hVgVdER\_UeYY\_YRgVeYV WhVdecRUZ dERZ\_dŽ





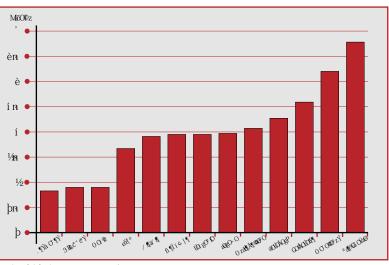
>¶ï ÚgznäÅlźÅOÚzqä]øäB1Ł;nái þþí Ê

2\_`UUWWAE CVZdeYVVI TVácZ\_R]jj ]RXVd aa]j `VVIRS]V eVJVgZZ\_ TYR\_Vd Z\_ GRJaRRRA ŽH ZEY ""# dZ\_R]d RgRZRS]VLZE ZI ^ f TY SVeeVc d aa]ZU eYR\_ eVV> Vec`a`]ZER\_CVZ\_LVCVI R`a]VLh YVV eYV2VRV) & TYR\_VdZ2]d deZZ\_XZdeVVNTeeYRe =`d=RX dYRd"') dRLZ dReZ\_dLR\_U eVf ddR\_\d } cde Wic eYZdZ\_UZRe` Z

; ccXgUbXgYfj JWYgX]a Ybg]cb

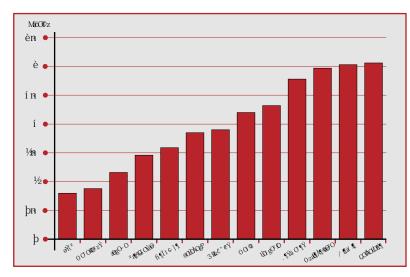
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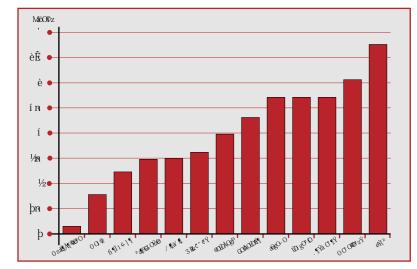
>¶ï ÚgznäÁlÁzÅOÚzqä]øäB1Ł;mäíþþíÊ





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 $EYV & VZ_d W[] Z_e` \} gVXc fadZ:_ \} cdea]RIV Zd2j d/2LW] `hVUSj > RXR]R_VdL=` d=RX cL=R 2 cdf TR_3R_R_U 2 cdR R RLeVV_Sj GR]aR R2d R_U ERCRART Z'__ eYVWf ceY Xc fa RCV@` 9 ZXZ_dL3¾ 3¾R_U2_e` VKM cdR W] `hVLLZ_eVV]R deXc falSj 4 `bf Z_S`L> Rf [VR_UeVV> Vcc a` ]ZR_CVZ_Z$ 

$$\begin{split} & EYV > Vec`a`] \underline{Z}R\_CVXZ\_cR\_\d] Reb SVIRf dV \\ & eRi aRj Vcd V_XRXVU \underline{Z} Tf ] ef cVicV] ReVU RIZZZZd \\ & 1'' #! * #/ RcV`_] j Rd`R] ac`a`ceZ_`VerVe`eR] \\ & 1 # & (!('' * / Z)) \end{split}$$

$$\label{eq:error} \begin{split} ERS]V\& \ dr_{deV}dVZ_dWceVV \} gVUZ \ V_{deV} \\ dT_a \ a \ dr_{AeV} \\ 45: gRf \ VZ \end{split}$$

 amammunication  $z^2 e^{A}$  and getter (A and <math>qr gOetter (A and <math>z qetter (A and A and

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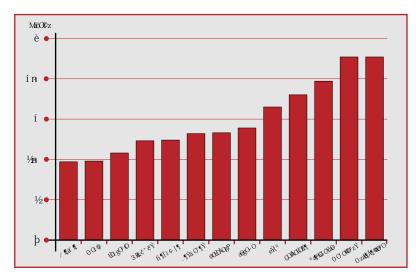
# H 971 @H F5@F9CCIF79G B89L

EYZIZ UVI 14C:/UVRJdhZYeYV&VZ\_dZ\_dR]]VU TRARTZG WCT\_UFT&ZXR\_UUVgY`aZ\_XTF]efd? RI&ZZZIŽEY&VUZ?V\_dZ\_dYRgVSW\_UVZZ\_VUe` TRaefcVeYZLhZY"\$Z\_UZRe`cdudWerS]V&#/Ž EYV4C: UZZUVdeYVT f\_egi ddVZ\_dZ\_e eYdW Xc f adŽEYV> Vec a`]ZER\_CVXZ\_R\_U> RXR]R\_Vd [VRU eYV dR\_\Z\_XLW]] h VU Sj 2\_e VRAHHLGR] aRRAA R\_U2j d/2LR\_UeYV\_Sj 2eRIR RERRARI L =`d=RX dL4`bfZ'S`L@`9ZXZ\_dL=R2dfTR\_ML > Rf [VR\_U3¾3¾1dW} Xf dVS! /Ž

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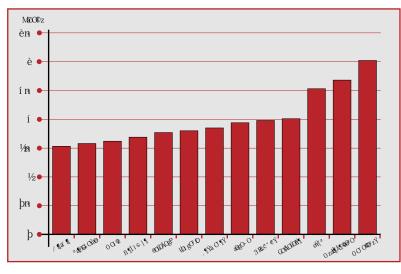
>¶ïlýznäÅlźÅOlźqäjøäB1Ł;naíþþíÊ

D\mg|WU``]bZUghi Wi fY'X]a Ybg|cb EYZIUZ`V\_dZ\_Z\_T]fUXdeXVW]]`hZ\_XZ\_UZIR e`cd+TZ\_V`RdNedLeYNecXELe`eR] dbfRV^ VecVd`W da`cedWNZZEZdR\_UXcW\_RcNetR\_UeYV\_f^SVc`W g`]f^ VdZ\_afS]ZT]Z5dr2ZdidWetS]V&#/Ž

 $:= eYZUZ V_dZ_L`_]j eh`Xc`fadIR_SVUZeZ'$  $XfZhVUŽ:_ eYV} cdeXc`faLhZeY gRJfVdhV]] RS`gV$  $eYVRgVRXVVcR] eYVdXZ_dLRV> RXR]R_VLeV$  $> Vec`a`]ZeR_CVXZ_R_U2j d/2Ž2]]`eYVcdXZ_d$  $RVZ_eYVdXT_UXc`faŽ$ 

 $@VZ_eVEVdeYVeVZdeYVeCVdV_TVZ_eYV$ 





>¶ïlýznanÁlźÅOlźqä]øäB1L;naipþíÊ

JVRUZ\_XXC fa`WAYVeh` dVZ\_dZ\_eYVWcd feY`W eYVT f\_eejŽEYZIZIaRce20f JRcjj de2Z\_XSVIRf dVZ eYV45: > RXRJJR\_VdR\_U2j d½ RdVU h\_Z\_dZ eY a]RIVR\_U dvT\_U W/^ JRde a]RIVLdVdaVI6ZeVjjŽ:\_ `eYVch` dd1e4YdVdVZ\_dRtVbf ZeVhVJ] ac`gZUU hZEY eYVZ\_de3JVUTRaRIZej\_WUNUVcTf Jef d3 RT6Zej Zej LSf e Zeh` f JUdW^ eYReeYVdVYRdSW\_RVW2f cV e` ^ R.V`ae2 f^ f dV` WeYZŽ

 $EYV> Vec`a`]ZER_CVXZ_dR_\d] cobVceYcW`W$ eYV} gVZ\_UZIRe`cdf dAU+TZ\_V`RdARed\_XcW\_RcARd R\_UeYVRec\daVcZ\_YRSZER\_eZ`\_ eYZITRAVeYVZ\_VR4 cdef Tef cVUZ`V\_dZ\_U`VdRTT dUhZEY eYV45:ERd eYVcVXZ\_dR\_\ddVT\_UVCS`eYZ

 $EYV dVT \_ UXc fa `WZ V dvXZ \_ def c_d `fee SV^ `dvY^ `XV_V f d_d XXdz X eVRe ]h]g bch bYW ggUf] mh Y WUgY h Uh W `h fU``XmbU! a ]ga `]g X]fYW mXYhYfa ]bYX `Vmc f`fY`UhYX` hc `U`fY[ ]c bly [bZUgfi Wh fY'' 3j R_U]RXLeVV 45: TYRedd `h X&Re&cgRZRZ \_ dR_UUZWWZ TVd R` `_XdvZ \_ dZ$ 

HYW.bc`c[miX]a Ybg]cb

$$\begin{split} & EYZIZ_{1}fUXI \ gVZ_{2}UZIRe^{C} cd_{+} \ i \ U eV_{1}VaY_{V} \\ & ]Z_VL^{S}ZVeV_{1}VaY_{V}_{V} \\ & IZ_VL^{S}ZVeV_{1}VaY_{V}_{V} \\ & T dVXdaVcYfdVY_{1}ULT^{a} feVcdaVcYfdVY_{1}U \\ & R_U: eVc_VF_{VEZ_{d}VCYfdVY_{1}UUdV} \\ & XfdV \\ & S\#/Z \end{split}$$

 $:eZIYVEVeYRe]RXVZ_VbfRJZ3VdReVVf_UŽEYV eVZ_dVRJ]TJVRejjZ_e eYeWXcfaeZieYV}ce`_VL T^acZiZ_XeYV>Vec`a`JZR_CVZZ_L>RXRJ]R_VdR_U2_e VRXRdHZZIVV]`hVUSjRXcfaT^a`dvU `VGRJaRR324_R_UERCRARTIŽEYVS`ee` Xcfa T_eRZ_d33V433VL2jd2L=`d=RX dL@`9ZXZ_dL 4`bfZ S`L=R2dFTR_3RL2eRTR^RR_U>R_JVZ$ 

:\_ eYV TRdV `WeYV > Vec`a`]ZER\_ CVXZ\_LZEd  $d\mathbb{R} \setminus \mathbb{Z} \times \mathbb{Z}^{1} \mathbb{R}^{1}$  [J Uf Ve`YZXY eV]VaY\_j aV\_VedN  $e\mathbb{Z}_{LS} eY$  } iVU]Z\_V1"ZS ]Z\_VdaVc Y f dW^ ]U/  $\mathbb{R} \cup ^{SZ}V1S\# ^{SZ}VaY_VdaVc"!! aV a]VZ$ > RXR]]R\_VdR\_U 2\_e`VXXRdER  $d\mathbb{R} \setminus hYVCVeYY$  U ^  $\mathbb{R}^{2}$  ]j SVINF dV`VeYV\_f ^ SVc`VY`f dVY`]UZZV cVT dVcdLT ^ af eVcdR\_U:\_eVc\_VET \_\_VTeZ\_dZ eY`dVcVXZ\_dZ = RXR]]R\_Vd2% `VVcSR\_Yf dVI Y ]UdYRgVRgZUV L#& RT ^ af eVcR\_U" # R\_ :\_eVc\_VeT \_\_VTeZ\_Z 
$$\begin{split} & EYVCVZ \_ hZY eYV]`hVde i VU]Z_VeVVAY \_j \\ & aV_VeReZ_ZI> Rf ]VLhYZVeVV_VhZY eYV]`hVde \\ ^`SZVaV_VeReZ_ZI2j d2Z2dCVRUUY f dVY ]U \\ & eVTY_`]`XjLZ_2j d2 [f de #! ~`VVY f dVY ]U \\ & eVTY_`]`XjLZ_2j d2 Rever dVZ dVC; Z > Rf ]VL*ZX \\ & YRgVRT ^ af eVC; R_UZ_4`bf Z S`LSZX RVT_1 \\ _VIEVUe eYV:_eVC_VZ \\ \end{split}$$

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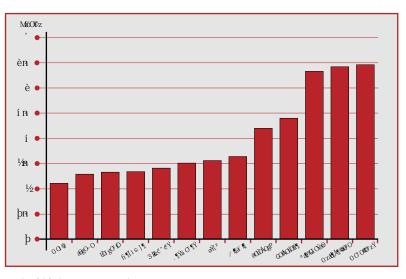
 $\begin{array}{c} {\rm EYZl} UZ^{*} V_{-}dZ_{-} Z_{-}^{*}T]f UVd eYcW Z_{-}UZRe^{*} cd \\ {}^{+} f dvf^{*} dLXR_{-}^{*}U JZSdRZdL^{*} f_{-}ZZaR_{-}^{*}Red \\ {\rm TV_ecVd^{*} c^{*}Tf} ef dR_{-}^{*}T ca^{*} dRZ_{-}dLR_{-}^{*}US^{*} \ dr^{*} ad \\ {\rm 1dW} Xf dVSS/Z \end{array}$ 

 $8 \vee \forall R || j dv R \cdot Z \cdot X \cdot Y Z \cdot Y \cdot R \cdot U || h g R f \cdot V R R \cdot V \cdot e$  $eY R e W c R R \cdot e Z \cdot 3 \cdot 4 \cdot 3 \cdot 4 \cdot Z \cdot R \cdot M \cdot R \cdot e Z \cdot Z \cdot Y h \cdot V \cdot V \cdot Z \cdot Z \cdot R \cdot M \cdot h \cdot f \cdot Z \cdot Z \cdot R \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot e Y \cdot Z \cdot Z \cdot R \cdot E Y \cdot E Y \cdot Z \cdot Z \cdot R \cdot E Y \cdot E Y \cdot E Y \cdot E Y \cdot E Y \cdot E Y \cdot E Y \cdot Z \cdot Z \cdot R \cdot E Y$ 

$$\begin{split} & EYV def ReZ_R d & AR d & f_ZZAR Red TV_e & d \\ `c Tf] ef dR T ca`dReZ_d & Zlgkj UXWWEV_e Z_eVV \\ & d & XZ_d`WCR a R & L2_e`WWAR R_U & d & R \\ & h & YV & * ~ L' (~ R_U' (~ WT^{h} f_V & d & VI \\ & h & YV & * ~ L' (~ R_U' (~ WT^{h} f_V & d & VI \\ & egy & J & L & R \\ & f_V & f_V & d & f_V & f_V & d & I \\ & egy & J & L & R \\ & f_V & f_V & d & f_V & f_V & f_V & d \\ & egy & J & R & f_V & f_V & f_V & d \\ & f_V & f_V & f_V & f_V & f_V & f_V & f_V & f_V & f_V & f_V \\ & egy & f_V$$

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 $EYV UZWWEV_TVd Z_eYV dR_\Z_Xd eYV dVZ_d$ RIYZGVZ\_eYVeh`Z\_UZIVdXGVR\_ZJAR`W`h hV] RCVZ\_dTf ]ef cR\_U\_R^Zh^ RETVdeYVTf ]ef cR] cVd f cTVdRgZJRS]VŽERS]V&&ch`hdeYReeYVCVZ\_d hYVEV eYV eh`^RETY^`de T]`dV] REVERBARIEL @`9 ZXYZ\_dR\_U > Rf ]V1VRTY RE RUZWWEV\_e ]VgV/Ž EYVCVZ\_dhY`dVeh` dR\_\Z\_XdRVVKdeYvdeRaRee \$'%B=ł ä≥í @zgoe²¶¶" øäq≎ z²Ý¶²

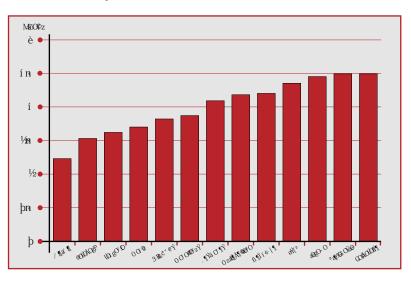


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 $\begin{array}{l} RV33\%43\%4h \fbox{P} RUZWWEV_TV^{M}4A^{b}fZ^{S} R_U \\ = \ d=RX^{d}h \Huge{P} RUZWWEV_TV^{W}RU2j d_{2}h \Huge{P} F \\ RUZWWEV_TV^{W}(\H{Z}) \end{array}$ 

:\_ eYVTRW`W2jd $_2$ LeV\_WREZV $dX_ ^ VR_d$ eYReZe $_d$ \_dYZXV&Z\_ eYV4C: eYR\_Z\_ eVV45:Ž :\_ `eYvch`ddLeYVdXZ\_ ZUVKCjj hV]] V\_U hVU hZeYTf]ef d?] ddf cTVdLSf eZdTf]ef d?] Uj\_R`Z' ZIdV[REZVj] ]`hŽEYVZ\_T\_dCeV\_Tj Z\_ eYZTRVZI eYRe2j d/2 YRdT\_dUARS]VZ\_dR]]VUTRARIZ; Vc df aa` $ceZ_X$ `c VCeVZ\_XTf]ef d?] REEZGjLSf eeYZd REEZGj ZL\_`eVV]j UVEV[aVUZ

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<sup>&</sup>gt;¶ï ÚgznäÁlźÅOÓzqä]øäB1Ł;naíþþí Éa

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 $\begin{aligned} & \operatorname{annumental matrix}_{2} \operatorname{got} \left\{ \begin{array}{c} \mathsf{g} \\ \mathsf{g} \\ \mathsf{g} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{g} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{e} \\ \mathsf{f} \\ \mathsf{e}$ 

>¶ïlýzmäÁlźÅOÚźqä]øäB1Ł;mäiþþíÊa

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>¶ilýznaklúz AOÚzqa]øa B1L;naiþþíÊ

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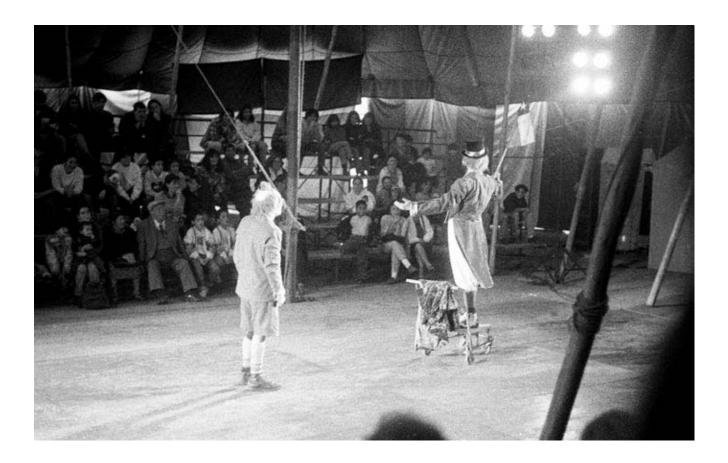
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<sup>@/.</sup>łäè



# 7I @H F5@7CBGI A DHCB'=B'7<=@9



# $H_{c}9^{\circ}8=J_{c}9FG_{H}MC$ : 7I @H F5@7CBGI A DHCB

5 ```h.Y.Yj ]XYbW' UbU`ngYX g\ck g h\Uh a Uf\_YX ]bYei U`]mcZUVWYgg hc W `h fU`` Webg a dhcb ]gU fYW ff]b[ Z/Uh fY cZ7 \]`! YUb gc WJYm' 7 ceYVgRe^ R` cZj ŁaRczZZRZ\_ Z If ]ef cR] T\_d ^ acZ\_ZI]Z ZAUe eVJVZZRZ\_ R\_U cRLZ ŁZ T ^ VSVZ XeVV^ RZ\_WATE ceYReUAcZyd aV a]V` WRITVdle` eYkc \Z UZŽ

## C J 9FJ =9K

@WR] eY dVZ\_ektgZh UU kć eYVF? 5 A #!!" Df cgYjŁS' ~ YRU S`f XYe\_VhdaRaVcdZ\_eYVaRde hWVŁS#~ YRU af cTYRdNU`c`eYvhZhV`SeRZ\_VU ^ f dZT eYY\_hVEVZ\_ektVdeVU Z\_UF cZ\_X eYV aRde ^`\_eYŁR\_U#(~ YRU eRVV\_deVade`af cTYRdV`c `SeRZ\_eYVS``\deYY\_hR\_eVUZ\_eYVd?`VaVzUŽ H YZV" & deteVU eYY\_YRU SW\_e`eYVeYVRevL ^ f ddf ^ d`c V YZSZZ\_dZ\_eYV]Rde eYVeYVRevL [f def ' d`c V YZSZZ\_dZ\_eYV]Rde eYVEZV RZ\_ eYV]Rdeh WXŽ@\_]j "#~ YRUSW\_e`eYVIZ\_V RZ\_ eYV]Rde^`\_eYLR\_UR^VEV\*~ dzU eYY\_YRUSW\_ e`T\_TVccdZ\_eVV]Rde eYW^`\_eYZ2^`\_XeY dV hY TRozZU`fed^VIFjefcR]T\_d^aeZ\_Ł%/ WeeYReeYW/RIezzeZdYVjaWeYV`e`UvgV`aRd ZUzzLFR]d#(″eYReeYVj XRgVeYV^``dve`eR]\ RS`feLR\_U#\*″eYReeYVj RIbfRZ\_eWeYV`hzeY `eYvchR]d`WzeZ\_XR\_UeYZ\_\Z\_XŽ

 $EYVXV_VR_UZdezSfeZ_`WF_]efdR_T_d^aeZ_TR_SVR_R_jdUfdZ_XRd_eYVeZTZ_UM_T^SZ_I$  $Z_XdvgV_ZeV^d`_R_RUZEgVSRZH_VhchRaVcL$  $aVZUZR_dS``\d_fdZLTZ_V^R_VYZSZZ_dR_U$  $T_TVccZEYVR_R_jdZdhRdc/dczZeVUe`eYVd/dvgV_$  $ZEV^d`_eYVSRZE!eYRe eYVj_hVCVeYV`_Vd^`ce$  $T^^`_jj_Rd1ZZeVUhZeYTF_]efdR_T_d^aeZ_Ž$  $@SgZ_fdjLeY`fXYLeYVCVRV`eYVcRIeZgZZdeYRe$  $TR_SVT]Rd2_VUR1dTYLeYVgZZ_SVZ_XeYVacZ_V$ V KR`a]VŽ

7 cT ^ aRdRegVaf ca`dvdL]RdejjLevVZ\_UVi hRd UZgZUVU Sj Tf]efd?]T\_df^ aeZ\_ ]VgV]Z\_e`Wfc Xc`fadŽ

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 $2eS) ~~ VeYVd? a]VLeYZIZIeYV]RXVeZ`fa ~~ VeYVWfcZ`_eYVZ:VeYVeZ`VLReeYVhWVV_UEYZd ~~ VSVd^ RZ_j hReYYeYVeZ`VLReeYVhWVV_UEYZd ~~ V^SVd^ RZ_j hReYYeYVeZ'L_R_UEdezZ_XjFL ~~ )~~ VeYV^ cBj eYVj YRgVIRS]VeYVgZZ_Z eYVZ: Y ~~ VEZVIREgYj ]RcXVac`a`ceZ_d`VeYV^ RcV RXU && R_U`gVEW RJVL^ V^SVd`VeYV]`hVc d`TZIVT_`^ZTXc`fa R_UcfcRJZ$ 

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EYZUXC faLUY\_URDR] eY dVhY YRgVT\_ł d^ W[fdc`\_V`WYVdyZ ZeV d]ZHVLŁT^ acZud #& `WAVa`\_UV\_eZEYVZcTf]dfdR] T\_d^ aeZ\_ ZUX\_VR]j T\_}\_UUe`\_VhdaRaVdthYZY8#" `W eYV SfjLR\_US" ~ `WYV dJ eYY YRgVIRS]VeNV gZZ\_Z\_eNVZ Y^ VZZ dV[REGV] YZX ac`a`ceZ\_ SV]\_Xe`eYVZ eVc\* WZRVd TZ IVT\_`^ ZTXc`faŽ

=bhYfa YX]UhY ₩ `h fU``Wcbgi a dh]cb

$$\label{eq:constraint} \begin{split} & E YZ dX^{\circ} f a \ T \ ^ a c Z M d\# (\ \ \ \ \ W A da \ \_ UV_e dR_U \\ & Z T f U dR_] e^{\gamma} dV h \ Y \ T \_ d^{-\gamma} V eh^{-\gamma} c e^{\gamma} dW^{-\gamma} W V \end{split}$$

d&V\_Z&V d]Z&VZ2]eY fXVeVY YR&VRd SdR\_eZ ]V&V] `VVIf]efd] T\_d^aeZ\_ŁZe W]dhV] dY`ce `V&YRe`V&VYZXYV&T\_d^aeZ\_XC faLhY`dV ^ V SVcdRVVRC^`cV]ZVj e`ReV\_UT\_TVcdZ aRczIf]RZEYZZZe&C^VZRVXC faZUZ&ZAYUU Sj ZedT\_d^aeZ\_`WfdZT1&` /LhYZYT^Vd dVT\_U`\_]j e`\_VhclaRvC cVRUZ\_XZ:ed^V SVcd ReV]ZVj e`SVj`f\_XaV a]VRXU") e`#%L^RJVL R\_U^V SVcd`V&YV^VZAAJVRXU") e`#%L^RJVL R\_U^V SVcd`V&YV^VZAAJVRXU") e`#%L^RJVL

< ][ \ 'W' 'h fU' 'Wc bgi a dhc b

EYZdXc f aLh Y dV^ V SVdT \_d ^ VSVahW\_ WfcR\_UdvgV\_`WeVZeV^d]ZeVULZdeYVd^R]Vde  $\operatorname{Re}\left[\operatorname{feb}^{"}\right]^{"} WeVdR^{a}VZ4^{-}dr^{a}Z_{Z}ZYZY$ Z\_R] TReVX cZdLhZeY T\_TVce ReeV\_UR\_TVdT cZ\_X ] h = 1Zed ^ V^ SVed Zd\_`e Re eYV ViaV\_dV`WeVjVgZdZ\_  $T_d^{aeZ}_{Lh}YZYZdRd YZXYZEYZdXc faRd$ YRdeYVYZXYV& Wgy`WRTVdde`TRSJVeVJVgZZZ\_ Z\_ eYVY^VI'! / /Ž2deYVZcac`} [Vh`f]Ud'X XVdeL^V SVcd`WeYZclXc`faeVUe`daVUeVVZc hWV\_UddVRUZ\_XU]ZdeV\_Z\_Xe`^fdZlLX\_Z\_Xe`eYV TZ\_V R`cT\_TVadR\_Uaf of Z\_XakVTZ; TY`SSZAŽ > dedWeYdVRIeZeZdRdRhR `WVgY`aZXRd  $\underline{Z}$  Uz $\underline{Z}$  Lf R $\underline{Z}$  5 V<sup> $^{\circ}$ </sup> XRaYZR $\underline{J}$  LR RXVac a  $\underline{C}$ RCVRXVU") è \$%R\_U^R]VLSV]`\_X è eVVYZXY d TZ łVT\_`^ ZTXc`fa R\_U ZzVZ\_fcSR\_DR\_eZX Ž >`de`WeYV^ RcVdefUjZ\_X`ch`c\Z\_XL`WeV\_ Rd ac`WadZ\_RoŽ

K < 5 H GI 6>97 HJ 9 DF98 €DC G+HC B G 5 F9 5 GCC 7 =5 H98 K =H≮ 7 I @H F5@7 C B GI A D! H€ B 3

E` R\_dh Vc eYZdbf VdZ\_LR\_ Rev^ aeh Rd^ RUV e` Zd ]ReveYVWWWe` VVZda`dS]VZ\_T ^ V]VgVd`\_ eYV cV[ReZ\_dhZad`SdkgvUŽE` U` eYZdLY ^ ` XVi \_V f ddf SdR` a]Vdh VdVR\_R]j dUUZ\_UVaV\_UV\_eljŽ\_ VRIYLeYVcVda`\_UV\_edSV]`\_XVU e` eVVdR` Vd TZ ł VT\_` ^ ZTXc` f a R\_U ddRevU eYRe eYVZcZ\_T ^ Vh Rd V\_` f XY e` T gVc eYVZc\_WUDŽE YZdh Rd Vbf ZgR]V\_e e` RdvZ\_X+Re R XgV\_ ]VgY]` VVZda`dS]VZ\_T ^ VL h YRe Zd Rdf TZBeVU h ZeY YZXYVc` c]` h Vc Tf ]ef d3 T\_df^ aeZ\_OEYc`f XY eYZd V VCTZVZe h Rd a`d dS]Ve` ZUV\_e3JVR]RcXV\_f^ SVc` VV4JReZ\_drZad SVeh W\_ Tf ]ef d3] T\_df^ aeZ\_ ]VgY]dR\_UeYVXV\_ł VER] d'S[VT6252VacUZda`dÆZ\_`WEAVCVda`\_UV\_eeŽ EYVCUVcV[ReZ\_dVZadY`]ULhZEY dZXYe gR236eZ\_dL WcR\_j VT\_`^ZT deRef dŽEYV^RZ\_T\_T]f dZ\_d RcVRdW]]`hd=

@\_V`V&YV^`de^Rc\UUd\REZ\_dAZdZleYRe SVehW\_dTZSSZZEj R\_UTF]efd?]T\_d^aeZ\_Ž EY`dvhY`T]RZ`e`SV^`deZeVXReVUZe`dTZR] \_Veh`c\d.ZZZZ.eY`dvhY`YRgV^`de VZZ\_UdR\_U V\_[`j`eYV`dv]gdhZEY`eYV`LR\_UhY`YRgVYZXYC ]VgV]d`V&RezTZARZ\_Z`cXR\_ZREZ\_d.T\_d^V ^`dvTf]efdŽ2eeYVd?`VeZ`VLeYVdVaVa]VRV ]VdlacZgRJjl`cZZ\_eVUR\_UYRgVRSc`RUCdTZR]Y`l cZc`\_Ld^VEYZ\_XEYReZI^ R\_ZWEVUZ]`hVc]VgV]d `W`Zterf de`hRUd`eYVcZZjT\_eRZMEVUZ]`hVc]VgV]d `W`Zterf de`hRUd`eYVcZZjT\_eRZ\_d`hdRT]VRc  $eV_UV_Tj$  e`SV^`cVVR`ZjlR\_UacZgRJjl`cZ/eVU  $R_U$ ]VdlacfdZ\_XZ

9 ZXY & TF ] ef d?] T\_d^ az\_L Re R\_j ZT ^ V [VgY] R\_U Z\_ R\_j VT\_` ^ ZT def ReZ\_L ZI R]d Rd d TZENU hZY R XXRN & RaadVIZEZ\_ V& UZY dZj R\_URXXR & CadVIZE a dEZ\_ e hRdde [VCR\_TVR\_U \_` \_ HZRZ Z\_RZ\_ŽAV a] VZ\_ e ZZIX c f a R]d dY h T\_dZEV\_ej YZXY & [VgV]d` VZ\_UZZU RZRZ Z`:\_ ` eY & h`dd e YJ RV` dZ\_e Ue hRddd / WV & d ^ Z\_RZ\_L dy NA VIZ\_ R\_U dy NA RZRZ Ž =RteljiLeY`dVhY`dVTf]efdR]T\_d\*aeZ\_Zl YZXYdeeV\_Ue`UZta]Rj Rdec`\_XdcTZgZTReeZfUZŽ EYZEIZh^R\_ZWOEVUZ\_XXRevCRaadVTZReZ\_WcUvi ^`TdRIjLXXRevCT\_TVc\_WcT^^f\_Zj RWKZd R\_U]Vdtla`]ZZTRJUZRWWTeZ\_Ž3j T\_ecRteLeY`dV hZEY]`hVcTf]efdR]T\_d\*aeZ\_eV\_Ue`SV^`dV UVRTYYUWY^ eYVdVeYZ\_XZŽEYVj RtVZ\_UZWWEV\_e e`UV^`TdRIj R\_UeV\_Ue`eYZ\eYReVgVj`\_VyYRd e`XdeSj eYVSVdeeYVj TR\_%Z

H YReZ a ZREZ\_dU eYVÅVRH TZEZ\_dYReVVć eYVTYR]V\_XdSVZ\_XRUUVÅHUZ\_eYZIARe`V&YV CVa`œOH Y WebWi globggi [ Yghih UhXYj Y'! cd]b[ `[ fYUHYf cddcfhi b]HYg Zcf UWW/gg hc` W 'hi fU``[ ccXg UbX gYfj ]W g Wei `X`\Y'd hc` Z fh\Yf U W 'hi fU``YbHYfdf]gY 'HUbgWYbX]b[ ` h\Y]bX]j ]Xi U`gd\YfY UbX'dfcj [X]b[ 'h\Y'VU! g]g Zcf U'a cfY VfcUX`mfYÛYW]j Y gcWJYm'

=``\UPEW^ eYZIdeR\_Ua`Z\_eLeYVZ'a`d eR\_TV`WhYReeYVTF]efd?]Z\_Ufdeg YRde``WWCZI V\_YR\_TVLŽ4R\_RXXReXcacVLZa`dEZ\_e`d TZA Z\_eXXREZ\_SVTEXREVUSjT\_df^aeZ\_`WFF]efd? X`UdR\_UdvgZVdD4VceRZ\_jjLdZ'a]ZEZT^VTYR \_Zf`dYRgV\_`a]RTVYVEVZ?`\_VEYVVELEYVVgZ UV\_TVdW^de`dfXXdeR\_`aa`cef\_ZjZleYVEVZ

# H9@9J = € = € B 7 C B GI A D H € B 5 B 8 9 J 9 F M 8 5 M 7 I @ H F 9

2deYVURRdvéWæYTJVRcji ckýkRjL2; fih Y j Ugi a U'c f]mic Z7 \ ]YUbgžW' h fU`We bgi a dhje b` ]gWe bÚbYX he h Y We bgi a dhje b c ZhY Y j [gje b` Ug h Y ge Y c f'd f]a Ufmige i fWY c ZUVWY gg he ' ]bZ fa Uhje b UbX Y bhYfhU]ba Y bh': e ZheY keW keV gVej Z' a` ceR\_ee`]`` \ T]` dVji ReeYV cV]ReZ\_dYZa SVeh W\_eV]VgZZ\_R\_U VgVej UBj Tf ]ef eVZ\_4 YZV e` URJŽ

### J =9K 9FG

EV/VgZZ\_gZh/VdRtV\\_`h\_e`SVYZXY]jdA4 ^V\_eVLLR\_UZeh`f]USVa`Z\_eVdde`ReeV^aeR UVCRZaeZ\_`WeYRegRtZkjZ?`\_VeYV/VdLetVF?5A #!!" DfcgyjacgZtVdR\_Raac`iZ\_ReZ\_ŽEYcW ejaVd`W&ZhV&TR\_SVU&&Z\_XfZhVUŁZ\_RTT d.R\_TV hZeYeYVadWW&V\_TVdRdTVæRZ\_VUŽ4`\_eeRgiehYRe ^ZXYeSVViaVT&UŁ\_V&YVcdTZHVT`\_`^ZTdeRef^ \_`cVUfTReZ\_R]JVgYJ\_`ca]RTV`W&ZUV\_TVRWWTe eYVZcT\_}XfdReZ\_Ž

### J ]Yk ]b[ Zcf YbhYfhU]ba Ybh

EYV]RX&deac`a`ceZ\_`V&YV4YZJVR\_dZ\_e&d gZhWJ1%/~/SVj`\_Xe`eYVejaV`WAFUZ/TVeYRe fd&deJVgZZ\_ WcV\_e&deRZ^V\_eZEYVj efc\_eYV eMVgZZ\_`\_hYV\_eYVj X&eY^VR\_UeYV\_eYVj aVcd\_RJZVeYVZcgZhZ\_XSj TYR\_\_V]Y`aaZ\_XZ >RJVdR\_Uj`f\_XaVa]VRXU") e`#%ac&U^Z \_ReVZ\_eYZdXc`faLhYZIYh`f]URIT`f\_eWc&YV ac&WEV\_TVWcda`cedac`XR`^Z\_XEYVj RJd eV\_U e`aeWc}]^dR\_Ud&Zdac`UfTWRSc`RLLRdR hRj`W&RZ\_XŽ

# J]Yk]b[ Żtf]bZtfaUhcb

2 gkg UZWWCV\_eXcfa ZleYV`\_V^RUVfa`W ZUZgZLfRJdhY`fdVeVJ\gZZ\_RdRdfcTV`VZ\_Wd ^RzZ\_ŽEYZRFUZV\_TViS''´ / efc\_deYVdke`\_WcR daVTZ;Tafca`dve`hReTYeYV\_Vhd`cd ^VdaVTZJ TfccV\_eRWWCdac`XR`^ VŽ:ed^V SVdRV^`cV JZVJj e`SV`JUVcRUfJedR\_Ue`SV^`cVZ\_eVcVdeVU Z\_yhYReZdX Z\_X`\_Z\_eYVTf\_eqj%Z

### J]Yk]b[ ZcfWca dUbm

2\_RfUZ/TV`WZ ZRcdXVi#\*" /fdddd/vgZZ\_ WcT ^ aR\_Z\_dYZ hYZ/VIRcjZX`fed ^ V`eYVc RizzzjŽ9`fdvhZvd RcV de`\_Xj ckacvdv\_eVU Z eYZIXc`faŁR\_UeYVj eV\_Ue`dW\`feV\_ekdeRZ ^ V\_e ac`XR` ^ Vdtd`TYRd4 YZ/VR\_d Ra`avCRd`cgRzZij ac`XR` ^ VdtR\_U^ ZIIVJ]R\_V fdac`Uf`TeZ\_deYRe ac`gZV/\_`h]VUX/fdWMJ Wc`ZWŽ

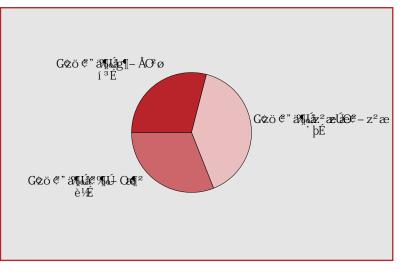
### 7 C BGI A DHC B < 56 + G

DVT\_UjiŁeYVeZ VdaV\_ehReIYZ\_XeVJVgZZ\_YRd e`SVT\_dZNOVLŽ5ZWWOV\_edefUZdddvgvRjZedVieV\_eŽ 2TT d.Z\_Xe` eVV Revele df cgV/ RePARS VW/^ eVV ? ReZ\_RJEVJV@ZZ\_4`f\_TZJ14`\_dV[`? RIZ\_R] UV EVV2ZZ\_€4?EG/1#!!!RŁT\_UFTeVUZ\_"\*\*\*Ł RgVdRXVeVJVgZZ\_Via`d`dVeZVhRd#Y`fcd&& ^ZfeVdaVcaVcd aVcUR Z "\*\*\*\* LT oXLV/ZX S`eY`aV\_eWygZZ\_R\_UaRjeWygZZ\_Ž2dZ ZRc R^`f\_e`W&Z VhRddaV\_e |ZdeV\_Z\_Xe`eYVdRUZŽ 2\_`eYVc^ VeY`Uf dvdeYVV/VTec`\_ZTyaV a]VI^ VeVc‰ ^ VRfcV^ V\_edTRczZU`feSj RaczeReVT ^ aR\_jŁ EZ VI:S`aVŽ:\_ #!!!LRgVdRXVgZhZ\_XeZ VhRd\$  $Y f d' S^{Z} f d S d T U R L R Z T C R V W$  $R^{\uparrow} = dR_{T} + dL_{TV} + \delta Z = VVSZ + dL_{TV} + \delta Z = VVSZ + dL_{TV} + \delta Z = VVSZ + dL_{TV} + \delta Z = 0$  $ReVaVa[VW^{\prime} eYV]$  hVc d TZ  $VT_^{\prime}$  ZT VeV[L]h`^V\_R\_UeY`dVRXVU`gVc&&Ž

$$\label{eq:constraint} \begin{split} & EYZUJj LZEdr^f JUSVeV^V SVEVUeYReeVVgZZ\_\\ & T\_dr^aeZ\_Zl^W_T^SZ_VUhZEY^eVcRIegZ. \end{split}$$

eXeLJZVVRZ\_X`ccVRUZ\_XeYV\_VhdrRaVČ\_`eYVc h`dULeNVgZZ\_fdVZIRTEGVR\_UdNVTEGVŽ@V8V\_L ZEZIRd TREFRIR\_Uc`feZ\_VR\_UZ\_g`lgVd`\_jjaRce`W eYV^Z\_UŽ2TT dZ\_Xe`cVARCTYSj4Rd`d4ReRi 1#!!!/LgZhZ\_XZIRdT`\_URG\_RTEGZEj VcRS`fe % ~``WeYV eZ\_VdaV\_ehReTYZ\_X`aV\_R\_UaRj eNVgZZ\_RZVŽEYVF?5A#!!"DfcgVja`Z\_ede` eYVdR`VT\_TIfdZ\_LZUZREZ\_XeYRe"S~``VaVaJV efc\_eYVeNVgZZ\_`\_WcT^aR\_jLYWUZ\_XZe`\_jj

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**ÇÎ al Qoal Ω 6** "ak¶ ¢ anti în CO2° antija 39 m è 'ao¶î Ýzo¶ Q YaO' qa' a nèi < akz¶ Å 2 Ê >¶î (‡znne≎ zi']¶ Åznä Å (¶ gz Ý Yzq a] α antiz 2 kå¶ (af Ê

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 $5 V/ZSVERAVJj `c`eVVchZMLaVa]VUEh`_eVV$   $dZ_dR_Ud_S`]deVReeVVZZ_ac`gZVde`TeVReV$   $R_Z RW`WhYReeVVJReV`chR_ee`SVLR_Ue`$  ZeVcackeeVV^VR\_ZXd`WZWZ\_dTZkjZ2d;Vd/d  $> Ree/43RSVc`1"*))/a`Zed`feLeVVVV_TeZ_$ `VeVVZZZ\_ac`gVdES`gVR]Le`SV`\_V`W`VZR  $eZ_, `c deVVdLZeac`gZVdRhVS`W`VZRZ_d$ SVchW\_aVa]VdZgV\_egVTRATZZdR\_UeVVdTZR cVacVdZedZ\_dR\_U\_`c^ deVRedTZkjSc`RJRded eYc`fXYeVVgZZ\_^VERVZZTTdZXe`eVV  $F?5A #!!"DfcgVjL4YZVR_dacWVc_VhdLTfd$   $cV_eRWWZdac`XR`^VdE}]^dcb`cedac`XR^^Vd$  $<math>R_UdVgZZ$ 

 $4^{+}$   $c^{-}$  Z XhYRe hRd df da VTeVL def UZd df h eYReaVa]VdUVI]RCVUXV\_cVacVWcV\_TVd`\_j aRd eZR]]j ^ ReTY eYVZc RTef R] T \_df ^ aeZ \_ 1 Rd^ VRef cVU SjetVaV a]VI^ VeVcR UY fdV ]UdeZ XZD Ra `aVARL\_Vhdac`XAR^ ^ VeL}]^ dR\_U^ ZTV]]R\_V f d ac XR<sup> $^</sup> ZXRCVR$ ] <sup> $^</sup> CV c$  [VdUbf R]] hV] dval</sup></sup> ckd/\_eVLŽD Ra`akRd dW^ e` YRgV eVV YZXYke RTef R] dReZ\_XdZ\_ ^ `de dedReRLR\_UTYR\_\_Vjd.eV\_U e Xzzverv acz czą RdRcvff jeży2 TYR\_Vj zd\_`e dW\_ RdR df TTVdd SVIRf dV ` WZed\_Vhd ` c TV/VScZej ac`XcR^ ^ Voz ) h d TTVddf RTYR\_V ZddW\_e SV UVaV\_Ud`\_Y`h a`af |RcZedd Ra`aVcRZPZGZhVcd f\_UVadeRUeYZŁRUdURLeVazZWaZWaZWaZWaZWa ZŁRIT d.Z.Xe Rdłczenczewie yXzyvaV a VeYV `aa`cef\_Zeje`]ZeV`feeYVZcU&VR`dgZTRcZfdj%Zu D'Ra`aVaRd^`SZZKVR\_URTefRZKVd'TZR|Z'RXZ \_RcZkd+yj`fRcVRaaVR]Z\_Xe`hYReZclZ\_aVa]Vd  $T \parallel VI \in V f_T_d I Z f d \sim 6 D S R \cup ^ R X R Z V L 6$ > VćIf cZŁ#?`gV SVc#!!"/Ž

2\_`eYVchBj`WMR^ZZXRIFB]T\_d^aeZ\_ Sj XV\_dVZle`dWhYZTY ac`XR^ VdRV^`de hRETYVUŽ2deRS]V&) dr`hd\_eYV"!^`cehRETYVU ac`XR^ VdZ\_eYV} cdeYR]WV#!!"Z]TJfUVeh` d Ra`aVRdR\_UR^ VUZRVgV\_dLSfeR]d\_RTfccV\_e RWWXdac`XR^ VR\_UR\_VhdSf]]VZZŽ

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2 def Uj T\_UTEVUSj eVV> ZZdej `WA]R\_ZX R\_U4``aVCR2\_1#!!"/`\_ eVVSRDCI`WAV7R`ł Zj 3f UXAE Drogyj R\_Rj dU Wfc RAVEL RLaRe `W Y f dY']U Tf ]ef d2] T\_df^ aeZ\_+]ZeVCREf dV R\_U acZ\_e^VUZRL RF UZ ł gZef R] X`UL R\_U dx gZTVŁ ^ f dZL R\_U gZef R] ReeZ: e R]d Z\_TIf UVU R\_y eN Vcd% TREVX cj ZEYV`gVCR]] dxf ]e dx`hd eVRe Z\_ "\*\*' ł"\*\*(L'S´`VY`f dY`]UL af cTYRDU`\_V`c `eYVc`V&YVTF ]ef d2] X`UL R\_Udx gZTVd^ V\_eZ\_VZ EYZLaVCTV\_eRXVCA dxU/\_edR]RXVZ\_TCVRU^ gVceYV "\*) (ł"\*)) a VZ U1&" /Z

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 $4^{d} acZ_S j$  TREVX of UZ2ZVdfa UZ3Wd V\_elj UVaV\_UZ\_X`\_hYZIYd TZ IVT\_`^ZTXc fa Zl eR.V\_ŽEYVR UZ I gZfR] dvTe cZleYV^`def\_VbfR]L hYZV eYV JZEVCREF dV R\_U acZ\_e^ UZR TREVX of Zl eYV`\_VT\_df^VU^`deVgV\_]j RTc ddeVVZ\_T^V bfZ\_eZVVŽ

$$\begin{split} & EYVUV_{j}\_ZZ\_`VWF ] ef cR_{j} T\_d^{a} eZ\_f dVU\\ & Sj eYV> Z_Zdeg`VVA]R\_Z_XR_U4``aVcReZ_V_{j}\\ & T^{a} aRdtMUeYVTF ] ef cR_{j} ac`UFTed^`deT^^`_] j\\ & cVARcUVURdSV_{j}`_XZ_Xe`eYZd_{j} VJUŽEYV7R^Zj\\ & 3f UXAEDF cgy_{j} V_RS_JVU ac`XVcHe`SV^RUVe`_{j}\\ & hRcURRVM_{j}VcR_R_{j} dZ_{i}T_gVcZ_X`eYVcX`UdR_{i}U\\ & dvcgZVdRdhV_{j}Z \end{split}$$

H YREREVEYV def Tef del Y f d.Y [UTYREREVEZ de ZT Roth TZREVU h ZEY YZXV (c TF ] ef del T \_ d ^  $aeZ_0$ 

=Ve Ze SV dZU`\_TV RXZ\_ eYRe W`h fU``We b! gi a dh]c bž Ug XYZ]bYX`]b`h Y`A ]b]ghfm c Z D'Ubb]b[  $UbX.7 ccdYfUl}cbghiXnž]gghfcb[ mi$ WebX]h]cbYX.VmiX]gdcgUV.Y ]bWea Y" EYV $def Uj Z_UZReVd eYRe Ze Zel eYZd gReZES]VL dReYVc$  $eYR_ R XeVReVc `c ]Vdb/c acWWeV_TV Vc Tf ]ef dR]$  $T_df^ aeZ_LeYRe RIT f_ed Wc eYV UZWWeV_TVZŽ$ 

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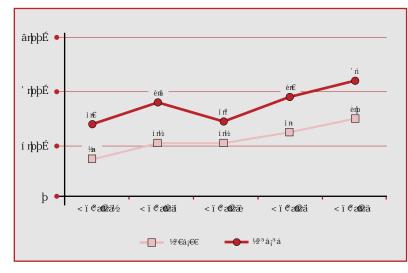
$$\begin{split} & \text{EYZ}(cMReZ\_dYZ) Z(R)d \quad U^{\land} \_decReWUZ_UZ(VR); L \\ & Z\_eYVWc^{\land} WT ccMReZ\_d SVehW_ eYVWFTR1 \\ & eZ\_R] RecRZ_^ V_ed`WeYVYf dW^]UYWRUR_UeYV \\ & UVaV_UV_Tj dReVZ_eYVYf dW^]UZ(Z_R); dZ1`WeYV \end{split}$$

 $\label{eq:constraint} $$ VIf ] d d T_d a Z_Z CVRZ_e e $$ Y f d Y JUZT V ZV A V ZV SVRd f e Zd XV VR a ] ZRSZZGZ$ 

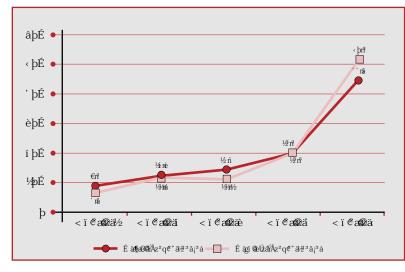
# 7I@HF5@7CBGIADHCB`5B8`=B7CA9.`@B?G`5B8` DCH9BH5@

 $\label{eq:linear} \begin{array}{l} H \ YVcV \ eYV \ cV] ReZ \ \_dYZa \ SVeh \ W\_ \ TYR\_XVd\\ \underline{Z} \ \underline{Z} \ \underline{T} \ ^V \ R\_U \ TYR\_XVd \ \underline{Z} \ Y \ f \ dY' \ ]U \ Tf \ ]ef \ dR] \end{array}$ 





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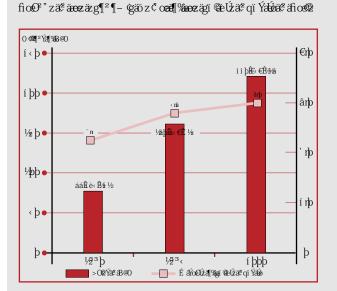
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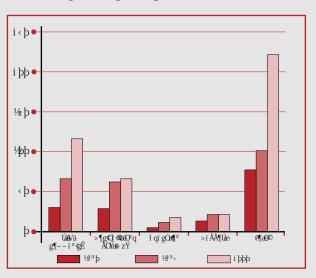


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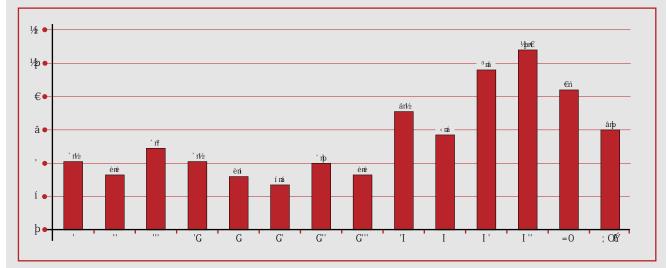
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## 7I @H F9 DC @7 =9G =B H + 9 % - \$g

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$$\label{eq:linear} \begin{split} Z^* a & \| V = V U S \\ & \| V = V U S \\ & \| V = V U S \\ & \| V = V U S \\ & \| V = V U S \\ & \| V = V U S \\ & \| V = V U S \\ & \| V = V U S \\ & \| V = V U S \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ & \| V = V \\ &$$

EYVTF ] ef eV a` ] ZZdd V&RS ] ZHVU S j  $eYVUV^{1}$  ] TREZT8`gVc\_^ V\_eZ\_"\*\*! V^S`UZUS`eYTYR\_XV R\_UT\_eZ f Zj Z\_eVJRZ\_e` hYReYRUX\_VSWAVZ EYVUZER`e`eXz YRURa` hVAV] Sf eUZWAAZ aRTe` `\_ 4 YZVR\_TF ] ef eVZEYVeVARETY`WZZ3ef\_\_Vc YRddr` h\_Y` h Rf eY`eZRZR\_ZT`V\_eVZdyRTF ] ef eR] ^`UV] eYRecAjRIVdeYV` ] UeeZRU`VDREVL]Rh R\_U VUFTREZ\_hZYR\_Vh T`^SZ\_RZ\_`WYVAV^`\_ZT UVEZTV&%"\*\*) Ł\*#ZEYZd\_Vh`dVk WZdLY` hł Vývě Z d We RdZe U Vd\_`eac`UFTVeVVT ]]VTěžV ^ VR\_Z Xd R\_U Z RVZ RZXd eYRe d TZVáj \_WUd e` Z eVXReV Užývdžij Ž5 V^ `TRIJ ScVR dh ZEY eYZi Rf eY`cžeRZR\_ TF]ef dQ ^ `UVJL R\_U eYV } cde eRd `VVFF]ef dQ TCVRZ \_ Zle`UV^ `TREZKV eYV JZW `W 4 YZVR\_ d TZVáj ŽH Y UJa c ZW' hi fU`dc `]Vvnighc` [ ]j Y W ffYbWnhc \i a Ub f][ \hg:Ugh Y VUglg c ZYj YfmXUmgc W[U``fY`Uh]c bg\]dg UbX`h Y` gc W[U``]a U[ ]bUfm':eZle`RVK^ UV^ `TRIJ Rd eYV\_`c^ RežgVWK^ Vh`c\ hZYZ hYZYT ]]VTěžV Vi a VčZ TVdR\_UZV ežEXdRcVe`SV]VXěZ ZXUŽ

EYV dZef ReZ\_d SWXeV R\_U RAAWC eYV RUgV\_e`W UV `TORIj Z "\*\*! UZA R decZZXUVXCW `W  $T = eZ f Z i Z TRaZ R Z e^R R (VeVT _ `^ i UZ R U)$ U VdacVeRZLaVć^ VReZ XVeVij RohVTe` Vol TZR ZVVŽ EYV^ Rc\VeeYfdT\_eZfVde`SVRdvT\_Uf\_Rg`ZJ RS [VVAR^ V~ VAVWAEV TVŽ3VIRF dv~ VAYZET eZ fZjł RT\_ecRUZTe`q`Uj\_R^ZTYRdV^VcXVUŽEYV^Rc\Ve ZdeV\_UZ\_Xe`dacVRU Zedy]`XZI%&gVghYVcVLSfe hZey feSVZ\_XRS/Ve aV&Vc ZedVV\_TeZ\_dZ^ `\_X `eYVceYZ\_X4ZeZd\_`eac`Uf`TZ\_X|ZW^\VR\_Z\_X4LXV\_} VARZ XT ||VIOZVZIV OZZIC CTOURZ XeVV^ `OZRI eZ\_dcVbf ZVUV/cd TZR Z\_eVXReZ\_Ž4`\_dVbf V\_ejj eYV&VZdRaV& R V eeV dZ SV&hW eYV^ Rc/V&L RdadRTeZTVR\_UZ RXZ\_RgLR\_UDeReVTf |efcVa` |Z TZKŽEYVAVa`]ZTZKYRgVe`T ^ Ve`eVc^ dhZeYeYV dVRZEj TeVREVUSj eYV^ Re\VeLhYZVT ^ aV\_dReZ\_X WcZedWZZXZŽ

3jT\_eRdehZeY eYVUZIeRe`cdYZeLhYZIY YRUR Xourelic Z' artie`\_ Tf lef cV Z\_ R Sc` RU dV\_dVLZXZL `\_ d`TZR] cV]ReZ\_dYZadXV\_VcR]]jŁa`]ZIZVdZ\_ eYV UV `TCREZT dj deV RIe ^ `CV `\_ da VIZ; TL ]Z ZEVU } VIUŽH YReacVU ^ Z ReVUUF cz XeVV | Rob UVIRUV `WeYVehV\_eZkeYTV\_efg hVcVdvTe`dR]Tf]efcVa`]Z  $TZdWIf dZ_XLWcViR^a]VL^ VcZeRXVR_U^ eYV$  $TeVReZ \_ R\_UUZetV^ Z_ReZ \_ `VReeh `c\dR\_UetaVIZ_T$ X`UddTYRdS``\d`cTZ\_V`RŽE`fdVRUZdeZ\_Tl  $eZ_UdRh_Sj > R_f V_j 2_e Z 8 Rec Ve^_1 \#! ! "/L$ eYVIf | ef cVa` | ZZZd` W4`\_TVeRIZ\_ 8`gVc\_^ V\_ed 1eVV4`\_TVeRIZE\_ZeVTV\_eeVIJVeVT RJZZ\_Tfd cV\_ejj Z\_a`hVc/YRgVSW\_TYRcRIeVc2kVUSj eYcW `S[VTezevd+"/ac`^`ez XeYVSRdzTv&WU^d`WW ^`TdRIj R\_U^ RddRITVdde`Tf]efdRJX`Ud±#/dfał a` ceZ\_XTf |ef cR| RTeZeZeXdR\_UV\_T f cRXZ\_XRceZeEZT ac UFTEZ RUS/XV VCREZ XeYVZ dEZEFEZ RIRU

}\_R\_TZR] dvdif cTVd\_WUVU Vvc eVvdVeh`eRdvdŽ

:\_eYV} ade deRXV`W4`\_TVaeRIZE\_X gVc\_^V\_eL eYVRU^ Z\_ZteReZ\_ `WARecZIZ 2j]hZ\_ hRdTYZk-j T\_TVc\_VUe`dY`cVfaeYVUV``TcRezTd\_deV`Ž@\_TV VXVU^^ `VVCVReZ\_R\_UViacVddZ\_YRUSW\_XfRd ReWULZehRd VIVaRje e XV VaRevRyUV `TareZT Tf]efcW%eYReTf]UT^Ve`eVc^dhZeYYf^R\_ cZXYed gZ ]ReZ\_dh YZele V T f cRXZ X ReeZef UVd`W e`[\cR\_TVR\_Uc\caVTeŽEYVC\ce2XC\a`ce1"\*\*"/ hRdf\_bfVdeZ\_RS]j\_eYV`fedeRUZXViR`a]V`W UV `TCREAKZ\_XTF]efcRIREZ\_ŁVĘV\_ZVZehRd]Zee[V RaacVIZReVUŽ5 hh Y gUa Y ha Yždfc [fYggk Ug a UXY b WYUhb f fYUhYf Yei U hmcZUW Wygežetha i `Uhbf 'a Ugg dUfhWdUhcb UbX` XYWYbhfU`]n]b[ 'WY `hi fU`'dfc Xi Whjc b'UbX' a UbU[Ya Ybh':eZdV\_`fXYe` cVIR]Yh^R\_j TF ) of cVW degeR dR UT ^ a VegeZ\_dh VcV YV JUR U  $Y^h \wedge R_j \wedge f dM \wedge dL Z dR Z dR UTF | ef dR TV_edd$ hVcV`aV\_VUeYV\_ŁR\_UY`h ^ fTY dfaa`œhRd XZEV\_e`Z\_ZZEREZEVdZ\_eYVcVXZ\_dR\_Ue`WWW.ded  $e^{h} R V 4 YZWR_T f e dV \sum h_Rsc RU EZ Z.$ "\*\*%Z6WW.cede`TcVReVc1f\_UZ.deZefeZ\_dR\_UXV.} VEREVaf SZEIdVIE c}\_R\_TZ\_XhVCVRd CVZZVUŽE YV =V/UV5 RIZ Vd4f | ef cR|Vd14f | ef cR|5 ReZ d 2TeL  $c_y=V_1 GRU_{6} RdZeSVIR^V_ h_ hZX$ e`eYVVWW.dcd`VeYVeYV\_DaVR\Vc`VeYVDV\_ReVe` dVTfcVZedaRdRXVLeVVTcVReZ\_`VeYV> Ra`TY` 4 f | of dR| 4 V ccVR U eYV 3 R|^ RIVLR 4 V ccVL eYV T^aVerrow VVUZX^RUVRepropriate 7@?51  $2CE R_UeYVY | UZX WeYV | ade 4 ^ ^ Z dZ Wc$  $4 f = cVRcVd \wedge VVIR^{1} = cRIZ_{2}$ eZ\_UzzeV\_SjeVV} ade4`\_TVaRIZE\_8`gVc\_^V\_eŽ 2 Tozezi R cvezich ` Vhi YReh RdRIYZkgvUZ eYVaVcz U a`Zede` yXXVRe RIYZkgV^ V\_edZ\_ VdeRS [ZEYZ\_X R TF | ef cV ` WUV ` TCRIj R\_U TF | ef cR UV ` TCREZKR eZ\_ŁSfegVij WinhYkVTfjefcRjUV `TcRIjhRd T\_TVc\_VU%bDfSVcTRcMRfiL"\*\*%L) #/ŽÎ7i`hifU`` XYa c W/UW/ii ža YUb]b[ 'W' hi fU``W/YUhji ]hmi b gc WYhmUh'Uf [Yžk Ugh Y i bÚb]g YX Vi g]! bYggcZh ]g; cj Yfba Ybh

EYV8`gk\_^V\_e`V6URU 7dZT\_eZfWe af ccfVIf]efd3a`]ZZdhZYeYVR`V`S[VI252vZ\_ aRczIf]RŁZcdfXYee`TcVRVZdzfeZ\_dTRaRS]V `WWd2vZ\_XLU3hZ\_Xe`XeYVcR\_UT`dZ\_RZ\_X eYVUZWCV\_eRfeY`cZzdR\_Ua`]ZZdZEYV"\*\*)

SZJŁd Schlof V\_ej R^ V\_UVU Sj etVackolV\_e 8 `gł Vc\_^ V\_eLZdeZ]SVZ\_XUVSReVUZ\_4`\_XVddŽEYVcV  $hRdac XdVd1 = R_f^SVc WdV_edLZTfUZXZ1$ TeVRelvedZ\_eYVeVJVgR\_eSfUXvedR\_Udec`\_Xdfaa`ce Wceał]VgV] dIZV\_eZ; T cVdWRcTYŽ@\_TVUV``TdRIj hRdd/If cVLY hVgVLeYVTf |ef cR| c` |V` WeYVDeReV  $dW^{V}Ue^{-1}$   $dVWF dZ 3V dLV dR |RI \ Wa^{-1} |ZZR|$ hZ]R^`\_XeYVaRceZdLeYZdTR\_SVafeUh\_e`  $eYVZ \sim fV_TV WRTWeRZ \gamma RCVEZV ] X_1 % R_U$ eYVeV\_UV\_Tj\_WcTf]efd?]`WWWZ\_Xde`SVT\_df^U aRdzęvijŽEYZdzzefReZ\_^VR\_eeYReeYVUZXWKV\_e d TZR RTè cdh VćV [VddRS]VR U YRU Wh Vć`aa`d ef\_ZeZde`aReeZZaReVRIezgVjjZ\_Tf]efcVŽEYVycZtV `VeYV^ ReUVE/2`\_Z!" \*\*\*/ cVef ]eVUEZ\_UVUEZ\_ T\_ecRUZTeZ\_dSVehW\_dTZR|acRTeZTVdR\_UeYVZc T ]]VTeZeV cVacVdV\_eReZ \_d eYRe 4 YZ/VR\_ d TZA WAZVU e`eR\Vac`aVdjZe`RTTf\_eŽ

### DfYgXYbhF]WUfXc '@U[cg']bhYbXg hc 'Wcb! Zcbhh YgYWU `Yb[YgUbXa U\_YW 'hi fYh Y'

\_YnbchYcZ\jg; cjYfbaYbh'<jgjgjbZJWihY Úgh, cjYfba Ybhrcg\ckUgnghYa UhWWca! a Jha Ybhhc WY hi fU dc JWm EYV WIZR UNI RR  $eZ_1 > R_j #!!! / WeYVIF ] ef dZ_a [Z_j WeYV4 YZ_NR_$ DeReV felZ\_Vdd ^ VSRdZTacZ\_TZa\_VdHeVVRfe \_ ` ^ j `W d TZAG hZey RVRIZZERZ Xc VVC eV DEREVLTC RESEV ^ ReZ\_R\_Uac`[VTeZ\_`WILV\_eZejEVUETReZ\_WcTE]} ef dR Rh Rev\_VddR\_UacVdkgReZ\_R\_UafS ZZKReZ\_`W eVVT f\_eej dTf ]ef dVYV2ERXVLUVIV\_eeRj2EReZ\_ R\_UL Z\_XV\_VR]LVbfR]Z;; `WRITVdde`ReeLTf]efdR]X`Ud R\_UeVIY\_`]`XjŽEYZIXV\_VRJ Raac`RIYZISRI\VUfa Sj T\_TONEV^ VREFONDŽEYV`aV\_Z\_X`V¥R>`\_VUR 1eWaddeW\_@ER aRRIVR\_U`eWcYdER&VdEVdLTf] ef dVWdeZeRdR UXReYVdZ XeLa`Vegi VgV edR UeYV T\_\_VTeZ\_SVehW\_afS[ZTh`c\dR\_UReeh`c\dRdV VIR a Va VRTF of da Zi Zev UVUe SVR REEV ZXXVLZV\_e`WgVqiUR; [ZZZXZ?`\_VeVV/vdteVvc`[V`W eVVDeReVR\_UZedTf ]ef dVa` ]ZIZdRdVUZa]R, W^`de TVRC ji Sj RWA WALOVRIYZ XZ ZZROZVÓŽ

## H + 9 - B G + H + C B 5 @ 65 G - G C : 7 I @ H F 9 D C @ 7 - 9 G

#### CF; 5B-₽5H€BG

EYV`cXR\_ZkReZ\_R| decf Tef cV eYc`f XY h YZIY DeReVTf | ef cVa` | ZZd RcVZ' a | V V eVU Zd h VR  $R_U f_WIf dVUŽE YVdV a^ ]ZIZVd ReV UZdecZSf eVU$ R^` X\_f^Vc`fdS`UZvdhZeY\_ ` TV eeR|T`d UZ\_ReZ\_X RfeY`cZejŽEYV^RZ\_Z\_deZefeZ\_ZdeYV > Z\_Zdeg` V6UfTReZ\_ŁhYZIYY`fdvdeYV4f]efdV  $5 Z_{Z}ZZ_{Z} Z E YV = Z_{S} C_{Z}C_{L} 2 C_{Y}Z_{S}Vd R_U > f dM$  $f^{d}D_{c} = 32 > /LhYZY dYRCVd eYV^RZ$ dvda`\_dZSZZZEj WceYV\_ReZ\_dYvCZERXVhZEY eYV  $? ReZ_R > _f^ V_ed4 f_TZER d T^ Vdf_Uc$ eYZda`ceWZŁRdU eYV4` dy` UV4RZTRIZ  $4\mathbb{Z}$  V<sup>A</sup> Re<sup>A</sup> Xii  $\mathbb{R}_1$  7Z/<sup>A</sup> 4 Voe  $\mathbb{R}_2$   $\mathbb{R}_2$  3 RU/  $\mathbb{R}_2$  U eYV 4 ` ^ Ze<sup>1</sup>/2UV 5 ` \_ RIZ \_ Vd 4 f ]ef cR]Vd 1 4 f ]ef cR]  $5 \ ReZ_d4 \ ^ 2eeWZ2 d Zg g eWZZ YKZERXV$ ^ ReeVed ZieVV5 ZVITZ\_ UV2 cbf ZVIef cR12 cTYZ eVTef cVDVcgZTV `VveYV> Z\_Zteg` `VVefS]ZTH` c\dŽ 2\_`eYVcS`Uj hZey [Vdb/ca`hVcdZleYV5 VaRce^ V\_e  $W_{f} = V_{V_{1}} + f_{ZReZ_R_U4f} = V_{U4f} + V_{U4f} + V_{U4f} = V_{U4f} + V_{U4f}$ ckerzenD644/thYZYT ^ kdf\_UkceYV> Z\_Zek/Z  $DVTCVERCER48 \vee VCR UV8 SZC_ 1 > ZZEcj WeVV$  8 V\_V&R] 8 `gVc\_^ V\_e DVRVATZEVŽCVAb`\_dSZZG Wc^ R.Z\_X4 YZVR\_ Tf]ef dV\\_`h\_ RSc RUVAJde eYV 5 ZVTTZ\_ UV 2 d\_e d 4 f]ef dR]Vd1@VVTV`W 4 f]ef dR] 2 WWXdd` V&YV > Z\_Zdej` WT dZX\_ 2 VW WXdZH ZeY fedWZ\_Xe` JZEVGVj DReVS`Uj hZeY Tf]ef dR] dVdb`\_dSZZEZdL^ V\_eZ\_ dr`fJUSV^ RUV `V&YV4`\_dV[`? RIZ\_R] UVEVJVZZE\_ 1? REZ\_R] EVJVZZZ\_ 4`f\_TZ/LeYV> Ra`TY`4 f]ef dR] 4 V\_edV R\_ULWc TZ\_V Rac UT TZ\_LeYV4`ca`dRIZ\_ UV 7`^ V\_e`UV]RAc`UT TZ\_ 1Ac`UT TZ\_ 5 VgV]`ał ^ V\_e4`ca`dRZ\_ € 4@C7@/Z

EYZIWRX^V\_eReZ\_ZIaRedj Uf Ve`eYVgRzZej `WWV\_TeZ\_dR\_UUV^R\_UEZ:eZIRJd R ckef Je`W Z\_deZef eZ\_RJ h VR\_VeLY`h VgVZ:eYRd JVU e`eYV `gVdJRaaZ\_X`Va`h VcdR\_UYRd^ RUVZeUZWIF Jee` UVZX\_R\_UT`dLZ\_REVT YVcV\_ea`JZIVeLTRog`fe WWWIeZgVUVIV\_eRZEREZ\_R\_UcVXZ\_RZEREZ\_R\_U V\_XRXVhZEY ReeZetaR\_Ud TZRJ RIÈ ceŽ

6WW kede`V\_U`h eYVTf\_egi hZeYR\_Vhdd eV``WFjefcRjZdeZefeZ\_dSVAR\_hZeYeYV2j]hZ\_ 8`gVc\_^VeŽDfSdVbfV\_ejjLZ\_5VIVSVc"\*\*)Ł AcV3LV\_e 7 CVZ dV\_e 4`\_XVXtl R SZ]  $e dV CXR_XV$ eYVDeReVoted Tef cVdcVda`\_dXS]VVXcTf ]ef dC] a`]ZIj Ž AcV3LV\_e=RX de`` f a eYVSZ] R\_URaa`Z\_eVUR AcV3LV\_eXR] 4f ]ef cV2UgZt ce`T`dZ\_ReVa`]ZIj Z\_eYZIRCVRŽ WAVSZ]ZIaRthULe UBj dZ\_deZf eZ\_R] WRX^ V\_eRZ\_ hZ] X2gVhR] e`R cV cXR\_ZREZ\_ SRcMU`\_ R 4`\_dN[`? RIZ\_R] UV 4f ]ef dR 1? R eZ\_R] 4f ]ef cV4`f\_TZ/ R\_UR7`\_U`? RIZ\_R] UV 5 VeRcc`]]` 4f ]ef dR] 1? ReZ\_R] 7f\_UVXc 4f ]ef dR] 5 VgV] a^ V\_eZ

#### H + 9 @ ; 5 @ : F 5 A 9 K C F ?

EYVAV` cXR\_ZAREZ\_R] ac`SJV` dR:V JR:XVj UfV e` eYVZ\_RUNDFRIj` VeYV JVAR] VAR` Vh`c\ hZeYZ hYZIY Z\_deZef eZ\_d`aVAReVŽ 2e eVV SVXZ\_ZX`W eYV "\*\*! deVV:V hV:V`gVc S!! UVICVAd`c JR:hd T gV:Z\_XIF jef cR] ZdF VZ?` ac`X:VdHhRd^ RUVZ `cXR\_ZZ\_XR] eYVAVR\_UVAZ\_XeYV`Z\_e`d\_deV`ReZ JVXCJRZ\_LA ZE:hR:dUVIZXU eYRe\_Vh ac`gZZ\_d h`f JUSVV\_RIEVUSj Z\_TJF UZ\_XeYV`Z\_`eYvc]R:hd `c RaaV\_UZ\_XeYV`e` eYV SF UXVeZ5 VA:ZV eYZi VARX`V\_eReZ\_LgV:j df SdeR\_eXI ac`X:VdHYRdSW\_ ^ RUVLZ\_TJF UZ\_XeYV;CR]UV&e4f ]ef cR] 5`\_ReZ\_d 2Te 1"\*\*!/LeYV:\_UXXV\_`fd AV a]Vd 2Te 1"\*\*\$/



## H ≤ 9: = B5B7=B; C: 7I @ H F9

? VÆYVčeYVT f\_eqi der RUZ\_d\_`ceYV^ Rc\\é U^ Z\_RZ\_ R\_UZ\_dezef eZ\_R] hVR\_VdleYRe Tf d cV\_ejj ackýz RVT\_UTZgVe` af S]ZT }\_R\_TZ\_X `VVIF ]ef cR] RI&ZgZZd`f eZLVeYVVUFTReZ\_R] R\_U f\_ZgVcZgj daYVcZZEYVTYc`\_ZTWRc` VDEREVZ\_ł eXCWCV\_TV1aRceZIF ]Rc]j Z\_ R\_RVR Rd dV\_dEzgVRd Tf ]ef cV\_YRd\_`e ackýV\_eVU d^ V }\_R\_TZ\_X ]Z Vd W^ SVZ\_XVERS]ZHVULY`hVgVZEh` ^ VIYR\_Zh` d dh`f ]USVUZEZ\_XFZHVUŽ@\_VT ^ SZ\_Vdaf S]ZI R\_U aczgReVIdVTe`cW\_UZ\_XR\_UdW\de`ScZ\_XZ\_aczgReV da`\_d cdYZa eYc`f XY eR ScVR\d eYV`eYVcac`gZVd UZVTedf aa`ceeYc`f XY T^ a VZEZgVW\_UZŽ

 $\label{eq:hydrodynamics} \begin{array}{l} H_{\rm V} & @Ym XY & 8c b UW c b Yg & 7i & h fU Yg \\ 14f & ef cR & 5 & BeZ_d & 2Te' & h Rd V_REW & Uf cZ_X \\ eYV & cde & eVc^ & WeYV & TVceREZ_L & \#) & ;f_V \end{array}$ 

"\*\*! Ł Rd a Roe `WeYV = Vj UV CWAC^ R EczSf eRcZR 1ERI CWWC^ 2Te/Ž<\_`h\_ Rde/VyGRJU/e%2TeL ZedfXYee`ac`gZUVR\_Z\_ded^V\_eWcSoZ\_XZ\_X Z\_TF]efcR]da`\_d:cdYZaW/^acZ9ReVV\_eVcacZ4NŽ AcZgReVda`\_d`cdac`gZUV&! ~ `WWV\_UZ\_XWcRał ac`gWac`[VTedLhYZVeYVViTYVbfVcac`gZVdeYV `eYVcYRJVSgihR<u>egZ</u>XTVceRZ\_eRJVdŽEYV]RhTR^V <u>Z</u>e`WEIV<u>Z</u> 2ac<u>Z</u>"\*\*"LRU^ <u>Z</u>ZEVEVUSj R4`^ ZE1/2 4 RJZ TRU cUV5 `\_RIZ\_VdAcZeRLRd1 AcZeREV5 `\_R eZ\_d2ddddh V\_e4`^ ^ ZeeWŽ2d`W#!!!Łac`[VTed h`œY'Ž#SZ[Z\_aVddYRUSW\_Raac`gVUZ\_RVRd RdUZgVcd/RdZ\_V8Rchef Tef cVLRU^ Z\_ZheReZ\_LVgV\_ed RUeWTeWReZ\_RUac`UFTeZ\_`WRoch`c\dZR hZLVcR\_XV/VRcVRcŽEYV]RhhRdcVIV\_ejjR^V\_UVU e`^R\VZed`aVcReZ\_d^`cV~ViZS]VR\_UVRIZZEReV R\_Z\_TOUROVZ\_U\_ReZ\_dŽ

EYV7\_U ? RIZ\_R] UV7 ^ V\_e UJ = ZSc j  $|\mathbf{R} = V \text{Tef} d\mathbf{R}_1$ ?  $\mathbf{R} \in \mathbf{Z}_{\mathbf{R}}$   $|\mathbf{X}^{+} \setminus \mathbf{R}_{\mathbf{U}} \cup \mathbf{C} \vee \mathbf{R} \cup \mathbf{Z}_{\mathbf{X}} \mathcal{T}_{\mathbf{L}} \cup \mathbf{C} \vee \mathbf{R} \cup \mathbf{Z}_{\mathbf{X}} \mathcal{T}_{\mathbf{L}} \cup \mathbf{C} \vee \mathbf{R} \cup \mathbf{Z}_{\mathbf{X}} \mathcal{T}_{\mathbf{L}} \cup \mathbf{C} \vee \mathbf{R} \cup \mathbf{C} \vee \mathbf$ hRdTeVReVU`\_ "!;f]j "\*\*\$Sj gZeefV`WeYV UVdTcZSVU RS`gVLZed VV\_UZ\_XT^ Vd`fe`WeYV \_ReZ\_R| Sf UXVéŽ 2]]`TReZ\_Zd eYc`f XY af S[ZT  $T ^ aV_{22} Z_d YV_J USj eVV4 ^ aV_1 RIZ_R UV_1$ =ZSc` j  $|\mathbf{R}=VTef d\mathbf{R}_1$ ? ReZ\_R 3``\ R\_U CVRLZX  $4 f_{Z} Z E V 7 f_{U} Z R U^{2} Z E V V 5 E^{1}$ Zetej `W6UfTReZ\_eYc`fXYZed4f]efcV5ZeZZZŽ  $: ed af ca`dVZde` \}_R_TVREZZZdR_Uac`[VTed]$ RZ^WUReac`^`eZ\_XcWRLZ\_XLecRZ\_Z\_XWcaVa]V  $V_XRXUZ_afS]ZYZ_XR_U]ZGRg_h`c\LS``\ac`l$  $Tf cV V_e Wc af S ZT Z CREZCLS`` VRXcL4 YZVR_$  $S`` \setminus V_1 a` ced R_U Z_eV_c_ReZ_R T` aV ReZ_Z_eVV$ }VJU`V\$``\dR\_UcVRUZ\_XLeYfdTf\_eVcRTeZ\_XeYV `SdeRI]VdUVcZeZXW/^ eYVRaa]ZIReZ\_ `VG2E e` S``\dŽ2d`W\*\*\*ŁRe`eR``W SZ[Z\_ aVd dYRJ SW\_ UZtezSfeVU eYc`fXY 7f\_UT ^ aVezZ\_dWc S``\ac`TfcV\_V\_d\_TYZUUV\_d]ZeVcRefcVLXcR\_edWc hozeved R U zever Tozzieł Tevrezevh`e Wehozeved R\_UXR\_edWceVRIYVcdR\_U]Z5cRcZR\_dŽ:\_ eYV]Rde eh` j VRcdeYZIVV\_UZ\_XYRdXc`h\_ Sj `gVc`\$! " ŁRd YRgVeYVW\_UdX Z\_Xe` 7@? 5 2CEŽ

H\Y:cbXc`XY8YgUffc``c`XY``U'7i`hfU' mUg5fhYg14f]efcVR\_U2ced5VgVj~a^V\_e7f\_U €7@?52CE/ZdeYV]RcXvdeDeReVda`\_d cdYZa`c acVUNTVatic WUTCVREVURUEVV UZT eZfVU SjeYV^ ZZERcj 8`gVc\_^ V\_eŽehRddvéfaZ\_"\*\*# ZeYVWc^`WRcZU/ce`eYVSfUX/eRTeLhZeYeYV  $RZ^{*} Watc^{*} = eZ_XeYUVgY^{*}a^{*}V_e^{*}WT_e^{*}dVR_U$ ReedZ\_eYVT\_f\_egieYc`fXYafS]ZTT^aVeZZ\_dŽ :edW\_UZ\_XT^VdW^ eYV\_ReZ\_RJSfUX/eR\_U  $U_RZ_dZeZdf_SjeYV>Z_Zdej V6UfTeZ_Z$ :\_ eYVac`gZ\_TV&LeYZIc`]VZIa]RJVUSj\_DVTcVeRc9Rd  $CVXZ_R/d > Z_ZEVZR/d > Z_ZEVZR/d > Z_ZEVZR/CVXZ_R$ DVTcVeRc2Red € D6C6> : D' Wc 6UFTReZ\_Ž2S`fe '! ´` `WeYVe`eR|SfUXveXVde`eYVcVXZ\_dŽ:\_"! j VRccL7@? 5 2 CE YRdUZteZSf eVU" ' L\*\*H#\$\$L) & aVade` & #\*\* ac` [VTed Z\_ eYVRCVRd` V & ZfR] Reed 1' \$#ac` [VTecht RF UZ 1gZF R] TeVReZ\_1981/LeVVReeV R\_UUR\_TV18%(/L^fdZT1888/L]ZeVdRefdV1\$"%L ecRUZEZ\_R]Tf]efcVdi'"%LYVCZERXV1"&"/LTf]efcR]  $R_URceZeZTVgR[fReZ_1'\%/L]$  TR] TcRAedR\_UTF] ef cVd1\*" (/ŁZ\_VMRdef Tef cV1#S) /ŁZ\_eVXReVU Roed  $\label{eq:linear} $$ 1\%/4: eV_ Redu*/4j feV cTVdeRdu*S/R_U Z_UZW_fdaVa]Vdu(!/Z $$$ 

 $:= RULEZ \_ e^{i} eYVRS^{i}gYLhYZYRVR] R_R^R R^{i} XR^{i} ~ WW_UZ_X^{i}VYR_Zh^{i}dtZ_deZef eZ_dR_UdvTi e^{i}dt] e^{i}dt] e^{i}dt] a^{i}ZZAL^{i}V_eZ_^{i}f SV^{i}RUV^{i}W$ 

$$\begin{split} H_{N}Y &: c bXc `XY `5 d c mc `U `Dfc [ fUa Ug' \\7 i `li fU `Yg 14 f ]ef cR] Ac` XrR^ ^ Z_X Df aa` ce \\7 f_U cf_ Sj eVV? ReZ_R] EV/vgZZ_ 4` f_TZL \\hYZY YVJUWf cT ^ a VeZ_dZ_ #! !! 1VUF TREZ_R] \\ac` XrR^ ^ VLTR` aRZX_e` af SJZZKVTYZUV_`dac` l \\XrR^ ^ Z_XLcVXZ_R]_`_l} TeZ_ ac` XrR^ ^ VdR_U \\_ReZ_R] } TeZ_R U_`_l} TeZ_ ac` XrR^ ^ VdR_R \\R]` TREZ_Xd ^ V'''' ( ^ ZJZ_aVd dZ` \\ \end{split}$$

H, Y :: c bXc 'XY '5 d c mc 'U = b]W[Uh]j Ug 7 i 'h fU'Yg FY[]c bU'Yg 1CVXZ\_R] 4f]ef d 3 :\_ZZF2ZydDf aa` ce 7f\_U  $\in$  72:C/ d\_ Sj eVV5 W aRce^ V\_e`W4f]ef dV`V&YV4`^^ f\_ZIReZ\_R\_U 4f]ef dVDVIdAR:ZRELhY`dVaf ca`dVZde`ac`^`eV If]ef d?[R\_URe:ZRELhY`dVaf ca`dVZde`ac`^`eV If]ef d?[R\_URe:ZRELhY`dVaf ca`dVZde`ac`^`eV If]ef d?[R\_URe:ZRELhY`dVaf ca`dVZde`ac`^`eV If]ef d?[R\_URe:ZRELhY`dVaf ca`dVZde`ac`^`eV X gld:\_^VeLR\_URd:W\*\*(YRURac`gUURS`fe '!! ac`[VIedh`ceYRe`eF]`V&S!^Z[Z\_aVd dŽ

$$\begin{split} H.Y.Di V`]W5fh7ca dYh]h]cbg cf_Sj eVV\\ 2cIYZeVTef cV DVcgZIV`VeYV > Z_Zdeg`VVAfS]ZT\\ H`c\de`dv]VTeh`c\d`VAdeVVcZ_deR]ReZ_Z afSh\\ [ZTSfZLZ_Xd`ch`c\d_RdcVbfZeVUSj]RhŽEYVcV\\ hVcV") T^aV&=Z_d`VeYZhZUZ_"****}H!!!Ž \end{split}$$

H.Y.7 C F: C 'Dfc [ fUa U'XY': ]bUbW[U! a ]Ybhc 'XY''U'=bXi ghf]U'5i X]cj ]gi U`12fł UZ łgZf R] :\_Uf deg 7Z R\_TZ\_XAc`XR' ^ VŽEYZł  $d_dT^ aV$ 52Z\_dWc WRef dV}]^ ac`[VIed eVV hZ\_VdRcVac`gZLVU hZeY (! ~ `WeVV d52 ReVU }\_R\_TZ\_XT dedZ 7Z\_R\_TZ\_XZ\_ #!!! e`eR][VU")) ^ Z]Z\_ aVd dWc#) ac`[VIedZ

>  $f_ZZaRJZZdYRgVRJd ^ RUVWW (ad `VeYVZc `h_taRoeZffJRc)j eY dV W4 `_TVATZ_tCRJaRcRat R_UDR_eXEX LR_UacZgReVR_U^f_ZZaRJT ca`ł dReZ_dR_UWf_UReZ_dYRgVh`c\Ue`^R\V TfJefdRJRIEZGZZda`dXSJVZEYVCVRCV}_R_TZ_X ^ VTYR_Zh`d`eYVc eYR_ eYVT ^ aVEEZgVW_Utt dTYRt4@C7@`d}]^ t^ R.Z_X]`R_dR_UtZ_eYV af SJZMZ_XZ_Uf deg LeYVUZWWCV_e eR_ ^ VRdf cVd$ 

ac`gZNUWcSj eYV3``\dR\_UCVRLZ\_X2TeŽ

 $EYVUZWWEV_eZ_ZZRZGVChV]Z]fdcReVeYVZ a`d eR_TVeYReTf]ef eV}_R_TZ_XYRdeRvV_`_Z7i `h fY' gdYbX]b[ `]b`% - - `]gYgha UhYX`Uh&S`V]``]cb` dYgc gzUVci hh fYY'ei UfhYfgcZh ]gWca ]b[ `Zca `h Y'di V`]WgYWcf' 7f_UZ_XYRdZ_TeVRAU XeVRejj Z_cVTV_ej VRcd.Z_T]fUZ_XT_dUARS]V Z_gVde^V_e n RSZ]Z_ avd dRj VRc/Z_Tf]ef eR] Z_WRdefTef eVeYcfXY feeYVT f_ejZ$ 

 $:e Z UZWIF ]e e UVJZVC R gVd Z R Z R_RVR Rd T ^ a] V Rd TF ]ef dR a ]Z j Z Eh ` T _ T] f dZ _ d U$  $V V XXLY h VgVZ@_ eV ` _ VYR_ULdVTe dR a ` ]Z$  $TZ dYRgVT] VRcjj a] R VURac` ^ Z V_ec` ]Vf_UVceV$  $4 ` _ TV dRTZ_ 8 ` gVc_^ V ed E YVCVYR dSW_de` _ X$  DeReVdf aa`œWcTf ]ef d?] T&ReZ\_R\_UT\_d^ al eZ\_ŁRdaRœ`WR\_WWkœe`&T\_TZJVeYVUV R\_Ud `WYZXY'Tf ]ef d%daZeY eY`dV`WeYVTf ]ef d?] Z\_Uf d eg Ž@\_ eYV`eYVcYR\_ULDEReVa`]ZTZdWcTf ]ef dV Z\_eYVSc`RUdV\_dVdW`hVR.ŽH YReT\_TVc\_YRd eYV4YZJR\_DEReVdY`h\_WcZdf VdTdfTZS] e`dł TZ4j dTY RdeYVT f\_eg `dTf ]ef d?] UZ\$Vd&jLeYV cWkc^f ]ReZ\_`WREZ\_R]ZU/e6jLeYVUZ\$VTf ]eXd `WdTZ8] T^^f\_ZReZ\_`ceYVhVR\\_Vd1`WF`]! ]VTeZeVZ`RVZ\_RZXdD=Z]h]gUWWYdhYX'hUhW''! hi fY'd`Ung`U`WYbhfU`fc`Y`]b`h.Y`Wci bhfm%j XYj Y`cda Ybhžh.Yb`h.Y`W`hi fU`X]a Ybg]cb` cZdi V`]Wdc`]WJYgk]``\Uj Yhc`VY'[ ]j Yb'h.Y`

D5 FH)



D9FGC B 5 @@ 9 B 5 7 < 5B; B; GC 7 -9HM

:\_ 4 YZM LVIV\_ eIf ] ef d? TYR\_XdYRgV aV\_Wf a dZ\_Z, TR\_e`aa` cef\_ZZXdWcaV a]Ve`UVgV] a eVZc `h\_hRj d`VZgZ\_XZ3f eeYVLVRLV^R[`c`SdHI]Vde` cVR]ZZ\_XeYZIa`eV\_eZR]ZEYV\_Vh dZf ReZ\_ ^ VR\_d eYRe Z\_UZgZLF R]dYRgVe` ^ R\_V f\_acVTVUV\_eVU WV Wcede`UV}\_VeYVZCZUV\_eZg\_R\_UXZgV^ VR\_Z Xe` eYVZca]R\_dWc]ZWZ

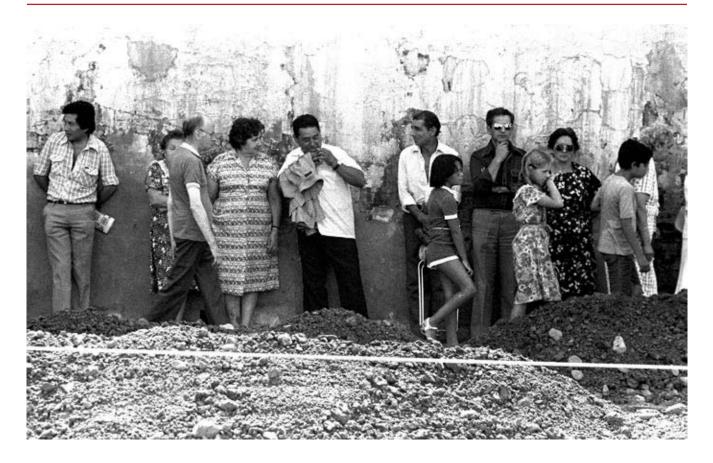
EYVTYR\_XXdYRgVXgV\_Rdc`\_XS``dee`Z\_UZ gZLF RZRZ\_Z\_4YZVŽ=bXj Xi U`nUhcba YUbg h\UhdYcd`Y`\UjY`hc`aU\_Y`h\Y]f`ckb`dYf! gcbU`XYWgcbgUVcihh\YW\cWYgžjU`iYg UbXfYUhcbg\dghUhl chcaU\_YidhYlf `]Z/d`Ubg"=h\Ug[fckb]bgfYb[h\UggcW}hm \UgʻgYhibWfYUgb[ ghcfY VmdYfgcbU`Ui ! hcbca nžhfUX]hcbg\UjY`cghh\Y]fUih\cf]mž  $UbX^{\cdot}Ub^{\cdot}]bWfYUg]b[^{\cdot}Wc]Wf^{\cdot}cZkUmg^{\cdot}cZ^{\cdot}]Zf^{\cdot}$ \Ug'VYWca Y'Uj U]'UV'Y"Ac`aVcjj f\_UVcde`UL ZUZZIFRZRZ\_ZIRXWRe`aa`cef\_ZijWcWgWjł `\_VŽ:eZdRecV`V\_U f dZ\_UfTV`V\_ee`eYVXc`heY `WWWU^^Le`]VdR\_TVR\_UTZeZTcZXYeeŽ3VZ\_XVM]jj  $\mathbb{Z}$  UZgZLf R ZIRh R `WWREZ\_Xe` \_WMVR\_U`eYł VcdŽ2eeYVcR^VeZ^VLZeU\_Vd\_`eUVaV\_U`\_]j`\_ VRIYaVcd\_ŁSfeZdReRd、WceYVhY`|V`WaTZkjŽ :eZleVVT ]]VToZV ZW WI TZG eYReac gZVdeVV VEYZIR] gR/f VeLeYV ~ CXR\_ZREZ\_ ~ WT ^ ^ ~ \_ WWW.deL eYV]R XFRXdR UeYVdaRIVdeYRe^ R\VcVIZac`TR cZXYeeL`SZAReZ dR UcVReZ dYZada`dZSIVŽ

EYVZ\_W& ReZ\_T]]VIEWUW& eYZICVá` œd Xi XvátdeYRe ^ R\_j 4YZJVR\_dU \_`e YRgVeYVd TZR] cvd f cTvdeYy \_WUW&d TTvdtvj Z\_UZgZLF RJZReZ\_Ž :VR2]RT\`Wi TZR] df aa` œ^ VR\_deYReaV a]VYRgVê  $eR_VeYVV_eEVCvda`_dSZZej f a`_eYV dvjgvd eYZi$  $TR_SVRd f cTV`WR_XfZh4L]`_VJZ_vdtR_UWf dedR$  $<math>eZ_Z_deVRU`VR_`aa` cef_Zej VcdvjVvAvRjZeReZ_Ž$  $7f ceVc^`cvLaczgReVd WWZZ_XdTR_hVR_V_RhY`]V$  $d TZAjZH ZeY f edRezUNDE cj aVcd_R] ZJV_eEZId` c$  $cNRd_RS]j detS]VcdrReVU gRjf VdLd TZR] ZZVTR_SV$  $decZaaVU`Wef deR_UR_j dV_dV`WeYVVef cvZE YZi$  $TR_cVdf]eZ_aV a]VhZeYUdhZ_XZ_e`eYV`dvjgvd$  $R_U eYVZc T]`dvTZCT]VLUVa]VeZ_X j Ve VeYeVc eYV$  $T ^ ^`_ df aa` ce_WUVUVc eYVT_def TeZ_`W$  $aVcd_R] ZJV_eEZIČZ$ 

EYZI} WY ARce`WYVCVa`cedW\de`R\_dh\ceYV bfVdEZ\_`VWY`h aV a]VZ\_4YZV\_`h ViaVZV\_TV eYVeRd\`WM/VVT\_defTeZ\_eYReTf]efd]TYR\_XV ZIZ a`dZ\_X`\_eYV`ŽEh`RdaVTed`WYZIbfVdEZ\_ RCVV`aYRZKVU+hYReZ`a]ZIREZ\_dU`VdeYVhVR} V\_Z\_X`WT`]]VTeZVdT aa`ceR\_UXfZLR\_TVYRgVVkc eYVT\_defTeZ\_`WZUV\_eZZdR\_UaVcd\_R]a]R\_dD 2\_UhYReT\_dNbfV\_TVdU`dTTVdHdR\_UVWZfdd Z\_eYZIZ\_UZZJfR]eRd\YRgVVkcT]]VTeZV`dVcR\_U d`TZE]cV]ReZ\_dYZaD



## 69-B; <sup>·</sup>5B · B8=J -8I 5@-B ·7<=@9. °C DDC FH B=H9Cž: 95 FG · 5B8 ·8≓: =7 I @H9G



:\_  $eYV^ UL_h dULR_UZ eYV dTZ get eYRe$ YRdV VXUZ 4YZV dZ TV:\_UVAV\_UV\_TVLAV a]V YRgVSW\_ZTXRZ\_Xj VXW e dXVeYVZ ZZRZY Z `CXR\_ZZ\_XeYVZ `h\_ ]ZVZTC ^ YVZER\_eR\_U aRczZ] SVXZ\_Z XLZUZZIFRZRZ\_ YRdSW\_ R Xc hZ\_XVCTVVC `gVCRTV\_f dJZTC ^ `de`VeYRe eZ VLeYVZ dzf eZ\_d`W`UVC dTZ gj leYVDReVL a`]ZZTLdTY`]L^ZZRg dVgZVLTYf cTYVLZ UF degHf\_Z\_dR\_Ua`]ZZTR] aRczZd`WWCVURCVRZYJ T YVCV\_edve`W`UVJdeYC fXY hYZTY Z UZZIFR]d T f]UTYR\_V eYZC\_Vh VXWU ^ ŽH YReaVcd\_R] Rf e`\_^j cVR]j R^ f\_eVU e hRd^ cV`c]VCH hZ]Z XRUYVCV TVE eYZIXV\_VR VA\* Vh`c\LhZY aVcd\_R] ZZ d\_TCRZZd`cZV]`XZR] R]eVC\_RZYd SVZ\_Xaf cf VUhZYZ\_ZdT\_}\_VZ 2deYVeh V\_ej I} cdeTV\_ef cj SVZ\_dZ\_U&ZU RZR eZ\_YRdeRV\_R\_Vh ef c\_1=RhL"\*\*%ZEYV} VJU `WiaV&ZV\_TV`aV\_e`VRYZ\_U&ZIFR]YRdVaR\_UU V\_`c^`f djZEYVIF]ef cR] ^ RadeYRed TZ&j`VW&d Rd^`UVJdVcT\_def T&Z\_XaVd\_R]ZV\_&ej YRgV U&ZVc&J VLhYZVReeYVd? V&Z VeYVgRZL&j`W VRYYRdSW\_f\_U&^ Z\_VZ:eZl\_`eVRJ\_`h Vc aV a]Ve`TY`dVR\_Z`RW`c^`UVJeYReeYVJ TR\_ RUYVVe R\_UeYRehZ]ScZ\_Xe X&YceYVLZW&V\_e deR\_Ud`V&YZcaVd\_R]ZV\_&ej Z\_e`RTYVC/e hY`JVZHY'WUggZfY`][]ci g`cf`dc`]HWU`]XYD! HJYg`h Uh YbUV`YX`]bX]j [Xi U`g`hc`XYÚbY` h Y`WcfY`WcbhYbhcZhYJf`]ZV`d`Ubg`]b`h Y` a [X1hk YbHYh WYbh fm\Uj YfYU`mVYWca Y` gYWcbXUfm`5bX`bch]b[\_`gYYa g`hc`\Uj Y`

#### Ya Yf[ YX hc HU\_Y h\Y]f d UWY"

AV a]VRV\_`h`S]ZXUe`TY``dveYVZ;]ZWa]R\_d WceYV`dvgVLd`S[VTee`eYVdVR]T\_deRZ\_edfa`\_ eYV`Ž>`cVZ`a`ceR\_ejj deZ]LeY`fXY1R\_UeYZIZI hYReCVR]jj TYRRTEVEZXVdeYV\_Vh\_dEfReZ\_/LeYVj RCV`S]ZXUe`SRdveYVdVac`[VTed`\_eYVdVZAE\_X VJV`V\_edeYRed TZ4j ^ R\_VdRgRZFS]Ve`eYV`Ž:\_ ^ R\_j TRCHLZ\_UWULeYV}VJU`Va`ddS]VViaVEZ\_TV ZLXc`hZ\_Xd`bfZT\]j eYRed TZ4j TR\_\_`eVgV\_Vd ^ f]ReVRUVbfReVXfZR\_TVVkcUVRZ\_XhZeYZE

 $EYV TYR]] V_Xd R_U UZ/VIF ] eXd `WICAReZ_X R$  $[ZWa]R_Z_eYZd hRj ^ VR_eYRe eYV eRd, YRd e`$  $SVT_W_eAUZ_RU/ZSVAReVLCV-VIEZ/V hRjŽEYV$  $gZZdHEf UVd`VaVcd_R] [ZWRCVSVT ^ Z_XR_`S[VIe$  $`WSdkgReZ_R_URe'aZT`VIF_gVcReZ_`VeYV$  $} cdeZ'a`ceR_TVŽEYZdyR_Re'^j%`VaVcd_R] [ZW$  $RTTM/VReVdZ_UZ/ZLFRZReZ_LRdZe^R-VdaV a]V$  $^`cVRhRV`VeYV aVcd_R] daYVcVd`gVc hYZIY$  $eYVj YRgVe`VI VEIZ/VT_ec`]Z=b`hc XUniŷ gc V!$  $Ymž'Vc`YYWjj Y`]ggi Yg'UFY`VY]b[_X]ggc j YX`$ Ug'dYfgc bU`]XYbHmiVYVc'a Yg'h Y'df]a Y`ÚY`X:cZc VgYfj UHcb'UbX'UWfcb"

 $9 h^{f} TY Z UZZIRZ ZIENOVZ 4 YZVO H YRETYRRIOZZICH YRECT TVOLORUUZZVIF]$ 

eZdU VdZe^ WehZeYOE` R\_dh Vc eVvdV bf VdZ\_d V aZZIR]jiŁZeZL\_VIVdRj e` YvRch YReaV a]VYRgV e` dbj RS`fe eYVZc`h\_ ViaVcZ/TV` VZ\_UZgZlfR] ZREZ\_Ž2TT dJZ\_XjiŁF? 5 A T`aVcRevUhZeY eYV 7RIf]ej` VvAd TY`]`Xj` VeYVF\_ZeVcdZLRU4 Re<sup>2</sup> [ZR UV 4 YZVe` T\_UFTeR bfR]ZEReZgV defUj SRcMU`\_ Z iUvaeY Z\_eVcgZh dudWRaaV\_UZ \$/ŽE YvdVh VcV TRccZU`fehZeY R% idec`\_XdR`a]V decf TefcVUSj TCZeVcZR`VW^a]`j^ V\_eLdecRef^ŁXV\_UV4LRXVR\_U cVXZ\_Ž

EYRe df Uj ac gZIXdeYVf\_UkaZ\_ZXWc eXZl ARce `WeYVCVa` œŽ: e YRdSW\_RUUVU e`R\_UVI aR\_UVU W'^ `eYkc V` aZZIR] d f cTVdLUkgVj aVU S`eYSj F? 5 A Wc eYZdCVa` œR\_USj `eYkcZ\_dzZ ef eZ\_dZ^`\_XeYV^ `deZ a` œR\_eRveYVF? 5 A #!!" Df cgyJ R\_URdf Uj `V/ZWYZde cZdESRAU`\_ VZdZ\_XRIT f\_edth YZIY XRgVVkeYkcZ\_dZXfedZ\_e` h YReVRIZZEREUR\_UYZ\_UKUU fTTVdbMJ T\_def TI eZ\_ `WaVkd\_R] [ZWa]R\_d1dWRaaV\_UZ %ZEYV T\_TJf dZ\_d`VeYZd ARce ReVSRAU`\_ R\_Rj dZl `W VgVg eYZ\_XeYReh RddZUZ\_eYVZ ekcgZh d.R\_U\_` e `\_R\_j aRceZlf [Rc` aZ Z\_ V ackdbW eYkvZB f`ekd YRgVSW\_ZTJF UW e` VV` a]ZjVeYVT\_TJf dZ\_d R\_Udr`h eYV\Z\_U`VJR\_XFRVaV a]Vf dVe` eR]\ RS`f eeYk4VZdf VdZ\_VgVg USJ [ZWZ

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EYVT f\_egi YRdTYR\_XULR\_U`\_V`WYV^`de dezZ\_XUVgY`a^ V\_edZdeYReaV a]V\_`h`cXR\_ZV eYVZ: ]Zgvd^`cVZ\_UZgZLFR]j eYR\_ hRdeYVTRdvZ eYVeZ V`WYVZ: aRv\_edR\_UXR\_LaRv\_edŽ

Î=ħ]b\_ ħYV][ [ YghWUb[ YħUh\UgH\_Yb` d UWY fYWYbhnžcfħYWUb[ YħUh+ŷY Yl dYf[YbWYXZ]g h UhdYcd Y XcbNiZY h YmVYcb[ hc Ubnh ]b[ a i W bck /=h ]b\_ dYcd Y UfY a cfY ]bX]j ]Xi U ]gh]WÅ =i gYX hc \Uj Y U j YfmfY][ ]ci g ci hcc\_ZZ f ]bgHUbWZ UbX h Yb =Xf[ZhX Uk UmZca h Uh Bck = j ]Yk ``JZZYUh Zh Y Z h fY ei ]hY X]ZYfYbhm Zca h Y k Um=X]X VYZ fY "6YZ fYZ dYcd Y

Î K Y``j Y`]b`Ub`YfU`k \Yb'hY'gcWJU``cfXYf`cZh`Y` bUhcbU``GHJhYž`cZWUggYgžYh\b]WJmiUbX`h\Y`hfU! X]hcbU``ZJa]`mž`]g`]b`XYW]bY"'H\Y`acghidckYfZ`` hYbXYbWni]b`acXYfb`gcWJYmi]g`h\Y`Yh\]WcZgY`Z fYU`]nUhcb`UbX`]bX]j [XiU``g'WWYgg''H\Y`W\c]Wfgž XYWgc bg UbX Wc bgWc i g WYUhj Y YZc flg c Z\ia Ub VY]b[g k \c 'Ugd JY'hc 'VY'h\Y'Uih\c fg c Zh\Y]f c k b `j Ygžh Y WYUhc fg c ZUb ]bX]j [Xi U`]XYbh]mžUfY k \Uh XYÚbY h\Y WYbhfU`W\UfUWfYf c Zc i f hja Y'Ï I 'f]W. 6YW z&\$\$\$

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H YReZI^ VR\_eSj Z\_UZZLFR]ZREZ\_ZIE/ReceRUZ eZ\_R] cWWCV\_edR\_UgR]FVdRVdW\_Rd`aeZ\_dR\_U \_`eRd`S]ZREZ\_dth YZVReeYVdR^VeZ\_VZ\_UZZLFF R]dRVSV&eVcRS]Ve\_UdZX\_`cTY``d/WceYV^dRgVd

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eYV\ZU`WZWeYV[hR\_eŽ7f]]ZUZeZUFRZAReZ\_ Z'a]ZddyWWeVeVc^Z\_ReZ\_ŁdyWWehReV\_VddR\_UdyWV CVRZKRZ\_Ž2deYVF? 5 A #!!" Df cgV CVgVRdLb 7\]YdYcdY\UjYUfY`UhjjY`m\][\XY[fYY` cZbXjj jXi U`jnUhcbžU`h.ci [\h.YfY'UfY'a U! cfX[ZZYfYbWYgh\UhX]j [XYUcb[ gcWcXY! a c [ fUd\]W]bYg" EYZdZdV-VTeVUSj eYVeFS]Vd Z\_eYV[WaYYR\_UT ]f^\_ŁhYZIY dY`h eYVcWaf ]ed`W R\_RUZZZZUNIT\_defTeVU`\_eVVSRdZI`WVfc Z\_UZIRe`cd1dWRaaV\_UZ (/Ž7ZdeljŁeWhZ]Z\_Xł \_Vdd`VZ\_UZ&ZUFRIde`deZT\e`eYVZc`aZ\_Z\_dVgV\_ hYV\_eYVj df\_T f\_eVce` eY`dV`WeYVcaV a]V`c Z\_deZefeZ\_deYReRCVZ'a`ceR\_ee`eYV^ŽDVT\_UjiŁ eYVZ'RXV`WeYV'dygvdeYReeYVjhZty'e`ac`[VTe e` eYVažEYZUjjŁeYVUXXWe` hYZY eYVj ReecZL SfeVeYVT f cdV`VeYVZc]ZgVde`aVcd\_R]UVIZZZ\_d `c`fedXLVTZETF^deRTVdŽ7`fceY|jŁeYVVieVee`  $hYZYUVIZZ_dRcVeR_V_R^{(1)}_XedRUZZ_R^{(1)}Z_Vd^{(1)}c$ `\_]jRAWCT\_dTZfdVgRfReZ\_Ž2TTdJZ\_Xe`eYZd  $\mathbb{Z}$  UVI LRS` f e YR WeYV a` af  $\mathbb{R}\mathbb{Z}$  \_ YR dR ^ UZ ^  $\mathbb{Z}$ YZXY`CYZXY]VgV]`VZ\_UZgZUFR]ZKReZ\_Ž

?`\_VeYVJVdH\_ZeZlf\_VgV\_]j UZdeZSfeVUŽEYV hVZXYe`VeCRUZZ\_YRd\_`e]ZAWUWCR]]Z\_eYVCR`V hRjL\_`eVgVg`\_VYRdeYVCR`V`aa`cef\_ZZXdZ\_ ac`daVTeLR\_U\_`eVgVg`\_VZIVbfR]j hV]]VbfZaaVU e`TY``dVSVehW\_eYV`R\_UCKPZXVeYV`Ž

 $\begin{array}{l} 6^{a} aZZIR | URR d' XX de eYR e^{V_{V}} YR gVR d/ZXYej \\ YZXY dc | VgY | `VZ_UZ gZLF R]Z R eZ_ eYR_ h`^V_Z \\ :e h`f | U dW^ eYR e dYW VAE dC^{Z} R eZ_ ZI^{A}` dV \\ R dF`f dW c eYV | R eVc eYR_ Wc^{V_{V}} SVIR dV eYYZ \\ eR UZ Z_R | c`|VdUV_V eYVZ ZV_eZZ dSj | Z_VZ X eYV^ hZ eYVY^ VR_U^ R EYZ RZ Z X eYV^ e` R \\ UX eW W^{A} af S | Z' UVIZ Z_I^{A} R Z_X R_U UVS R eVL \\ R_USVIR dV eYY `TIF aj R d'S` d Z_R eVa` dEZ_Z \\ eYVh` d|U`Wi` cVZ \\ \end{array}$ 

EYVj`f\_XkcaVa]VRVLeYVXVRvceYZZUZ gZLFRJZRZ\_ŽEh`UZWWCV\_eWX1e`cdRVReh`c\ Yk&ZEYVj`f\_XkcXV\_VRZ\_dYRgVXc`h\_faZ Rh`dUeYReZIXV\_VR]j^`cVZUZgZLFRJZVUeYR\_ eYVZ:acUVIVd1cdhRdLR\_UeYVZ:RezEfUVdcV-VTe eYZTYR\_XZ2eeYVCR`VcZ\_VLj`f\_XaVa]VYRgV WhVccka`\_dSZZZdR\_U`S]ZREZ\_deYR\_RUF]edL hYZYXZgVd^`cVcTaVe`eYVZ:RezEfUVdR\_UUV dZvZFHYV\_eYY\_RVRUF]edLeYY\_^ZXfeWy]JVd1 dMWUVeCc^Z\_VUeYR\_eYY\_`hSVZgVeYV`dv]gvd e`SVLSfeeYVjhZjTVceRZ\_jjSV^`cVZ\_UZgZufRjZXU eYV\_eYVZcaRcV\_cdRcV\_`hŽ

2Tf eVUZWWCV\_TVd`VZ\_UZZLf RJZRZ\_TR\_Rd SV dW\_R``\_XeYVUZWWCV\_ed TZA] deRHŽH ]gg\ck gʻ h\Uh h\Y`WUdUVJImiZcf gY`Z.XYhYfa ]bUHjcb` XYdYbXgbchi1 ghicb dYfgcbU`W\c ]WYgžVi hi U`gc icb UVWYgghc Vch W`hi fU`UbXia UHY! f]U`fYgci fWYg"EYZdf\_VbfR] UZHZZf eZ\_^ VR\_d eYRe\_`eVgVg`\_VIR\_Ugy] a eYZcZ\_UZJLfR]ZRI eZ\_e`eYVd? VVI eV\_eZ

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 $\label{eq:linear} 2dh V] RdSVZ_Xf_VgV_j UZdeZSf eUZ_adRieZVL Z_UZgZLf R]ZReZ_R]d^VR_dUZ0000V_eeYZ_Xde^UZ0VV WeV_eaVa]V, UZ0000V_eTR dvdRevReezZSf eUUe^ZZ$  $AVa]VdaVR^VVVT]Z_ZXcVVgR_TV^Wd TZR]$  $TReVX cZdhX/UVEL]RdERXLXV XRaYZR] TREZ_/$  $RdRSR2EWcUXeXc^ZZ_XZ_UZgZLf R]ZV_eEjZEYY$  $R]d cWWce^eYVUZ000V_eZeZ_Xc^]V^WT_d^aeZ_$  $R_UeYVVV^a]ZjVZ_Xc^]V^WeVV^VUZ0Z$ 

ÎKY 'žh YfYğ U'chcZZ fY][b ]bÛ YbWYž cb hY Yj ]g]cb Z f ]bg/UbWYžk \YfY h YmŘY U'k Ung g\ck ]b[ \ck h]b[ gUfY XcbY]b ch Yf We'i bhf]YgžUbX dYcd Y HU\_Y h Y]f 'YUX' Zca h Uhl fA UYžc XYf UXi hži fVUbž]bhYfa YX]UhY Q9; Ł

EYVZ\_eVcgZhddi`h eYReZ\_UZgZlFRZREZ\_R\_U eYVUVI]Z\_Z\_XRFeY`cZg``VecRUZEZ\_YRgVSW\_RI T^aR\_ZUUSj R\_fadfcXVZ\_UZgVcdEg R\_UXVReVc e`[VcR\_TVŽ

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2XZ\_LeYZlac TVdh Wedh ZYS`eY Raac gR] R\_U UZRaac gR]ŽE` d ^ VLaRoeZlf ]Rdj eYVj`f\_XddL Ze Zl R\_`aa`cef\_Zj e` af cef VeVVZc`h\_ZVR]d e` eYVcd.Ze Zl R eYcNRe e` eYV ^ cR] Z\_eXXZj `W d TZdj+hYV\_ ^`cV`aeZ\_dR:VRgZIS]VLaV a]V ^ ZXYe yeR:VR hc`\_X ef c\_%c eYVCV ^ ZXYe SVR y]`dl`WxdaVI&Zo R\_j ZV\_eZjVZ\_UZJLF R]ZREZ\_ hZeY V&WU ^ R\_UR\_RSdV\_TV`WIV\_df ckLR\_URał ac`gV`WZe` eYVcdZV\_eZjVZe hZeY Z\_UZJLF R]Zr L dJ] ch\_VddR\_UR\_f\_hZ]Z\_X\_Vdle` ckJReVe` eYI VcdLR\_U UZRaac`gVŽE YV XcNRe ^ R]`cZg LeY`f XYL SVJZgVeYRe eYVcVRcVS` eY X`U R\_USRU Rak VIed e` eYZITYR\_XIŽ

7 c ^ R\_j aV a]VLZUZZLFRZARZ\_ RJd YRdR daVIZ T ^ VR\_ZXeYRe cVJRevde eYVT f\_egiddvi TV\_eYZE giŽed XXv&dZVRZ\_\_\_`e[fdeW/^ eYV T\_deRZed`WF]efd]ecRUZZ\_LSfeRJd W/^ eYV cv&zZZ\_dZ a`dvUSj eYV^ZZERj 8`gvc\_^ V\_ $\tilde{z}$ 7c`^ eYV dR\_La`Ze`VVZUZZLFRZRZ\_LeYRe avZUZddV\_RdT\_ecRUZE giŽ@\_ eYV`\_VYR\_UL T\_d^ vZC R\_U^ ZtefdeR'`\_XZUZZLFRJdh vZv dec`\_XUZZvd`VZUZZLFRZFŽ@\_ eYV`eYv&Z} UZZLFRZREZ\_hRTIVVI\VUSVIRfdv`aa`cef\_ZZd e`a]R\_V&Wj Wc]ZWh vEv]Z ZeVZ Î C b h Y c bY \ UbX h YfYğ h [g hYW bc c [ ]! WU fYj c i hcb k \ JW \ Ug Ub ]bû YbW Ug k Y ZVYWU gY h [b[ g UfY Uj U] UVY bck h Uhk YfY Z fV XYb UbX h Uh \ Uj Y h Xc k [h h Y X]WUhcfg \ ]dÅ DfYj [ci g [ YbYfU! hcbg ] Y X UhU ha Y k \ Yb mci Wci Xbhi gdYU\_ mci f a [bX ZYY mÅ / UbX = h ]b\_ h [g \ Ug X]fYWmUZYWWX h Y k UmdYcd Y h ]b\_ UbX h Uhğ k \mh YmiY ]\_Y h YmUfYzk \ ]Y i gZU h ci [ \ k Y Yl dYf]YbWX U chcZh Uhz k Y WUb gYY UbX i bXYfgUbX bck h Uh]hğ bch ]\_Y h Uhi]b ch Yf d UWYgZUbX V[hVmV]h k YNY i g|b[ 1\\cgY ZYYXca g1\Uh Yhi gXc k \Uhk Y k Ubha cfY k ]|\ci f ck b`]j Ygž k \ ]W\ ]gk \Uh]ga U\_]b[ 1\\YgY W\Ub[ Yg \UddYb'Ï

fl Ya U`Yžmci b[ ži fVUbž]bhYfa YX]UhY G9; Ł

7 c^ R\_j 4 YZVR\_dtZ\_UZ5ZLf RJZREZ\_ YRdRa`dZ eZ5VRdt TZREZ\_ hZEY eYVecR\_dEZ\_ e` UV^ `TcRIjŁ hYZYY ZdgZdhUU Rd R\_ `aa`cef\_Zj e` JZ5VZ\_ R\_ V\_gZc`\_^ V\_eeYReac`gZUXdeYVdT`aVR\_UV&WU^ e` cVRJZSVaVcd\_R] JZWa]R\_dŽ

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2]eY f XY eRLEZ\_R]^ `U\JdYRgVh VR.V\_UVR\_U aV a]VRV\_`h VXVce`UVAc^ Z\_Vh YRe\Z\_U`VJZW eYVj hR\_ee`]VRULeYZIU Vd\_`e^ VR\_eYVj YRgV\_` ^`UVJdRgRZIS]VŽ:\_VRIELeYVj fd'R]jj Z.V\_eZJVeYV TYR\_Xd\_`h X Z\_X`\_Z d TZkj hZY eVVRaaVRd R\_TV`WVh gRJf VIR\_USVRgZ f caReAc\_dŽ\_deVRLL eYVac`S]V^ dW^ de`SVeYReeYVd/RcVd7Z&Z\_XR\_U ^ f ef R]jj T\_eeRLZIe`gLR\_U eYRe VRIY`V&YV^ ZI acVdV\_eVURdR\_R]^`def\_Rg`ZJS]VUV^ R\_UŽH.Y` YZZ:fhic ZWc bgfi WIb[`U`gY'Z]a U[Y`UbX`U` gUHgZUWc fm`jZY`d`Ub`Jb`h.Y`a ]Xghic Zh.YgY` dUfUXc1 ]WU`XYA UbXg'gYYa ghc VY'cbY'cZ h.Y`[fYUhYghgftU]bg`cb`dYcd`Y`hcXUm"

ÎHYa cfYWc [WYgmci \Uj Yžh Ya cfY WebZ gYXmci UfYžVYWUi gYmci XcblÅt \_bck k \[W. cZU``hcgY h]b[g`]gth YcbY mci fYU`mk UblÅ 9j YfmVc XmgUmgžĐ Yhcb k]h mci f`]ZYNh Ydfc VYa ]g =¥i bch[c]b[ hc HU\_Y]hVYWUi gY]hŶgZ][ \hYb]b[ fYU`mžVi h mci IĴIY] chgc a UbmWkc [WYgT] fl Ya UYZUXi ½zi fVUbž\][ \G9, L

EYVU/ R\_Ud`\_aVcd\_R]ZV\_eZj VlacVdNUZ eYVZ\_eVcgZhdTR\_SVUZgZWUZ\_e`eYCWXc`fad= eY`dvUvZgZXW/`aRceZTZREZ\_Z\_eYVd\_deV`d `Wd TZdgLeY`dvUvZgZXW/``eYvcd\_R\_UeY`dv eYReaV a]V^ R\_Vfa`\_eYV`dv]gVdŽ H≰9/89A 5 B 8 G C : CC 7 = 5 @CMCH9A CžC F Î H≰9 A 5 7 < = B9Ï

:\_eYVLZWWCV\_eRIT f\_ceLeYVZ RXV`Wd TZAG Rd Rd d&V`cWWcdVdaVIZA]ji e`ZedVT\_`^ZT`cXR\_ZAR eZ\_ŁaRceZIf]Rcji h`c\R\_Ud TZAdVIfcZej dj d&V`dŽ EYVaVcTVaeZ\_ZleYReeYVdV^R.V`\_VR\_UeYVdR`V UV`R\_U+Z\_UZZLIFR]aVcWc^R\_TVŽ

Î 9 YfmighYd mci HU\_Yžmci ÑY Ug\_YX hcc a i W cZ<sup>A</sup> gc k \ Yb Yj Yfmh ]b[ Ng gc XY! a UbX[b] ž]b Yj Yfmk Unž]ha U\_Ygmci Å a U\_Ygmci Å ZYY`h UhYj Yfmh ]b[ NgU[ fYUh YZC flžY j Yfm`lhY'h |b/ žUbX'nc i ÑY U'k Ung' ghti [ [ ]b[ k h h Uhž hXc Ygb h Yhmci UcbY VYWUigYmci h\]b\_ h\YbYl hdYfgcb a ][\h VY [YH]b[ cb VYHYfžUbX ]Zmci gUW Yb cZ mci a // \h/Yhh\fckbci hcZmci f\*cVÅ cf 'i ghdUggYX cjYfÅ /h\Uhŷgh\Y ghfU]bÅ mci 1 ghXc bNiZYY`\UddmUVc i hh |b[ g'Ubm a cfYžf]/ \lBÅ Zcf gca Yžch Yfg=Wci XbÑi gUnž=XcbŇi\_bckÅž=Ňi HU`\_lb[ UVcih dYcd Y b a mgh UhcbÅ žVYWU gYh YfY UfY XJZZYfYbhg]hi Uhcbg \YfYžUbXmci WUb XYbhZna cfYk h cbYVYWUi gYh UhỹthY cbYinci ``]jY']bžUbXihUhỹgik \Uhi=Na hY``]b[` mci UVci HÏ

fAU`Yžmcib[žifVUbž`ck'Q9;Ł

EYVEV ZELR gVcj hZLVEREVRU a VETVaeZ\_ eYRe h`c\YRdTYR\_XUUZ\_RhFj eYRe YRdeeR\_dWc^ VU Ze Ze` eYVTV\_ecRj ReaVTe`VaVcd\_Rj ]ZWZEYZd WWJZ\_XZdT\_dGeV\_ehZeY VI a VCZ/TV+Z\_RYZXY[j UVEVAF]RevUd TZRj dj deV^L^ R\_j`aa`cef\_ZZdUVc a Vcd\_Rj UVgVj a^ V\_e UVaV\_U`\_ Y`h ^ fTY Zd VRc\_UV&/ h`c\Ž2eeYVdR^ VeZ VLeY`f XYLeVV UV R\_LU^ RUV`\_ aV a]VSj R dTTVdM/j h`c\} Z\_X ]ZWdW^ e` XCRee`T aVhZeYŽ2eeYV]VRdL e` ^ R\_j` eYCRdaVTed`WaVcd\_Rj ]ZWYRgVe´SV dRICZ\_TVUe` eYV`Le` eYVLeY\_eeYReeYVgVcj ZJNR `VRaVcd\_Rj ]ZWa]R\_SfZeRc`f\_Uh`c\T ^ Vde` SVdW\_RdRT\_ecRUZEZ\_Ž

E YZd T ecRUZteZ TRoted R a R] `W aacVddZR U ZIVXEZ RT `g\c eVZ RXV`Wh`c\ Rd Ze Zd MaWZZ/TWeURJŽJVeZeZdUZWZCF]ee Rg ZLŁ dZ\_TVeYV]`dd`Wh`c\ZddW\_\_`e[fdeRdRdfcTV `WWT\_`^ZTYRUUHYZaŁSfeRjd`RdyaVcd\_RjR\_U d TZR UNREYZZ 3 VIR dv Ze Zdd R] I T\_d^ Z XLEYV ViaV2Z/TV`VA`c\Z`acVX\_ReVdeYVZ`RXVaVa]V YRgV WITZE CXR\_ZEREZ\_ŽH i gžigc WU i gmghYa gi UfY dYfWY]j YX Uggca Yh\]b[ Yl hYfbU`ž]a ! dYbYhfUV`Y`UbX`Yl]ghYbhJU``mcddfYggjjY"' H\cgY`]bhYfj [Yk YX`X]X`bchYbj ]gU[ Y`Ubm ch\Yf`Zcfa cZcf[Ub]nUh|cb`h\Uhikci X` a U\_Yh Ya Ygg WobhUX]Wo fm H ]ggYYa g hc UVW/ci bhZcfh\Y]a U[YcZgcWYhmUgUb ÎYWebca ]Wa UW ]bYÏ k \]W [h]g i gY Ygg hc fYglgh

Î 6YVVI gY flyj YbLih cgY k \c [ c U[ U]bghih Y' a UWV ]bY UfY VY]b[ dUfhcZh Y a UWV ]bY'Ï fA UYZUXi 1zi fVUbž\][ \ 09, Ł

 $EYV_{y}^{R}RYZ_{w}ZIR_{d}^{d} aRRU_{i}ZR_{z}^{R}R_{v}ZR_{v}^{d}$   $hI_{g} + RYZY_{w}ZY_{w}ZV_{z}^{d}R_{v}Z_{z}^{d}R_{v}Z_{z}^{d}R_{v}UU$   $e^{i}C_{R}V_{e}^{d}Z_{e}^{d}TIV_{e}^{d}M_{i}^{d}]_{j}Z_{e}^{d}U_{v}^{R}R_{v}^{d}A_{v}^{d}R_{v}^{R}$   $aVCV_{e}^{d}Z_{e}^{d}TIV_{e}^{d}M_{i}^{d}]_{j}Z_{e}^{d}U_{v}^{d}R_{v}^{d}A_{v}^{d}R_{v}^{d}$   $uVRIY^{A}V_{e}V_{e}^{d}V_{v}^{A}T_{i}V_{e}^{d}Z_{v}^{d}Z_{v}^{d}Z_{v}^{d}Z_{v}^{d}Z_{v}^{d}V_{v}^{d}N_{v}^{d}$   $aVa_{i}VSV_{u}^{d}EZ_{e}^{d}d_{i}V_{e}^{d}hYZY_{v}^{d}V_{v}^{d}V_{v}^{d}N_{v}^{d}$   $e^{V_{i}}R_{v}f_{u}Z_{v}^{d}A_{v}^{d}Z_{v}^{d}R_{v}^{d}Z_{v}^{d}R_{v}^{d}$   $R_{u}UVA_{v}^{d}R_{v}^{d}R_{v}^{d}Z_{v}^{d}Z_{v}^{d}$ 

H≰989A5B8GC:CH≰9FGžCFÎ8=GHB7H€B H≰FCI;<CI779CCÏ

EYV dVT\_U UV^ R\_U Zd eVRe ^ RUV Sj ` eYVcdL



R\_UZe`aVdevdZ\_gRzfdhRjdŽH YReTc`aaVUfa ^`de Voolf V\_elj Z\_eVz\_eVcgZhdhRdyWcMZ\_% R\_UyhYReaV a]Vd3 %ZEYVg`ZV`VeYVy`eVVc6 obf ZvdaV a]Ve`efc\_eYVd4/WZ\_e`RcVacVdy\_eReZ\_ VceYVzcSV\_VjeŽDYcd`Y`UfY`YI dYWhYX`hc`VY` g`VWVggZ\_žYI WY``]b`Yj YfmUfYU`cZ`]ZY`UbX` g\ck\_ihUhihYmWUb`gYhihYa\_gY`j Yg`UdUfhi Zca\_ihY`fYgh`HYReZiUV`R\_UVUZ\_aRe2Tf]Rc RcVVT\_`^ ZT`d`TTVdtLR\_fahRdU`TRcWc aReYL T\_daZff`fdT\_d`^aeZ\_LeYVcZXYeaVcd\_RJ Rał aVRR\_TVR\_URy\_`c^R%MCZj\_]ZWZ

Î 6YWU gY =h ]b\_ gc WYImcf h Yk cf Xž= Xc blvi\_bck k \Uhir WU``]lž\Ug VYWca Y Yl hYa YmWca dYhhj Y UbX'h Y cb mk UmcZ [Yhhb[ Ubnk \YfY cf glUbX]b[ ci lžX]ghb! [i ]g\]b[ mci fgY Zig hc gd YbX U`chc Zha Y UWX ]Yj ]b[ h cgY [ cUg h UhYbUV Y mci hc Y] WY 'f

fAU`Yžmci b[ži fVUbž]bhYfa YX]UhY`G9; Ł

:eV VEXIdW^ hYReaV a]VdJ eYReeYVdVU/ ^R\_UdREVUZ/WIF]ee`XvéRc`f\_UŽEYVJ`aV\_eYV hJ; e`eYVd/TX\_ZZ\_R\_URTVaeR\_TVSj`eYvd eYReREVd dec`\_XJ; UVZEVUŽ2\_UaV a]Vd`h\_dv/W Z`REVZIZ\_G`]gVUŽEYVd/UV^R\_UHREVR] eYV^`cV Z\_VJFTERS]VZ\_eYReaV a]VaVEVZEVEZIdVTX\_ZZ\_ RdSVZ\_XVgVc^`cVVffdgVR\_UUZWIfjee``SeRZ\_Ž

EYVaV a]VZ\_ekgZhWT]RZ We SVVcTWZ\_e R\_ReezerUV`WT^ af dzeVT ^ aVezezeV\_VddSj eYV ViaVTeReZ\_d`WeYVcoŽEYZdac`gZVdTlfVde`Tcfł TZR] Rola VTed`WefS[VTeZgVViaVcZV\_TVe`URjŽ7Zcde]jŁ ZUZZIFRZARZ\_SjUZZZTZ\_^R\VdZUZAVIFJee` SV/\_Xe daVIZ/TXc f adŽAV a VdW dReYVce cZV RS`gVVgVg``\_VR\_UVgVg`eYZ\_XŽEYZdZUVecZ`V\_eR e`deRS]VL^fefR]dVTX\_ZZ\_R\_UZ\_YZSZedaVa]V  $W^{\wedge} dR_{Z} XeVZ WWZ XdRS^{1} feeYVTYR V Xd^{W}$ aVcd\_R] ]ZWZ2dRcVcf ]eLaV a]VWW ]Zd ]ReVUR\_U }\_UZeYRUe`XZeVRdYRCVU^ VR\_Z\_Xe`eVVZc]ZVVi} aVZV\_TVŽDVT\_UjiŁR\_ZV\_6Z; SRMU`\_ eYVZVR`W ViTV]]Z\_XZl`\_VeYReZlT\_deR\_ejj cV]Z\_bf ZlYZ\_XeYV a`d&Z\_dZeYRdcVRIYVUe`afcdfVeYV`\_VdRS`gVŽ  $5 \text{ ZdeZ} \text{TeZ} _ \text{Zd} \text{R} _ \text{ZV} \text{e} \text{Zd} \text{e} \text{e} \text{VeVc} \text{T} ^ \text{Vd} \text{Z} \text{e}$ SVZ\_XŽEYVeh` eYZ\_XdłeYV]RI\`WT\_TcVeVXc`fa ^ V^ SVcdYZa R\_U R\_ ZV\_eZej eYRe Zd T\_deR\_ejj ^`gZX`\_ł RcVdec`\_Xjj Z\_eVccV[ReVUŽ

 $\begin{array}{c} EYVEV RV \ eVVC Rdv Vied e \ eVVUV \ R_Ud^RVV\\ Sj \ eVVcd \ cZ \ a \ dVUSj \ cV[ReZ_dhZeY \ eVvcd_R]! \\ eY \ fXYeVJ \ U \ \ e] \ \ hReZ_dhZeY \ eVvcd_R]! \\ eY \ fXYeVJ \ U \ \ e] \ \ hReZ_dEYVCVRVLWcVI \ R^ \ a]VeVVZ \ l \\ yh YReaV \ a]VcJ \ \ zZEYVCVRVLWcVI \ R^ \ a]VeVVZ' \ l \\ a \ \ dEZ_dZg \ \ gVUZ \ cV[ReZ_dVZadhZeYZeZ \ Revel \\ a \ \ dEZ_dZg \ \ gVUZ \ cV[ReZ_dVZadhZeYZeZ \ Revel \\ a \ \ dEZ_dZg \ \ gVUZ \ cV[ReZ_dVZadhZeYZeZ \ Revel \\ a \ \ dEZ_dZg \ \ gVUZ \ cV[ReZ_dVZadhZeYZeZ \ Revel \\ a \ \ dEZ_dZg \ \ gVUZ \ cV[ReZ_dVZadhZeYZeZ \ Revel \\ a \ \ dEZ_dZg \ \ gVUZ \ cV[ReZ_dVZadhZeYZeZ \ Revel \\ a \ \ dEZ_dZg \ \ gVUZ \ cV[ReZ_dVZadhZeYZeZ \ Revel \\ a \ \ dEZ_dZg \ \ dVZReZ_LRWWEZ_k \ cVVVeV \ cV \ RVVVeV \ cV \ R_Ud^RVVeV  cV \ R_Ud^RV \ cV \ R_Ud^RVeV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RVeV \ cV \ R_Ud^RV$ 

#### H≰9'89A 5B8G'C: 'H≰9'C9@ žCF Î5I H≰9B! H¥7 +HЙ

H YfY ]g U bYYX Z f Î Ui h YbHWJmi VY! WUi gY h Y Î a UW ]bYÏ UbX h Y ]a dYfUHj Yg c ZÎ h Y c h Yfg UfY YI dYfJYbWXX Ug gc a Y! h ]b[ U]Yb UbX YI hYfbU h Uhdi g dYcd Y VYmc bX h Y UWWYdHUV Y ]a ]ngzh YVeYVceYVdv [Z ZdRVUVeVc Z WSj gRJf V& ad TY ] XZR dRevd `c eYV ej aV WI TZR cVJReZ\_dYZad UVEXVZ/2f1 eYV\_eZZg %ZdR^ SZAF `f d=Z^ RJ ^ VR\_ RUVEXVVc V R\_TZARZ\_ `d.Vbf R]jLR]`\_XZ Xe VIRAVŽ

ER\V\_R] e`XVeYVeLaV a]VU`\_`e dW^ e` dVI ReVe`eYVUZXWKVeeYZXdcVbfZVU`WeYV Sj d dev drevv evvalle Uevv dygvdRdev f XV evv h VcV dZ a]j RjeVc\_Rezevul ev Re ev Vj T f]U TY`dV R^` XŽEYVI RCV\_`eViaV2ZV TVU RdRlevc RozeVeL SfeRddZff]dR\_VfdLf\_Rg`ZLRS]VUV^R\_UdŽEYVj ReVervZ' ^ `gRS]VSRI\Uc`a RXRZ\_deh YZIYaV a]Vd ZWalR dYRve SVWc WZH g g c bY c Zh Y \_YmbchYg cZh\Y W ffYbh |bX|j |Xi U`|nUh|cb' dfc Wyggž Ug dYc d Y Yl dYf YbWY h h Y ghfU]b`cZ\Uj ]b[ 'hc fYgdcbX'hc WcbhfUX]W hcfmXYa UbXg UbX h Y WYfHUbhmh Uhbc a UhYf]U``mj]UV`YžgcWJU``mUWWYdHUV`Y UbX'dgmWc`c[]WU``mgUhgZJWcfm`]Z/'d`Ub' WUb VY Z fa YX k h ci hfYZ fYbWY h h YgY 18 V&X/\_L" \*\*#, 6Yd/\_SV&L" \*\*) /ŽH ZeY fea V&Vd ^ R\_TVLeYVEVZEL` ]ZeZ\_Xe`SVYRU, hZeY`fedfTTVdeL d TZR dVT X ZZ ZHYRUe T ^ VSj, R UhZeY fe UVERIY^ V\_eW/^ R] eYZŁZEZUZZWIF jee T\_\_VIe hZey hYRe`\_VSVJZZgVde`SV`\_VdecfVdJJŽZ

 $:UV_eE_{1}^{2} R_U^{2}Wa]R_dRVUVdEZSVLEAVWAL$  $|ZVaReYdeYc f XY R ^ Z_V VU ` WT _~ZEZ X UV$  $^ R_UZD ^ VaReYdRVd TTVdW/L eVvdRvf_d TI$  $TVdW] ` c e of ` f dZD ^ VEZ Vd]RXVT_TVdZ_d$  $RV^ RUVe` f edZVU/ R_UdR_U^ R_j aVd_R$  $Z af ]dvdRvd aacvdWZD ^ VEZ VdUV/ZReVSf e$  $d dRZ RSJVSR/R_TVdRVRIYZ&VUeYc f XYT ^ ac ł$  $^ ZWZE YVVRVRJd deReVXZd` WT_W_eRZ_hZYY$  $R_U`aa`dZZ_e` f edZVU/ R_UHR_Ua`hVVM$  $R_VC^ REZ_` WYVU/ R_UVCR eV_eZZjZZXZL$  $eYVVRVT f cdvdZ_JZWeYRe_V&VCRIYZ&VR_j T ł$  $YCV_TVJVRZZ AV aJVUWW_TV/VdRXZ_deeYVT_ł$  $~ZICd` VeYVZc V_gZ`_^ V_eZZYZZZ XCRZWE j$  $Z_UZZLF RJZRZ_Z_G` ]gVdR_f_V UZ_XSR/R_TZ_X$  $RIESV6hW_R] eVVdeVeZ_dZ_Z$ 

Î@57? C: H+A9ÏžCF H×9K95?B90C;C: CC7=5@A95B-B;

?`eR] eYVUV R\_Ud WATZ\_XaV aJVRdeYY eg e`T\_ded TeRaVcd\_R] ZJV\_eZj hVZXY fa`\_eYV VbfR]jŽEYVUV R\_Ud`WyeYV^ RIYZ\_WodW^ e` acVU^Z\_REVŽ@S[VTeZgVjjLeYZd^ R\_VdR\_XCVPeUVR] `VdV\_dALdZ\_TVaV a]VdRSZZj e` ac`gZJVVCeYV ł dMgvd]RcXVjj UVaV\_Ud`\_eYV`aa`cef\_ZZd`WWCVU Sj d TZQ dj deV^ dLaRceZff]Rcjj h`c\ZDfS[VTeZgVjjL Y`hVgVLyeYV^ RIYZ\_V%j``^ d.d`]RcXV SVTRfdV ZeZ`a`ddRaRTV`WZZWeYRe]VRgvd]ZegVeZ`VVc `eYVceYZ\_XDZ

Î H. Y dUWY cZ ZXÅ žVYVU i gY nci gYY h Y k cfX hcXUnž Jhğ U``ei JW žei JW žWa Y cbž \i ffmi dž\i ffmi džei JW žYj Yfnh Jb[ Ŋğ U` fi g\Å žUa ]bi hY \YfYžUa ]bi hY h YfYžUbX h YfYğ bc Ha YZ f Ubnh Jb[ YgYžVYVU i gY gca Y\ck Yj Yfnh ]b[ Ŋğ U'k Ung U fi g\'Ï fA UYžnci b[ ži fVUbž\][ \Q9, L

EYV ]RI\`WeZ VZdd^VeYZ\_XgVg cVR]ŽEYV UV^R\_Ud`WeYVy^RIYZ\_V%]ARgV ]ZegVeZ VZ\_eYV URJ e`afccfV`eYVcRdaVTed`VJZWLcfTYRdeYVVR^ł ZjŁWZY\_Ud`ccVjR ReZ\_Ž

3feeYVy]RT\`WzZ`WZzCl^`cVeYR\_eYVRSdV\_TV `WXXWeZ`VŽ:eUVzgVdW/^RgVg`UVA`Tf]efd?] R\_UadjTY`]`XZIR] acUZIR`V\_&Z\_RJjdKd`WhYRe aVa]VdBjRS`feeYVd`S[VTed`XXVdadeYReeYV y&Z V%oWeYVy^RIYZ\_V%oR\UdZYRUe`dAva SRT\W^ZadUV`R\_UdR\_UdWeYV`Z\_aVdaVTi e&ZZEYV]RI\`V&Z VdW^de`SVdyReVUe`eYV Z\_RSZAGje`dWeYZXdW^^RgZuha`Z\_eeYReTR\_ dr`heYVdZ\_Z\_TR\_TV`WeYVdVUV`R\_UdWc`\_Vd `h\_a]R\_dZ\_]ZWZ

Î: fca ci lg]XYžnci gYYUa UW, JbYk \JW Jgh Y WImcZk cf\_ž']\_YUdUWYcZ JZ h Uhjg Uk Ungh YfYUbX h Uhinci Ifinic \_YYd WYUf cZ:VYWUi gY =\_bYk h Uhih Y WcgYf =[ chž h Ya cfY =k Ug [ Yh]b[ gi W\_YX ]bžVYWUi gY nci ÑYž=gYY ]h']\_YÅ U'\_JbXcZZc [ th Uhinci [ Yh]bhc UbX h Yb nci ÑY ]bg]XYZUbX Jhỹgc \UfX hc [ Yhci hcZ]hž cc\_ Xck b cb nci fgYZ UbX gYY h Uhinci ÑY ]bg]XY h Uhih ]b[ 'Ï fA UYžmci b[ ži fVUbž]bhYfa YX]UhY C9; Ł

EYVZ\_RSZZEj e`dWeYZ\_XdW/^ eYZlgZha`Ze ^ VR\_deYRe`\_]j eYVU/^R\_Ud`WeYVy^ RIYZ\_V‰ RVgZES]VLTRCZ\_XR\Z\_U`VydyWWXX&M\_\_VdYZ H\Y`UW\_cZha Yžk\]W`]ggi W\_UfYWffYbh WcadU]bh]bthY`X]gW gglcbgcZ7\]YUbgž gYYaghcaYUbthY``UW\_cZU'dYfgcbU`cf Wc`YWhj Y`aYUb]b[`WUdUVY`cZdiHhb[` h\Y`WcbhfUX]WcfmiXYaUbXg`cb'dYcd`Yhy` `]ZY'd`Ubg`]bhc'dYfgdYWhj Y"

ÎHY [fYUha Ugg cZdYcdY]b h ]g Wei blfmž k \ c UfY XYdc]HWhYXžk \ c UfY Webgi a Yf! ]głžk \ c \ Uj Y bc \ ]ghcfJWU`a Ya cfnžk \ c \ Uj Y bc j ]g]cb cZgcWYhmÅ Ï fl Ya UYžUXi `lži fVUbža YX]i a !`ck @9; Ł

Cca Y ]bhYfbUhJcbU`Wa dUfJgcbgfYj YU`h\YYbcf! a ci g`cUX`cZk cf\_]b[`\ci fgVcfbYVmdYcdY`]j ]b[` ]b`7\]YUb`WJhYg fl 6Gž &\$\$\$\$L'`A cfY`dfYWJgY`XUhU` g\ck h\UhUVci h\UZh\Y'dcdi UhJcb`\Uggca YZYY` hJa Yž U'h\ci [\`h\]g`]g`j Yfmi bYei U``mX]gff]Vi hYX` Ua cb[`gcWJU``[fci dgf7 UhUzbž&\$\$\$L''Ch\Yf`XUhU` fYj YUž Z fh\Yfa cfYž h\UhdYcd Y k ci X'dfYZYf hc WUffmcb k cf\_b[ 'b h\Y]f ZfYY ha Y'fl B 8 Dž &\$\$\$UL'' 5 WWcfX[b[ hc 7 UhU'z bÑgghi Xnžh\fYY'ei UfhYfgcZh\Y' dcdi Uhfcb k cf\_b[ Zca 'A cbXUmhc : f[XUmU'gc k cf\_' h\YgUa Y'bi a VYfcZ\ci fgcb GUhi fXUngzk \]Y UVci h U ʿÚzh\Xc 'gc cb Gi bXUng Ug k Y`" :\_ eYVRSd/\_TV` VRaVcd \_R R\_UT ]]VlēgVgZhł a`Z\_d\_eYVd/UV` R\_UdRVdW\_ Rdf\_ReVdS]VŽE YZd RWWdeVZZ RXVaV a]VYRgV` VeYVZ` h\_ TRaFSZZ eZdŽH Y ]bhYfj ]Yk g'fYj YU``U`gffcb[ `ZYY`]b[ ` c Z d c k Yf`YggbYgg c f`]bWUdUW]hm`a Ubm ]bX]j ]Xi U`g`ZYY``i bUV`Y` hc `Vf]b[ `UVci h h Y`W Ub[ Yg]b h Y]f Ybj ]fcba Ybhh UhUfY` bYYXYX ]Zh Y]f d`UbgUfY hc Vea Y hc Zi ]h]cbŽ 2]] d ced` VeiV a]VWV] eYZlhRjŁW/^ eY`dVhY h`f]U]ZVe` TYR\_XVeYVZ h`c\Z XT\_UZZ\_de` daV\_U^` dve? VhZY eYVZ VR^ ZZdLSfeVW] eYV TR\_`eLe` eY`dVhY` SVJZgVZeh`f]USVZ a`d dS]Ve` TYR\_XVeYVa`]ZZTR`cVT\_`^ ZTd deV` Z eYVhRj d\_UUVUe` ScZ\_XRS`feeVV\Z U`VeTZkj eYV h`f]U]ZVe`dWŽ

Î l bZ fli bUhY nÅ VYWU gY =[ chhc h Y glu[ Y k \YfY =1 ghglUfhYX hc UWWYdhh Uhh ]g ]g h Y k Umh ]b[ g'UfYža ]gYfUV YžUbX gc \ck Yj Yf k ]``]b[ =Ua UbX \ck Yj Yf a i W Ybh i g[Uga ` UbX YbYf[ m=j]Y [ chž=jši 1 ghgk YdhUcb[ VmU``h ]gÅ Ï fA UYžUXi hži fVUbža YX]i a !`ck @; Ł

2\_Z`RW`WZ VZIZ\_d\aRHSJV\&'^ Ra`d&gy Z`RW`W\_Vd`h\_RSZAj e`RIĕŽEYV\\\ef dV\i Zhd hYV\_TYR\_XVZda\cTV&g\URda`ddSJ\LR\_UeYZdZ l a]ZdRSVJZW&YReaV a]VdRIeZ\_dTR\_ScZ\_XRS`fe eYZHTYR\_XIŽEYVJ\\dHV\&YaV a]VYRgVZ\_eY\&C`h\_ RSZZj e`RTH\_eYV^`dVZ ^ VUZNeVR\_UTf ceHZ\VUZd eYVZ:Z`RW`V&YV\\ef chLR\_UgZIVg\cdrZH ZeY\_` e`^`cc`hLJZWZdeJ\CT`aVUZ\_e`eYVaC\dL'eR\_URJ] U\^R\_UddW^ Vbf RJj Z`a`ceR\_eR\_UaC\dLZXŽEYV Z\_e\cgZhdckgVR] RhZV\dac\RUZ\_RSZZj e`eYZ\ SY`\_U eYVaC\dL'eLd ^ VeYZ\_XeYRe ZiRdt TZNU hZeY]`h dyI\W&W^Ž

ÎBck žk \Yb =X]X a U\_Y d Ubgžbch ]b[ WUa Y cZh Ya "GYWUi gY h YfY k Ug U ha Y k \Yb =Wci X h ]b\_ U\YUXžUbX bch ]b[ ž bch ]b[ WUa Y cZ]hi fA UYžUXi 1ži fVUbž]bhYfa YX]UhY G9, Ł

#### A =GHFI GHC : "H≰ 9"C H≰ 9F

3V&UVdeYZdd/\_dV`WeYVVNefdvLdTZR][Z\_\dRV R\_`eYVc`WeYVdTZR]dvdfcTVd\_WUVUe`T\_decfTe ZV/c6&ZdR\_U]ZWa]R\_dZEYVjac`gZUVR\_Z`RVZ\_Rj `V&YVyH V&&YRe X&ydaV a]VR YZXVc dXRU Wc eYVZc`h\_KSZZGj e`RT&ZEYVcfaa`ceR\_UTRaRSZZ eZd`WeYVcLeYVcVT X\_ZZ\_R\_URWWTeZ\_eYVj X&yLT ^ Ve`Wc^ aRce`V&YVZ\_UZgZLFR]ch\_dyW Z`RXZ5ZTFdZ\_\_Vh`c\dr UVaZ\_WSj ef dL R]`h [ZWV1aV5Z/TVde`SVdTZR]ZKVUŽEYcf XY eYV^LZ\_UZgZLFR]dUZT gVc eYRe eYVdVV1aV5Z/TVd ReV\_`ed ^ VeYZXafcVj aVcd\_R]LSf eeYReeYV6V RVYZde cZR]R\_UdTZR]V&Te cdeYReZ\_fV\_TVeYV^Ž EYZLUZT gVcj ZLZ a`ceR\_e Vc eYVT\_defTeZ\_ `VMRAVU^VR\_Z\_X6Z

HZEY feR\_Rock `Wate`\_Xd'TZR]S`\_UdtaVa]V RV/VdVbfZavUe cvRZveyvZcavcd\_Rja]R dŽfde RdZ'a`ceR\_eljŁeYV/T^Ve`dWhYReZd`fecZUV `WeYVd/WeYVd TZR] V\_gZc`\_^ V\_eLRdWeVZX\_Lf\_ł  $T_ec$  ||RS|VR\_UeYf deYcVReV\_Z\_XZ2deYVf af ccf V eYVZc]ZWa]R\_dL^fTY`WeYVZcV\_VcXi\_^fdeeYVcVi WEVX Z\_e``cXR\_ZKZ\_XUWW\_TVdRXRZ\_dehYReeYVj aVcTVZgVRdeYVUR\_XVcdRcf\_UeYV+T^aVeZZ\_ W/^ `eYVcdL]RI\ `W/S dVIf cZijLReeRI\deYRe X  $f_af_ZMULRSZerg UV R_UdZ: WaVed_R]a]R_d$ U\_`eZTIFUVR UUGRh d'deV R TVW/^ y`eYVark eYV SVT ^ VRacReVX ` WVW TVRXRZ dev eYValZ  $EYVWRc`WeYVR\_`_j^`fd@eYVeLUVelle2SVURe$ [V\_XeYZ\_eYV"\*\*) CVa`ceLZdRd R^R\_ZWeReZ\_ `WYVUZINTF | eZdZ g` | gVUZ T\_ ded TeZ XdRezUNNT e`q`aVcd`\_R|ZV\_eEZdŽ

ÎÅ h Y k UmdYcd Y Ufci bX \ YfY `cc\_ Uh nci fYU`mVch Yfga Y U`chÏ

 $K \setminus UhXc mci gYY ] b h cgY cc_g3$ 

Î: fi ghtUhch gca Yha YgžYhj nžU`chcZ Yhj mÅ /\mdcWfgnigca Yha Ygžgca Yha Yg =ĴYYHU\_YXhc dYcd Yk \c [ c Đ Ynž=Ši [ UXh\]b[ gUfY[ c]b[ k Y``Zcfmci ž=Ši [ UX` h\YmJYYk cf\_YXci hÅ NžVi h]bg]XY'=\_bck h\Uhh\\Uhh\YmJYhY``]b[ a Y]gh\YYI UWi cddcg]hY'Ï

ÎÅ =ih |b\_ ]hỹ \UfX ]b Uk Umin \Uj Y UdYf! gc bU]hmcZnci fck b \YfYžh Ym[ YhUhnci ž dYcd Yk \cgY cd]b]cbg nci XcbÑiWUfY UVci hgłUfh[ Yht]b[ Uhnci ž]hỹ VYhYf i ghic \_YYd ei ]YhÏ fA UYZUXi izi fVUbž]bhYfa YXJUhY Q9, Ł

:\_UzgZLfRJZReZ\_ŁeYV\_ŁZŁ\_`eRafcVjjdfS[VTezgV

ac`TVdt\_`cRafeVjj acZgReV`\_VŽDFTTVdtUVáV\_Ud `\_aVa]VdRSZZej e`^`f]UeYVV\_gZc`\_^V\_eeYVj ]ZgVZ\_łZ\_UZgZuFR]jj`cT]]VI6ZgVjjŽ2\_UeYZdRSZZej ]RcXVjj UVáV\_Ud`\_cVdfcTVdeYReRVRT6FR]jjdTZRJŽ 3f eeYVWIeZleYRe]hlgh Yj Yfm]bUXYe i UWncZ h YgY fYgc i fWYg h Uha U\_Yg ]bX]j [Xi U`]nU! h]c b`\UfX`UbX`gfYggZ ``]b`7 \]`Y"

## = B8=J=8I5@N5HCBCHF5H9; =9G

3 VZ\_XR\_Z\_UZGZIFRIZ\_4 YZVZIRYRUR\_Ud ^ VI eZ\_Vd]`\_Vj\_TYR]V\_XZJVeaVa]VU\_`e`\_eYV hY`]Vegi e`Rg`ZJZZ;fdeRdT]]VT6ZgVZV\_662Xd RcVhVR\_V\_Z\_XtaVa]VRVSVT ^ Z\_XRhRv`VZ\_UZ gZIFRIZRZ\_LR\_UeYVdVac`TVdVdRvVRTVJVRZ\_X R]]eYVeZ\_VZeZIRVRIELe`LeYReaVcd\_R]cKRIZRZ\_ UVaV\_Ud`\_VRTY Yf ^ R\_SVZ\_XR\_UeYReV&WU ^ e`UVIZVhYRej`fhR\_eZIRgRJfVZ3V4hW\_RaRe eYReZIX\_VVcX`UR\_UR\_f\_TVcRZ\_V6fcVET\_l defTeZ\_XRaVcd\_R]JZWa]R\_ZIRTYR]V\_XVeYReZi d ^ VeZ\_Vd ^ Ve dTTVdWJ]jLd ^ VeZ\_Vd\_`eLSfe eYReZIR]^`ckRhBjdVYRfdZ\_XZ

> R\_j [ZWa]R\_dR:VacZ R:Zj deR:VXZdWcT ał Z\_X h ZEY Viek\_R] eYcVRedŽ6]f UZ X eYCV eYcVRed dW^d e` SV eYV VZde deVa e`h RcUd dR:ZMXTe`cj Z\_UZ;ZLFR]ZIREZ\_Ž

Î=Xc bħiVY ]Yj Y ]b îh Uha cXYž=łá WUi [ \h i d ]b ]hVi h=Xc bħiVY ]Yj YÅ žgc k \Uh= k Ubh]gZcf łh Ya fl \Yf W ]XfYbLic VY\_Ydh ci hcZ]lźlc "Jj Y ]b îh Y k cfX k ]hci hVY]b[ gc a i W cZh Y k cfX flÅ lž=a YUbžnci ħY ]bg]XY U gnghYa îh Uhk cf\_g ]b U dUff]W Uf k Unžgc g]bW nci ħY h YfYžnci `\Uj Y hc [ c ` U c b[ k ]h ]lžVi h]hXc Ygbħia YUb nci ħY HU\_Yb ]bžf][ \l8 6YWUi gY îh Uhỹ k \Yb îh Y flci VY glUffgžk \Yb nci ħY HU\_Yb ]bž=a YUb ` k \Yb nci fYU`nžfYU`mih ]b\_ ]hỹ gc ]a dcf! HUbhhc "Jj Y i d hc îh Y Yl dYWUhcbg îh Uh Wa Y Zca U``h Uh?

585DH⊞; HC Hk989A5B8GC: Hk9ĨA5! 7<-∄9Ï

EYV&VR&VUZXWW&V\_ehRjd`WT\_WJ\_&Z\_XeVV eY&NRedŽEYV}cdeR\_U^`de`SgZfdZtle`RURae d'TTVdbMJjj e`eYVUV R\_Ud`VeYVy^RIYZ\_V&R\_U eYVy`eYVdVZ@\_VdvLa`\_UV\_eTJRZ`VU e`YRgV dd]gVU eYVT\_edRLZEZ\_SVehW\_YZLda`ceZ\_X g`TReZ\_R\_U eYVVR^ZLj Z`RZ\_Rcj YVWJed TZ4j hRdZ a`dZ\_X`\_YZ`Sj RURaeZ\_Xe`eYVU^ R\_Ud hYZIY eYReZ`RXVV\_eRZJVUŽ

y.ehRdcVR]]j YRcUe XVeZ\_e eYV\_ReZ\_R]ıc hł  $\underline{Z} X \in \mathbb{R}^{\wedge} \subset$ , :  $\operatorname{ecR} \underline{Z} \setminus U \setminus g \setminus g \cup L$ :  $\operatorname{YRURC} h \underline{Z} X$ ^RIYZ\_VYVEVZ\_^jY`fdk ,d`^j]ZWIYR\_XU hYV\_:YRUe`eR\VeZ`VRhRjWo^^eYReŽ7ZdeZe hRdSVIRfdV`Wf\_ZgVdZgLSVIRfdV: UZLjeYRgV eZ Vê Û S`eYeYZ Xa D'EhV]E: YRUê < EhYRe hRdYRaaV\_Z\_XeVV\_hRdeYRed TZkji hRdaf dYZ\_X ^Ve`afe^jdefUZVd}cde 3VTRfdVRda`ced ^  $R_LRc$  hVL: U\_e \\_ hLYVVZ 4YZVeV ^ Z&Ye VRc\_ &! `c'!! eY`f dR\_U aVd dR^ `\_eY Re^`deLR\_UeYRečd\_`eV\_`fXYe`\Wa'eYVNR^Zj :hRee`YRgV :ň a``cRU:hRdĕXZXe`  $^{R}VU' hZey hYRec' hZ_XT f UXZeV^ VLd Z_$ eYRehRjeYVcVhRdacVdfcVe`T\_TV\_ecReV @W TfcdHZWeYYUe U^ VL[VeddWLhV]]aR j`fL:  $U_e^{\tilde{e}_{tot}} He^{WR_URYRWZ_Z_LWfc^Z_Z_L}$ V\_`fXYWc^Ve`\Wa^jWR^ZjjZ\_dNRd\_RS]V dej JVR\_UUVUZIReV^ j dvJV& c`hZ\_XLeYV\_ : h`f JU YRgVUVUZIReVU^jdMV&c`hZ\_Xމ

Î Cc WYYmYY dYWg mci îc \Uj Y U ei U]Ú WUHc b VYZcfY mci WUb [c c b îc glUfhU ZUa ]mÅ žh Yb k \Yb mci ÑY U dfc Zygglc bUž mci ÑY YI dYWYX îc a U\_Y U gi WWYgg c Z]hÏ fA UYžmci b[ži fVUbž]bhYfa YX]UHY C9; Ł

3fe\_`eVgVgS`UjYRdeYVRæzSfeVde`RIYZgV eYV\Z\_U`VaVVXC^R\_TVUV^R\_UVUSjeYVddeV R\_UeYVdTTVdIViaVIðUSj`eYVdZEYVd/RæzSfeVd Z\_TIfUVdVrd\_FSJVVRc\_Z\_XdLRYZYJVgV]`VvarZ}



 $\mathbb{Z}$  XLVUFTReZ\_Led TZRJ deRef dR\_UeVVcZXYeaYj dZRJ RaaVRCR\_TVLR^`\_X`eVVcdŽ

 $\hat{I}$  Gc WYImilg"]\_Y U V/c c[ ]WU Wc W\_. mc i \Uj Y hc VY Xc ]b[ h ]gžUbX h ]gžUbX h ]gÅ Ï

5bX`\ck Xc`mci \_YYd`id`h\UhdUWY3<ck` XcYg`]ha U\_Y`mci ZYY3

Î GhYggYX" =a YUbžgi ddcgY Zcf gca Y fYU! gcb cf ch Yf =k Ubhle gli Xnž Vi h=VUbliž UbX =\Uj Yblij chUbma cbYnž VYWU gY gc WyYm gYlgh Y df JWYgž =a YUb h Y a Uf\_YlÅ 5bX h YfY ne i UfYžne i WUblitUZcfX [hgc ne i XcblitXc [hUbX h Uhỹ h Uhžme i HYUX k UhYfž h Yb ne i RY hec c X": cf k cf\_žgc WyYmYI ! dYWg ne i he VY UWYfHU]b U[YÅ H Uhỹth Y ch Yf df Yggi fYž VYWU gY ne i \Uj Yhe [Yh a Uff]YX VYZcfY ne i RY 'S [Zne i RY U a Ubž [Zbchh Ymh]b\_Å ž=Xcblit\_bck žh Ymh]b\_ ne i RY k Y[fX']

fAU Yžmci b[ži fVU bž`ck G9; Ł

 $EYV dV UZ W IF [eZd^ V.R_ eYRe RURacR2_ Zl_`e R]h R] dgZh VU W ^ eYV de Lla`Z_e` VR a Rd ZgV gZ eZ Z Z Z Z Z Z M W R_ RIYZ gV V_e eYRe cVbf Z V dc Z] dZ 7c` ^ eYZ de Lla`Z_eL^ R_j Z UZ Z J f R] dc VT _ de Te R_R c R Z gV` VM W V R] Z R Z_ R_U TRA RIZ W ca V cd _ R] R I Z_ h Z eYV de V Ž$ 

#### 89.9B8=B; 5 DF=J5H9KCF@8

7 c R\_`eYVć]RXVXc f a `WáV a]VLeYVT\_eR UZTeZ\_SVehW\_eYVZc`h\_acWWccVUhRj`WZgZ\_X R\_UeYVUV R\_U1`WYVd deV^dW^de` XcWreVc T^ac`^ZMŽEYZdafedeYV^Z\_RUZWTf]eaVcd\_Rj a`dZZ\_Ž7 c R dBrceLVgV\_eYV^`de RTfeVRhRcM \_Vdd`WeYZdT\_ecRUZTeZ\_U`Vd\_`e]VRU aV a]Ve` yScVR.%hzEY VI eVc\_R]UV^R\_UŽ

H.Y ghfUhY [miz: ``ck YX`]gbchhc VfYU\_k]h` h`YgY`gnghYa gžk \]W`]g`]a dcgg]V`YžVi hhc Vi ]`XU'dUfU`Y`Î k cfXcZcbYNýck bÏ k \YfY` h`Y`GY`Zh\Uh ZYY`g`XYb]YX`Vmih Ya `WUb` fYWc[b]nY`UbX`fYU`]nY`]hgY`Z AV a]Vfd R]jj T\_defTeeYZh`dUZ\_acZgReVLZ\_Zt]ReZ\_W`^ `eYVd`cZ\_dZV\_edRicZTVWceVVZcTYZUSZ

9`h U j`f cVRTee`eYVdVcf]VdeYRedTZkg UZTRANCIe`j`fLhYReU j`f U RS`feeYVLU j`f dR.VeYVL]VRgVeYV < 0

Î=YUJ YIX Ya ŽUbXIX YII Y=cVYnilg lc UI f]j YUhk cf\_UhUdUfljWi Uf lja Y"=Xc k \Uh ]gfYei ]fYX Zf k cf\_bcfa U`nžk \JWi ]gU k UnicZVY \Uj ]b[ IkUhXcYgblÅigi ]ha YžVi h cbWY =Å ci hcZh YfY =h fck ]hcZWea ! d YhY`nž=Zf[ YhUVci hgcWyYmŶg Uk gž=`]ghYb` hc a i g]WžfYUX a mVcc\_g""Ï fA UYžnci b[ ži fVUbž ck C9, Ł

@\_TVTcVReVULeYZIacZgReVh`cJUZId`VM]`W ^VR\_Z\_XER\_UeYV`aa`cef\_ZEXdWcdM/WARJZReZ\_ Ze ac`gZUddW^ d`f\_VVZZ\_XLeYRe eYV dRIcZ\_TVd \_WUVU e`RURae e`d`TZR]djdeV^ dR\_UeYVh`cJU `Wh`c\dW^ ^fTY^`dV^ R\_RXXRSJVLR\_UVgV\_ eR\V`\_ Ra`dEZgVX]`ddŽ2\_ RJZV\_ReZ\_X[`S^ R] hVJ]SV[fdeZ\_WUZWE^ R\VdZea`ddS]Ve`VLFTReV `\_VdTYZUEV\_`cSfjeYV^fdZT`\_VhR\_edR\_UeYV VJVRec`\_ZTVbfZa^V\_ee`JZEV\_e`Ze`\_Ž

#### CH 9F D 5 7 9G

EYVyh`dJU`W\_Vd`h\_%dedReV3j d^VZ Vd ^R\_ZWdedZedMJVZ\_eYVT\_dedTeZ\_ŁdvR]`cZ RXZ \_RgŁ`VyR\_`eYVca]RIV%ZEYVCVLeYVRfeYV\_eZTdJW TR\_SVcARJZAVUhZeY`feR\_j\_WUe`JZgVZ\_aRcR]JVJ h`dJUŽEYVy`eYVca]RIV%ZeleYVcAR]^`VWsfeYV\_ł eZIZj\_R\_UZeTR\_SVWsf\_UZ\_eYVVkefcVLeYVaRde `ceYVackdV eŽ HYV\_ZEZZ\_ eVVWef ckLevVy`eYvca]RIV%zd\_`d ^R]j `fedZ.VeYVTZejLT]`dVe`\_RefckL`cRSc`RLŽ :\_ eYV WefcVy`eYvca]RIV%aVa]VU`\_`eh`c\L `ch`c\ZIUZWWEV\_eeYvEVW^ hYReZeZIZ\_eYV y^RIYZ\_V%JCRAAh`c\LWcZ\_deR\_TVL`cerRUZEZ\_R] RXEZIF]efcXŽ

Î=ZYY =Ãi ZU`]b[Å =VY[]b hc k cbXYf \ck h ]b[gk]``VY XcbYž \ck h Ymk cbŇiVY` XcbYž=ĨX``\_ Yhc [ YhUk UmZca h Ulžgc gca Yha Yg=h ]b\_ =ĨX``\_ Yhc VY ]b 7 \]cfž VYWUi gY =ZY`nci WUb `]j Ya cfY Ui h Ybh!! WU`mih YfYžnci \_bck 38fYgg]b[ UV]h`\_YU` <]bXi žh Uhk ci X VY a m]XYU'Ï fl Ya UYZUXi 1ži fVUbž]bHYfa YX]UHYC9; Ł

7`cRWhŁeYVy`eYk`a]RI%ZdZ\_eYVaRdŽ:\_ eYVySjX\_Va]RI%ZehRda`ddS]Ve`WW]eYRe`\_V hRdRaVdd\_ŽEYZdZi\_`eeYVd?^VRd\_`deR}Xd?Wc T]]VłezgVZLV\_eZZd`c`eYVcWc^d`VWT\_`^ZT `ca`]ZZIR]`cXR\_ZREZ\_Ž=b`h.YgY`bUffUhj Ygz h.YfY`]g'bc`X]gWYfb]V`Y``cb[]b['Zcf`Vm{cbY` gcWJU`Zcfag''CReYV&LZeZl\_`deR}Xd?WcReZ V hYV\_eYVcVhVcVTVcRZ\_cVdfcTVdeYReZeh`f]U SVX``Ue`YRgVRgZJRS]Ve`UBJŽ:\_e7ZhySjX\_V a]RI%eYVcVhRdeZ\_VL`\_VTf]UXVeSj hZeY]VdŁ aVa]V\\_Vh`\_VR\_`eYVČZ:eZhacZ\_RzJj Ruf]ed hY`Vg`\VeXZŽ

Î A i a g'bck 'i ghih jb\_ UVci ha cbYmUbX h\Ym[ ]j Y h\Y\_ ]XgU\ci gY\_ Ynžgc h\]b[ g \Uj Y W\Ub[ YXžVYWU gY]hk UgbNiUVci h a cbYmVYZ fYž]hk UgUVci hUZZYWJcbž cj Yž VYWU gY W\]XfYb k YfY h\Y a cghgUWYX h\]b[ 'Ï

fl Ya U`Yžc`XYf`UXi `lži fVUbž]blYfa YX]UhY`C9, Ł

#### hZeYeYV]ZW VeYVacVdV\_eŽ

AKYRadWceYZłdWRt \_Ł^ `de`WYVKAb`\_UV\_ed \_RcRezgydda' h WeYReeYY acWWcyWe T \_def Te y`eYyca]RIV46Z\_eYVacydy\_etygy\_ZWYVdyh VYJVdt dRUZIR]R\_U^ `cVac`S]V^RZIŽEYYCyth YReZh^ `de aVcd \_RJLRfeYV\_eZTR\_UUZWWCy\_eRS`feeYV^ ^ RJ SVJVdHIJWRcR\_UYRUVce`dRevISfeeYVRUgR\_eRXyZł eYReZETR\_SVV1aVZZ\_TWUZ\_cVR]ZWZEYYCytaV a]V TR\_SVh YReeYY RYhZeY feYRgZ\_Xe`JVRgVZef\_eJ e`^`cc`h`c^ZdJZeW/^ jVdeyURZ

Î=ZYY`U'bYYXZcfgdUWYždYUWY`UbX'ei]Ylž

UbYYX'hr Xc gla d'Y'h lb[ g'k lh U``a m gYbgYgUhi bYX hc h Ya Å =Z=YUhVfYU\_ZUgh =k Ubhhc Yb c ma mVfYU\_ZJghž=Xc bhk Ubh hc VY Xf|b\_|b| a mWcZYY |b U fi g\žVi fb|b| a mhcb/ i Y'VYWUi gY'=ĨjV' | chhc \i ffmci hž VYWUi gY = j Y [ chhr VY gca Yk \ YfY Y gYÅ HY k Um=WUb / c UVci hh lb/g lb h Y Whnž bch[Yhhb[ ]bhc hfUZ(W/Ua gžVY]b[ UVYhc  $U_i c |X_i f_i| g \leq f_i g \leq$ k U\_ UbX bc h[ Yh]bhc h Y WUf/'i gh[ fYUh"  $G_{\mathcal{C}}$   $h Uh \not g k \setminus Uh \neq \mathcal{J} g Um b [ <math>\check{z} = \mathcal{Z} Y \check{z} = \mathcal{W} U b a U_Y$ gca Yfcca Zfa mgYZUbXWfYUhYUgdUWY  $k \setminus YfY = WUb$  j Y Ug = d YUgY k h cih Uj !]b[ hc ^cghY UbmVc Xnž=Xc bNik U\_ cj Yf UbmVcXmhcXc  $hUbX = XcbMi \setminus UjYhcVY$ [c]b[ Ufci bX a U\_]b[ [fYUhWUb[ Yghc Ubmh\]b[ 'Ï

fl Ya U`YžUXi `lži fVUbž\][\`G9; Ł

:\_ eYV\_RCREZENELEYVEVREVEYCWChYVEVCI`VWG Voj UB; ViaVEZ/TVEYRERVT\_deof TEVURDY eYVc a]RIVE%eeYVW?ZjEVEWEZ\_VER\_UT]`d/VEZ/UŽ EYVEVDZ]SV]``\WJRE^`CVT]`d/j]REVC`\_hYV\_ eYVEVaVEZ/TV`VZ\_UZEZEFRZERZ\_Z\_EYVUZWEV\_e REVRCI`VVRZj; JZWT^VEC

H YVEYV čeYY SVJ`\_Xe` eYVaReH LeYVacdd/e`c eYV Wef c/Ly` eYVca]RIV6/BEV dW\_ Relaf c/Jj Z\_UZ gZLFR]`aeZ\_deYReTR\_ SVRIYZ/g/UeYc`f XY Z\_UZ gZLFR] WWW.ežE YV\_RcHezgydU \_`eeRvVfad TZR] `cZLV]`XZIR]a`dEZ\_dZ?`cZleYVC/R\_j UV/EVve V\_[Zde`eYVcd`\_ eYV[`fc\_Yj e`yR\_`eYVca]RIVZZ

 $\begin{array}{l} CV{IIf $\underline{Z} \times \mathbb{R}^{e} eV_eZIZ_{ij} \ W^{\wedge} h YRe eYcV_eV_dZ_iZ_i \\ R_ $\underline{Z} \cup Z_{i} I_{i} R_{i} R_{i} Z_{i} Z_{i} d TZ_{ij} eYRe $ZIeV_eYcV_eX_RX_i \\ EYV bf Vde $Wc \ \mathbb{R}^{e} eYV_eZIZ_{ij} \ ^{VR_{-}}d]^{\ \ } dV_{\underline{Z}} \times eZid^{2} \\ 3VIRf dVeYV_eX_{i} Z_{i} e_{V}V_{c} \ ^{\circ} af $S[ZTUZIIf dZ_{-} R_{i}^{\circ}] fe \\ \end{array}$ 



eYVYZek cZIR]R\_Ud TZA]TYRRRIekc`VR]eYZekeYv&V Via VcZv\_Tvd RcV Wyee e`SV aczgReV ^ ReeVccŽE Yfd. hYV\_aV a]VWWJgRXfVjjf\_VRdjRdRcVdf]e`V&4V^Ł eYVjac`[VTeeYZdf\_VRdv`\_e`eYvZc`h\_dvJVVZ'RXVŽ EYVdyJVZdZv\_eZ;VURdZeddfcTVŽ

Î Å a ma i a gUJXŽia mk cfXžmei JJY WUD[YXIXVYVU i gYVYZ fYž=a YUDž=hfmhe VYYUgn[c]b[ž=hfmhe ]ghYb UDXVY\YdZ ž UDX UhYm=JYYVYW a YÅ =i gYXhe gYYa m a i a UDXXUXW a ]b[\ca YZca kcf\_ ]\_Ynca VJYgžh UhYg\ck = A [c]b[he YbX i džUDXUWhi U`mh\UhYgʻi gh\ck = Ua YbX! ]b[i dÅ I

Î Å not i f dYfgc bU']lmiW Ub[Ygž]hVYW a Yg Ygg ho YfUbhVUg/WU'nžh Y gUa Y k UmUg not i h ]b\_ a cfY UVci hino i fgY Zih Uhğ bch \YU'h nž=Xc bhth ]b\_ ]hğ \YU'h mZ f gc WYhnž h Uhğ \ck not YbX'i d XYgfc n]b[ not i fgY Zi fA UYZUXi 'lzi fVUbz]bhYfa YXJUH 'Q9, Ł

Hk 9 9L 5 7 9F65 H98 G9@ . DFC H97 HB; C B 9G9@ : FC A 5 DFC 6@A 5 H7 B8 J 8 I ! 5 @N5 HC B

RIVESREZ\_`VRUVEEVUZ RW`WhYRe`\_VZ] eV RF eV\_eZT DNJÆE YV VI RIVESREZ\_ZI eV eYVZ RXV`VEYVeN RIVESREZ\_ZI eV eVZ RXV`VEYVeN eXIRALe^VUZIJRIVZ\_XZ\_ dec`\_XT]]VIEZEVEVWEV\_edR\_UZIJREEZ\_`aa`dEZ\_ e`eYVV\_gZ:\_^Ve`VVJ dEV`dR\_U`aZZ\_ddW\_ RIXZZ\_XEZN e`eYVZ\_RF eYV\_eZT DNJÆV

;`d/hR\_eVUe`h`c\RdR\_ReeZHLSfeeYVUV^R\_Ud `WZd&FReZ\_]VUYZ`e`eR\VR[`SZ\_RSR\_\+

Ccž]hVch\Yfgnci k \YbgcWYInigUngÎnci ci [ \hhc VYk cf\_]b[ žVY]b[ gi WWYggZ`UbX` a U\_]b[ a cbYnÏÅ 3

ÎE i ]hYžh UhVch Yfga YžYl UWhm'l

5bXk \UhXc mci Xc hc WcdYk ]h h ]ggffU]b ]hWUi gYg mci 3

 $\hat{I} = \tilde{M} \hat{I} ghifYg \| bYXbck \ddot{T}$ 

Mci ŊŶY'[ ]j Yb']b3

Î = ĴY Y [ ]j Yb ]bžVi h]b ł\Y \ c dY ł\ UhdYf! \UdgÅ /a UniVY VYWU gY c Zh UhÅ H Y h ]b[ ]g t\ UhÅ ]hğ U``WebbYWYXZVYWU gY =WUbliti [ Yha Uff]YX UbX \ Uj Y W ]XfYb ]Z=ĴYY [ c h bc h ]b[ ž=a YUbžmc i \_ bc k 3 = WUblitiXc ]lž gc ]hğ gc fhc ZX JZWY lÅ ž=a YUb ]hğ U```\_\_ Y U WFWY h UhbY jYf YbXg'I

H YfYlŷbc k Umci hB

Î B c ž=h, ]b\_ h, YfY ]g U k, Umic i hž]hĝigca Y! h, ]b[ ]b h, Y a ]bX'Ï

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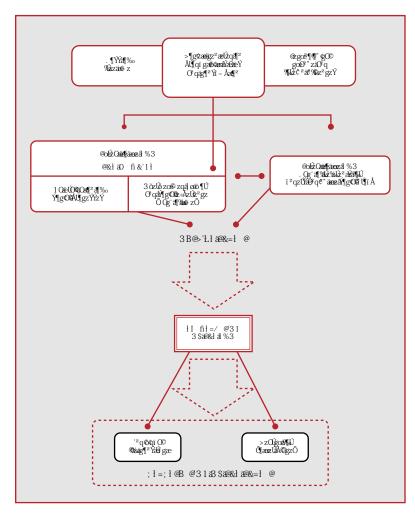
Î=h,]b\_ h,Y k Unici hžfYU`nž]g'bchhc []jY'U` XUa b'UVci hYj YfmVcXmY`gYÅ Ï fA U'YžUXi hzi fVUbž]bhYfa YXJUhY Q9, Ł

9 UWY fVUHc b`c Zh Y`GY Z]g`bc hh Y`]bYj ]! HUV`Y`Wc bgYe i YbWY`c ZUbm`]bX]j [Xi U`]hU! hc b`dfc WY ggž Vi hfUh Yf`c Z U`Zi ghfUhYX` ]bX]j [Xi U`]hUhc b`dfc WY gg"`:e cVdF]ed W/^ T\_~Ze SVeh W\_aVcd\_R] [ZW R\_U eYV`cXR\_ZAR eZ\_`Wd TZ gj Z@\_eYV`\_VYR\_ULeYVh VR.V\_Z X`W eRUZZ\_R\_U`WAYVcZXZ ig` Wd TZA] g deV^daf dYVd aV a]Ve`hRUd dyWVA&c^Z\_RZ\_,`\_eYV`eYV&L eYVhBj d`TZA] g deV^dRcV`cXR\_Z&UUU Vd\_`e]VgV eYVeZ`VLcbRIVL]R\_XFRXd`c TRaKSZEZ/deYRe Rv \_WUVUVccd/WVA&c^Z\_RZ\_ŽGYWUi gY`dYcd`Y` `UW\_`Wc`YWjj Y`fYZ/fYbbg`UbX`ZYY`dck Yf! Ygghc g\UdYh Y Ybj ]fcba Ybhgh Ym`]j Y ]bž gc WU``ZY ZY `gcddfYggjj Y UbXh fYUhYb]b[ " H YmfYUWiVmX]gUbW[b[ h Ya gY j Yg Zca gc WYhm UbX fYhfYUh]b[ `]bhc h Y GY Zi Ug U k UmcZfYWcj Yf]b[ `h Y]f ck b ]bX]j [Xi U`]hm

EYVVI RIVESREZ\_`V&YVDVJVZdReV&b`\_dve`eYZd T\_~ZleeYRe^V&Vj h`cdv\_dZeŽ2daVaJvhZeYURh &/^ dTZb] JZWLeYV&VRQVRUj dIRETVeVd fcTvdReV UVaJV&U j Ve VKceYVČZEYVTRARIZEj VC T]JVTEZEV ]`\_XteXc^ RIEZ\_LhYZIYZdhYReZ\_TEVREMdaVaJVd WWJZ\_X`WAVcd\_RJWWWEZEV\_VHZZfjeZ\_ReVj hVRAł V\_VLŽ2\_UeYZdWWJZ\_X`WWWEZEV\_VHZRIYRdSW\_ dW\_LZdVAU\_EZEJWZZK RJZREZ\_Zle`dTTWCŽ 7ZXfcV%d cf^ RZEVGEVUj\_R^ZGEYREJVAUX6/ eYVdTZbJUZAVIFJEZd`VZ\_UZZLFRJZREZ\_e`eYV V RIVESREZ\_`V&YVDVJVŽ

 $EYVRZ `VeYZIUVIRZaeZ_ZIe`dr`heYVVgi Vgi UJ_UZ_V_dZ_`VWF]efd]TYR_XLeYVadReZIR] ^ R_ZWHRZ_d`VZ_UZGZIFRJZRZ_UZWIF]eZdZEYV ZURZIe`dgVR]e`eYVZ`a`ceR_TVVk2Yf^ R_UVi gV] a^ V_eZ_dTZG RdRhY`]V`WRdvVIed_`c^ R]j dVRdUURdVT]fdgVj acZgReVLdTYRdeYVJZgVd`W T fa]Vd`cUZIIfdZ_dR^`_XVSV_UŽ$ 

\$'%B=łäþ @ozäq%õgi @ozÝä¶%ä6°q©¢qiOQiQe¶²



# $7 < 5 \text{ DHPF}^{-}$ &

## H + 9 7 < =@95B : 5A =@M 69H 99B 7I @H F5@7 < 5B; 9 5B8 H 98 ≓ : =7I @H9GC : "=B8=J =8I 5@N5H €B



EYV4 YZNR\_ VR Zj ZfTYR\_XZ\_XŁZ Zd`CXR\_ZKR eZ\_ŁZ\_ZdZ`RXVR\_UZ\_eYVCJReZ\_dYZdR``\_X Zd^ V`SVdŽAV a]VaVcTVZgVeYZfTJVRdj R\_URd d TZReVZehZeY eYV^`UVc\_ZREZ\_`VVeYVT f\_eqjŽ 5 ZfIf ddZ\_dRS`f eeYVVR'Zj`V&V\_Ckg`]gVRc`f\_U eYVZ aRTe eYRe d TZRJ TYR\_XkdLR\_U aRceZff [Rdj Tf ]ef cR] TYR\_XkdLYRgVYRUfa`\_Zž

Î5 chcZh |b| g \Uj Y WUb[ YXÅ H |g \Ud! dYbYXk |h a mXUi [ \hYfzf][ \lB 6YWUi gY g \Y Uk Ungi gYXhc gUmhc a YZh i a ZXc mci k Ubha Y hc VY f gh ]\_ Y nci 3 H Ym X]Xbl\li Yhmci [ c ci h]bhc h Y ghYYHzcf [ c ci hk ]h Vcng\la /bcZa m cj YZh cgY k YfY X]ZYfYbhHa YgÅ Cc = ]\_Yh YgY WUb[ Yg hccZ ]\_Yh Y fYUhcbg \d dUfYbhg \Uj Y k ]h h Y]f WU ] XfYb bck žh UhWća a i b]WU hjcb h Ym \ Uj Y k \ JW = fYa Ya VYf = X]Xb Nii \ Uj Y k ]h a mck b dU fYb hyž UbX k Y Vća a i b]! WU hY VY hYf bck Å Ï fl Ya U YžUXi hži fVU bž ck Q9; Ł

@aZ\_Z\_dRS`feeYVZ`aRle`Wff]efd]TYR\_X/`\_ eYVW^Zj;gRgŽD^VRdaVTedL]ZVeYV\_Vhc`]V`W h`^V\_ŁReVgZhUURda`d&gVLhYZV`eYVddfTY RdeYV]RT\`W&Z`VWcW^Zj;XReYVZ\_XdRVdW\_ Rd\_WR&Zj`XeYVCZ\_XdRVdW\_ Rd\_WR&Zj`GedaVTZTTYR\_XdRV\_`eeYV^RZ\_ a`Z\_e`WT\_TVc\_Z@gVcZLZ\_XeYV^R]]ZdR\_`eV `Wh`ccj\_RS`feeYVWefcVZK\UHYjYf']a\_U[Y` dYcd`Y`\UjY`cZhY`ZJa\_]`mfUbX`griX]Yg` g\ck\_ihUhihYfY`UfY`a\_UbnłžfY`Uhjcbg\]dg` VYłk YYb`hY`ZJa\_]`miUbX`gcWYhmUfY`ZY`h hc `\Uj Y`VYWca Y`dfcV`Ya UhJWU`" EYVEVZd R WWJZ\_X eYRe eYV UV R\_Uda]RIVU `\_ WY ZZdd Sj d TZAg ^ R.V Ze YRdU Wc eYV e` aVEVVc^ eYVZc W\_TEZ\_ŁeYV gVcj c`]V eYRe ^ R.Vd WY ZZdd Z a`ceR\_ee` 4 YZ/WR\_Z

> R\_j aV a]VR:VcVd2X\_We`eYv0/UR\_Xkdt.Sfe ^`deUv02X\_dedReVX2/de`T aVh2EYeYV^ŽEYV^`de T ^ ^ `\_`\_V2de`egie`T]`dVeYVVRY\*21jZ\_fa`\_ ZedM\_WateYRe22:212'aVg2Zfde`eYVZ\_~fV\_TVd`W d TZÁjŽEYVÁV de REV XZALU SVR: d^V VAFZELSFE eYVj YRSV R OLLNI WWWTE+ eYVj hZLV\_ eYV XRa SV ehW\_ VR\*Zj R\_U d TZÁjŁ^RZ\_XZE VSV\_ YRUU: Wc TYR\_XXA e SV^R\_RXUZ\_ eYVU ^ VAEZT TZTIVŽ EYZEL e R\_dVA:^REZ\_ `V EYV VR\*Zj Z\_e R c WAXV VA^ d TZÁj ZEF\_U F SEVU j R c VREZ\_ e eYVA TZR U \_R\*ZI d U c TSEVU j R c VREZ\_ e eYVA TZR U \_R\*ZI d U c TSEVU j R c VREZ\_ e eYVA TZR Z ^ V c V j R X c R e V U c V V V F R jZj `V ZVZ\_ d TZÁj RE JR X Ž

## :5A =@MHMD9G5B8:5A =@M89AC; F5D<=7G5F9<sup>·</sup> 7<5B; =B;

:\_4YZ/NLRUZ\_R]^`deVg/dj`eY/cTf\_egjZ\_e/V h`d/ULW/c^d`WR^Zjj`c2R\_ZREZ\_YRg/TYR\_X/UŽ EY/d/RcVe/\_U/\_TZ/de/ReV^V/XXLY`hVg/dL`g/c bfZEV]`\_Xa/vZUd`WE2^VŽ

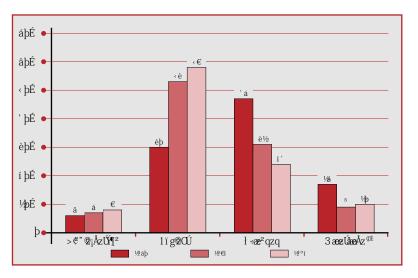
EYVUZWIF jej `VIT ^ aRZ\_XeYVd f cIVd RgZJ RSJV ^ R.Vd Z YR RCU f de` da VR. `VIJVRc eV\_UUŽ 5 RRW ^ :? 6 R\_UeYV4 2D6? drogy dr` h eYR L `gVcR]`\_XaVZ U1" \* (!1#!!!/AV eV\_UVUY ZXd YR VUNJZ VUR\_U\_f TJVRcR\_UdZ\_XVaVd\_ VY Z JZdYR vZ\_TCVRMUZDZ\_XVaRV\_e\_f TJVRc VY ZXd h YZIYZ\_TCVRMUZDZ\_XVaRV\_e\_f TJVRc VY ZXd h YZIYZ\_TCVRMUZBZUJJ Uf cZ\_XeVV hV\_eXeYTV\_ł ef g L dW e` YR VSW\_T ^ Z\_Xfa RXZ\_de eVV JZ Zde` eVVZ Xc` heY Z\_ eVVJRe UVIRUŽ eTR\_SV dZJ eYR LU da ZUJ Y CV VA` L a RXZ\_de eVV JZ Zde` eVVZ Xc` heY Z\_ eVVJRe UVIRUŽ eTR\_SV dZJ eYR LU da ZVeYVaCU ^ Z\_R\_TV` Wh` ła RV\_e \_f TJVRc VY`ZZ dL eVVZIR XCV e UZV dZ ' VZ' WC^ Z2 T ^ a RC Z VC f UJ 164 = 24 L #!!!"/dr` hd eYR eVV UZ teZSf eZ\_` W` f dW` JU g a VdZ\_ 4 YZ VZI T]` dVe` eYV=RZ\_2 ^ VC R\_ RG VC XZ

 $\label{eq:linear} AkeYRadeYVXeVReVdeTYR_XVYRdSW_Z_eYVejaV `VS`_UdeYReUVJ_VVR^Zj cNJReZ_dYZadadTYRd ^ RczZXWLSZeYLVRcjj actX_R_Tj R_U R_f]^ V_e dReVdudW} XfcVd%# R_U%S/Ž$ 

EYVS`\_UdeYRe eRUZZ\_R]j YVJUY fdW`JUd e`XeYVcYRgVhVR\V\_VUd ^ VhYReZ>`dV^ RczZXd RVSVZ\_XR\_f]JVLZ\d ^ VR\_UT dej eY fXY eVV ac`TVLfcVZZEYVac`a`ceZ\_`VSZeYd`fceZLV^ Rd cZXVYRdcZV\_LR\_U^ RczZXVZeM/WRdZ\_TCRRZ\_Xj SW\_da]RIVUSj T YRSZRZ\_Ž6Rdj ^ `eYVcY``U YRdR]d Z\_TCVRMŽ

2]] eYZdd XXXddelYRe ^ R\_j aV a]VaVCTVZgVedH UZZ\_R] Wc^ dRdackgV\_&Z XeV/ W/^ UkgY] aZ\_X eYVej aV WMREZ\_dYZadeYY hR\_eL`cRdWZZ\_Xe cV-VTe eYV daVTZ; TT\_UZZ\_df\_Ukc hYZTY eYY RCVe`SV]ZgVU`feZ> R\_j j`f\_XaV a]VhR\_ee eR.VeYVZc cV[ReZ\_dYZa hZeY eYVZc aRce\_Vc WkeYVc hZeY fe j Ve ScZ\_XZ\_XR deRS]V W^ Zj Z\_e`SVZ\_X RSR\_U`\_VU h`^V\_`c dZ\_XV^`eYVcd YRgV e`

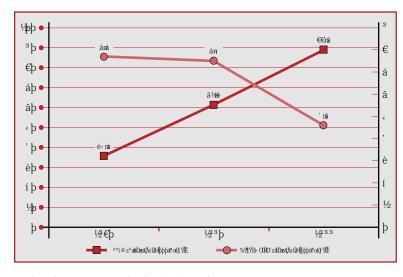




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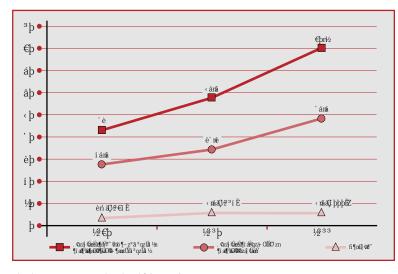
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. Tozä tázetáli zározali na CÚCC za qzlove tegali z tázt tega z té



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>¶ï Úgznabalt; äl One¶²O Ga≽ï Únzonaŭ þþ!∕É

`cXR\_ZKVRY`fdY`]UTRARSJV`WFdHZ\_ZXeVVZ: TYZJUZY\_ŁhZeY`feeYVZ\_g`]gV^V\_e`WeVVWEYVC; ^R\_j dváRReVU aV a]VhZY'e`deRceRoKoV hZeY R\_`eVcaRce\_VESfeTR\_\_`eVC^RZKVE/VcV/ReZ\_ł dYZa, `eYvcd\_hY`YRgVSW\_RSJVe`R\_f]eYVZ: acVgZfd^RccZKX/LTCVReV\_VhWA^ZXdT\_eHZ\_ZX TYZJUZY\_Sj UZWWEV\_eWRYVcdŽ

EYVIVUV `XRaYZTYR\_XIdRVSVZ\_XRT ^ 1 aR\_ZUUSj R]eVCReZ\_dZ\_Z RXId`VeYV VR ZjŽ 5 ZgVoZg R\_UZ\_WC RZg Z\_VR Zj RcR\_XV V.ed RVZ\_TCVRZ\_Xj dW\_Rd\_`c^ R]ŽEYZd Xc hZ\_X [VXEZ RIJ ZlaRcej UFVe eYVhR] eYVTF]ef dV`W Z\_UZgZf R]ZREZ\_R]`hdaVa]Ve UVIZUVVceYV 1 d/gVd`\_Y`h eYVZd TZR]eZdd^f f]USV cXR\_ZVL R\_UXgVdeYV eYVcZXYee R]eVceYV Ž:e ZdR]d UFVe 'hY'k JXYgdfYUX'dYFVWdhc b'hUhih Y' Xca ]bUbh ]bgh]h h]c bU`UffUb[ Ya Ybhg Zcf' ZJa ]mcf[ Ub]nUh]c b'UfY`]b W[g]g'UbX'bYYX' hc VY WUb[ YX netS]V(!/Ž

> `dVeYR\_YR]WWR] dda`\_UV\_ed dXRdU eVV Wr`Zj Rd aRce `WeYV\_RefcR] Tj TJV `WJZWZJVe %% L^R\_j `WeYV j`f\_XaV a]VLSVJZØV eYRe eYV UZgVcZg `WWR`Zj eZdLeYV UZJVTF]eZd eYV dW ecRUZZ\_R] Wr`ZZd X Z\_X eYc f XYLeYV TCZCd `WeYV aRecZrCTYR] ^ `UVJLeYV aRceZC] dvaRreZ\_ `WeYa RecZrCTYR] ^ `UVJLeYV aRceZC] dvaRreZ\_ `WeYa C UFTeZ\_LcMifrZj R\_U Wr`Zj JZWLR\_U eYV JVXEZ RIj `WeYV UZWWCV\_e `aeZ\_dLR]] ^ VR\_ eYRe eYV Wr`Zj dr`f JUSVdW\_RdRgRZZSJVd TZR] T\_decTrZ\_1eKSJV' \*/Z

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>¶ï ÚgznaB1Ł; äl Ove¶²O®sï Údzønai þþ½Ê

EYVWc^ `VeYVW? Zj dW^ de`SVSVT ^ ZX ^`dV`aeZ\_R] R\_U~ViZS]VSj eYVU3jŽJVe'h Y` j Ugha U'cf]micZ7 \]YUbg gYY'h Y]f`ZJa ]mi hYg Ug'h Y'a cghi]a dcfhUbhZJWicf`]b'h Y]f` dYfgcbU``]XYbh]hYg`UbX`]b'h Y]f`dfcgdYWg cZfYU`]n]b[`h Y]f``]ZY'd`Ubg" EYVF? 5 A #! ! " Df gyJ Rd U+yAV a]V]``\e`UZWWCV\_eeYZ Xdh YV\_ eYJ ej e`UV}\_VeYV dV]g'd`cd3 hY` eYJ RVZ H YZTY`VeYVW]`hZXh`f]Uj`f d3 YRdSW\_ ^`deZ a`ceR\_eZ\_UV}\_ZXhY`j`f RV0%d VeYV dVa`\_ddReVU25ZNUZ\_e` eY`dVeYRedWc'e` eYV WY Zj ij`fc VY`ZjLj`fcTYZU2V\_/ R\_UR]]`eYvc dVa`\_ddEeYVeeV`V\_U fdZ`a`ceR\_TV`VeYVV8' H Zj`TR\_SVdW\_ieKS]V("/Ž

H YV\_aV a]VdaVR\RS`feeYVWY ZjŁeYVZc`h\_ `cR\_jS`Uj`dhYReT\_TVc\_eYV`RV\_`ed ^fTY eYVdYZedZ\_Zd`cXR\_ZREZ\_`cUV``XRaYZdRd eYVTYR\_XdZ\_eYVhBjZd^V`SVddVJReVe``\_V R\_`eYVŽARceZIFJRcV`aYRZdZdaJRIVU`\_TYR\_Xdd Z\_eYVcVJREZ\_dYZaSVehW\_aRV\_edR\_UTYZUCV\_Ž @WT`fcdxLaV a]VdZ`RXVR\_URdXdh`V\_e`VeYVdV UZWW/dXVRejjUVáV\_UZ\_X`\_hYVeYvcZeZleYVaRd V\_ed`ceYVTYZUCV\_hY`RVdaVRZ\_XŽ

K < 5 HH = 9.05 F9B HGH = B?

EYV^ RZ\_UXWWC/TVaVCTVZgVUSj aRV/edZleYRe TYZUEV\_`h SVT ^ VRUF]eR\_UZ\_UVaV/UV\_eVR2ZC eYR\_SWXXZEYZCZReecZf eVUe`RgRCZG` WHR'dKZ 7ZcdejHR\_U^ `deXV/VR]jHeVXVZleYVXVR2vCZ\_UZ gZUFRZREZ\_WdeXCWSj TF]ef cR]TYR\_XZDVT\_UjH VRZKCR\_UVRC]ZCRITVCde` ^ `UVc\_ \\_`h]VUXVR\_U dZ]dLhYZY gVcj bfZl\j V\_RS]VTYZUEV\_e`UVR] UZVTej hZeY eYVh`c]UhZeY`f e eVVZ\_g`]gV^ V\_e `WeYVZ:aRV/edeYVdZ]d\_WUWe`ZeVcRe e` eNRIY eVVZ:aRV/edeYVdZ]d\_WUWe`ZeVcRe hZeYRd TZkj eYReZITYR\_XZ\_XhZeYUZkj Z\_XchWUZ Î=łħ /b\_ łħ Y bYk [ YbYfUł]c bġźW ]XfYb Ug gł W UfY ]bfYX]V mg\_]Z ZZ f ]bgłUbWYż= Xc bħii bXYfgłUbX Ubnħ ]b[ UVci hWea di łł YfgUbX =Vci [ \hc bY łħ UhgYha Y VUW ' SS łħ ci gUbX dYgc g c f gc źU b]WY d]YWY cZYei ]da YbhUbX =VUbIħiYj Yb li fb ]hc bź VYWU gY =Ăi głi W VUW ]b łħ YÅ žVi h ħ Y\_]XźĐXUXđÑ Y gUngžĐ YfYħUbX łħ Y \_]X dfYggYgUVi łħ cb UbX dfYggYgUbc łħ Yf Vi łħ cb UbX ]hk cf\_g\*=łħ ]b\_ ]hŷ łħ Y bYk [ YbYfUł]c bža migcb \Ug łUi [ \ha Y U`chcZ ħ ]b[ g'Ĭ fħ UYZUXi łži fVUbž ck 09, Ł

7`fœYjjŁeYVX RV eV TYR\_XXX WY ZZX RV f\_UXX Z\_XSVIRFdV`V&YVUV R\_UX`V% `& R\_U eYVVT\_`^jŽEYV\_WU`cUXXVe`Z\_TXRVeYV

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Hoggoza¶%aaaza%¶@¶ö ¢" aq¶aa⁄¶ï ag¶² Ýqz lå–¶Ýaa≎ Ŷ láÐ aa¢ aqz в ¢" aö oq¶aa⁄¶ï aOlźĐa ÇÅz lágz² aÐ' z YÈ

>¶ï ÚgznaB1Ł; äl Ove¶²O@a≽ï Údzonai þþ½Ê



ARCV\_edWWjeYcWReV\_VUSjeYcWVTYR\_XxdtZ\_hRjd eYRe UZWWC UVAV\_UZ\_X`\_Y`h eYY dWeYVc`]V`W eYVWR Zji Z\_ cV]ReZ\_ e` d`TZKejŽEYVcVRcVeY`dV hY CVERZ R\_ZUR VEYVIR Zj RdRa RIV Weef Th ef cVU dVIf cZej R\_U Rf eY cZej ŽE YV ZVR Zl eYRe Zed ^ V^ SVaddY f JUSVaYj dZIR] ji R\_Uad TY ]` XZIR] ji Z\_gf\_\_VdRS|Ve`eYV^V\_RTVd`WRdTZXaj TYRdRIA eVcZkVU SjaYjdZRJgZ]V\_TVR\_U^`dRJUZddVcZ E`UR,`d^``cVY`c7k`\_eR] VR^ Zj; cVjReZ\_dVZadLeYV Z'RXV'WYZUCV\_RdY' |UVcd'WZXYedhZEYcVca`\_dZ SZZEj WCeYV dygVdR\_UeYVhVR\V\_ZX`V&ReVC\_R RfeY^2Zji h`f]UdW^e`^R\_VZeUZWTf]eWcaRd V\_ede` UvgV]` a  $decReVXZvd` VaV_VVT__eR_U$ dywww\_tvz\_eyzetyzucy\_žeyzetac`S/V towed  $R_V_c^{-}$  fdT\_~ZieWcaRcV\_ed`WeYZdejaVLhY` eV\_Ue`]Rj eYVS]R^ V`\_eYVZcTYZUcV\_R\_Ud TZkjŽ

## EYY WY a`hVdVdde`VIVCTZWeYVRfeY`zêj eYY WY ZigVeVUZ eYV'Ž

Î? |Xg hc XUmUfY i d h YfY k ]h h Yf dUfYbhg" =a YUbžh Y c bY k \c g\c i hg c i XYghc f k \c gUng k \UhXc =WUfYž=h ]b\_ h UhŶg k \c lŷ ]b W Uf[ Y h YgY XUng Ï fl Ya UYZUXi hzi fVUbža YX]i a ! ck @, Ł

AREV\_ed`VR UZWWEV\_e ej a V REV eY dV hY`dW eYVWY`Zj RdRa]RIV`VWWWAZ\_R\_UT^^f\_ZIR eZ\_Łd^VhYKEVeYRe^R\_Vdfa Wc eVVT JU\_Vdd R\_U VITVdJZVUV^R\_Ud`Vdf TZAj fedLNŽEYVdV hVJT^VXXREVC Vof RZj R\_U UZDIF dZ\_R`\_X WY`Zj^V SVcLRdeYVj dWcVJREZ\_dYZd`VeYZd \Z\_URdYVJaZ\_XUASVj a a Vcd\_RZZ/dR\_UdZJdeYRe XZgVaV a]VXXREVC Z\_UAV\_UV\_TVR\_U Z\_UZZLFR] RF eYV\_eZZj Z\_eYVVATV`VeYVUAVcd\_RZZ\_XUA ^R\_Ud`W1TZAjŽEYZdj aV`VWY`Zj JZWcVbf ZXd XXReUVUZREZ\_LY`hVSVZAREV\_edWMJ eYRed TZAJ UV`R\_ULLARceZIF]RCj h`c\LU\_`e]VRgVeYV V\_`fXY eZ\_Ve`cKRZAVEVZCZ\_RXV`VeYVWY Zj Ž EYYJ SJR`Vd TZej R\_UeYV^d/SdVC eYZELhZeY eYVTYZUEV\_TRERIGZIEZ dŽ

Î H. Uhğ "JZ" Cc mci Ñ Y [ chhcží][ \ hžh Y Vcgg gUng glUmi bl] b]bY. gc i bl] b]bY [h]gz ]\_ Y [h cf bch'5 chcZha Yg = \Uj YbŇk UbhYX lc " =h]b\_žb]bY cÑVc WžUb \ci f Ygg k [h a m k JZ UbX XUi [ \hYf "=Ñ cb m \Uj Y ha Y hc YUhža mXUi [ \hYf k ] ``VY ]b VYXž=Ñ gYY \Yf h Y bYI hXUn 6YWUi gY hca cffck Ŋ Ubch Yf XUnž Yhỹ \cdY gc Ubnk Unfl fh UYZUXi hzi fVUbž ck (9, L

#### K < 5 HH = 9.7 < = 0.8 F9B H = B?

EY`dv'hY`dW WY`Zj cVJReZ\_dVZad W/^ eYV TYZJUda`Z\_e`WgZh eV\_Ue`T ^ Vfa hZeYZ`RXd UZWWEV\_eW/^ eY`dv`WaReV\_edŽEYYj aVETVZgVeYV TYR\_XdESfeeVj YRgVR^`čVa`dZegVZ`RXV`Wal TZGj R\_UReVdReYVETZETf^daVTeRS`feeVVVR^Zj`d RSZZEj e`cVda`\_Ue`TYR\_XVŽEYZEZdeVVdR\_Ua`Z\_e `V&YVj`f\_XdecVda`\_UV\_edŽ

7 ceYV ŁWY Zj cYREZ\_dYZadRCVZ\_UZWIF]eZd R\_UeYY WWJ RUgVcdMj RWWNEVUSj eYZĎEYY U \_`eSJR`Vd TZdjŁSfe]RcXNj dWeYVReeZefUd`W eYVZ: aR:V\_edR:ITR dZ X:eYVac`S]V dZEYVj eV\_U e`Vi`\_VReVeYV LY`hVgVd:Sj R:Xf Z X:eYReeYVZ: eRUZZ\_R] faS:dZ, Z X:ac\gV\_ed eYV W^ RTel Z X UZWWEV\_ejj Ž 2 f eY` dZR: $dR_{C}$  Reodef UVd: ^ Zhef dd: \_V4)VTe R\_U R VRZf dV e`Vf ac\dt RWWF2\_ R:V eVV T ^ a]RZ\_ed ^ `de` V&V\_ g`ZIVU hYV\_ TYZUEV\_ UVdTcZSV eYVZ: VR`Zj YZde`g R\_U V\_gZc`\_^ V.eŽ EYVj dW eYVdVRdUVj TZV\_e SVTRf dV d`TZ9 TYR\_XV R\_U eYVZ\_T&RAUTRARSZZEX.dR\_U cZXYed` Vj' f\_X aV a]V^ RUVUZWWEV\_ecVJReZ\_dYZadS` eY a`ddS]V R\_U\_VTVdRjŽ

H ± 9 : 5 A = 20 M 5 G 5 \* 89 9 B 7 9 5; 5 = B G H G C ! 7 = 9 H M

EYVUZWWEV\_TVSVehW\_ eYVeh``fej``\dZl`Sł gZfoŽEY`dVhY`daVR\RdaRV\_edeR]\RS`feeYV UZWIFjeXd`V&VeVe^Z\_XeYVEvV\_TEZ\_RdZeVe^V UZRZdSVehW\_eYVEVWYZjR\_UdTZKejŽEY`dVhY` daVR\RdTYZUEV\_UVETESVeYVUZWIFjej``W&WZ\_X

eYV^ dylgvd W/^ ecRLZeZ\_RJ VR^ Zj cv/ReZ\_drZadŽ EYZdUZXWKKV\_TV^ZXYeSVT^^`\_e`gZ/hd`\_ eYV WRYZ ZUZWWCY\_eTf\_ecZkdLR\_UUReVSRI\ TV\_f cZkŽEYVaVIf JZcZj ZleYRea UbmdUfYblg bck VY`]Yj Yh Uhh Y]fHug\_Ug']bhYfa YX]Uf! ]Yg VYlk YYb h Y]f ZJa ]mUbX gc WYlm]g hc XYZYbX h Y]f ZJa ]mU[ U]bghgcWYhnžk \]gh a UbmW\]XfYb Xc bchWfY Yb[ U[ Ya Ybh k ]h, gcWYhnUgh Y]f fYUgc b Zcf k Ubhb[ hc ZYY'h Ya gY'j Yg'Zca 'h Y'ZJa j'm' 6gV Wc j`f\_XaVa]VLeYVLeYVLRY Zj ZIRSVeeVca]RIVeYR\_ d TZkjŽ:e ZleYVa]RIVh YkVaV a]VRVac`eVIeVU W/^ d TZKA R UhYVEVEVY TR R SVEVV MgVEZ EYVZ RXV VEYV RY Zj RdyZ dZ V/Ley f cellen R\_1 `eYvca]RIV%aR]ZidhZeYeYVVRc]ZicUvdTcZaeZ\_`W d T2X4j Rdy`fed2L1%%R UyR|2Z/%Z2dh2Z|SVdW VKceYVć`\_ŁeYVćVZIRcY/ReZ\_dYZaSVchW\_ eYVc`]V RddZX\_VUe`eYVWR^Zj; R\_UeYV[VeyV]`W^Zdecfde e`hRdddTZAjŽ

### $\Rightarrow$ 5; 9GC: H = 9: 5A = M

:^ RXXd`VXYVXY Zj; R\_Ud`TZkj; R:VZ\_eXcVJR4VLŽ 2 ^ f]eZgRZFeVR\_R]; dZl`VXYVbfVdtZ\_dRS`feeYV VXY Zj; Z\_ eYVF?5A #!!" Df cgY hRdfdVU e` Xc`fa UZWWCV\_e gZVhd`VVZeR\_UZdCVJReZ\_dYZa hZeYZ\_RXXd`VXdTZkj;ŽEYVR\_R]; dZlT\_dZVXVU bfVdtZ\_dRS`feeYVZ a`ceR\_TVRecZsfeVU e` eYV VXY Zj; Z\_ R cR\_XV`VVR16ZgZEXdLRS`feeYVaJRIVd hYV2VaVaJVJZVU e` SVLR\_URS`feeYV^VR\_ZX eYV; RecRIYVU e` eYVZc`h\_VXY ZjZdtdVRaaV\_UZ (/ŽEYVR\_R]; dZlcVgVR]d}gVUZWWCV\_eejaVd`VWY`ł Zj; Z\_ RXXŽ

#### 8YHJWXYX<sup>-</sup>]a U[ Y

7`caVa]VZ\_eYZITRAX`gLeYVWA`Zj\_Zl\_`e hYReUVj\_VdeYVZ:ZUV\_eZjL\_`cZIZ=hYVeVeYy V\_[`jeYV`dMgVd^`deŽ3VZ\_XhZeYeYVWA`ZjZL\_`e eYV^`deZ`a`caR\_eeYZ\_XWceYV`ER\_UeYVjeV\_U \_`ee`TRoj`feRIeZgZZdhZeYVFYZ; A`CV`WRdfcTV`W ec`fS]VŽEYZIZIeYVZ`RXVeYRe''%``WVda`\_UV\_ed YRgV`WAVZcWA`ZZXZEYVjeV\_Ue`SV`]UVcRUF]eeL h YZY ZI\_REFOR T\_OLVZ\_XeYRe WY Zj RI6Z922Xd RV`VWXdZ a`ceR\_TVZ\_eYVZ:URZj ]ZgVdR\_UeYVV RV\_`TYZUV\_Z\_eYVY`^VZJ`f\_XaV a]VZ\_eYV ]`h Vc dedef ^ YRgV eYZ:IZ`RXV Rd h V]]LeY`f XXL aRceZff [Rc]j ^ R]VZ

#### FY`UhcbU``]a U[Y

EYVÅV aV a]V]ZVSVZ XhZY eVVZ VK\* Zj, R\_UL VåVIZA][jLeR]\Z Xe`VRY ^ V SVŽEYY TRoj`fe RI&&&ZdR\_UX`fehZY eVVZ VK\*ZXČEYVK\*Zj ZIRa]RIVhYVVZd^ V SVd]VRc\_e`cVR\*Zj ZIRa]RIVhYVVZd^ V SVd]VRc\_e`cVR\*Zj e`VdeVy UZIFdIa`]ZZTdR\_UdTZ&jŽEYY] [ZV e`dWVK\*Zj S`\_UdZ\_eVc^d`WZR]`XFVŽ2]eY`fXY eYV RV[RXV]j UV\_USj eYVZ VK\*ZZDEZZZ]eY`fXY eYV\_]j a]RIVhYVVeYVZ ZJV\_eZj ZIT\_defTeVLŽ 2TeZZZdR\_UcV]RZ\_dZad`feZDVeYVVK\*Zj RV Rd gVg Z a`ceR\_eVcaV a]VhZY eYZIZ RXHhY` ^ R.Vfa "(~`VeYVZ\_eVcZAh d?`a]VŽ:edTYZWV ac`a`\_V\_edRVaV a]VZ\_eVYZXVcdeRef^ ]ZZZ X Z DR\_eXX HR\_UZZIWF\_UZ\_R]]RXVXc`fadŽEYV&V RVaV a]VhZY T\_dZVdS]VVUFTRZ\_R] TRAZRJL BcfaUhjjY<sup>•</sup>]aU[Y

EYVÁVAV a]VdZV\_e&j ZlUV}\_UUR^ `deVITfł dZgVj Sj eVZCVP ZZdŽEYY U \_`eTRoj `fe^ R\_j VP Zj RISZZdESfeeYVVP Zj ZITJVR j hYVOVY YRgVV\_[`j UUAV dv]gvd^ `deZ\_d/TV\_eeZ VŽEYY eV\_U\_`ee`X `fe`VeYVY fdVe`XeVAER\_UeVy RV\_`eZ\_eVCAEVUZ\_a`]ZZTR] `cd`TZR] ac`S]V dŽ EYVZCVP Zj Zd ReYVcd ^ VeYZ\_X dv]VW\_T]`dVU hYVCVeYY TR\_}\_UCAER\_Udfaa`ceŽEYZdZdeVV Z RXVdYRCVUSj eVV]REX(deac`a`ceZ\_`VAA`\_ł UV\_ed1%5″ /ŽEYVaV a]VT\_TVc\_VURCV]ZVJj e` ]ZeVZ\_d d?]RCVREZj dAcXdV\_eVUŽ

#### GYZXYbmb[ ]a U[ Y

EYVZ\_eVccV/ReZ\_dYZaSVehW\_WP Zji R\_Ud TZkej

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<ul> <li>– ¶ ÝaäÅOĺžë¶ ‰Ý¶ g¢ aøäannanna</li> </ul>		∺_7@ <b>~4</b> [200	പ∎⊥്റം≊ം	>Z %00	 നിന്നും പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗം പ്രസംഗ പ്രസംഗം പ്രസംഗം
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n	PP	rp	PP	TP	FF

>¶ï ÚgznäÁlźÁOÓzqä¶²äæezä] OÝÓ/á¶%äæezäB1Ł; äl Oed¶²O&a>ï Útzonai þþ½É

Zdd^VeZ\_VdT^a]V^V\_eRg R\_Ud^VeZ\_Vd`\_V `Waa`dÆZ\_ŽEY`dVhY`Y`|URyUVeRIYVU%Z`RXV `WeYVWR^Zji RcVRdaV1ZRj1RdNŽEYV/U\_`eUV}\_V eYV dygydZ\_dyReZ\_e`eYVZcVR^ZZddSfeeYYjU \_`eU`d`Z\_cVjReZ\_e`d`TZkej VZeYVZ`eZdoReYVceYV `aa`dzeveeYvzcuveriy^V\_evov^ eYvzcur^ zzdzd`W RaZNVhZeyeYVZeUVeRIY^V\_eW/^dTZkijŽEY`dV hY`YRgVeYZdZ'RXVRcV\_`eXgV\_e`WcXZ\_XhZ.V d TZR cVReZ\_dYZadLR\_U eYZd Zd cV-VTeVU Z\_eVVZc YZXY dReVd` Wa' TZR] R^ ` dR]ZA^ R\_UZ\_e`]VdR\_TVŽ:\_ XV\_VCRULeYVjeV\_Ue`eR\VR\_VXRezeVgZuh`WeYV TYR\_XXd eYRe YReV TIf ccVU Z eYV T f\_eq R\_U WWJT\_WWWWSjetVŽAVaJVZ\_etVyUVeRIYVU‰ TReVX of XV\_VcR]j TfeeYV dygVd`WWdV^ VR^ Zj R\_Ud'TZR] cWWcV\_edLSfe\_`e SVTRfdVeYV/ YRgV  $R_VaVIZA]_j YZXY UVXW VZ_UZZLFRZARZ_, Z_$ WATE EYY REVEV VREZ UZZLI RZKUŻCREY VLEY V WW eYRe eYVZc VR^Zj `WWkd\_` ReZeVe` eYV ac`S]V^dTcVReVUSj d`TZVejLSfeRTefR]j eV\_Ude` dvác UfTV cR a]ZijVeYV Ž

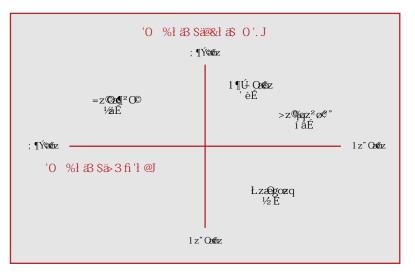
 $EY dV hY YRgVRycVReZ_R]\%Z RXVRcVZ R$ UZWWEV\_edEFReZ\_ŽEYVjRVjkc^Ra`dEZEVZ'RXV`W d TZK j R\_UVdeRS |ZY dec`\_X |Z\_\dh ZeY ZeŽE YVj RcV eYV^ `dee`]VdR\_eR\_UUV^ `TdReZIR]]j `dZV\_eVUR\_U eV\_Ue`eR\VR^ `cVMg`fdBS]VgZMh `WgYVTYR\_XVd Z\_eYVT\_f\_eqŽ4`\_d\bfV\_ejjŁeYVj\_RcVac`fU`W 4YZ/VŽEYVZcWR^ZjjZ`RXVZd\_`eeYRe`WRXc`fa T]  $dVRXRZ_ded TZkj, devVeLzeZdeVVV acVdZ_ <math>W$ eYVZ RXVeYV YRgV WaV a VL WeYVZ WLdR U cZXYedŽEYY eYV dygvdUZa]B eYVYZXYVeUXXW `WZUZGZLFRZZREZZ ZeYVCR^a]VRUdWeYVNR^ł Zj RdRa|RIVhYVVZUZZIFRZj TR\_SVCVRZVU R\_UhYVCVaVa]V]VRc\_e`cV[ReVe``\_VR\_`eVVcŽ EYVac`S[V' RdeYV dWZeZd\_`eeYRed TZA YRd TYR\_XULSfeeYReeYVhR, WR ZZdRcV\_`h`cXR \_ZKVUUVd\_`eR]`heYVZc^V^SVcde`UVgV]`a eYVZcZ\_UZeZUFR]R\_UdTZR]gTReZ\_ŽAVcYRadWc eYZd CVRd\_LeYVj eV U e`Rddvce eYRe eYV VR Zj Zd  $R_Z$  dezef e $Z_Z$  Tozotkóž

EY dvhY Y JUL ` c' REZY & UydyWUV\_j Z\_X Z RXd` WAYVWY Zj eR VR dRYVC\_VAREZY gZh ` W d TZdj R\_U eYVTYR\_XdZe YRdf\_UXX\_VZE YVZ Z dEZ Te Zde` hZEYURH W/^ d TZdj R\_U^R/V eYVWY Zj eYVZc`\_]j dZ{Z TR\_eh`dJUŽ:eZdhYV\_ eYY RVhZEY eYVZ: WY ZZdLZ\_WRELeYReeYY WWJ ^ `de a Roe `Wd TZA'g Ž:\_ eYZd ckda VTe eYY UZWWC  $dZ_{\pm}Z_{\pm}TR_{\pm}e_{J}$  W/ ^ eY dV hY Y ]U `eYkc Z RXkd `WeYVWP Zj Ž

H YZIVS` eY eYVAVXc f ad YRgVR\_VAE262VRe2Z ef UVe`hRdUdd TZAġLeYVAVReV^R`c UZWWAV\_TVd SVehW\_ eYV^ŽCVacVaV\_eRe26vd` Wy\_`c^Re26vm VY ZZAd dW^ e` hZeYUCH W/^ d TZAġ\_`e SVI TRf dVeYVj ReVCKREZ\_XRXRZ\_deZeSf e SVIRf dVeYVj V^S`Uj TVæRZ\_ ecRUZZ\_R] TF]ef dP] ecR26d h YZIY ackgV\_e eYV^ W/^ dWZ\_X h ZMc d TZAj daRIVdRd a`ddvdZ\_X R\_j dZX\_Z TR\_TV` WeYVZc` h\_ŽE YVj dW^ e` SV UVERIYVU W/^ d TZAġ SVIRf dVeYVj }\_U^ VR\_Z\_XRJ^` de VI TJf d2gVjj Z\_RY`^` XV\_` f d U^ VdeZTR\_U]`TR] ZWZE YZEZ\_ eVV2c[f UXV^ V.et.Zi h YVCVeYVZc dZX\_Z TR\_ES`\_UdRvUvgVj aVUŽ

 $\begin{array}{c} & {\rm EY} \ dV \ hY \ R_{\rm M} \ c^{\rm A} \ R_{\rm y} \ dM \ UV_j \ Z_{\rm x} \ & {\rm Z} \ R_{\rm x} \ & {\rm W} \ \\ & {\rm eYV} \ & {\rm W} \ & {\rm Z}_j \ {\rm LS}_j \ T_{\rm eR} \ & {\rm H} \ {\rm R}_{\rm y} \ \\ & {\rm eXV} \ & {\rm W} \ & {\rm Z}_j \ {\rm LS}_j \ T_{\rm eR} \ & {\rm H} \ \\ & {\rm eXV} \ & {\rm W} \ & {\rm Z}_j \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm A}^{\rm a} \ \\ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ & {\rm eXV} \ \\ & {\rm eXV} \ & {\rm$ 

\$'%B=łä' '- O'zÝa¶%aaaza%Qo-@%aQÅzVýz2aO'zÝÈ



>¶ï Úgznai ÚzÁOÚzqa¶°äæezä] OÝÝä¶%aæezäB1L; äl Oæ¶°O®≽ï Údzonai þþ½Ê

$$\label{eq:restriction} \begin{split} & \text{RV}\_`e\_\text{Ref}dR] \text{Sfe} \end{tabular} \text{TXdg} \end{tabular} R\_U e^{T}\text{R}_{\text{A}} \text{TXdg} \end{tabular} \text{TXdg} \end{tabular} R\_U e^{T}\text{R}_{\text{A}} \text{TXdg} \end{tabular} \text{TXdg} \end{tabular} R\_U e^{T}\text{R}_{\text{A}} \text{TXdg} \end{tabular} \end{tabular}$$

### H 9 D 5 F 5 8 C L = 7 5 @ = A D C F H 5 B 7 9 C : H + 9 : 5 A = € M

E`4YZVR\_deYVVR^ZjZleYVa]RIVeYReUV}\_Vd eYVZcZIV\_eZejŽEYVjWWjdvTfcVeYVcVLR\_UZeZehYVcV eYVj V\_[`j eYV dVjgVd^ `deŽEYVj h`f]U ]ZVe` XZeVVeV\_^`dVeZ Ve`ZeŽEYVVR^ZjjZdZ a`ceR\_eŽ 3feeYZUUVd\_`e^VR\_eR\_jejaV`VWR^ZjZd acVU  $^{Z}R_{d}$ [Vddd2] eYReeYZdZ a`ceR\_TVZ a]Zd R]RI\`Wac`S]V^dŽH\Y'dfYXca ]bUbh]a U[Yg' cZhYZJa]mghYaZica dfcVYaUhJWYIdYf]! YbWYgcZgcWYhm H.]gaU\_Yg]h\UfXYfZcf ZJa]]Yghc VYWca YgUhgZJWhcfmd UWYgZcf h\Y`dYfgcbU``UbX`gcWU``XYj Y`cda YbhcZ h Y]f a Ya VYfg EYVaRcRU i ZR] }\_UZX`WeYV F?5A#!!"DfogVjdYf]USVdec`\_XjjV`aYR dXxU+hYZveYvW?ZjZthYReU}\_vdeYvZv\_eZj `WeYV gRole ^ R[`cZej` `W4 YZJVR\_dLRS`fe'!″` `W eYV^ eYZ\_\eYReZ\_ZdadVdV\_eWc^ZeZdRdfcTV `Wec`fS]VR\_UT\_~ZTeL`cZdZ\_ToZKZŽ

EYVViaV2Z/TVeYRe^ R\_j aV a]VYRgVYRUhZeY [ZWZ\_dTZkjŁR\_UaRceZIf]Rc]jhZeYdjdeVdR\_U  $\mathbb{Z}$  de  $\mathbb{Z}_{d}$  \_`eac`gZVeYVSRCKIWcRcReXNMe`cj\_ViaV2Z/TV `WaVkd\_R]UvgVj`a^V\_eR\_UT]]VTezgVSVj`\_XZ\_XŽ :\_bfVde`WeYVWc^VELhZeY\_`hYVcVVJdVe`efc\_ WceYVViaVZZ\_TV`WZZ]`XfVR\_USV]`\_XZ\_XLeYVj hZeYLdRh Z\_e`eYVNR\*ZjjŽD ^ V}\_UeYVeYVdR^ V UZKVIF ]&ZdR\_UT \_~ZTedRdZ\_d TZKgLR\_USVT ^ V UVERIYVU W/^ S`eYŽE` `eYVceLeYZIhZeYUcRhR] ^ VR\_dRcVRWc^ ReZ\_ `WeYVecRLZZ\_R] ZNReYRe `\_]jU^VeET]ZWIR\_ac`gZV^VR\_ZXR\_Udfał a`ceŽ@eYVcddeZ]RcVRW&\_eVUSjhYReeYVjViaVcZ V\_TVRdd TZR V/T]f  $dZ_R U^{R}$  V/V/ZCVR\* ZZ $dZ_{e}$ RCWWWW/M/ d TZKjłR\_UZ\_ ^ R\_j TRdvdRXRZ\_deZEŽ =Rdelj1Ld^ VaVa]VLhYZV\_`ehZthZ\_Xe`ScVR\eYV ]Z\_\SVehW\_d`TZVej R\_UeYVNR^Zj `ce`hZeYUeRh

 $\underline{Z}$  e` eYV]ReeVeLUZET gVc e` eYVZc VorderReZ\_ eYRe d`TZKej YZ\_UVcd eYVUVgV]`a^ V\_e`VeYV\Z\_U`W VR^ Zj cV]ReZ\_dYZdeYReh`f]UV\_RS]VeYZd]Z\_\e` SV^ RZ\_eRZ\_UVŽ

Dec`\_XVR^ZZIdRcVRSRdZTacVT\_UZEZ\_WcYfł ^ R\_ UVgVJ` a^ V\_eŽH ZEY` feeVV` ŁZEZUUZWIf ]ee`  $RIYZgVeYV \setminus ZU$  VaVcd RIVgV a^ VecVbf ZVU WERD TZG VIRIOZVIZ OVAROVULOM VIANZR OZ UZ gZLf RjdŽ3f eeYVdecV\_XeY R\_UTV\_edRjZj\_\_WUVURcV \_`e`WeYV\Z\_UeYReeYVUReRcVgVRJŽ:\_4YZJVLeYV Z'a`ceR\_TV`WeYVWP^Zj; WebfV\_ej; UKoZeVdWV^ eYVhVR\_Vdd`WdTZkejR\_UeYVUZWTf]ejaVa]V YRgVZ\_RIYZkgZ\_XaVcd\_RJUkgVj^a^V\_eeYVcVZEYZd  $\mathbb{T}\underline{R}_{c}$  of  $\underline{c}_{z} \mathbb{Z}\underline{e}^{2} \mathbb{R}$  of  $\mathbb{R}\underline{c}\mathbb{Z}\underline{Z}_{z} XXc$  f\_UWcd/WWW\_TV RXRZ\_ded TZK jŽE YV deV\_XeY `WeYV 4 YZVR\_ WP^ } Zj ZIR<sup>^</sup> SZAF <sup>^</sup> f d.SVIRF dVZe ZIR deV\_XeY eYRe TR\_ SVefc\_WRXRZ\_de\_eYVcVdeŽEY\_dVhY\_deReVeYRe WAY Zij X RIdR U cV[ReZ\_dYZadRcVR] eYRe ^ ReeVad RtVf of Riji eYVgVoj aV a VhY RtV^ `de UZdecf del WeYVcdŽ

EYZtydetV\_XeY%daVR\V\_ddTZkijłR\_UTR\_SVT^V RecRaWceYVWYZj ZedyVXH\Y`acfY`h\Y`ZJa! ]`micdYfUhYg`Ug`U`WcadYbgUhcfmigcifWY`cZ a YUb]b[g'UbX'`cmU`l}Yg'h\UhUfY'dfcdYfm gcWJU'z'h,Y'a cfY']h]g'kY][\YX'Xckb'Vm UXX]hcbU'`XYaUbXg''H,Y'kYU\_bYggYg'cZ gcWJYmiUfY'h\ig'hifbYX']bhc'U'gffU]b'cb' h,Y'ZJa]m'EYZdYRaaV\_d\_`e`\_]jReeYV]\&J`W ^ VR\_ZXdR\_UV`&Z\_d.SfeR]dReeYVaCREZR ]\&J'`WREZ\_ŽAZgRZARZ\_ R\_UUXXF]REZ\_`W SRDTV&^d`WITZ]d/If Czj 1YVR]eY'TR\LaV\_dZ\_d. h`c\L\UfTRZ\_/YRgVerR\_dWckUR]RXVSf d.V\_ `WXda`\_dSZZgi`\_e`eYVW?ZjZEYVa\CT\aeZ\_ `WRTCZEZZ eYVW?Zj eYRedfUZdc\g\R]Zl]RX\j Uf Ve`eYVdeRZ\_eYZl`g\c]RUZda]RIZ\_X`\_ZHR\_U e`eYVVa\CZ/TV`WY`hW?ZZddecfXXJVe`T aV hZeYeYV\_Vh&Rc\dRZZ\_VUe`eYV`Sj Tf]efcR] TYR\_XZZ

:eZL\_Ref d?] W&WY ZZde TYR\_XVRd TZdj U VŽ 3feac S]V dR:ZU/hYV\_eYZdTYR\_XVScZ\_Xd\_Vh cVda`\_dS:ZZZdeYReReV\_`e^ RETYVUSj eYVUgy] `a^ V\_e`WAZ]de T aVhZeY eYV ŽEYVdVdZ]d ReVf dfR]jj ac gZUUSj d TZdj R\_U d TZAJ S`\_UŽ :eZdeYf daRceZIf]Rejj UZJVIF]eWcd TZdj R\_U eYV WY Zj hYV\_eYV]ReeVcZdWcTVUe`UV}\_VZedJVAdR UWW\_TVRARZ\_deeYVWc^ VŽ



## 69-B; <sup>·</sup>5 <sup>·</sup>K C A 5 Bž69-B; <sup>·</sup>5 <sup>·</sup>A 5 B <sup>"</sup>H s → D5 7 HC: <sup>·</sup> 7 < 5 B; 9



K \Yb h Ym`cc\_ UhW Ub[ Yg']b [ YbXYf fY`Uhcbg Zca h Y dc]bhcZj ]Yk cZh Y ]bX]j [Xi U`]miUbX Yei U`]mih Ym XYg]fYž dYcd Y Uddfcj Y cZh Ya `][ \`m'k \Yb']h Wa Yghc h Y cddcfh b]]}YgUbXdfcV Ya g ]bj c`j YX`]b fYU`]n]b[ h YgY XYgfYgXUmVm XUnž \ck Yj Yfžh YmgYY h YgY W Ub[ Yg Ug U a U'cf gci fWY cZWcbĴ]Wh

## H ± 97 < 5B; -B; FC @ C: K C A 9B

7`c^`de aV a]VLeYV hRj h`^V\_dc`]V YRd eYVT f\_egidTf]efd?] TYR\_XdŽ@VR] eYVTYR\_Xd Vg`]gVUZd`\_V`VeYV^`de`SgZfdd\_^ae`^d`W aVcTVZgVLLVkeYVc^`dvLzZdeVV`\_VeYReZdgZhVU ^`dea`d&zgyljŽEYVF?5A#!!" Dfcgyl dr`hd eYReeYVUZWWCV\_eXc`fadTgyl&UUSjeYVdR`a]VR&V Re`\_VZ\_eYZIRdbldd`V\_eŽ

EYVZ\_łUA eY Z\_ekcgZhdck@kl] eYRe eYVTV\_ecR WRef cl^ WYZL\_Vh dEf ReZ\_ YRcISW\_ etVerR\_dEZ\_ W/^ Rc`]VTV\_ecNU`\_ ^ `eYk?Y` UR\_UY`f dY']U RU^ Z\_ZhEREZ\_ e` `\_VeYRe eR\kdZ\_ eYVh`cJU`W h`c\ R\_Uaf S]ZT RIEZEZCZ

K \ Uhi \ Ug W Ub[ YX mci a cghB

ÎK cf\_ž]hý XcbY a Y [ ccXhc [ Yhci hcZh Y \ci gYÅ UbXh Uhý h Y a U]b h ]b[ ž=h ]b\_ž [ Yhh]b[ ci hhc k cf\_ WUb[ Yg Yj Yfnh ]b[ 'Ï fl Ya UYžUXi hži fVUbža YXli a !ck 'Q9, Ł

 $\label{eq:restriction} \begin{array}{l} AReeZIZAReZ_Sj h`^ V_ Z_ Wc^ R] h`ch`fedZV\\ eYVY^ VYRda]R_ WURTV_eR_ c`]VZ_ eYZITYR_XXZ\\ EYVcNRd_ Wc Ze ZleYV_WU Wc YZXVc VRc_Z Xd\\ d eYRe U^ VedZT`S[VFeZgVd eYV^ cMgVd TR_SV\\ RIYZ&gVLZ9 ZXHbf R]Z_ i VUFTReZ_LYVR]eY TReVL ZV_ eYZ fTReZ_ eYc f XY T_d^ aeZ_LcVR04ReZ_L\\ R]] eYvdVeYZ_XdUV^ R_U^`cVR_U^ `cVZ_T^ XZ\\ 4`^ SZ_VUhZeY eYVZ_cdeSZZ_ eYReZIRWRef cV`W\\ eYV]RS`fc^ RcVeLeYZHYRdUZgV_h`^ V_Ze eYV\\ h`cVWCIVZ \end{array}$ 

4f Jef dR] R\_UUV^ XRaYZTYR\_XdYRgVRjd RII T^aR\_ZUR\_UV\_T fdRXU eYZIac`TVdŽD^R]Vc VR^ZZdL^``dVW^RJVY`fdY^]UYVRUR\_UeYVcZV `VZ\_UZZJFRJZRZ\_YRgVTcVReVU`aa`cef\_ZZdUVc h`^V\_e`Raac`RIY eYVZ:dVJVARJZREZ\_W/^ R Sc`RUVcaVdeVTeZVeYR\_eYRe`WeYVY`^ VŽ

2\_`eVc Wate c ZleYVa`hVcW] Tf ]ef cR] `f eaf e `VWV Z\_Zt`hYZIYŁW/^ eYVaVcdaVtëzgV`Wobf R] cZXYed\_YRdTYR]]V\_XU eVVa`hVc^VTYR\_Zt`dcVf dezTeZ\_Xh`^ V\_`dZV\_ezgi e`eYVY`^ VŽE YZIYRd XgV\_ cZtVe`af S]ZT`a`]ZIZd eYRe RcVTcVRZ\_X R\_ Z\_eVcVdz\_XVR^ Vh`c\ Vc eYVacRtëZTR] ac`TVd1`W cUVJ\_ZXWV R]VZJV\_ezzVdŽ\_4 YZVLeVcVRcV[Rhd R\_UZ\_ZZRezgVdhY`dvVWWatd cR\_XVV6/^ eYVac`ł ^`eZ\_`VWcVReVcVbf Zgi Z\_T\_[f XR] cV[ReZ\_dvZad e`eYVTcZ\_Z R]ZReZ\_`VWM f R] YRRdt' V\_eZ\_eYV h`c\a]RIVŽER.V\_R]] e`XVeVveRUZZ\_R] Vbf Zgi XRa SVeh W\_ ^ V\_R\_Uh`^ VŽ

 $H YZ V dZ ZZ R_e Z e V T f e j d YZ e c ZR$ 

 $\begin{array}{l} UVgV_{a}^{A} V_{e}LeVdVTYR_XdRVdeZ] Z_TZaZ_eSj\\ Z_eA_RZ_R_deR_URUdŽ > VRf eVUSj W^R_VaRd\\ eZZREZ_Z_eVVh`c\WcIVR_USj XV_UAcVbfZj\\ R_UV^a`hVc^V_eL_Vdtac`XddYRdSW_^RUV\\ Z_4YZVeYR_Z_dZ`ZRcjj UVgV_`aVUTf_ezZd\\ VjdhYdXZ \end{array}$ 

K < 5 HK C A 9B 5 CD F9 HC . 5 K = 89F 5 B 8 A C F9 9E I 5 @K C F @8

7f]] a Rez ZZ RZ \_ Z d TZ gi eYc f XY h 'c' R\_U Vof R] cZXYed ZIR X R] eYRe h ' ^ V\_ Rob ZV e Ž: e Zd \_`e[f de VRc\_Z Xa ' h Vc eYV f dW ŽE YV f R]d dW eYV a` eV\_eZd e` R\_NC^ eYVZc Z UZgZL f R]Zgi R\_U af cdf V eYVZc a Vcd\_R] UVg/\`a^ V\_eL d ^ VeYZ X eYRe Zd UV `\_dedReVUSj eYVUZWWZ X^ VR\_Z X deYRe ^ V\_ R\_Uh` ^ V\_ ReeRIY e` h `c' udW efS]V( SZ

2eeYVd? VeZ VLh`^ V\_Z eYVY folhZydR\_U cleZtVddX? V\_eVlacVdRUv2EVe`U`d ^ VeYZX UZWWZV\_ehZeY eYVZ:]ZzVZ

 $\label{eq:linear} \begin{array}{l} 2 \ X & R_j \ h^{\ } \ V_h & Z & S \ R & A \\ \hline & R_j \ h^{\ } \ V_h & A \\ \hline & R_j \ Le & V \\ \hline & R_j \ Le & V \\ \hline & R_j \ Le & V \\ \hline & R_j \ Le & A \\ \hline & R_j \ Le \ Le & R_j \ Le & R_j \ Le \ Le & R_j$ 

@ ∕. ł ăiè O z OF ∉ " a¶‰an¶Ú độ ¶Ú ∉ " äÅz¶Å@ àối ] ÝO-Å@ ÈQÅzÚzz² a67 z ÝÈ

; œlDÝz äæeDej z Ýæjqz ÝgÚj z Ýão œDeëo¶ï Lá ö¶Ú ä-z CP Ýäe¶ao¶ï nauuuuuuuuuuuuuuuuuuuu	aaaaa OQ aaaa	z÷ ñaä\$z−O®zää	
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4`\_W\_eWhZYRhZVch`dUh`^V\_d&ARaV eYVZ: dMWZ`RXŽHZY eYZl\_Vh ac`daVTe SW&V eYV`ŁeYY\_UZT`gVcZ\_eYV`dMgVdTRaRSZZZdWd ^Vcj\_UV\_ZUSj\_eYVecRUZZ\_R]c`]VZ`a`dWfa`\_ eYV`ŽEYVd&f]eZHZXYVcdMW&W^Ž

Î=ĨYYXY Y'C dYXĨ=ZYY`a CfY ]bXYdYbXYbH' : ]fghcZU`Ĩ=ZYY`=Ĩi fYgdYWhYX`a cfYÅ`Am \igVUbX`]gU`a U`Y`WU`i j ]b]gh'\Yi\ci [\h k ca Yb k YfY'h YfY'gc h YfY Wc'i X`VY gca YcbY Ufci bX hc k U]hcb \]a "Cc i\]g h ]b[ Ĩh]g`W\Ub[ YĨ\Ug`a UXY`a Y`[ fck UbX` fYgdYWia ngYZUbX`]h\Ug`a UXY`a Y``] a ngYZVYIHYf Ug`k Y``Ï fl Ya U`YĨUXi hĩ h\Ubĩ\][\@, Ł

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EYVXXR4VædæRZ\_ZIZ\_eYVCVJRZ\_dZaSVehW\_ h`c\R\_UVR^ZjŽHYfY`]gUVcbÛJWhVYłkYYb` h`Y`lfUXJljcbU``XcaYgłJWXYaUbXgik\JW` Xc`bch[c`UkUnžUbX`hY`bYk`XYaUbXgi cZkcf\_"ERSJV(&dr`hdY`heYVeh``gVcJRaZ\_ h`^V\_d]ZgVdLX&ZXCZVe`hYReYRdSW\_TRJVU eYVZ:yU`fSJVh`c\Z\_XUB9%ZEYVCZefReZ\_ZlaRd eZf]RcjjUZWIfjeWch`^V\_YVRUZXY`fdVrJUČZ

4`\_~ZTeZd\_`eT\_}\_VU`e`eVVT\_eRUZTeZ\_d SVehW\_^`UVc\_h`c\R\_U eVV eeRUZEZ\_R]VR^{1} Zj Ž?VhZ RXVd`VVEYVR^Zj ReVRJd RdfcTV `WdeeRZ\_ŽEYVh`^R\_Zd\_`]`\_XVc VfaVTeVU e` hRZe`\_YVc Yf dSR\_U`c]``\RANC eVVTYZUEV\_ R]`\_VŽCREYVELdVVZd VfaVTeVU e` SVR aZJRc`W eYVZc Z\_UZEZUFRZAREZ\_ a]R\_dŽEYV\_VhZ RXVd`W h`^V\_dc`]VZ\_eYVVR^Zj UV^R\_U eYRe d/VTeVI ReVR\_V\_gZc`\_^V\_e hYZTY WdeVcd YVc TYZUEV\_d dylWdeW^ ŁJWC\_Z XTRAFSZEZdŁdylWeWJZC\_TVR\_U RSZZEJ E CYJREV E `EYVCH R\_U CVCHVEWZC\_TVR\_U R\_UHYZTY ac gZJMYVCYF CSR\_UHZEY CVT X\_ZZ\_ R\_UV^ `EZ\_RJ CHEZHNIEZ\_Ž.\_ `EYVCH` CULRCHHRd CW\_ Z\_VRCJZC TYRAEVCLEYVW? ZJ ZIVI AVTEVUE ERVRJ^ `CEVITJF CEVCHXLEYVW? ZJ ZIVI AVTEVUE ERVCHVERVLEYV REVIZE ERVCHVERVLZEVTF JEE AVCVC^ Z\_ EVV CHJEVEL EVCHVERVLZEVTF JEE AVCVC^ Z\_ EVV CHJEVEL

@\_ e`a`WeYVdeRZ\_dZ\_eYVY^VLeYVXVRV eY`dV`WeYVh`c`a]RIVZ7`ch`^V\_LeYVUZWIF]ej `WRLRaeZ\_Xe`eYVaRIV`WyeYV^RIYZ\_V&hAZYR]] ZedT\_dbfV\_TVdWceYVUVgY`a^V\_e`WREZWI e`g`Z\_UZgZLFRZREZ\_LZTT^a`f\_UVUSjac`S]V^d daVTZ\_Te`eYVcXV\_UVcZEYY\_RVaRZU]VdHYR\_ ^V\_WcVbfZgR]V\_eh`c`R\_UYRgV]VdHTYR\_TV`W ac`^`eZ\_Ž7fceYVc^`cVLeYVZ.h`c`Z\_XdEfReZ\_ ZLUAV\_UV\_efa`\_eYRe`VeYVZ.YfdSR\_ULdZ\_TV hYVcVeYY\_JZgVR\_UhYReY`fcdeYY\_V&a YRgVe` SVRcR\_XUWceYV]ReVcdT\_gV\_Z/TVZ

$$\begin{split} H & \land V_W [et ReeYy RVR] h R_d & ez Z [Reh`c`L RdZWeYVZ; RSZZej e`U et Z_XdRdh V] Rd & V_h V V Z_U f Se Z YZd [VRUdeYV`e`a] RIVVi et RUV R_U d'`_ et V dv[gvLaRez If [Rc] Z_et VRVR h Y V V et V] RV & `de [Z V] e`SVU f Se U R_U S V Ze [VL+et VZ; RSZZej e`T_ec`] et VZ; V`eZ_Z$$

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EYf d.e' h`^ V\_dU fS]Vh`cZ\_XUJ; ZHUUU eYVyU fS]VdedZ\_%JRf dU Sj eYVac`TVdt`VUf] ef d?] TYR\_XŽEYVT\_~ZleTcAReUSj eYV\_Vh UV ^ R\_Ud`WeYVY`^ VZIT ^ a`f\_UUSj eYVdedZ\_ `WeYVZc h`c\Z\_X V\_gZc`\_^ V\_eZ 7 c bgffi Wf]b[` ]bX]j [Xi U`]mihc XUm]g`Xci V`mX]ZÚW` hZc f` U`k ca Ub"

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de g ŽEYY RV^ ` cVRaacVIZREZV` WAVVTYR\_XdŁ R\_UV\_[`j eYV Ž3VIRF dVeYY YRgVWhVcWr Zj cda`\_dSZZEZdŁeYY V a VCZ/TVeYV dcdZ d` VAV h` c\}Y ^ VcYREZ\_dYZa JVddZ eV\_dJj Ž2eeYVdr V eZ VLeY FXYLeYY dV\_dVe/ReeYVZacZeZXVU/dEF} RZ\_ZI`\_]j eV a` drg R\_UeYReZehZ] V\_UhYV\_ eYY Xké ^ RocZUR\_UYRgVTYZLEV\_ŽAVCYRadRdR cVdF JeL^ R\_j j` f\_XcVda`\_UV\_edacWVce` a` dra`\_V ` c Rg`ZUeYZddVaŽ

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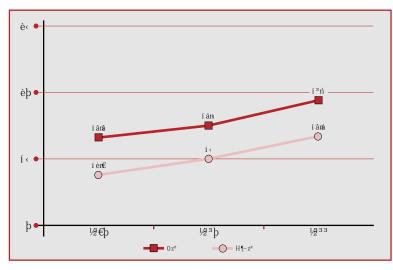
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EYZELYRELEN ^ R[`c T \_dbf V\_TVEZ 7Zcde]jŁ ^ R\_j h`^ V\_VaVZZ\_TVVE^ d`WUZEEZ Z\_RZ\_ R\_U gZ ]V\_TVEYRE eYY \_VgVc da`ceZD ^ VVgV\_ cVRcUeYV RelaRce`VeYV\_Ref dt]`dVc`VeYZ\_XZZ EYVhV]]L\\_`h\_ UZbRZEj SVEhW\_ eYVZ\_TZLV\_TV `WU^ VdeZTgZ ]V\_TVR\_U da`ceZ\_XcRevdZIRaRZ\_ł VM\_VR`a]V`VeYZZDVT\_UjŁZERWWECHEYVZ RXV eYY\_WC^ `WETZEj Re]RCXZH`^ V\_YRgV]Vdt UV^ `TCREZT R\_UTZEZTRh RV\_VdtleYR\_ ^ VZ

H`^V\_YRgVR[cVRU] ^ RUVXcVRede2LVde hRdLd dMVNUNEVC^ZREZ\_RUdMVNRaadVIZREZ\_LSfe]RCXV dVTeZ d`WeYVWY RVa`af ReZ YReVSW IVWY SVYZUŽ: VeYVj ReVe`d/ReVZ\_eYVd/RIYZ/gV^V\_eeL Ze^R,\_`eSVV\_`fXYe`UVgV\`aRUZET`fcdV`W V R TZAREZ R U ^ ` UVC ZKREZ Ž: eZd ` eR ^ Ref  $e^{t}$  W XXU af of Z XW eYV  $^{U}$  W ZREZ Z h`^V`dSWRgZfcRUZeWh`dURc`fUeW'Ł SVIRF dv eYZthZ] YRaaV R jhRjŽCReYVŁWW.ded \_WUe`SV^ RUVe`cVd`]gVeYVdaVIZ;TdedRZ\_deYRe ^`UVc\_ZkReZ\_Z\_4YZ[VZda]RIZXfa`\_eYV^Ž H\YYlWYggj YXYa UbXgcZhYkcf\_dUWY UbX<sup>·</sup>hY<sup>·</sup>Yl UWYfVUhcb<sup>·</sup>cZhY<sup>·</sup>ZJa ]<sup>·</sup>mUg<sup>·</sup>U<sup>·</sup> gci fWY cZa YUb]b[ `\Uj Y WYUhYX ghfU]bg h\UhUZYWik ca Yb'dUfhWi 'Uf'm' :eZdZVi  $eYRe Ryh^{\ }R_Ze\%LZET f cdV1dW=R^R_L#!!!/L$ [fdeZIVZ\_XV R\_TZaReZ\_d]Mj Sj cWWcV\_TVe eYV ^ RWW RV aa dez Łhż Yreve Xevhr e R UVSREVRS`feeYVT\_decRZ\_ecleYReTfccV\_eWc^d`W ^`Uvc ZReZ\_a RIV`\_S`eYh`^V R U^V Z eYVWW.ee cvRlZkVeYVZc lZWalR dcRezWRIe cZjŽ

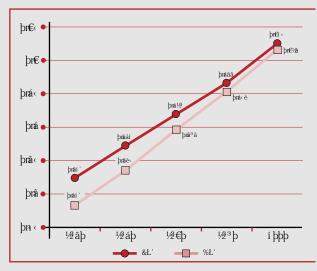
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<sup>%</sup>OÅäjzaözz²äoë – O°äqzõz¶Å–z²äoëqz÷äO°qä"z²qzĺåqzõz¶Å–z²äa ¢qz÷Z

ÇÎB> zzaOÅ2² q€3/38¶kâqza0@â¶8aqQ60g¶- ŶÝ€" ä¢ q&zÝÊ >¶î (ģzna) (źÅOźqa] a≅B 1 Ł; naj þþ\∕Ê k YfY`) \$1 ``ck Yf`cb`Uj YfU[Y`h\Ub`a YbÑgžUfY`bck` cb`mi')1 `cf`gc``ck Yf'

FYWe'[b]n]b['h]ghfYa YbXci gdfc[fYgg'[]j Ygi gU VYHWf UddfYWJUhcb'cZh Y'UW ]Yj Ya Ybhghe XUHY''' H]gXcYgbcha YUbž\ck Yj Yfzh Uh[fYUhWWU`Yb[Yg Xc'bchg]```]Y'U\YUX''K \Uh'g'h Y'df]a UfmWUi gY'cZ hY'[Ud'h\UhfYa U]bg3'7 YUfmbchk ca YbÑgWUdU! V]]h]Yg ]b hYfa gcZ\YU'h UbX'YXi WUhcbžh Ym\Uj Y' `cb['VYYb Ugk Y``'d UWYX'cb Uj YfU[ Y Uga YbžUbX' gca Yha YgVYHYf'FUh\Yfzh\Y'[ YbXYfYei ]m[ Ud hc! XUmigXi Y hc h\YX]gff]Vi h]cb'cZdck YfzUga Ub]Z/ghYX' ]b'UWWgghc a UhYf]U`fYgci fW/gžh\Y'Yj Y`cZYei ]mi ]b'YWebca ]W`]ZYž UbX'UWWYgg'hc 'XYWglcb!a U\_]b[ ' UbX'YUXYfg\]d'dcgh]cbg]b'gcWYmi'I b'Yggk ca Yb' dUff]W[dUhY'Z `mi]b'h YgYžh Y'UddfcUW.YgbYYXYX' hc i bXYfg]UbX'UbX'U'hYf]bYei ]mi]b']gWi ffYbhZcfa ' UfY'i b'\_Ymhc'dfYj U]''

HY [YbXYfYa dck Yfa Ybha YUg fY fl 9A Hzdfc! Xi WX Vml B8Dhc a YUg fY k ca YbhğdUfhWdUhcb ]b gcWYhmỹg dc ]hWU UbX YWebca [WXYWgcb!a U\_! ]b[zWYUfm] i gfUhYgh gghi Uhcb. 7 \]Y fUb\_g cb m Ze flmib]bh. ci hc Z\* (Wei bhf]YgUfci bX h Y k c fX Ze f k ca YbhỹYa dck Yfa YbhžU ghi Uhcb h Uhghgc XX m k ]h ]hg ][ \ fUb\_]b[ Ze f \ i a Ub XYj Y c da Ybh[ Yb! YfU m

5 'XYHJ'YX 'cc\_'Uh h Y XJZYfYbh XJa Ybgc bg cZ h Y; 9A 'fYj YU`g h Y a cgh Ja dcflUbh ZJWYhg cZh Jg gh Uhc b''5 hdfYgYbhžk ca Yb 'c X cb mU`ga U``dfc! dcfl cb cZY YWhYX 'dcghg 'f gh % cZa Unc fgž % 1 cZ a i bJWdU `Wei bW] cfg UbX '% 1 cZdUf JUa YbHJfJUbg UfYk ca Yb''H YgUa Y 'c Xghi YZcfh Y a cghfYgdcb! gVY dcghg Jb ch Yf gd YfYg cZdi V JWUXa JbJgfUh cb. 'f gh% 1 cZfY[ cbU``[ cj Yfbcfgfl*bhYbXYbhYg*ž% 1 cZ dfcj ]bWJU`[ cj Yfbcfgfl*c VYfbUXcfYg*ž% 1 cZa ]bJgfY! fJU``fY[ ]cbU``gYWfYHJfYgf*gYfYa Jg*ž& 1 cZa i bJWdU`` gYfj JWY `YUXgf*X/fYWcfYga i bJWdUYg*;UbX'' (1 cZ UddYU``Wei fh't X[ YgUfY k ca Yb''Bchk ]h gJUbX b[

#### @ / . ł äá€ %z²qz**ĺźz** – ŶözÚ z²*ä*ä²qz÷ä þþí äC?qäg¶ – Ŷ²z²äãOÚO] ®Ý

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h\YgYÚ i fYgž]h]g]a dcffUbhhc fYWc[b]nY\ck a i W.` dfc[fYgg\UgVYYb a UXY]bfYWYbhnYUfg]bUddc]bh ]b[k ca Ybhc dfca]bYbhdi V`]Wdcg]h[cbg"

H, lg X lgd Uf lmi lg U`gc `gYYb` lb`h.Y`df lj UhY`gYWrcf.` Ub Yl d`cfUhcfmYl YfWgY WebXi WhYX Zef h, lg FYdcfhi g\ck g'h\Uhz`ci h cZ &&2) \*- `Yl YWi hj Yg lb`h.Y`Wea ! dUb lYg Zef`k \ JW\` lbZefa Uhleb`k Ug cVHJ bYX`fHJ ` 9X]hcfYgz &&\$%4ž h\YfY`k YfY` i gh &z +% k ca Ybž cf` %&1 `cZh Y`hcHJ``C bWY`U[ U]bžh. lg X lgd Uf lmiWUbbch VY`di hXck b`YbhfY`mhc`g\_]```Yj Y`gz glbWY`(\*1`cZU``` dfcZygglcbU`g lb`h.Y`a Uf\_YhUfY`k ca Yb'`5``h.YgY Ú i fYgʻi be i Ygʻic bUV mfYdfYgYbh UʻW UʻYb[YʻZcfʻ gc WYhmUgUʻk \c Y"

K \Uhigh\Y`ghiUhcb`cZ[YbXYf`Yei]miUbX`Ya ! dck Yfa Ybhjb`h\Y`7\]YUb`fY[jcbg3

DUfhW `Uf`UbU`ngg cZh`Y`]bWca Yg`X]a Ybgcb`cZ h`Y`; 8=fk \]W`]gh`Y`cbY`h`Uhg`ck g'h`Y`[fYUhYgh X]gdUf]hYgL[]j Yg`ig`U`VYhYf`]XYU`cZ\ck`[YbXYf` UbX`[Yc[fUd\]WU``]bYei]hYg`cjYfUd"`Hcc"[fcidg cZfY[]cbg`]b`dUfh]W `Uf`gHUbX`cih`cb`h`Y`dcghj Y` gXYž]bYei]mi`YjY`g`UfY``ckYf`h`Ub`h`Y`bUhcbU`

\$'%B=läá %z²qzÚaz−ŶözÚ-z²aäë°qz÷äjøädź"¶?naĭþþíZ



$$\begin{split} & (\dot{\mathcal{A}}) = 2z_{*}^{2} \Delta^{2} q \mathcal{C}_{*}^{2} \mathcal{A}_{*}^{2} \mathcal{A}_{*$$

Uj YfU[ Y]b h Y A Yhc dc ]HJb FY[ ]c b UbX h Y FY[ ]c b c ZHUfUdUWz "H Y a c gh bY[ Uhj Y d]Wi fY [g gYYb ]b Ú Y fY[ ]c bg fb bhc ZJ[ Ug Už 5 HJWUa Už 7 cei ]a Vcž @U 5 fUi WUb JJ UbX A U[ U``UbYgL k \YfY h Y [ Ud VYhk YYb ZYa UY UbX a UY dUfh]WdUh]c b ]b h Y YWe bca mlgWe bgXYfUV m`Uf[ Yf h Ub ]b h Y We i blfm Ug U k \c Y fgYY UddYbX]] '%dL' 5 h h Y gJa Y ha Yž h fYY c Zh YgY Ú Y fb bhc ZJ[ Ug Už 5 HJWUa U UbX @U 5 fUi WUb JJE \Uj Y [ YbXYf Ya dc k Yfa Ybha YUg fY' j U`i Yg VY`c k 'h Y `bUh]c bU``Uj YfU[ Y" 5 g'U fYg 1ž UW [Yj ]b[ '[ YbXYf Yei ]mh YfY k ]``VY U'dUfh]W Ufm UfXi ci g HJg\_"fFY[ ]c bU`Ú i fYgZ fYUW cZh Y; 9A ` We a dc bYbhg fYZ/ffYX hc 'WJb 'VY 'UbU'ngYX ]b 'a cfY' XYHJ]`]b UddYbX]] '%c Zh ]gFYdc ffE" 6YWU gY cZ]gW a dYl [mžh gd Ybca Ybcb WUb cVj [ci gmVY UXXfYgYX Z `mcbmcbWY h Y]gg Y cZ [YbXYf Yei U]ma cj YgVYncbXh YfYU a cZdi V]W dc`]WnUbX VYW a Yg dUfh cZU k [XYf W h fU``XY! VUhY h Uhei Ygh cbgh Y k Umk Y W bgfi Wici fgc WU`` fY Uh cbg ldg UbX ``] Y ci f XUmh !XUm`] Yg': cf h Y` W U``Yb[Y a d`]Wh b h gX]U[ bcgg tc VY HJ\_Yb i dž h Y VUgWYei U`]mcZU``]bX] [Xi UgʻÚfgh YYXg tc VY` UVWY dhYX "K Y bYYX tc fYW [ b]nY h UhYj Yfnc bY \Ugʻ Uf][ \htc gYZfYU]nUh cbž YUfb tc fYW bW]Y cddcgb[ ` j U`i Ygž gc WU``[ cU`gž ]bhYfYgfg UbX 'Zc fa g cZW h fY` UbXžYgdYWJU`mžVY k ]`]b[ 'tc g\UfY dck Yfk ]h b ci f` \ca YgUbX`b gc WYm'

### H + 97 < 5 @ 9B; 9HC A 5G7 I @ B + M

$$\begin{split} & \text{EYVc} [Vd \end{tildelta} \en$$

 $\begin{array}{c} H YV_ `_V We Vc ]Vd IYR_Xd d U Vde V e V d.\\ R e Y e V da WUR_U UZ VIZ_ `WYR_XVU _`e \\ R h B d^ REIYZE YVX We d Z de A e YRe V TIF a VU \\ Z h `^ V d Z R Z R g R_U a d R e Z V V V d g \\ Z h `^ V d Z R Z R g R_U a d R e Z V V V e \\ Z h `^ V d Z R Z R g R_U a d R e Z V V V e \\ Z h `^ V d Z R Z R g R_U a d R e Z V V V e \\ Z h ` V d Z R Z R g R_U a d R e Z V V V e \\ Z h ` V d Z R Z R g R_U a d R e Z V V V e \\ Z h ` V d Z R Z R g R_U a d R e Z V V V e \\ Z h ` V d Z R X P & R I F \\ Z h Z d Z d Z e \\ Z d Z d Z R Z R g R_U I F \\ e V V V V R & R I F \\ Z d Z d Z d Z & R & R \\ Z d Z d Z d Z & R & R \\ Z d Z d Z & R & R \\ Z d Z d Z & R & R \\ Z d Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R & R \\ Z d Z & R \\ Z d Z & R \\ Z d Z & R \\ Z d Z & R \\ Z d Z & R \\ Z d Z & R \\ Z & R \\ Z d Z & R \\ Z d Z & R \\$ 

5F95GC: D9FD@9L+HM

EYZITYR] V XVe` ^ Ruff Z VZV & di YRdRZM e`gRg Z XUVXWdZ eYVUZWWCV edaYVXd` VURZj Z VZZTVZZITYR\_XXdZ h` ^ V eYReYRgVTR] VUZE Z e`bf VdZ\_ŁZZIZ eYVRXRZZ g`gZ XeYVXXR2Vde Z eVGREZ\_hZY eYV eYReeYV] VgY `VaVka]ViZj Zd YZXYVdŽ 4 YZVLeYZI^ RZ g' VR\_ddV]RZ dYZd hZYZ eYVRY Zj R\_UT fa]VdR\_USV6h W\_aRV ed R\_U eYVZ TYZUZV ŽE YZIZI hYVXVUZ6hZ e RS`fe aRecZCTYR] Rf eY` cZg LeYV^ RJV^ `\_`a`]j` VMI fR Z ZZRZZVLRF eY` cZg LeYV^ RJV^ `\_`a`]j` VMI fR Z ZZRZZVLRF eY` cZg ZZ ^ `UV] ^ VREYVCY` UR\_U eYVf\_V6f R] UZecZ6f eZ \_ `VVI^ VEZTVV\_TZ\_dZd V aVZV\_TVU Z aCREZVZE YVXVUGV]`a^ V ed RV SVZ XCVZ WCTVUSj\_Vh JRhde`ac`eVTeeYVRY Zj L TYZUZV\_ R\_Uh`^ VZ

EYV faYN Roll UVd\_`edW^ e YN gVSW\_d Xon Re Rdj Ve Z\_ eYV } VJUd`Va`]ZEZT dR\_U h`c\Ž EYZ LZ T\_dZEV\_e hZey eYV WATe eYRe ac Xoud Z\_ TO NEZ\_XV of RJ RITVOUW ch`^V\_Z eYV UN ROURD YRd SW\_T^ aRCREZ VJ aVTEVU W/^ eYV\_Vh\_J`XZ TR\_aVCYR ad SV VI aVTEVU W/^ eYV\_Vh\_J`XZ TR\_aVCYR ad SV VI aVTEVU W/^ eYV\_Vh\_J`XZ L`h`aVCREZ XZ\_eVV`cXR\_ZCREZ\_`VVh`c\Ž? Vh `cXR\_ZCREZ\_R] dEREVXZ dSRCMU`\_Y`cZk`\_ERJ\_VI X eZREZ\_R\_UT`aVCREZ\_cV/ReZ\_dVZadLR\_U`\_ ^`dV~VIZS]Vh`dZ\_XRcR\_XV^V\_eeL^RJ\_VIeV\_U eYVaVca]VIZsj\_RS`feZUV\_ezej e`eYVh`dZ\_Xh`dU Sj\_Z`aVcZ]Z\_X^ROHF]Z\_VRfeY`dZej Z\_eYV}VJU`W ^ReVcZR] ac`gzZZ\_Ž

#### 5 G=@9BHD9FD@9L=HM

3j T\_eRRehZeYh`^ V\_d]ZSVReZ\_hYZYYRd T ^ VT ^ a]VeVhZeYZV]`XXdtd TZd]^`g^ V\_edt USReVR\_UeYVT&ReZ\_`VR[ek\_ReZy^`UJdeYV dEf ReZ\_`W RdIf ]Z\_Zj TR\_aVeYRadSVd^ ^ VU f a Rd`\_V`WZV\_eaVa]ViZjZb dfUWfJWYZa U`Y` ]XYbH]mi]g`VY]b[ `WU`YX`]blc `ei Ygf]c bz`Vi h h\YfY`]g`bc `gc WJU`miUddfcj YX`Ub[ i U[ Y` k]h`k \]W.`lc `Uff]W `UHY`h ]gž [f de Rd eYVeV Zd\_`Sc` RU USReVR\_U\_` d TZd] ^ `gv^ V\_e Vec ^ V\_d ]ZSVReZ\_L]Ve R]`\_VZ\_dEZf eZ\_R] cWec^d `c RJeAc\_ReZyV^`UJ/df a`\_ hYZIY\_Vh adRieZVd TR\_SVSRMUŽ

 $:eZIRTET R]j h`^V hY YRgVX_VWeYVEZ REZT REZT REZT REZVERVER VY RUT ]Z.Z eVVEYVEZ REZT REZ A V REV VW RUT ]Z.Z eVZ VV REV V$  $WEYRE V YRGVX_VC ^ VhR e hRUCKVREV VD RZ Z eVZ VL A VhR e hRUCKVREV VD RZ Z eVZ VL A Z eVVEYC E Z eVZ E RZ Z R Z V EZ Z R Z V EZ Z R Z V EZ Z R Z V EZ Z R Z V E Z EZ R Z V E Z EZ R Z V E Z EZ R Z V E Z EZ Z R Z V E Z EZ Z R Z V E Z EZ Z R Z V E Z EZ Z R Z V E Z EZ Z R Z V E Z EZ Z R Z V E Z EZ Z R Z V E Z EZ Z R Z V E Z EZ Z R Z V EZ Z R Z V EZ Z R Z V E Z EZ Z R Z V EZ Z R Z V EZ Z R Z V E Z EZ Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z V Z Z R Z Z R Z V Z Z R Z V Z Z R Z Z Z R Z Z R Z Z R Z Z R Z Z$ 

ÎH YgY UfY IA Y IA Jb[g'IA UIA\Uj Y fYU`m[ch a Y k cf\_YX i džZYY]b[ IA UIA=Xi U'gcflicZ g'Uj Y UbX IA UIA\Y \UgbNii[fck b Ug'U'dYf! gcb"H.]g']g'k \UIAfYU`ma U\_Yg'a YZ f]ci gž ZYY]b[ IA UIAA YfY ]g'U'dUflicZ \]a IA UIAğ'g]``` [\_YU`]IAY Vcnžgc`\]g'a i a a m\Ug'lc``cc\_` UZAYf`\]a žcf`\]g'bUbbnžk \cYj YfÅ Ï fl Ya U'YZUXi 1ži fVUbž]bHYfa YXJUHY C9; Ł

7RIVU hZEY eVZtlf a YVRgRJLR\_U hZEY \_`eVZ\_Xe eVJ] eVV^Y h eVVZta`dZEZ\_dh`f]USVcV cXR\_ZXUL ^ V\_WVJ eYReeYVJ RcVcVda`\_UZ\_XdReYVc aRdZgVJj e`eYVTYR\_XXdSVZ\_XUZZV\_Sj\_h`^ V\_Ž

Î=h,]b\_ h,Uhfa YbE\Uj Y`\UX`hc`UXUdhhc` h,YgY`VXUb[YgÅ VmVY]b[`acfY`gi Va]g! g]j Y'Ï fA U'YžUXi`hži fVUbž`\][\`G9, Ł  $6gV_ZVf_eYZ_ZXJjLeYZdaVca]VtZgScZ_XdWceYTVceRZ_gaZRJcVRTeZ_dVO'^ eYV^V_hY'$  $VtaVcZ_TVZEZ> R_j `VeYV^LVcaVTZRJJj j`f_XL$  $hVJ]VUFTREVU `_VcLYRgVUVgV] aVU Z RZZ RZZd$  $`WT` aVcReZ_ R_UT ^ ac` ^ ZHZ_VR^ Zj ]ZNL$  $R_URhZJZ_X Vcde dWeYV^ eYc fXYZ$ 

Î 5 bX UgZ f a m`]IhY VcnžGYVUgIz bž\Yjğ [ cha Yž\Yjğ[ cha Y Vmh Y bcgYžVYVUi gY \YjğVf]`]UblžVV.]XfYb UfYVf]`]UblÅ =Xcbjki \_bck ž=`cj Y WUb[ ]b[ \]a ž=`cj Y VUh! [b[ \]a ž=`cj Y di Ihjb[ \]a Xck b hc gYYdž= `cj Y a U\_]b[ \]gZ cXž=`cj Y ]Ižmci gYY3Ĭ fA UYZUXi jzi fVUbža YX|i a !`ck G9, Ł

3f e eV&VRV `eV&dhY` &RIE Sj UV` \_ZZ\_X eVVIYR\_X&Z\_eVVW RJVc`]VŽ2TT dZ\_Xe eVV Ł eV&VYRgV&df]eUZ\_RTZZA` W dV%LeYRe`dV& Z\_hYZY eV&diVdYRU ac`aVcy&&VE&VE `eV&ZEYY YRgVRJd &Af]eUZ\_eVV^` &RIU `eV&ZEYY YRgVRJd &Af]eUZ\_eVV^` &RIU URZ\_` `Wi`^ V\_ŁhY` eVY TJRZ\_YRgV]`de eV& dJV&&AVTZEYV\_` &RIXXR Wc y`dV%eYRe eV& aV a]VUZbJRJ ZI`SgZfdj RjVRc\_ZXe` &T g\c eVVZV\_eZj eYReeYY eVV dJg\dYRgV]` &Z

 $K \setminus Uh\tilde{g} \setminus UddYb b[hckcaYb3]$ 

ÎH YMNY UVcj Y h YagY jYgžk ca YbgUd h Yf \igVUbXgXck bžh Uhŷth YZIg\]cb''

ÎK ca Yb k YUf ħ Y hci gYfg bck "Ï

Î ∔Îğîk ca YbÎğî 'JVYfUl<sub>i</sub>lc bžih Ymik UbhYei U? ]Imžih YmĨAY dUn]b[ 'i gʻVUW\_ ]b`ci f`ck b` We`]b'Ï

Î H. YmŴY hc hU`mg\Ua YYgg'bc k žf][\hi h fci [\h Y k \c Y c Zgc WyYmfl fA UYgzUXi hzi fVUbž`ck 'Q9, Ł

 $H YV_ ^ dt = TZZZZT ^ UTA ^ V_ ZletV^ VeY U f dUe dRddweeYVf_UVc^ ZWZW_ZEJLR_UaRd eZIf [Rc]j eYVaRecZeCTYR] VR^ Zj dj deV^ LeYZT^ Rj SV XZV_ addieZIR] WWWIeZ_ eYVWc^ ` VZZ [V_TVŽ$ 



# H ≤ 9 A DC FH5 B 7 9 C : : 99@B; G ≥ 5 : : 97 H ⊂ B 5 B 8 · · · 7 C B J 9FG5 H ⊂ B



D'TZR]  $\mathbb{R}_U$  af S]ZT ]ZW YRd  $\mathbb{R}h$   $\mathbb{R}$  d  $\mathbb{C}h$   $\mathbb{Z}$  VU  $\mathbb{R}$ d'S[VI& gV SRUEL eVRe ere dIV\_Ud af  $\mathbb{C}h$   $\mathbb{U} \land \mathbb{V}e$   $\mathbb{Z}$  $\mathbb{C}h$   $\mathbb{R}e \mathbb{Z}_d \mathbb{R}_U \vee \mathbb{T}_{\uparrow} \land \mathbb{Z}$  ere  $\mathbb{C}h$   $\mathbb{Z}_d \mathbb{R}_U e^{1}/\mathbb{Z}$   $\mathbb{Z}$ a Ree  $\mathbb{Z}$   $\mathbb{F}$   $\mathbb{R}$   $\mathbb{U} \vee \mathbb{Z}_{\uparrow} \land \mathbb{U}e^{1}/\mathbb{Z}$   $\mathbb{Z}_d \mathbb{R}_U e^{1}/\mathbb{Z}$   $\mathbb{Z}_d \mathbb{R}_U$  $\mathbb{V} \land \mathbb{Z}_d \mathbb{R}_U \land \mathbb{Z}_d$   $\mathbb{Z}_d \mathbb{R}e^{1}/\mathbb{Z}_d \mathbb{Z}_d$   $\mathbb{Z}_d \mathbb{Z}_d \mathbb{Z}_d \mathbb{Z}_d$  $\mathbb{V} \vee \mathbb{Z}_d \mathbb{R}_d \cap \mathbb{Z}_d \mathbb{Z}_d \mathbb{Z}_d \mathbb{Z}_d$  $\mathbb{Z}_d \mathbb{Z}_d EYZISVZ\_XeYVTRMLeYVUMáVdeRdaVTed`WaVd

d\_R|cV|R&Z\_dVZadTR\_SVdV\_e`SVcV|VgR\_ee` Yf^R\_UVgV]`a^V\_ee``ŁdZ\_TVeYVac`UFTeZ\_`W Rd`S[VTegVdV\_dV``WeYVyH V%ZtRTV\_ecR] RdaVTe `V&EZEYZtTYRaeVchZ]UVdTcZSVd^VTYR\_XdeYRe RcVRWWWEZ\_XaVa]VdV^`eZ\_R]]ZgVdLdMfR]ZejL WZV\_UDYZadR\_UaVcd\_R]T\_gVcdReZ\_dLR\_Ud^V TYR][V\_XdUVczgZ\_XW/^eYVdXZ  $2d Z U \xi Z U F R Z R Z - R L R L Z \ d eV U e'$   $SVT ^ Va V cd _ R Z V L Z G R IY c R Z _ d Z Y R d e' SV$   $d R a V U Z U \xi Z U F R ] j S j e V V U _ R Z d Z Y R d e' SV$   $d R a V U Z U \xi Z U F R ] j S j e V V U _ R Z d Z T ^ ^ f _ Z$   $I R Z _ R U T ^ Z e' V e d a V I f Z c e' Z Z 6 ^ 2 Z 6 ^ 2 Z - d$  Y R s V R T V e R ] c ' V V V Z Z d R c d f ] e L R j a V a ] V  $e' U R J X \xi V f _ a c V T V V Z Z d R c d f ] e L R j a V a ] V$   $e' U R J X \xi V f _ a c V T V V Z Z d R c d f ] e L R j a V a ] V$   $e' U R J X \xi V f _ a c V T V V Z Z d R c d f ] e L R j a V a ] V$   $e' U R J X \xi V f _ a c V T V V Z Z d R c d f ] e L R j a V a ] V$   $e' U R J X \xi V f _ a c V T V V Z Z d R c d f ] e L R j a V a ] V$   $e' U R J X \xi V f _ a c V T V V Z Z d R c d R e V C S S V R ] ` e V c d T Z h e Z d Z h Z Y e V Z c d ` f d ' c a R e V C S S V R ] ` e V c d T Z h e Z d Z h Z Y e V Z c d ` f d ' c a R e V C S S V R ] ` e V c d T Z h e Z d M e Z h R U d M f R ] S ` U S V h W ^ R R L U h ` R R U h ` R R Z h V W Z d c v d V R E Z X Z Z d M V Z c V a V Z d C V C W Z d C C U T E Z N R V M Z j ` c V T _ ` Z T V V T E Z Z$ 

Î=Ăi WebgWYbhci g UVci hih |b| g Uh\ca Yž Vi hih YfY UfY YggYbhU h |b| g th Uh\Uj Yhc Xc k |h i gžk Y Wea Y Úfgh"±hǧ\UfX Zefa Y hc gUnžmci \_bck žk Y Wea Y ÚfghUbX a m W\]XfYb Wea Y gYWebXžVYWJi gY h Uhǧ gca Yh |b| =gh]`ÚbX ]h\UfX hc Wea Y hc HYfa g k |h ž\Uj |b| hc VY U k ca Ub ÚfghUbX U a ch Yf gYWebXžVi h=Ăi Wea d YhY mWYUf UVci h]hžh Uhǧh Y k Um]h]g'I fl Ya UYZUXi hzi fVUbža YX]i a !ck @, Ł

 $\label{eq:started} \begin{array}{l} AVeYRad SVIRT dV `VeYV bf Vde VC Rf eVV_eZZej Ł eYZd Z`RYZ_Rj`VeYV Tfa]VU Vd_`eT_eV^{1} \\ a]ReV eVV UZd1]feZ_`VVed^V `SVcd Z_UEZLf R]! \\ Zej Z5 VdaZVeYV de`_Xjj df S[VIeZeVR_UV^`eZ_R] \\ TYRKREAC RCIEZS W.e`eYZd cVReZ_dYZeVVZd_``eVR] UVdZVe`^VEXV FeYV`eVVZ'_eYZd acVIZW \\ dV_dVEYV_Vh Z`RW^WeYV Tfa]VZd_`ec`^R_eZTZ \\ CReYVc eYV T_eRcj, eYZdh Rj`VT_def TeZ_XeVV \\ Tfa]VZd[fdeZ VUSj eVVgVcj VReeYReZeR]`h deVV \\ Z_UZgZt fR]dT_TVc_W e`VeRZ_R_U cVRZEV eYVZe``h_aVcd_R] ZV_eZZKZ$ 

Î 7 Uf cg \Ug [ ch \]g `]Z Z \Y WUb Xc k \Uh \Y k Ubhz = WUb Xc Ubmh ]b[ `=k Ubhž Vi h k YMY hc [ Yh YfzfYU`m]hỹ `]\_Y h Y hk c d]`Ufg \c X]b[ `i d U \ci gY'' =Zcb mh YmWei X VY c]bYX hc [ Yh Yfž Vi hk Y\_bck h\Uhk Y WUbMi a Yf[ Y]bhc cbY Ubch Yf VYWUi gY ]Zk Y X]X` h\Y \ci gY k ci X ZU``Xck b'ï fl Ya UYZUXi hzi fVUbža YX]i a !ck C9, L

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$$\begin{split} & EYV \ensuremath{\underline{Z}} Xh \ensuremath{\underline{Z}} Xh \ensuremath{\underline{Z}} YeY \ensuremath{d} S[VIe `W T fa]VdSc`f XYe`feeYVZ a`eR_TV`W^` \ensuremath{\underline{Z}} R] \\ & UT ^ f \ensuremath{\underline{Z}} V'` \ensuremath{\underline{Z}} V'` W'` \ensuremath{\underline{Z}} R] \\ & UT ^ f \ensuremath{\underline{Z}} ZCV[Rescy]j \ensuremath{\underline{Z}} eeVV \ensuremath{\underline{Z}} V' \ensu$$

DuffRJZ; ZdW\_RdRgZFJU\_RZW&Tfa]Vd JZWeX&Y&R\_UV&aVcd\_RJKRZ\_Ž:eT^ł acZMdU\_RZDARU^VR\_ZMARWRYZUZ; ET YRde drRaVR\_Ua]RIVReeYVdkgZVV&RVcd\_RJV1 acXdZ\_ŽAVa]VdWeYZRRARCZXRXCRETYR\_XV W^ eYVdufRJZ; `VackgZfdX/VRZ\_dLhYZY eYVJUKICZSVRdd^VeZXcWf]R&USjdTZkjR\_U UZWIFJeWcZUZgZfRJde drRaVZ

Î C bY fYU`mc Vj ]ci g WU Ub[Y ]g ]b Wei d YgÑ gYl i U ][mžk \ [W] ]g ZYYf bc k žmc i HU\_Y ][h a cfY ZYY mUbX a cfY h\Yk Ummc i k Ubh UbX bc hh\Yk Ummc i h\]b\_ ][hci [\hhc VY Xc bY]]

fl Ya U`Yžmci b[ži fVUbž]bhYfa YX]UhY`C9; Ł

2TT  $dZ_X_j Ldv fR_{Z_j} ZISVT^Z_X dvRez_v_j$   $Z_UAV_UV_e^WaCTCAREZ_R_UeVVZ_defeZ_^W$   $^RczZXZEYZIR_SVdW_LWCVR^a]VLZ_eVVVRIe$   $eYRedv fR_dVRZ_dReVf dR_j ZZZREVU^feZLV^W$   $^RczZXZAVa]Vj^f_XCeYR_eVVRgVRXVRXVVC$   $^RczZXV1#*Wc^V_L#Wch^V_YRgVdvIfR_$  $<math>cVRgVdvIfR_dLWC^V_ej eYR_^JUCaVa]VZEYZI$  $<math>df XXddeYReadVRZER_dvIfR_aRZEVCRVL^e$  $TRfR_SfecXvf[RZ]$ 

 $5 \text{ ReR ac' UF TWU Sj} eVV4^{2ZE} ? RIZ_R UM$ DZLR1? ReZ\_R 2:5 D4`^^ZHZ\_14@? 2D 5 2/ d'XXdHLWdeYVc^`ckLeYRedMfR] cyReZ\_dReVSVI XZ\_Z XReR\_WCZCRXZH YVCWRR``\_XAV a]V S`c\_Z "\*S! eVV^VLR\_RX/VZZHZ\_hRd"\*Ž Wch`^V\_R\_U" (Ž, Wc^V\_LR^`\_XeY`dVS`c\_Z  $\begin{array}{c} \begin{array}{c} & & & & & \\ & & & & & & \\ & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & &$ 

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>¶î lếz năl ² gi z Ya6ail Qe ¶² O8aqzafi¶– Ŷ Gé0- ¢² đặa> z-i O8az² afi os@nafi¶– Ý¢ ² ail Qe ¶² O8aqz®o- ¢(O4Gi31 >'Ł Èna ½ 3 €Ea

> "\*) ! eYVRXdRv") Ž.R\_U"'ŽŁ vá Vlázyj ŽE YZI d`h Sfe deVRUj U ZANE h ROLDIVR]ZC Z ZEREZ \_ ZIR gVcj X`UZ]f de REZ \_ `VeYVTF] ef d?| TYR\_Xde YRe YRgV`TTF ccVUŽ2^`\_X`eYVc eYZ XE Ze vásk?] de YV Xc h Z\_XXRa SVeh W\_ dví f.R] ac RieZ V R\_U VY Zj eZcE eYV VXWU^ j`f\_XaV a]VYRgVRe.R\_ VRC]ZC RXVe UVIZUVY`h e`SVYRgVLeYVXCVReVcZ a`ceR\_TV Red RIYVUe`Z\_eZ`ReVcV]ReZ\_dvZad R\_UeYVXc`h Z\_X ]VXEZ\_RIj`Va(VRET cVR\_URWMREZ\_RIeYVCTSdeR\_TV `VaVvd\_RIS`\_UEŽ

> $$\label{eq:linear} \begin{split} & 2TT \ dZ \ Xe \ eYZ \ dR \ Vd \ eYJ \ L() \ \ \ \ VeVaVa]V \\ & eYZ \ Z \ Z \ Z \ dL \ C \ XWc \ d \ V \ Ve \ YReVg \ J \ f \ eRg \ dJ \ Rd \ dZ \ AJVR \ dL \ Rd \ AJVR \ dZ \ AJVR \ dL \ AJVR \ AJVR \ dZ \ AJVR \ dZ \ AJVR \ dZ \ AJVR \ dZ \ AJVR \ dZ \ AJVR \ dZ \ AJVR \$$

 $\label{eq:linear} \begin{array}{l} \label{eq:linear} \end{tabular} XV^ We V bf R \end{tabular} \$ 

Î H. YgY XUngž Znci ÑY bchgUhgÚYX gYl i U`nž nci WUb hY``nci f dUfhbYfžnci WUb XlgWigg Jhk Jh nci f dUfhbYfÅ žnci WUb gUnž cc\_ž dYf Udg k Yg ci Xhfnigca Yh Jb[YgYÅ Ï fA UYžc XYf UXi hzi fVUbž JbhYfa YXJUHY C9; Ł

A]VRofdVZd\_`eeYV`\_]jafca`dV`WdMfR]ZejŁ Y`h\gVZžecTT\_ee2SfeZ\_e`eYVTfa]VdV``eZ\_R] cVJReZ\_dYZaZcT]VRc]jR\_`eYVZ

:e^R SVeYRek \Uhig W\Ub[ b[ b a Ubm dYcd YNg YmYg ]g bch ]b[ Ygg h Ub h Y ]a !  $U[Y^{c}Z^{c}jY'' = gVTR_{-}]^{Xc}SVZV_{e}ZVU$  $hZey R_ Z_dezef eZ_R_ZWU cV_ReZ_dVZeLRdZ_ ^ Rd$ cZRXVL`chZeYRVWCZ\_`WZ\_UZeZLFRZEZWELRdZ\_c`ł ^ R\_eZIZA^ Ł`chZeYS`eYRe`\_TVŽE`URJŁ]`gVdW^ d e`SVZ\_dvaRdrS]VV&/^ eYVVdR^Vh`c\TcVReVUVcZe Sj  $Z_UZ = T_{Z} = gVZ = J_{T_{A}}$ ZXZeckof ]edZ\_Z\_TckRchUZ\_UZeZufR] Rfe`\_`^ j R\_U  $X \in \mathbb{R} \cup \mathbb{R$ eV]]VIef R]]jŁV^`eZ\_R]]j R\_UaYj dZR]]jŽ=`gVe`URj Zg gvdRUVXcW V&V\_dZ\_SVehW\_ZUZZIRZZKŽ EYZIZIHYj eYVvgvq URj ]ZevcRef cV~\_eYVcv]ReZ\_ł dYZad`WTfa]VdYRdSWAf\_e`daVR\`WT\_~ZTeR\_U T ^ ac` ^ ZLV ^ ` cVRd eYVVi acVddZ \_ ` VIR ^ Ref eV ]`gVeYR\_RdRdX\_eYReeYZd]`gVZdhR\_Z\_XŽ

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:edW^de`SVj`f\_XaVa]VLV^S`UJZX\_Vh Z`RXZ\_RZdR\_UZV\_&ZXdHY`RV^`deRaadVIZA &ZV`V&YV\_Vh\_Wc^d`V&MfRZijŽEYVj\_WWjeYRe eYVdVRVSV&&cd`Z&Ue`hYReeYVj\_eYV^dMg&dRV `chR\_ee`SVŽ7`ceYV^LdMfRZijZiZ a`ceR\_eV& aVcd\_RJU&jY`a^V\_eR\_U~ViZSZZijZ\_T\_defTd Z\_XcVJRZ\_dYZadhZY`eY&dŽ

 $\hat{I} = c bWY [ c hlv [ Yh Yf k ]h U V cmUbX h Y$ Ufghilja Y k Y k Ybhci hk Y g Ydhlv [ Yh Yf zh Yb UZh fk UfXg = gU[Xzbc z h ]g ]gbl h Y k Um $h Xc ]|z = bYYX h _ bck \ a Ufgh UbX k ]h$  $h Y bYl hcbY ]hk Ugb h h Y gUa Yzf][ \ B 5bX'$  ='h ]b\_ 'h Uhỹ [ ccXž='h ]b\_ ']hỹ [ ccXVY! WUi gY mci `YUfb 'UbX'mci ]ỹ Y [ chž`]\_Yža cfY` hc 'lU`\_ 'UVci hï fl Ya U'Yžmci b[ ži fVUbž]bhYfa YX]UhY 'C9; Ł

 $\label{eq:starting} \begin{array}{l} 3fed ^ VaVa]VLR_U VdaVIZR] ji Ruf ]ed dvRie \\ TcZEZIR] je eVdv TYR_XdZ_dvfR]Zej ŽE YVj dW \\ eYV Rddev^ Z_X W^ eYV_Vh Reszef Uvd`W \\ h`^ V_LR_U eVV dvfR] advT TZej R_U Rdvkæzgvi \\ _Vd1`WevVdvRdXzgZ XcZeVe eVVTYR_XdZ_eVV \\ hRj T fa]VdcV]RevZeYZdZ avZdh YRed ^ VRuf ]ed \\ dWRdevVv Ref dR]`dUvc`WeYZ XdZ$ 

 $2Uf ]eh^{\wedge} V_eV_Ue^{\vee} UhV]^{-} eV cZh eV y dW eV cWTYR_Xda^{2} Z_Xe^{2} eV VW^{2} Zj LhZe^{2} [fgV_ZV dM fR]Zj cV^{2} Z_Xe^{2} VR df cR_TVe/Re_VPe^{2} vdhZ] eR V cV ch^{2} dSZZj Wc eV Zc TYZU cV_ZE YV WRc^W Y RgZ_X eW_RXV^{2} eV cd_VR^{2} Ve^{2} Vc^{2} Vc^{2} c c dZ_XV^{2} eV cd_Z eV Zc VR^{2} Zj Z_Wc^{2} de^{2} Z z] Z_dRS^{2} fedM fR]Zj Z$ 

Î H. ]g UXmgUJXžk \mXc blkimci [ ]j Y mci f XUi [ \hYf WebhfUVWdhj Yg3 A m\U]f Ua cgh Z<sup>™</sup>ci lÅ =gUk ]hUg gca Yh ]b[ ']\_Yž'\_Y' gYbX]b[ \Yf cZhc dfcgt]h hY \YfgY ZVY! WUi gY [Z=[ ]j Y \Yf d] 'g gc g \YWUb gYYd k ]h h ]g cbYZUbX ]hXc Ygblkik cf\_ ci lžg \Yfy [ c]b[ hc [ c cZk ]h gca YcbY YgY UbX h Yb k ]h gca YcbY YgY UbX k \cÅ Gc th Yb h ]g]gth Y k Um=gYY \Yf \Uj ]b[ VcnZf]YbXgž gUm[b[ žf][ \lž]hŷtU<sup>™</sup>cj Yf k ]h i g bck Å =ŷ Y VYYb k ]h mci U k \]Y UbX h Yb ]hÑ VY gca YcbY YgY UbX h Yb gca YcbY YgYÅ Ï fl Ya UYZUXi lži fVUbža YX]i a !ck C9; Ł

 $EYV^{a}Z_{d} a d d AUSj ^ V d ReV_{ee} e VV$ VR^Zj Sfee e VV^ d MgVd R\_U e VZc ^ Rdff ]Z\_Zj Ž 7 ch`^ V\_e e e V V d Mf R ZZFRZV V R J V\_Xd  $\label{eq:restriction} \begin{array}{l} R_U \mbox{Worker} & R_V \mbox{Worker} & R_Z \mbox{R} \mbox{H} \mbox{Worker} & R_Z \mbox{R} \mbox{H}$ 

Î H. Uhỹ f][ \ lžth YmXYVVXYZVYVU gY h Ym Xc bhī\_bck k \ Uhh YmhY Xc ]b[ žUbX Uh h Y YbX cZh Y XUm]Zgca Yh ]b[ \ Udd Ybgž h YmXc ]lžU W ]X Vea Yg U cb[ UbX h Uhỹ h Uh K \ c gi ZY fg h Yb ]Zh YfYhỹ U W ]X3Å = ]\_Y h Ya hc VY XYhY fa ]bYXžV i hbchgcÅ K ca Yb k \ c UfY a cfY XYhY fa ]bYXžk ]h a cfY ]b]hJUhj YZ cc\_z=UbX h Ya a cfYÅ

h\YMMY W\]X]g\žh\YMMY bcha UhifY Ybci [\Å H\YMMY bchZ ``ma UhifYžh\YMMY` \UZk Umh\YfYžVYWUigY h\YfYNg bc UXj Ub! HU[YZcfh\Ya `]b`\Uj ]b[ gYl k]h\Ua Ub'' 8cYg'Uk ca Ub`VYWca Y`a cfY`cZUk ca Ub` VYWUigY`cZh\UBÄ

fAU`Yžmcib[žifVUbž`ck`G9;Ł

:\_ df^ RgŁetv Rykc ReZ\_ `WZ\_UZZI RJZj Xgwł cztwe RaRozif JRchRj `W cwR\_ZzZ X etw cwJReZ\_drZa `WR T fa]VŽ-łi jg` ja dcfłubh Ugʻ Uʻ fy`Ułjc bg\ jd`VYłk YYb` jbXjj JXi Uʻgʻ UbX`Z; f` h\Y`k Umi jh Ya dck Yfgʻ dYfgc bU``XYj Y`cd! a Ybh UbX``YUfb]b[ "EYVT fa]VSVT ^ VdR\_  $V_UZ_zdM_WZ_UZddZ_Z TRZ_SVT ^ VdU etWVU$ W/^ ^ RczZw/R\_U ac`T&RZ\_ŽEYZI V\_T fd&Xd aV a]Ve` YRgV^ `dv~ViZS]VR\_U^ `dvT ^ a]M cvJReZ\_drZad.h Y&VT\_~ZIeR\_UT ^ ac` ^ ZWRW RUXZKS]VaRe` WZWe X&VZDM fRZj SVT ^ Vd RTV\_eCR\_Ra VIEY&Z2Uf jedRvf\_VRJ RS` feeYZŁ j`f\_X^ V\_RITVaeZŁR\_Uj`f\_Xh`^ V\_RvgVg V\_eYf dZdzTRS` feZZ

EYVT ]]VIƏZVR\_UafS]ZI yH V%Z a]ZdRS`\_U `WIZZI VZZ UAZZE YZI dvG ]edZ\_eVVTdVRZ\_ `W R dfS[VIƏZV dvR]Zij `W f df R] dvT X\_ZZ\_ R\_U RTIVadR\_TV eYRe VI eV\_Ud SVJ `\_U S]``U eZd R\_U `S]ZNRZ\_dR\_UeYReadVIVUvdeYVRXdW V\_edR\_U RdR\_XV V\_ed dvbf ZVU Wc eYV adRieZIR] Sf dZ\_Vdd `VIT ^ ^ `\_ ]ZWZ 3f e VZV\_UdYZa U Vd\_`eT ^ V W/^ \_`hYVdZ: e dvbf ZvdRa`dEZgvLRWMTeZ\_ReV Z RXV`VeYV`eYVZ7 c eYZLd TZdj \_WUde`SV dvadvd/evURdRa]RIV`VRWMTeZ\_RdhV], eYRe ZL eYVCV\_WUde`SV dY`ZZZ\_ eYRe Vbf RZizJEcf dL h`dtLcVIZac`TZijEZ\_dY`ceER] eYRe T\_dEZf eVd eYVd S[VIEZ\_WCYEZ\_ WceYV`eYVZ

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?`eR] Wc^d`Wd TZR]^`UVc\_ZREZ\_cVdF]eZ\_R ^`dV`aV\_g`aV`Vd TZRSZZG`Z\_d&RULRdYRdSW\_ dW\_LeYVWfdeReZ\_`VV\_UZGLFRZREZ\_TR\_JVdU aV a]Ve`dWA cWAXVZ\_ecRUEZ\_R]g`aVdŽ:\_WddL eYVF?5A #!!"Df`cgY\_cVgVd[de?Re`eY`dVhY` WWJ eYY\_YRgV]`de`fe`Sj\_eYVcVTV\_e`TYR\_XXdZ\_ eYVT`f\_cg`R]d\_eV\_Ue`SVeYVgVg`aV a]VhY`U \_`eYRgVV&Z/LtdR\_UhY`^`deUV}\_VeYV`dA/gVd SjeYVWY`ZjŽ

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3feeYV}T&ZZfd`d\/cT\_defT&UZ\_eYZhRjZl U&cZ`V\_dR]e`eYVT&UZSZZg``Vhi`d\/dR\_U`V&Y`d\/ hY`da\/R\eYV`Ž3`eY'eYV"\*\*)C\/á`ceR\_U eYV #!!!C\/á`ceUV``\_deR&VUV`aZZIR]jY`h]ZeeV @ / . } æ '² æ¶i Ú¶Å¢¶? 1¤Ð©¢" ǎO]¶i ææz äÅOÝæ ðÅz Úz22 æ7 z ÝÈ

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EYVWRceNRecVR `dJcZlWRXZVLR\_UeVV]RI\ `WT\_}UV\_TVZ\_eYV`dVcViacVdtVUZ\_h`dUdLR]d  $eZVZ_hZeYR_eVc\}_UZ_XVeYZeVa`eZDYcdY'$ gYYa hc ÚbX ]hj YfmX]ZÍW hhc gdYU\_ cZh Y]f YldYf YbWygZica hYdcghi YgXY"EYVhR TYR\_XVR\_UdTZR]]ZWRdVeR]\UURS`fe^R\VdZe dW^ eYRe eYV T\_dZe `W\_`eYZ\_XSfe]`dd R\_U RAZEZ\_Ž=ZegVZdRZURS`feXRZ\_dR\_UajVRdfcVdŽ EYVWc^Vcf\_UV\_Z7S]j ViZdeLSfed U eYV]ReeWZ EYVaVcTVZeVUacVTRZfd\_Vdd`WdVcR\_UeYVWRc df cc`f\_UZ\_XZŁY`h VgVŁdW^ e` ^ R VZeUZWIf je e`daVR\a`dZZZYjŽHZEY`feRU`fSeL`aeZ`ZA^Zd \_\_\_\_\_\_WUNU\_e`\_\_TY\_VScReV\_XRZ\_dZ\_\_eYVT\_^ ^ `\_\_ ]ZW\_`W d TZAjŽ3fed TY R\_Reezef UV TR\_`eSVVia VTeVU hYV\_d`TZR]]ZWVZda`œeRjVURdRAR\_UdRdS`i hY`dV]ZU^fde\_VgVcSV]ZAVUŽ

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2 d.Z\_XWcYVjaZdR\_VddV\_eZRJ aRce`WdTZRJ cV[ReZ\_dŽ:eVdeRS]ZHVdeYVS`\_U`VVT`aVcReZ\_+ hVTR\_`eT aVhZeY VgVg eYZ\_XLR\_UhV\_WUeYV @eYVZ:eRd R]`hdXV\_fZ\_Vj d`TZR\WWZ\_Xdd`TY Rd XRezef UV R\_U ^ f ef R] Raad VIZReZ\_ e` V^ VCX Ž EYVUZAVIF jej aV a VYRgVZ RolZXVCYV a ZUFV e Zi Rez\_łhYveyvceyzdev^dw/^^ZT\_Tyzyu  $\underline{Z}$   $\underline{U}$   $\underline{U}$   $\underline{Z}$   $DZ_TVaVa|VTR_`e|ZVhZYfedaa`ceR_UZ$ VgZEPS]j\_WU`eYVczLeYVUZWTF]ej`WVdEPS]ZYYZ\_X RUZRI`XFVRS`feT`aVcReZ\_ [VRUde`cVdV\_e^V\_eŽ AV a]VY`aVeYRe`eYVcdhZ]U`d^VeYZ\_XLSfe cWarz W/^ Rolz XŽEYVR XVc eYRe RIT ^ aR Zdd eYZtlYfce ZtleYVcVcf]e`WReecZsfeZ\_XZ]]thZ]e`R\_ @eYVchY`UVd\_`eVM}]R\_f\_g`ZTVUViaVTeR eZ\_ŽFYhYUhb[ ]bhc cbYgY ZWUb h fb gc WU` Ya chcbg ]bhc gY ZXYghi Whj Y Ya chcbg

^ R.\Z.:e VdHS JZh Vd S` eY eY Zc Rfe`\_`^ j R\_U eY Zc JV X Z RIj RdaV a JVLR\_USj eY Vd? Ve` \V\_ Zc f aa` cedeY Zc dy WW &W^ ŽE YV dV dR V V ed UM }\_VVRIY a Vcd \_`ddy We VdaV TeŽH YV\_ aV a JV YRgV ec`f SJV dJ Z\_X yj Vd‰ c y\_` %R\_U Z\_deVRU T ^ V `f eh ZeY R yj VdR\_U\_` ‰c R yd ce` V MaeYZd^ R. Vd Ze YR U/C e` V\_XRXV Z\_ cVJReZ\_dYZad VdHS JZH VU eYc`f XY da WIYŽyDJZaa Vj %YR SZd` V da WIY d`X X de eYRe^ Zbef de e`h Rd d` eY Vcd ZH J` dV j cVJReVU e`]`h a Vcd\_RJ dy WW &W^ Ž

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2dTF | ef cVZ\_XV\_VR] TYR\_XX&T\_gVcReZ\_R] dj |VdRVZ\_VgZeS]j R]eVcZ\_XŽEYVbf R]ZReZgVdefU Zddr`h eYRecVda`\_UV\_edaVcTVZgVeYZeT]VRc]jŽ

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hc \ck h [b[ gk YfY VYZ fY [g]h Uhbck nci WUb HU\_ UVci hgi V'YWg h Uhk Yi gYX Ua cghlc dfYhYbX k Y X]XbNi\_bck UVci hž cf [Znci X]XHU\_ UVci hh Ya [hk Ugj Yfm a i W ]b df]j UhYžUbX bck cb h Y hY Yj [g]cb UbX cb h Y fUX]c UbX Yj Yfmk \YfY nci \YUf h Ya HU\_]b[ UVci hgYl i U UVi gYžk [ZY! VYU]b[ žj ]c YbWYžXfi [ gžUVé \c]ga žnci bUa Y]hÅ Ï fA UYžUXi lži fVUbž]bhYfa YX]UhY C9, Ł

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bchdfYcWWd]YX`k]]A`hY`kYZUfY`cZhY`Wca! aib]minoci `VY`cb[`hc"`6ih]h]gh\Y`Wcaaib]minoci ` VY`cb[`hc'h\UhaU\_Yg*noci*`dcgg]V`Y'Ï

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2\_`eYVcWRefcV`WeYVTYR\_XVZ\_T\_gVcReZ\_Zd eYVUZET gvg eYReZeTR\_SVRe``] Wcac`Uf TeZeZejŽ EYV |Revole `cXR\_ZKReZ\_R| eVV cZk1 decv6d eVRe eVV h`c\`WT`d.Z.ReZ.XXc`fade`TRcq``feeRd\dTR\_ SVU\_V^`dVWVIZZ\_ejj ZVeYVWc^`WUZR`XfV R^` XXc`fa^V^SVcdZd^R RXVLŽ2ddVceZgV VdŁ TIRZEIŁEYVCNUFTEZ\_`NR^SZAFZEIŁEYVNZZZEZ `WefS[VTeggVacVffUZTVdRUT\_TVecRez\_`\_eYV WARdZ\_T^^f\_ZTReZ\_RCVUW^VUe`SVZ\_decf} ^ V\_edWcdfTTVddŽHZeY`feUV\_jZ\_XeYVa`dZeZeV WWWTe eYRe eYVdV dedReVXZdTR\_YReV`\_`cXR\_ZkR eZ\_dR\_UZ\_UZeZIFRdLR\_UZ\_UWUeYVfcXV\_e\_WU WceYV Z\_^R\_j TRoWLZeZd\_VTVdRoj e`a`Ze `fed` Vf\_UXXRS]VRdaVTecŽ7f\_TeZ\_RZZZAYV UZEVTEZ\_`WT\_gVcdReZ\_Z af ccfZe`WcXRZkR eZ\_Rjac`UfTezezej^RjSVRjVe^`cVZ\_eV\_dzeVhRj WchY]]j dyWeWWeV\_eZR] dj deV de` df S`d Z\_ReV aVcd\_R]R\_UdTZR]dfS[VTezzzeje`e`eVVZcV\_UdŽEYV WWWTed`WeYZIZ\_Z\_TOURDZ\_XeYVUZIVIF]ej`WZ\_UZ gZLF RJZREZ\_YRgVSW\_\_`eVLŽ=R\_XF RXVZHF dvUe` ecR d'Zed ^ VéYZ XR eVIVUV ee` eYVacRTeZIRZZXd `WY``dZ\_ReZ\_ŁhYZYZłeYVV^``eZ\_R|RW/k^ReZ\_ `W\_VdMWZ\_cVIReZ\_e``eYVcdŽ:X`cZ.XeYZdR\_U gZhZX|R\_XFRX/\_|jZ\_ZedZ\_def^V\_eR\_TYRRIeVc Z:lRUfS]VIVLXVUch`dŽ

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EYVLØWTF JeZd`VIR\_XFRXVdW^ e`UVcZeVVW^ eh` cVReVUeYZ Xd+RacVIRz f dZ' RXV` Wd.VdLR\_U ]`h aVcd\_R|dM/WKdeW^Ž:eZtYRcUe`Z`RXZ\_VR yXc fa ]R\_Xf RXVeYVRaj %LSVIRf dVeYVdVRvUWał c``eVUŁT^ a]Vi ac`TVdtVdhZeYRdec`\_XYZe`cZIR f\_UVETFccV\_eŽEYZtUVd\_`e^VR\_ŁeY`fXYŁeYRe eY`fXYeTR\_`eSVX&V\_e`d^VTc&VcRteZ\_Ž 7ZceljŁdYcd YbYYXhc HU`\_ UVci hh Ylf Z/Ufg" 2deVV" \*\*) 9 f ^ R\_ 5 VeVj` a^ V\_eCVa` cedY` h VUL WAZf cVe`U`d``\_]j decV\_XeYV\_deYV^ŽEYV^`de Z'a`ceR eWWRce`SVUVRJehZeYdW^de`SVaVa]Vd WARC`W VR `eYVELR UeYVWARCeYReeYVZCT^^` `d.V.cZdWRXZIVŽEYVYZde`cZTR|^V``qiZd]RUV\_ hZey of Ty WRodŽ@\_]j Sj Via VZV\_TZ\_Xey VTevRezev a`ddszzezd`WASREVR UUZWWCV TVhz]aVa]VSV RS]Ve`TR|^ eYV^Ž

GYWE bX'nž h YfY'U'ge 'gYYa g'he 'VY'U' bYYX'he 'edYb'i d'WE bj YfgUhje bU''W Ub! bY'g'Zef'h Y'Yl dfYggje b'eZYa ehje bgë Veh ' dYfge bU'UbX'ge WU" EYZEZ TEVRAR aa 'ef\_Z eZdWET 'aVREZ\_R\_UT 'dZ REZ\_HERRH U Sj > ReeZ\_Zh"\*\*'/`\_T\_gVcREZ\_dSVch W\_aREZ/ed  $R_U^{VUZR}$  dEWWR 4 YZVR\_Y deZENdYRdch'h\_Ž > `de`VAJLEA' f XYLZEZ ac gVclaVcd\_R]R\_Ud TZN dMWCdEW LSVIRF dVaV a]V`SHZ\_CT X\_ZEZ\_`\_ eYVSRXEI WIYREZIA `de aVcd\_R] e' eYV Ž

# $7 < 5 \text{ DHPF}^{-}$ ) .

# 7<5B; 9G → F9@; -€IG → 89BH +9G 5B8 5::-@5H€BG



 $CV[ZZ_ZI'_V WAV^ `deZ a`ceR_eVIacVdZ_d `VWf] dd Z:e YRd R]h R da]R VUR TV_eCR c`]VZ aVd_R] cZ_e YRd R]h R da]R VUR TV_eCR c`]VZ aVd_R] cZ_ZZ dEZ_R_URDR df CTV`WT^ f_Zj ^ VR_ZXZ dX_VCR] SVRc`_eYVcVI ]RZ_dYZ hZY cR_dTV_UV_eR cR_ZZ dX_VCR] SVRc`_eYVcVI ]RZ_dYZ hZY cR_dTV_UV_eR cR_ZZ dX_VCR] cZ_RU^2Z dTZ dX_ZZ dX_VCR] cZ_RU^2Z f dVIacVdZ_ZE UR LEYVZZ_R R U `VEYVTYR_XdZ YRd f_UXX_V _ WUCHE SVR_R j dVUZ eYVT_eVIe YCV_EVIE Z R U `VEYVTYR_XdZ R CVVC eX$ 

EYVhVR V Z X `WeeRUZZ R] Z RXZ RZd`W $4YZVR U eYV RZ R] a `JZZR] T ^ f ZejLR U$ eYV WUVC Z UZZLF R] de`UVZX eYVZ Z V eZZdR U JZWa ]R dVc eYV dygVLYR VRWA U a V a ]Vd 
$$\label{eq:linear} \begin{split} &|\underline{Z} \setminus dh \,\underline{Z}Y \, cV_{\underline{Z}}Z \_ \underline{R} \ U \,\underline{Z} \, d\underline{Z} \, \underline{Z} 
$$\begin{split} & EYVaVcd\_R] \land R\_ZWHRZ\_d`WVJZZfdaYVd\_`\land V\_RRV \land R\_j + Va]ZZEUV1]RREZ\_dLafS]ZT\\ & R\_UacZgReVacRieZVdLZeVcacVeReZ\_dLWVJZXdL\\ & f\_T\_dIZfdac`TVdVcZCV4RcTYeYc`fXYd`cgVjd\\ & R\_UZeVcgZhdTRdd`_]j RaRezR]ZXYe`_eYVdV\\ & aYV\_`\land V\_RZ7ceYZdcRd\_dL}\_UZXd`WeYZdejaV\\ _WUe`SVUVSReVUhZeYTRfeZ_ZD \land VYja`eVcdd\\ & RS`feeYV^VR_ZXR\_UUZVTeZ_`WYR_XddZeYV\\ & cVJZZdej`W4YZVR_dRVUZIffd4UUSVj`hZ$$

$$\begin{split} & E YZ l cMZ Z dz j Lh YZ V Z dT _ eV_e YR l dYZ eW U L \\ & YR d_`eUVI J Z VU dZ Z TR_e j Z eVV ]R de"!! j VR dZ \\ & 2TT d J Z X e` :? 6 UR H L SV J Z WZ 8`U W J W^^ \\ & ** ~ Z "*! (e` *% Z "** # Z E YV a d'U^ Z R_e j \\ & 4 Y cZ d Z R_e f d' W Z d d' J Z Z d Z j YR d_`eTY R_X U \\ & X Re j V Z V Z \\ \end{split}$$

 $4 YZ_VR_d c_VZZ_fd]_VR_Z_XdR_V c_VR_VC^VUSj$   $Z_eVc_ReZ_R] T^aR_cZd_ZEYV:=eVc_ReZ_R]$ D TZR] Df cg/y Ac XR^a V1:DDA/T^aR\_VU eVV c\_VZZ\_fdSV\_ZVWV VeVVZ\_YRSZER\_ed`V% T f\_ecZd `\_UZWWCV\_eT\_eZ\_V\_edR\_UhZeYUZWWCV\_e]Vg/yd`W UVg/Y`a^V\_eZ@VR] eVcVT f\_ecZdL4YZ\_VCR\_\U c\_VgV\_eY Vc eVVaVCIV\_eRXV`VaV a]VSV/ZgZ\_XZ 8`U146AI:DDAL#!!''Z

EYVZ\_de£feZ\_R|^ R\_ZWHEReZ\_d`WeYZHCVJZeZfd WWJZ\_XYRgVR|d dr`h\_ T\_dELVHES]VT\_eZfZejŽ HYZV eVVTYfcTYVdU \_`e dW^ e`ac`gZJVR

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$@[D^{2}] \stackrel{(a)}{\longrightarrow} 0 \\ (b) \\ (c) \\$

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$$\label{eq:transform} \begin{split} T & a \end{tabular} V \end{tabular} T & b \end{tabular} V \end{tabular} V \end{tabular} T & b \end{tabular} V \end{ta$$

## H≰9<sup>-</sup>7<5B; -B; A5DC: 7<IF7<5::-@5HCBG

 $\begin{array}{c} @\_VSR2TWc^ & WVZZfdWaVZ_{IVZieV} \\ WWZX^VSV_ZXZ & & \_V^WAVZ_{d22}feZ_{d2}Re \\ VacVdZZ_eVVT^ f_Zj + eVVTYfdVVZ_{0}gVc \\ eVV__ZXeV^LeVVYRdSW_RdZXYeUVIZ_VZ \\ UVIRWUTYfdY^V SVCZZEYV^ & eCZZZTR_e \\ TYR_XLY hVgVLYRdSW_ eVVUZVCZ_TRZ_ & W \\ TYfdTVCR_UeVVCZAZ_eVZcVR2gVhVZXeZYV \\ CVIV_eUSREVRS^feeYV_Vh = Y_UV4f]edicVZ \\ Zfdh`cZZ RIeZZUZR2gV^WAZHTYR_XLR_U \\ WYVWc^R_CVTX_ZZ_ZYRCCVR2gVZ \\ \end{array}$ 

H YfY`\Ug`VYYb`U`g`ck `Vi hdYfg]ghYbh XYW]bY`]b`UZJ`]Uhcb`k ]h`h\Y`7Uh`c`]W 7\ifW`"-b`fY`Uhj Y`hYfa gža Ya VYfg\]d`cZ Yj Ub[Y`]WU`W\ifW\YgždUfh]W`Ufmh\cgY`cZ DYbhYVcgU`cf][]bž\Ug] fck b`gdYWUW`Ufmi  $gbWY h Y \% * $g' E YZIYRI^ RUV4 YZV^_V WYV T f_e Zidh ZeY e VYZXV de ac`a` ceZ_`WgR_XV/Z TRdZ_ DaR_ZM da VR/Z_X2^ VZIR1AR: VE!" **) / Z$ 

:\_RULEZ\_HRJeY f XY eYY YRgVRgVcj d'R] acVd V\_TVLeYVCVRV\_`\_ł4YcZEEZ\_Wc^d`WcXR\_ZXU h`cdYZaUVcZgZ\_XS`eYW^^ ^ZxCReZ\_W/^ \_`\_ł 4YcZEEZ\_T f\_ccZddR\_UeYVXc`hZ\_Xa`af]RcZgi`W @cZV\_eR]^jdEZZd`ŽEYVZcUVXcW`WZ\_dEZFeZ\_R]ł ZKREZ\_R\_UafS]ZTacVdV\_TVgRcj XcVRejjŽ

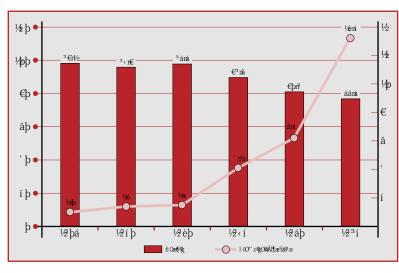
 $\begin{array}{l} @\_Vh Fy `VY `\ Z XZ XCReVcUAEZ Re TYR Xdd Z cVJZXZ f dRWJZReZ _dZde`T ^ a ReVVRIY a Vdd _d`d Tf ccV_e a` d&Z _ Z eYZd cVXRU h ZeY eYRe `VeYV Y f dW` JU eYYJ XcVh f a Z ŽE YV dR` a]V f dVU Z eYV4 @? 2D 5 2 d` cgYJ ZdcVJVgR_ee` eYZdR_RJ dCd 1 eKSJV) */Z \\ \end{array}$ 

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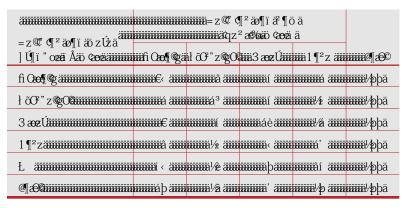
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>¶ï Úgznän ¶Åï ©æ¶² áfi z² Ýi Ýz Ýráil Œ¶² Oãå² Ýa@eææð¶‰sæ@eðáæg ÝÊ

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>¶î (ģznal ²gî zYa6a) Qg¶²O8aqzafi¶– ŶÚá0- ¢²a\$a>z+ïO8a²afiox®nafi¶– Ý¢²ai Qg¶²O8aqz®a>qQ4fi31 >'L hãa ½3€É EYVEVZL\_`eR]RXVUZWWCV\_TVSVEhW\_ eYVaVd TV\_eRXV`VaVa]VScfXYefaZ\_4ReY`[ZTYfdM Y]UdhY d'SdvbfV\_elj ZJV\_eZjVhZYVgR\_XV[Zf 1'  $^{\prime}$  / R\_UeYVaVCIV\_eRXV`VaVa]VScfXYefaZ\_ VgR\_XV[ZR]YfdW`]UdhY X `gVce 4ReY`[ZZf 1( $^{\prime}$  /ZEYVUZWWCV\_TVZLZ\_eYVRSd]feV\_f^SVdŽ 7 c VgVg'VgR\_XV[ZIR] X Z\_X`gVce 4ReY`[ZZf'L eYVEVVRV}gV4ReY`[ZdhY`X eYV`eYVchRjŽ2 aVd\_ScfXYefaRdR\_VgR\_XV[ZIR]ZddZXYejj^`dV [ZVj] e`SVT^VR\_`\_lSV[ZgVceYR\_R4ReY`[ZT ZŽ2XRZ\_L`\_VZ\_Wfc`WeY`dVScfXYefaZ\_R \_`\_lSV[ZgZ\_XY`fdW`]UdSdvbfV\_ejj\_V`SdRIV Rdv[ZXZ\_Ž

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 $CV[ZZ f d RW]ZeZ_d ReV R]d Red TZeWU hZeY dZ_Z TR_e UZWWEV_TVdZ_eVV d TZe] ` dZ_d ReZ_ ` W eY dV hY a` ddvdd eVV Ž6gR_XV[ZIR] d eV_U e` SV ^ ` dVZ_e`]VdR_ee` h Rdd UZWWEV_TVeYR_4 ReY`]ZdŽ ? `_lSV[Zgkdd YRgV eVV YZXV de]VgV] ` We`]VdR_TV R_U_`_lVZftZe Z_REZ_ŽEYVJ R]d UZWWE Z_ eYV dT aV` WeYVZE Zek& de Z_ eYV h` d]UZ6gR_XV[ZIR] d eV_U e` <math>\land RVeYV$ ] TR\_VZXS` f cY` U eVVZE dZ\_Z l TR\_e h` d]UL4 ReY`]ZdRV^ ` cV` dZ\_eVU e` h Rdd eYVT f\_ej Re]RcXVIR\_UVc\_`\_lSV[ZgkddZeZleYV h` d]U Rd R hY`]V eYRe Zl^` de Z` a` cR\_eŽEYVJ

JZ.VhZVUZWWCdZZ\_Z;TR\_ejjZ\_dTZła`]ZEZTR]`fel ]``\Ž6gR\_XV[ZTR]deV\_Ue`SVZ\_UZWWCV\_ee`hRtUd UV^`TdRIjŁR\_U`\_]jR^`\_X\_`\_łSV[ZZgVcdZtR ^R[`cZejT^^ZeeVUe`ZEŽ4ReY`]ZTdcV-VTeeYV Tf\_ecjRe]RcXVZ\_eYReR^Z\_`cZejdTSdTcZSVe` UV^`TdRIjŽ

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 $H YV_V gVc def UZdUVRJZ_X hZY cVJZZ_f dR_MJZA$  $eZ_dR_UacRieZIVdReVaf SJZHVULd ^ VT ^ V_l$  $eRe cdcVRIe hZY d cacZdV Re eYV deZ Z_XUZaRZ$ J $SVeh W_ aV a]VdTJRZ de SVcVJZZ_f dR_U eYVZc$  $RIef R] cVJZZ_f dacRieZIVŽ4 VeRZ_j jLcVIV_e def UZd$  $T_dZeV_ejj dr'h eYRe aV a]VhY derevery ReV$  $SVJZgVcdR_USVj_Xe RTYf cTY XV_VR]jj UZaJR$  $RgVcj ]`h ]VgM_VeVJZZ_f dacRieZIVŽ5 VaV_UZ_X$  $`_ eYVUVJ_ZZ_ f dvULUZWWEV_e def UZdVdeZ ReV$  $eYRe RS`fe (&` `WaV a]VU _`e acRieZIV eYVZc$  $dx]ZZ_ cVAF [Rc]j R_UaRceZIZAReV`_jj Z_ R dreYvc$  $da`cRUZIh Rj eYc f XYTVCV`_ZdCf TYRdSRaeZI`d.$  $^ RceZRXdR_UVV_VR]dZ$ 

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>¶ï LýznäAlźÅOLźqä¶°äæzä] OYÝä¶%æzäB1Ł; äl Oz¶°O&>ï Lózonai þþ½Ê

EYVF? 5 A #!!" Df ggy R]`hdf de` UZWWY\_ł &ZEVR``\_XeYCW ej aVd` VEV[ZZ f dacRieZIV`VR If ]ef R]\_Ref cV`c Rdl TZEWU hZY RaRZY`ca]RIV `Wh`cdYZZ?`^Z\_RJ SYJZgVcdRV eY`dV hY`d3 eYY RV cV[ZZ f dSf e acRieZN eYVZ cV[ZZ \_ gVj [Ze]V`c\_`e Re R] 1## ´Z@SdcgR\_eSV[ZgVcdRV eY`dVhY`acRieZNeYVZ cV[ZZ \_ ZcVAf ]Rcj R\_U]Vdl eYR\_`\_TVR hW\ 1\$\* ´ZACRIeZZ\_XSV[ZgVcdRV eY`dV hY`acRieZV eYVZ cV[ZZ \_ dXf ]Rcj R\_URe [VRde`\_TVR hW\ 1\$# ´Z6gR\_XJ[ZR]dRVNE^`CV [ZV] e` SVacRieZZ\_XSV[ZgVcdeYR\_4ReY`]ZdH Y` eV\_Ue` UZZJVSVh W\_eYV`SdvgR\_eR\_U\_`^ZR] IREVX cZvŽ

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H YRe ZI YRaaV\_Z X de VIZ TR] j Zi eYRe cV/ZZ f d Vi a V ZZ TVZTYR\_XZ XL\_`e\_VIV dR Zj h VR.V\_Z XŽ EYV a REZIVIT f C R] j e & V\_R dR j RU de ZI \ Wc e W Z eV\_de j` WM/ZZ f d`Sd kgR\_TV d kg ZIV dh`cd YZ L TV \`\_Z dz a Re`cl RI E ZZ Z d R V T ]] VI E ZV R\_U Z dz f e Z\_R Z E YV UR R IS`gV d V-VTe`\_] j e V U M T] Z V Z\_ e V d V a RI E ZIV Z A Z B E V U R R S`gV d V-VTe`\_] j e V U M T] Z V Z\_ e V d V a RI E ZIV Z A Z B E V A R E V \_`e c Z f R] j Z dz f e Z\_R Z A U YR V.`e U V] Z U Z e YV d ? V h B Z E YV 4 6 A I: DD A #! ! " df U j d ^ h d e YR S j Z e C\_R Z\_R d R\_URU d R E XV a c a `c Z\_ `W 4 YZ VR\_d a d J L Wc V R` a ] VL d ^ V Z X E YR Z I T\_dZ E V e h Z Y 4 YZ V d R \ Z X R``\_X e V T f\_ł e Z d h Y V V d Z f d S V Z WZ 1^` c a d g V Z Z

 $5 VZ_dZf eZ_RZRZ_R_U d S[VIZZRZ_VRZ_VRZV] VRW TIF cWe UZWCV_e UXWU UAV_UZX`_$  $eVVIYf cIYe hYZYaV a]VRVRMZeVZ6gR_XMZ$  $IRdRV^` cVZVj eYR_4 ReY [Zde addezVeYZc$  $cMZZ_Z_dZf eZ_R]jLRdeS]V*S dr`hdZDf UZd$  $dZ TVeYV''*' ! ddgVR] eYReeYVdVZZ f dV a VZV_TV$  $Rdf TZRVU hZY AV_eVT dR] ej aVVgR_XMZr`ZdZ i$  $dARCS]VW^ eYVICVRZ_` WI a VZV_TVdeYReZgV$  $RdV_dV`VSV]`_XZ Xe`RT ^ f_ZjLRdR cWXXV$  $W^ eYVZ_dVIF dzj TR dUSj dRaZJTYR_XVR_Ud i$  $TZR VIJf dZ_Z3VIR dr`WrVd S[VIZZVVV_TZ_Z$  $aV&Vc^dVgR_XMZR] cVZZ_Z 4 YZVh`f]UdV$  $e`SV]Vddf dIVaeZ]Ve`UZ_dZF eZ_RZRZ_Z$ 

9 VEV RARZ\_ eYV dÆF REZ\_ gREZA dZ\_ RIT d.R\_TV hZeY SVJZAGVAT UV^ `XARA YZT R\_U d`TZ TF]ef dR] TYRCRIEVEZÆZTÄZ: WAYV UZWWAZ/ egi a Vd` VAVJZAZ dÆj REV eR\V\_RdR ac`ij Wa UVZ\_dÆF eZ\_RJZAREZ\_ŁZe



ecR\_daZVdeYRe^V\_LeYVfaaVcdeRef^LeYVj`f\_X R\_UTZjHUNJ]VdRV^`cVacZgReVZ\_eYVZcVJZZfd VfaVcZy\_TVŽEYVdVRVeVVgVja`a`af]ReZ\_Xcfad eYRedn`h eYVYZXYVde]VgVj`VVVdcRLEZ\_RJZReZ\_ R\_UZ\_UZgZfRJZReZ\_Ž3jT\_ecRdeTZcZh`^V\_LeYV VJUVcjjLeYV]`hVcdecRef^ R\_UeY`dV]ZgZ\_XZ\_dfcR] RvNcdhY`RV^`de]ZVjje`TYR\_VjeYVZcVJZZfd VfaVcZy TVeYc`fXYZdeZfeZ\_RJZxUacRieZIVZŽ

EYZIZ WC RZ\_ d'XXvdedeYRe fY`][ ]ci g`YI ! dYf]YbWY`]gWUb[ ]b[ i bXYf'h Y dfYggi fY cZ [ YbYfU`W`h fU`WUb[ Y]b h Y Wei blfmUbX` h UhžVmUbX`Uf[ Yžh Y X]fYWfcb cZWUb[ Y` ]g'h Y gUa Y`\YfY`Ug`]b ch Yf`UfYUg cZ`]ZY.` hck UfXgh Y df]j UhY Webgfi Wfjcb cZa YUb! ]b[ "EYZIYRIT\_dVbf V\_TVdR\_U d7Zki TYR]V\_Xd WcZ\_UZZIFR]dtTyf cTYVdR\_U d7Zki Z\_XV\_VRJŽ

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EYVď S[VIežežkeZ\_`VeVJZZ\_R\_UeVVVeRIV! ^ $V_eW$ ? ZdZ\_džef eZ\_R]^ R\_ZWHREZ\_deVReYRd `TIF ceVUZ\_adRiežIVRdR cvdf ]e`VeVzl YRgVSW\_ RIT`^ aR\_ZVUSj R\_Vh Raac`RIY e`TVf cIYVďZH Y` e i U`]IUHj Y`gh X]Yg Wc bXi WhYX`Zc f`h`]g FY!

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Uhih Ya WijijWU``m' 2\_UeYZIRZZIA ZISRAU`\_ eYVT\_ecRe SV&h W\_ eYV d'S[VIZZVTYRRIEAC` W cMZZZ\_`\_ eYV`\_VYR\_UR\_UeYV`S[VIZZZ i R\_U eYV\_TVa`h Vz' V&YVZ\_deZf eZ\_`\_ eYV`eYVŽ

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7c`^ eYVdeR\_Ua`Z\_e`WR\_Z\_U&SZLFRJZKUUWKeYL TYfcTYVdeV\_Ue`SVdW\_^V&YJjRdZ\_deZfeZ\_dL R\_Ue`SVT^ aRcVUhZeY`eYVcZ\_deZfeZ\_dZ 4`^ aRcZd\_dSVchW\_TYfcTYVdR\_Ua`JZEZRJaRd eZdV&WbfV\_ejjT^VfaŽ

### ÎFY][]cbg'UfY'hY'gUaY'Ug'dc']HWU^dUff]Ygž hYmbYYX'aYaVYfg'Î fAU'YzUXi`lži fVUbž'ck'@9, L

$$\begin{split} & \text{EYZt} \text{TZzZTZt} LXV_VR][j YVRUW^^j j^f_X \\ & \text{aV a}[VLZh W_ SRMU^_ eYVZ:gZh WeYVhB] eYV \\ & \text{4YZ}R_ 4Rey^ [ZT 4 Yf dY YRdSW_ X Z_XZ_ eYV \\ & \text{Reb UVIRUZE YdW eV_UV_TZd ReV ZV_eZ W R_U \\ & \text{RbddUZE YdW eV_UV_TZd ReV ZV_eZ W R_U \\ & \text{RbddUZE YdW eV_UV_TZd ReV ZV_eZ W R_U \\ & \text{RbddUZE YdW eV_UV_TZd ReV ZV_eZ W R_U \\ & \text{RbddUZE YdW eV_UV_TZd ReV ZV_eZ W R_U \\ & \text{RbddUZE YdW eV_UV_TZd ReV ZV_eZ W R_U \\ & \text{RbddUZE YdW eV_UV_TZd ReV ZV_eZ W R_U \\ & \text{RbddUZE YdW eV_U eV dZ W A BV ZZ W R_U \\ & \text{RbddUZE YdW eV T_UF ReVZH ReV ZZ W R_U \\ & \text{RYZM gRJf VZ2_f WRG f dS]VT ^ aRzt_Z Zh WV \\ & \text{URh_ YdWhZY eV GZZ Xd TZH T ^ Ze V e W \\ & \text{RVEW R W R_V W R_U \\ & \text{RVEW R W R_U & W W R_U \\ & \text{RVEW R W R_U & W W R_U \\ & \text{RVEW R W R_U & W W R_U \\ & \text{RVEW R W R_U & W W R_U \\ & \text{RVEW R_U & W W R_U \\ & \text{RVEW R_U &$$

eYV & Rey`]ZT4Yf cTYVEZ\_`eYV cT^a]RZ\_eZleYRe eYV4Rey`]ZT4Yf cTYYRdT\_TV\_ecReVU cVTV\_ejj`\_ Zdf Vd`WacZgReV^`cR]Zgi ŁaRceZff [Rc]j eY`dv cVReZ\_X e`eYVNR^Zj; R\_U dvf f; RZgj Ž e^R.VdaV a]Vf\_VRdj e`YVRceYV4Yf cTYZ\_eV\_dZyVZ\_XZd^`cR] deR\_TVZ\_ eYVdvRcVR4 eYVgVg`\_VdhY`dvXc`hZ\_XRTe`\_`^j eYYj\_`hTVjVScReVZEYVeYZUT`a]RZ\_eZleYReeYZd \_Vh`cZV\_eReZ\_ZdV acVdbVU\_`eZ\_afS]ZTU/SReV Sf eeYc'f XY eYVVV VCIZV/`WcRUZEZ\_RJZ~fV\_TVZ\_ eYVTZETJVd`Wa`hVZ

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ÎHY7\i fW \UgVYYbWUb[]b[ UWi Umž ]h\UgVYYb`ccgYb]b[ i dUV]!žVi hU``hY gUa YžhY7\i fW kUblg'hcghcdhYfYV?! ]b[ U``hYgYUVcf]cbgžVi h]hkcbMi YhdYc! dYi gYWebXca gžk\YbdYcdYUfY\Uj]b[ ` gYI i U`fYUI]cbg\]dgVYZfYaUff]U[Ybck"' HUMỹk\YfYhY7\i fW ]g[ c]b[ kfcb[ ž= h]b\_"HUMỹk\YfY]hỹ cg]b[ dYcdY' fAUYUbXZYaUYžnci b[ ži fVUbž\][\@, L

 $CV[ZZ\_LeYRe ViaVeZ_TVhYZYL]ZV]`gVR_U VeX_LeYRe ViaVeZ_TVhYZYL]ZV]`gVR_U VeX_LeYRdYRd TZej`dR_UZ_UgzLfR]d^`e$  $eeR_dIV_UV_eR] bf VeZ_dR_UViaVeZ_TVLYRdYRU$  $R_UhZ] YRgVRgZER] c`]VZ_T_deef TeZ_XRT]]VTeZV$  $dV_dV`VeYVyH V%Z_4YZVZH ZeY`febf VeZ_LZe$  $hRd eYVTYf cIYVd eYRe Z_ eYV^ZLe`VeYV d`TZR]$  $T_~ZTed`VeYV]ReVehV_eZeY TV_ef g`d`TTWUVU$  $Z_^RZ_eRZ_ZXeYVZJNR`VLREZ_R]T^^f_Zj Rd$  $R_VeYZIR] S`_UR``_XaV a]VZEYVVWW.ced`V4Rd$  $UZ_R] CR4_DZgR9 V_c2ef V.e`VARZ_R_U_`h$  $Wc^aRe`VeYVT`f_eg`dYZe`cZR]^V``gZ$   $\begin{aligned} &3f e e^{i} V^{T}f \left| e^{i} d^{R} TYR_Xd_{h} XZ_X_{h} XZ_X_{h} R_V \\ e^{i} Re e^{i} d^{R} R_{g} d^{r} TYR_{h} V_XZ_X_VZ_5 ge^{i} U^{i} Z_{h} fa g^{r} \\ &c Z_{h} X_{h} U^{i} D^{h} U_{h} U_{h} e^{i} a U^{m} VY_{h} Y_{h} D^{r} Z_{h} fa g^{r} cZ_{h} Y_{h} U^{i} D^{r} \\ &U^{i} a c_{j} Y^{i} he k UfXg^{r} df_{j} U^{h} Z_{h} fa g^{r} cZ_{h} Y_{h} U^{i} \\ U^{i} a c_{j} Y^{i} he k UfXg^{r} df_{j} U^{h} Z_{h} fa g^{r} cZ_{h} Y_{h} U^{i} \\ U^{i} a c_{j} Y^{i} he k UfXg^{r} df_{j} U^{h} Z_{h} fa g^{r} cZ_{h} Y_{h} U^{i} \\ U^{i} A U_{h} Y_{h} g^{i} H_{h} U^{i} Y_{h} f^{i} & W^{i} W^{i} W^{i} \\ U^{i} A U_{h} Y_{h} g^{i} H_{h} U^{i} Y_{h} f^{i} & W^{i} W_{h} W^{i} \\ U^{i} Y_{h} y^{i} y^{i} a U_{h} U^{i} D^{i} H_{h} g^{i} Z_{h} Z_{h} d^{i} Z_{h} e^{i} \\ e^{i} T_{h} U^{i} U_{h} Z_{h} f_{h} Z_{h} e^{i} Z_{h} U^{i} Z_{h} e^{i} \\ a^{i} d^{i} S_{h} Z_{h}^{i} U_{h} Z_{h} f^{i} Z_{h} d^{i} A (Z_{h} Z_{h} d^{i} A (Z_{h} d^{i} A$ 

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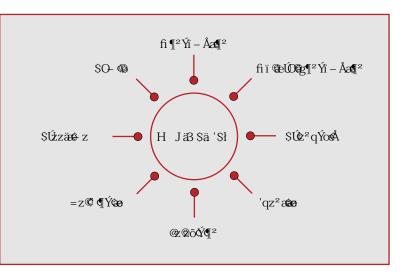
EYVZ aRIÈ WIF Jef dR TYR\_XV`\_ URJ; JZJZ XZI RJekéZ XeeRLÆZ\_RJhRj d` VJZWR\_UXV\_kREZ X\_Vh `\_VÉŽ:^ RXkd`VeYVcM/WURJ; acRieZtVdR\_UhRJ d `WM/REZ Xe` d`TZkj; RcVR]] TYR\_XZ\_XŽ2dRckff JeL R\_Vh ^ Ra`WZ ZRZEXdR\_UUZWKV\_TVdR``\_X d`TZN Xc` fadZiV`VeXZ\_XŽE YZdvTeZ\_`VeYVCV a`ceUkflčZSVdeVvhRj d`VJZWeYReacVU`^ Z\_ReVZ\_ 4 YZJŽE YVV` aZZIR] URERdkéVkeY Z\_eYZdTYRekć d`XXkde eYRe eYvdV RV\_`e acZgReVT\_def Ted\_`c VgV\_Xc` fa`\_VeLTEVRAURARZ\_deRSRI\Xc` f\_U`W cMREZVZ\_UZWKV\_TVe`hRtdd`TZkj; RdRhY`]VŽE YV ^ Ra`WhRj d`WJZWZ\_4 YZJVZELReeYVdR`VeZ`VL R^ Ra`VkiV a]VdZ`RYZ\_RZd`WtTZkjEkeVV\Z\_U `WAYREZ\_dYZadeYYj hZAYê WCXV/hZeYZeR\_UeYV d'TTVdAdR\_UWAZfcXdeYyj ^ WehZeYZ\_eYVac`TVdAŽ HRjd`WZZWUVCTCZSV\_`e`\_]jdaVTZ;TZ\_UZgZufRjdL SfeRjd eVVdTZAje`hYZTYeYVjcVjReVŽ

$$\begin{split} & \text{EYZIZI} ` \text{WeYV XXRev& Z' a` ceR_TV Wc Yf^R_UVgY}` a^ V_eXH YRe ZIRe deR VZ_eVV_Vh ac` TVdt ` VXLV_e&g` Wc^RZ_ZIeVVUVgY}` a^ V_e` VZ_UZ gZLF RJZREZ_R_UXXRevC` aa` cef_ZZXdWcaVcd_R] ch/WxRJZREZ_Ž2]cl Re deR VZIeVV <math>\setminus Z$$
 U` Vd TZG eYRe^ RJ cVd' eYVdVh RJ d` V/ZWŽ2\_URdYRd SW\_dVL\_` e VgVg` d` TZG ac` gZLVd R d` ZeS]V a]RevVc^ Wc eYVUVgY` a^ V\_e` VR d` S[VTeZgVj] cheXMRE g` Z\_UZgZLF RJZREZ\_Ž

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Xc f adc\df ]  $d_{X}^{X}$  eYZIZ eXXRe\UR\_Rj dZlh \CV e\c^ \Uy4 YZIVR\_h Rj d` \VZIVZ

EYVX: fadtvf ]&ZXW/^ eYZI^ f]&ZRZRWR\_R] j dZlh VEVUVCT&SVUSj TC dVZ\_XeVdVyeYZU` dV% Xc fadh ZEY eYV` cZXZ\_R] gRZRS]VdW/^ h YZIY eYVj UVcZgVUŽH YV\_ eYZI h Rd U \_VLeYV TYRRI&cZ&ZCd eYReaRceZIF]Rcjj UV}\_VUVRIY Xc fa T f]USVRał acVTZREVUŽE` dfaa]V^ V\_eVRIY Xc fa ac }]VLeYV cV]ReZ\_dYZa` VWRIY hZEY` eYVc df cgVj bf VdeZ\_d h RdR\_R] dVUŽ

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$\begin{array}{l} 0 & \ qz & gg\ ^2 & 1 - z ( \end{tabular} ) & \ gc  & \end{tabular} \\ & + & & & & \\ 1 & + & & & & \\ \dot{\gamma} & & & & & \\ 2 & & & & & \\ \mathcal{T} & & & & & \\ 1 & z & & & & \\ 1 & zz & & & & \\ \dot{\gamma} & & & & & \\ 1 & zz & & & & \\ \dot{\gamma} & & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & \\ \dot{\gamma} & & & & & \\ \dot{\gamma} & & & & & \\ \dot{\gamma} & & & & & \\ \dot{\gamma} & & & & & \\ \dot{\gamma} & & & & & \\ \dot{\gamma} & & & & & \\ \dot{\gamma} & & & & $	mal²æÚæe−z²ammmmmmmm	₩₩>zØga€z
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1¶–¢OQ z©&UY <del>annun muunun ke</del> zée <del>aannun muunun muunun muunun aannun saannun muunun muunun muunun saan saan saan saan saan saan saan</del>	ma⊄Qe¶²O <del>annnnnnnnnnnnnnnnnn</del> ma ÝgÚ zg <i>a</i> nnnnnnnnnnnnnnnnnnnn	₩₩₩ ¶ö ₩₩₩O zq¢ – ä

### A 5 D C : 7 < ≠ 295 B K 5 MG C : @ 9

 $EYVWJ] hZ_XUKATCZacZ_ZIRyd_Radr^{0}W$   $eYVdZ_XcfadZ_{e}Vch^{d}LZcZISRAU_{a}cH$   $TZWTYRCRTeVCZbZTd_hYZVeYVRCMC^{WR'SZbZTd_j}$   $eYch_faSj eVVdReZbZTRJ_R_RjdZlYRgVSW_$   $VJZ Z_REVUZ$ 

Cffi [ [`]b[ ZJa ]`ma Ub#k ca Ub`f&& Ł : def XAVUB Z UB `fee` YRGVR UMVe W^Zj [ZWLSVIRF dVeYRe ZleYV^ `deZ a`ceR\_e eYZXeYVEV ZĽ6gNG eYZX: U`Zle` \Vá^j W^Zj XZX VGV eY fXY eYZHR\_SVgNG YRUReeZ NŽ

 $Ddf XX Z XV P^{2} Z j^{V} V_{R} Uh^{^{}} V_{Y} Rev Red U I$ eZ\_RIZ RXV VerVh`dU+eYVZc^ RZ T\_Tvc\_Zde` ^RZ\_eRZ\_`dUcR\_UUVIV\_TjZ\_eYVAR^ZjŽEYVAc aVcd\_R]ZV\_eZj Zlc`eVUeYVcV,eYVj UVj\_VeYV^ł dygvdSj eYVZcVR°ZjŽEYZd`fej``∖ZdcVZ\_WćTVU SjeYVZccVZZZdZj,eYVjRcVSVZdgVcdhY`acRTeZV  $eYVZccVJZZZ_RddZLf`fdjLR_U^R_j`WeYV^RcV$ VgR\_XVJZIRJdŽEYV`fedZUVh`dJUYRd]ZegVRaaVR WceYV Ž:e^ ReeVade` eYV``\_]j Z\_d WACRdZeTR\_ ac`gZVcVdfcTVdR\_Udfaa`ceVVceYVReeRZ\_^V\_e`W eYVZcacZeReVX RŽEYVj daV\_UeYVZcVXVeZ^V]``\ł ZXWchRid`WZ ac`gZXeYVZcWR ZidZefReZ\_Ł  $R_U h YV_e W_h h Rei Y eV_V g Z Z_e V Z c a c W K V_T V$ ZdWcfdWM ZWc^ReZ\_eYRe^RvdeYVZc Zgvd VRZKZEYV X\_VR]j YRZVWh WZ/UdR\_UU \_`e `eR^` XeYVZcZeVcVdedVZeYVcŽ

EYY RV\_`eRhB dRS]Ve`d dRZ eYVZ W^Zj ZNRJŽEYY WY eVZ ZT ^ VZ ZRVbf ReVVceYZŽ EYVZ VI aVIBEZ\_dVceYVWd cVRVf\_TVdRZ HRd eYY YRgV]`de`feSj eYVTYR\_XdZ eYVVT\_`^jŽ 4`\_d` acZ\_ZL\_`eR^ R[`cdfcTV`VZ eVZRZZ Ze`dTZcjLdZ TVeYY TR\_`\_]j RWXdUeYVSRZTŽ EYVdVUZNTF jeZdLT ^ SZ VUhZY eVZ eV\_UV\_Tj e`hZeYUBA Ze`eYVZ acZgReVh`dLL^ R.VeYV d ^ VhYRe^ZbcfdeW] R\_UZ e`]VR\_ee`hRdd`eA VcdŽ@\_]j hZeYZ eYVW^Zj TR\_eYy }\_Ud ^ VRdV R Ucfaa`ceŽ

 $\begin{array}{l} \label{eq:linearized_linea$ 

fd R]jj dfaa`ce R]RXV\_f^ SVc`V4V a]VLhYZY ZhhYj eVy TR\_WWJ eYRe eYVZ: JZgvd RV R YVRg cvda`\_dX5ZZijŽ

=bgYWfYUgd]fUbhff%1 Ł

: eYZ \ j`f R]h Bj dYRgVe` RahZVe` SVeekćj`f cod/YŽ/ EYRečch Yj : ^ R\VeYVVWWcee` XléeVVeYZXt: h R\_e R\_USVRITVAEVUSj` eYVcZŽ \\_`h eXReeYZIZUZIVIF]e R\_UeYRej`f TR\_cKR]jj`\_jj cVjj`\_j`f cod/YŽ/

 $: \_dVIf cVRhzR_edRV\_`edRez] WhzeYhYRe$  $eYY RVReackd/_ežEYY eYZ \ eYY YReVRUfg$  $e`SVevceYV dvgvžEYVRhzRez_d`WrzIXc`fa$  $eV_Ue`SVTYR_V]WeYc`fXYT_d`aeZ_ŽEYzd$ ZhhYvcVeYy dWRITVHZS]VaReYde`hRuUXc`heYLhZeY cVff ]ed eYRe ReV aVcTVaeZS]V e``eYVchŽ3fe $T_d`aeZ_Zd_`eVgvg`eYZ_XŽ3VeeVzZxeVV ł$  $dvgvdRdd ^ VR_dSVZ_XcVT X_ZXU R_U RITVaeVU$ Sj`eYVchŽ

$$\begin{split} & \text{EYZELL} f c XV \equiver SVeekc e YV dMg kill The dvid e YV \\ & \text{R_i Zej LSVIRF dvie YV e Rdv Zl_` e R_ VRdj`_VR_U \\ & e YV RVRARZU` VWRAF c VZE YV e YZ_ e YVZ_X R Z \\ & d e YV c g R V Le YVZ_R ] Z d Wh R_UVRESVEH W_Le YVZ \\ & RIYZej V V_e d d e YVE a c VIRCZ f d R_U e YVZ_a ReY R \\ & \text{I`_Vj`_VZE YVZC^ RZ_d f c IV` VZ_d VIF c Z j Z d Z \\ & e YV WVZ_X e Y e e YV U _` e T_ec`] e YV^` de Z l \\ & a`ceR_eg R Z S ] V d Z g`]g VUZ_e YZ d b V v E YVZ_d e \\ & e YV ReR_j e Z V Z_e e YZ b f V e YZ_a`ceR e e YZ_X Z d \\ & e YV ReR_j e Z V Z_e e YZ b f V e E YZ a`ceR_ee YZ_X Z d_Vg k [f dee` ^ R_V U Z \\ & \text{E } YV U Z \\ & \text{E } YV Z f d e e Y V Z d YZ e YZ b f V e YZ_A e \\ & \text{E } YV R e YZ e R V Z_E e YZ e \\ & \text{E } YV R e YZ e R V Z e YZ e \\ & \text{E } YV R e YZ e R V Z e YZ e \\ & \text{E } YV R e R = 1 e X V Z e \\ & \text{E } YV R e R = 1 e X V Z e \\ & \text{E } YV Z e YZ e YZ e \\ & \text{E } YV R e R = 1 e X V Z e \\ & \text{E } YV Z = 1 e X V Z e \\ & \text{E } YV R = 1 e X V Z e \\ & \text{E$$

 $7 cZ_dViff cVRbhZR_edteVVR^2 Zj ZiRa]RIVh Y CV$  $VRIYZ_UZgZIFR] [VRc_de cV/ReVe `eYVcdZCV/ZsZfd$  $acRieZIVWRef cVdbf ZeV dec`_Xj Z_eYVc2]ZgVdLaVd$  $YRad Rd R_`eYVc a ReY e h RcUd d TZG Z_eVXReZ_Z$  $EYY_hReIY eV/VgZZ_ Wc T ^ aR_jZ2a Ree W ^$  $eYZLeYVc2 Tf ]ef cR] T_d ^ aeZ_Z[]`hZ$ 

2 YZXY ac`a`œZ\_`WZ\_dVIf cVRdzZR\_edd} eYY YRgV\_`WZV\_UdŁ`\_jj RIbf RZ\_eR\_TVÖZ5 VdzZveYZŁ eYY ^ R.VWWXced e`VdeTS]ZY cVReZ\_dVZadhZeY `eYVcd\_VdaVIZA]jj Z\_ eYVZ: daRV 62 VŽE YZddW^d e`SVRX`UhBj`WY\_UZ\_XcVT X\_ZZ\_LR\_U`W ]``\Z\_XVVcd f cTVd`Waa`cef\_Zj eYReTR\_^RUV eYVZ: eRch`WdMVIZ ac`gV\_V\_e VRZKČZ  $2Uf ]eh^{\wedge} V_{R_{u}} UY f dh Z v dR V Y R g j dach dV_{eVUZ_{u}} f a L R dZ le V ]^h d TZ l V T_^ ^ Z T X c f a Z$ 

7 cbhYbhYX ZUa ]ma Ub#k ca Ub ft&& Ł : ġVXeR]`ġŊj WY ŻjŽ=f TŻj hVU\_ehR\_eVić R\_jęYZXR\_U: TR\_ZUFJXV^jdJVWR SZĚZTEFRJJŁ eYZXIYRgVX\_VhVJ] Vić f dLR\_UeYRe^R\Vd^V bf ZV^aeZZHZŽ

4`\_eV\_eVU VR`Zj ^ V\_ R\_U h`^V\_ WVJ X`U RS`fe]ZWLVZeY & SVIRT dveYy YRgVRIYZgVURX vRe UVRJ`C SVIRT dveYy YRgVSW\_RSJVe d'dRZ RhBj `VJZW eYR ed ZdeYv^ŽEYY RVT\_} UV\_eeYR eeY VZ: ^ RZ\_UVZEVI e`YRgV R dRSJVLYVRJeYj VR`Zj JZW Zdd^ VeYZ X eYY TR\_SV d'cV` VRIYZgZ XŽEY VZ: d'TIV dZ JZW^ VR\_deYy YRgVSW\_RSJVe ac`gZV Rd JZJ SRZEI V & eY VZ: VR`ZZ dLV\_RSJZ X eYV^ e` h VR eYC eYV f ad R\_U U`h\_d eYRe TZ:Tf^ dR\_TVd RhBj dScZ XŽEYY VgV\_YRgV cT TIVU VL h ZeY f e X vRe deRZ HZ\_YR^`\_ZZ XeYVZ cv4a`\_dSZZ j e`h RLd eYV VR'Zj h ZeY dyVARJZREZ\_ŽEYVZ: deSCINTEZ\_ Z\_JZWZ ISRUU`\_ eYZ ISR\_TVZ

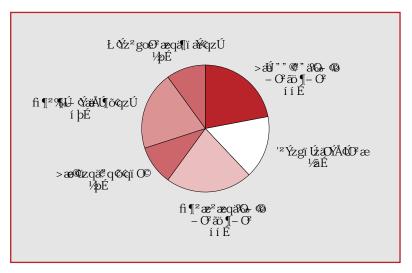
EYZLX: fa YRCR/RZZYJ dc`\_X&/\_UV\_TJ e`ł hRUUZ UZZLFRZRZ\_ŽEYZLZU/-VIAUŁR``\_X `eYceYZ\_XŁZ eYVT\_gZIZ\_ eYREZZUEYZC`h\_ UVIZZ\_dR\_U ZWTY ZWEYREX e`SFZUEYZC` WE CZEYZU/WZ RWZIRT ^ aR\_ZUSJ C/RZZ/ aWEIV`W Z\_URS`feeYZC}\_R\_WLRUYZ ZJ Zł T ^ VZUC WIZ/ee` ^ WEEYZC; WUZZWIFC/`W eYZŁAV a]VZ\_ eYZLX: fa RV\_`ee` T\_TC\_VU RS`feT\_d^ acZ\_ŽEYY eR\_VEYVcc`fS]VE RI bfZVeYVeYZXUEYJ [ZVR\_URVZ\_Ra`dZZ\_ e` U dŁSfeeYY dWZERU[fde`\_V^ `CVdfcTV`W XRZZ TRZ\_ R``\_XdgXEJ`aV\_e`eYVŽ

:\_eYVZ:daR:VeZ:VeYVjeV\_Ue`TR:cj`feRTe&gZ eZdeYReac`gZ.VeYV`hZeYZ\_U&gZ.fR]XReZ:TRZ\_+ da`ceLcVRLZ\_XL^fdZT`cY`SSZdŽ3jR\_U]R:XXLeYVj YRgVRX`U]VgY`VWF]efcR]T\_df^aeZ\_Ž

> V^SVcd`VeYZIXc`faUZa]B, RaRezTf]RcT\_ł TVc\_RS`feeYVbfRZej`VeYVZcYf^R\_cVJRz\_dYZaČ EYZIZICV-VIEVUZ\_eYVgVcjZa`ceR\_ea]RIVeYRe eYVViaVcZ/TV`VWCZ/UcYZaR\_UdTZSZZejYRdZ\_ eYVZ:JZzVČZ

2d dVARUd eYV UV `XRaYZT TYRRIeVZeZid`W

\$'%B=łäþ 0 OÅa¶%ana coo20°äö OøÝa¶%ans%ana



> ¶ĩ Ướz năi Ưź Ả Criz qa<br/>¶² acce aj Or Vât Nacce ab 1 Ł; al Or  $2^{\circ}$ ĩ Ướz vai þ<br/>þ $! \hat{E}$ 

ckda`\_UV\_edZ\_eYZdXc`faŁh`c\Z\_XaVa]VR\_U ^V^Skd`WeYV^VLZf^łYZ&YdTZłVT\_`^ZT Xc`faReVaReeZff[Re]jhV]]ckáckôk\_ekUŽ

Ghmì]nYX`]bX]j ]Xi U``f1%\$i Ł

:  $h\underline{R}_{ee}$  [ZgV^j `h\_ ]ZWZ `gVXe^j `h\_ ZJRd  $\underline{R}_{U}$ :  $R^{T}_{U'e}$ :  $\underline{R}_{c}$  ( $\underline{R}$ ]ZEVeVV Ž:  $\underline{eYZ} \setminus \underline{G}$   $\underline{VGS} `\underline{U}$  ZEV\_ $\underline{eZ}$  ( $\underline{Ve}$  U eVV $R^{T}$  VZ. U hYRe: a]( $\underline{RdV}$  $\underline{R}_{U}$ :  $\underline{V}_{1}$ ) dRcZ XhZeY eVVaVa](V: [Z) VZ

 $\begin{array}{c} \label{eq:product} Dig [ZkVUZ_UZgZLf R]ddWeYVh`dURdT^a`ddU`VWVa]VdRYVceYR_`VWc`fad`cZ_ddZfeZ_dZ_eYZh`dUVdRYVceYR_`VWc`fad`cZ_ddZfeZ_dZ_eYZh`dUVdRYZd`cYVc`h_UCVR`dZEYYj dWVe`VdWeYV`dMgddW^ eYVeZd`WeRUZZ_`cZ_ddZ ef eZ_dZ_:_XV_VR]LeYVeWCVLeYY_RVUARIYVU W^ eYVdVR_URVVbfZVYRaaj e`bfVdz_eYV`ZWeYJ_U_`eRTT dUhZeY eYVZc`h_`aZ_Z_dZ2 ]RXVac`a`eZ_`VWYV`RV_`_ISVJZgVcdZEYYj U_`edWeYVVW^Zj RdeYV^RZ_`S[VTeZgZ_eZZ_eYZIXc`fa eYReeYVYZXVde]VgVd`VZ_UZgZLfR]ZRR eZ_RVVWf_UZ$ 

7 c dj JZVU Z UZZIFRLEYVZ `h\_ a]R\_d R\_U gRf VdRVeYV^ `deZ a`  $ceR_eeYZ$ XŽEYVZ ZV\_ł eZj ZUVJ\_VUSj eYVR  $eVV_eZZ$ j hZY hYZY eYV T\_def TeR\_UUWV\_UEVOVŽEYVT ZEVZ\_XFZZX eYVZ RIEZZEVO bf VdeVvcd/WARZIRZ\_Z R] eYV U ŽEYVJ f dVeYVZ VOV eZ Ve` Xc`h RdRavd d\_LR\_UeYVJ }\_UZ\_T\_d^ aeZ\_R\_`aa`  $cef_Z$ j e` T\_def TeeYVUVZZVUZ RXVR\_UZ\_d U Z XLe` XREZIVEYV dJgvŽAf jef d?] T\_d^ aeZ\_a]R dR\_ Z'a`caR\_eaRceZ\_eV&cd/WeWRJ&ReZ\_RE&&&& ^ Bj SVCRU`WeWCAVaVa]VeYReeYy UV&X\_eW&c ]ZgVcIRcleYVZ\_UV&CVCUZEREVR\_UUZA]Bj eWZcZW\_ł &&j e``eWcdZEYY ydj]Z&%eWZc]ZgVZ

Dġ JZWUZ UZZIFRJdRV\_`eZ UZZIFRZŒZĬĔYY YRġVa JV\_ġ `WXX/UdR\_UeYZ \ ZeZłcZXYee`eR \V R\_ZektkieZ eYVT f\_eq `dWafckŽEYY eYZ \ Ze Zih`cq Z XeYRed TZAġ YRdSVT ^ Vd Z aVcd\_RŽ BfRZġ `WZWR\_Ud S[VTEZYV N] SVZ X`fXYee` SVeYVYR] ^ Rc\d`WR X`Ud TZAġ ŽEYY ReVgVg e` JV&R\_ee`hRUd`eYVcdeYVZ `aZ Z\_dR\_UeYVhB eYY JZ§VŽEYY eYZ \ eYRe VgVq`\_VZIV\_eZeWUe` SVeYVhBj eYY hR\_eŽ3feeYY RV\_`eZektkieWU Z a` JZZIdR\_URV\_`ecVXdeVXU'e`g eVŽ

EYY RV/ZVJ e'SVJ  $f_X^V V$  W/ eV/ VU f^1YZW deRef ŽEYY U \_ 'eYRZV R[`cc&da`\_ł dZZZZZ de h Rd d'eV & ZEYY RV f d'R]j dZ X/V R\_ULZW RcZULRV ^ 'cV ZVJ e' diaRREV eYR ^ V SVcd WeVcXc f adŽEYY eV\_U\_'ee YRZVR dES]VaRe\_VŽEYY RVX/VR]j a`dikdivU WZXY d/WW W R\_UX T\_}U/ej eYc f XY ZWŽ

7 cbZcfa ]ghdfcj ]XYf ff&\$1 Ł

: U\_`eRdaZVe`R\_jeYZX^fTY<R]jŽ: h`c\V& ^jTYZUEY\_R\_Uegi e` ^R\VdfcVeYYjU\_`ehR\_eV& R\_jeYZXŽ: YRgVe` h`c\ YRUVVceYR&R\_UhYY\_: YRgVd^VdaRVE?V: JZVe` c\Ri R\_UY\_[`j^jd\W hR&YZX&\V&ZZ\_Ž

4`\_V&^Zeac`gZ.VdRV\_`eUZgV\_Sj XvReZ.Vi RJŽEYY RVTJVRCe/ReeYVZc^RZ\_cVa`\_dSZZej Zl e`hRtUdeYVZ:TYZUU/\_R\_Ue/Re^V&Z\_Xe/VZ\_WUd ZleVV\_\_jj eYZ\_Xe/RecVRJj^ReeVoZ4`\_d\bfV\_ejjŁ eYY\_UYg`eVRJ eVZcV\_VXj e`VNJ}]]Z\_Xe/ZlUFejŽ EYY\_WJ e/ReeYY\_YRgVU\_Vd hYV\_eYY\_YRgV RIYZgVU e/VSRdZTeRA、`Vac`gZLZ\_XhYReVgC Zl \_VIVdRj e`eYVZcVK\*Zj`dhV]]SVZ\_XŽ:VeYY\_dT1 TWUZ\_eYZLeYY\_VaVZ/TVRW/ZX`VY^ZdZ\_ RIT^a]ZhVU%R\_URA\_``eYVcChRUe/R\_eYV `aa`cef\_Zj e`cVeVUSj R\_jS`UjŽ

]VgV] `WRdaZReZ\_ŽAVćYRad Wc eYV d? V cVRd\_Ł T\_Wć^Zdeac`gZV kdU`\_`eaRezTf]Rdj WW] eYV ł dMgVde`SVVZeYVchZ\_Vd`c]`dkdZ\_T^aRcZti\_ hZeY`eYVcaVa]VŽ

EYVZccVJZSZckZig eV\_Ude`SV\_`^Z\_Rj, eVyTJRZ e`SVJZkgVLSfeU`\_`eacRIeZCNZEYVZcTf]efcRjT\_ł df^aeZ\_Z[]`h R\_UeVJVgZZ\_ZiTYZV-j RdfcTV `WW\_eVceRZ\_^V\_e Wc eVv^ZEYZIXc`fa Z\_TJfUVd aV a]V`WVgVcj dTZłVT\_`^ZTXc`faŁRXV R\_U V^a]`j^V\_edeRzfdŽ

8]gYbWUbhYX`cihg]XYf`fl%\$ıŁ

 $EYVWAREZ: U_eSVZQVZ_R_jeVZ_X_hZAVa]V$  $[fdeeVZ_NS`feeVV dVgVdR_UaVa]V]ZV^VU_e$  $XIERTVR_TV`cR_j YVae`XIE`_ZD : acWVEe`SV$  $`_ ^j `h_ R_U]``\ `feVIE^jdVZEdSVIE_`ee`$  $T^a]ZREV]ZWZ$ 

 $5 ZN_TYR_eVU ` f ed LNd RVUVERIYVU W ^ eVV$ h`dUeYy ]ZyZZEYZZL` eSVIR dVeYy RVZł UZWWCV\_dSf eSVIR dVeYy WY eRV ` f eZ YVZ dRIZ\_ZI`\_V WAU e^ V\_eZ YY eYV ` f eZ YVZ dRIZ\_ZI`\_V WAU e^ V\_eZ YY YRVTVRUU e` SVZZ VY RVUZZ Jf dZ\_VU hZY dV ZI^ RUVWC` eYV ZZ VY RVUZZ Jf dZ\_VU hZY dV [ZZ\_R\_UU \_` eSVZZ VY RVUZZ Jf dIVVZE YY WY] eVV dR' VRS` f ed TZR]` cXR\_ZREZ\_dR\_Ua` ]ZZ ZE YY U \_` eVgV\_V aVIe^ f TY W^ eYVZ VR' ZZ dZ

EYV/YRgV\_`ZJfdZ\_dRS`feeYV^dMgVdŽEYV/ UZU\_`eTcVReVeYVZc`h\_ZUV\_eZeXd eYVj RcVhYRe eYVjUZ\_JZWR\_UeYVZca`d&Z\_ZdeYV`\_VTYR\_TV a]RIVUeVV ZŽCVARUZX eVvdR\_Ud TZkjŁeVy ecje`Rg`ZUSVZ\_X`gVchYV]^WSjeYV^ŽEYVj gZzh eYV^ hZeY ^ Zeef de R\_URdVdReYVcZ e` [VdR e e`hRddeY`dVeYY\_dWRdUZXWCV\_eŽEYY\_YRgV\_` WZY\_UdŽDZ\_TVVgVgS`UjYRde`]``\`feWceYV^ł dMgVdLeYV/ V/aVTee`SV/WAR`\_VR\_U\_`eZ`a`dVU fa`\_Ž?`cU`eYVj Rd\^fTY`WeYV^dy]gVd ZeZd YRUV\_`fXYe`X\ec`f\_UeYVUZWTf]eZd`WZRZj ]ZWŽ:\_eYVZ:WWWeZ:VeYVj\_YRgV\_`RZ:d`WeYVZ: `h\_R\_UdeRy\_ReY`^VŽEYVy\_RtV\_`eZ\_eVtVdeVUZ\_ Tf | of cV ceYV^ VUZZŽE YVZcdeR\_TVZTT\_dZdeV\_ehZeY eYVZcSV/ZWeyReeYV/YReV\_`a`hVce`TYR XVeyV hRjeYZ\_XdRvŽEYVZcd/WWdeW^ZddReYVc]`hŽ

 $\label{eq:stability} \begin{array}{l} 5 \ ZN_TYR_eVU^{*} \ fed{L} \ dd RVe^{*} \ SVVM_UZ_VgVg\\ d^{*}TZ^{1}VT_{^{*}} \ ZT \ ded Ref \ LSf e \ RVT_TV_edReVUZ\\ eVV[^{*}hVc^{*}_VgXVg \ RVZVgVg \ e^{*}SV \ R_fR_{1}RS^{*}fd \end{array}$ 

 $\label{eq:linear} $$ VclaReZf[Rc] f_V a]^j VU^_VdLY f dh ZevdR_U $$ VclaLY f dh ZevdR_U $$ 

deRS]VaRce\_VZŽEYVJWWJeVVJYRgV]`de`feSjeVV VT\_`^ZTR\_Ud1ZZJTYR\_XXdZ\_eVVTf\_ecjŽ

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EYVÁV HRJ d`VJZZZX JZVV YRZVZ a JZREZ\_dVVc eYVZ RXV VRIY aVcd\_ YRd`VVZd`c YVca]RIVZ d TZAj R\_U`VA YREYV`cchVRIYZ gVdeVVAZE YZZd ZJf decReVUSj eYVVRIe eYREH YV\_ eYV eYZ \ RS`f e 4 YZVd VT\_`^ ZT UVgV`a^ V\_e Z\_ cVIV\_e j VRcd. dj JZAU Z\_UZGZI fR d R\_U T\_eV\_eVU VR^ Zj ^ V\_ R\_Uh`^ V\_WJ eYRE eYVJ RVXRZ VcdZ3j T\_ecReE. decf XXJZ\_X VR^ Zj ^ V\_ R\_Uh`^ V\_ R\_U UZV\_ł TYR\_eVU`f ecZVAcd dW eYV^ dvJgvd deeYvc Rd]`dvcd. h YZVZ\_dVIf cVRabZR\_edR\_U T\_Vc^ Zbeac`gZVcd RVUZGZUUSVA W\_eYVA`a`dEZ\_dZ

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4 YZWP\_hBJ d` VJZWREVR^ R\_ZWHERZ\_` Wit TZAJ UZGVodZj ŁSfe RJd` VVEVV gRCZGj` VVEVJReZ\_drZad SVeh W\_ d TZAj R\_U VRIY Z\_UZGZLF RJŽ:\_ ^ R\_j TRACLEYY REVEYV cVcf Je` WR\_VXREZGV cVJReZ\_ł drZa SVeh W\_ eYV eh`ŽE YZd SVZ\_X eVV TRALE h Y` X]j Yfg]mih Uhibck 'YI Jg/g WebgJg/g Jb`k Ung' c Z]ZY VYIk YYb k \JW. "JHY We a a i bJWUHcb' Jg dc gg/V'Y UbX`k \JW. "JHY We a a i bJWUHcb' Jg dc gg/V'Y UbX`k \JW. "JHY We a a i bJWUHcb' Jg dc gg/V'Y UbX`k \JW. "JHY We a a i bJWUHcb' Jg dc gg/V'Y UbX`k \JW. "JHY We a di bJWUHcb' Jg dc gg/V'Y UbX`k \JW. "JHY We a di bJWUHcb' Jg dc gg/V'Y UbX`k \JW. "JHY We a di bJWUHcb' Jg dc gg/V'Y UbX`k \JW. "JHY We a di bJWUHcb' ZC be hWe blf]Vi HY Ic [ fYUHY fgc WU']bHY[ fU! Hcb'' 7RX^ V\_eVUUZGVCZj ZIRT\_dbf V\_TVR\_U ^ R\_ZWHRZ\_` VVEVVRSdV\_TV` VR yH V& R\_U eYZd ZIRac`SJV eYRETR\_` eSVVJf UVŽ

EYVd TZAJ eYReZIV VXZ\_XW^ eYVTF Jef cR TYR\_XXdhZJ TVerZ\_Jj SV`\_VhY`dVhBjd`WZW RVgVj UZgVcdŽ3f eZehZJ`\_Jj SVUV``TCreZTR\_U We fdS]Ve Yf ^ R\_ U&Y a^ V\_e e e VV e e eYRe U&Y a^ V\_e `WeY dy WR\_U d/T X\_ZZ\_ `W eYV@eYVcRdvf\_U&aZ\_WSj Rde`\_XyH WZE YZI hZ] YRe SVRyH %% WR\_Vh deR`aL`WT fockL UY\_W^ `d/Sj T ^ f\_ZReZ\_ R\_UZ\_e&REZ\_ R` `\_Xa]fd] Z/V\_e&Zd R\_U ]/dI Sj R\_ RSdedRe \_`eZ\_ `W d/Ac R\_U f\_ZejZE YV eRA `WSfZUZ\_X e ]/dR\_TVLeefde R\_U `aV\_VdIe`h RdderV@eYVc ZleYfd R\_ fcXV\_e`\_VZ\_eYVaddV\_eZWeYV WefcV Zle`SVd/If d/UŽ

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EYVUZ9VAZE `WhR d`WZWZIR WATE R\_UZ+Zd d ^ VEYZ\_XeYRe hZ] Z\_eV\_dZ9VZ\_WAT AŽEYZI hZ] ^ R\_VE`]VAR\_TVR\_Z\_UZ4V\_dS]VT\_UZ5Z\_WCeVV \_Vh WA^ d`W1 TZ9 cV]REZ\_dZ2ŽEYV]ZW W1 TZ4j ZIRERTE dtE RUHE`]VAR\_TVR\_UEVVARCTYVEV67R] Z9 REVTCT TZ9 ZVEVVTYR]V\_Xd`WEV\_Vh VARRV E`SVT\_W2\_EVUL[fdeReReZ`VhYV\_Ze`]VAR\_TV R\_UUZTCZ Z\_REZ\_]``\]ZVVRd R\_dh Vde`eYdV R^ VTYR]V\_XdŽ

E`]V&R\_TVCV/Revde`UZWWCV\_TVŽ?`ee`[fdeR\_j UZHZ\_TEZ\_LY`hVgv&LSfee`eY`dVeYRecv&f]eV&'^ eYVVIVCTZHVSj`eYvd`VeYVZ:V&WU^ R\_UV&'^ cV&HVTeVceYVT^^`\_V&WU^ `VW]13ZJSV\_jL "\*\*\*\*/Ž4`\_dvbfV\_ejjLZeZUZHZ\_XFZHVUV&'^ eYRe RTTV&eR\_TV`WUZgv&Zej hYZTYZISRMU`\_ ^VcV  $\underline{Z}$   $\underline{U}$   $\underline{X}$   $\underline{W}$   $\underline{V}$  eYVjU\_`eRWWTe`\_Vd`h\_Z\_eVcVdedLcVXRdUVdd `WhYVeYVceYVjZ\_eVcWeVhZeY`eYVcdŽHc`Yf! UbWY XcYg bcha YUb U dUggj Y Uhh XY hckUfXg'hY'chYfžVihUWhjY'WcbWYfb'Zcf' h Y ZYXca cZgc WYhniUg U k c Y 2dWc\_`\_łUZETCZ`Z\_REZ\_ŁZecVjRevde` eYVcRUZIRI, Vof Rit Zej `WR]]Yf^R\_SVZ\_XXŽ:e^VR\_d\_`ed`^fTY  $R_f h Z_j Z_X \text{ Vdl} e^{-1} ac^{-1} e^{-1} Z_V \text{ Vdl} R R$ a`dEEgVUVdEVe``gVcT^VeYV^ŽEYfde`]VcR\_TV acVLZa`dEZ\_dza`[ZEZIR]jj T ccVTe%taRj d`VSVVRgt Z\_Xe`hRdd`eYVcdŽ3`eYRcVR]d`S[VTezgVhRjd`W `cXR\_2KZ\_Xd`TZkjLR\_UaRceZff]RcjjeYVT]]VTeZeV Z'RXZ\_Rg'eYReUV}\_VdVRIYaVcd\_`\_eYVSRdZd`W VbfR]ZejR\_UVXWU^Ž

EYVRezef UV`W4 YZJVR\_de`hRtUde`JVdR\_TVR\_U \_`\_łUZdłóż Z\_ReZ\_ YRdd ^ VT \_ecRUZle`cj R\_U ac`S]V ReZIR] WRef ckdŽH YZJV Sc`RU]j da VR Z\_X eYVčV ZIR Xc`h Z\_X RaacVIZReZ\_ `WUZgkdzej R\_U Vof RZcj ŁT \_dzUkdS]VZ\_e`JVdR\_TVR\_UUZdłóż Z\_R eZ\_ `SgZfdj aVdzde hYV\_ZeT ^ Vde`aV a]Vd `aZ\_Z\_dRS`fe da VIZJT dzef ReZ\_dR\_U a RoczIf JRc Xc`fad`WaV a]VŽE YfdL dRIZch Ł TV\_d cdYza R\_U cMZXZfd`c da fR] UZdłóż Z\_ReZ\_ ReV ck[VIekU Sj `g\c)! ~ `WcVda`\_UV\_ed hYV\_ eYVdV d'S[VIed ReV Rh VU RS`fe Z\_XV\_VdR] `c R5dedRie ekc^ dž: W bf VRh VU RS`fe Z\_VZ\_g`]g\UZ\_LY`h VgVdLeYV dzef ReZ\_ TYR\_XkŽ

$$\begin{split} & EYV g Reh^{R} c Ej c V V I e e YV Z V R e Y Reh^{V} V \\ & R_U^{V} Y R V Z W E V e c Z Y e Z D^{V} V) ! ~ `VeY^{V} d V \\ & Z e V c g Z h V U S j : 5 6 2 D F _ Z j V c Z j ~ V 4 Y Z V # !!! \\ & U_{e} e e Y Z \cdot e Y Ree e Y V V d^{T} f ] U S V h R X V Z V b f R Z j \\ & S V e h W_{V}^{V} V_{R} U h^{V} V_{Z}^{T} s h e e Y V V d^{T} f ] U S V h R X V Z V b f R Z j \\ & S V e h W_{V}^{V} V_{R} U h^{V} V_{Z}^{T} s h e e Y V d^{T} f ] U S V h R X V Z V b f R Z j \\ & R h W h Y e Y V c^{V} V_{L} h h^{V} V_{Z}^{T} s h e e Y V d^{T} f ] U S V T_{d} Z V e V \\ & R h W h Y e Y V c^{V} V_{L} h^{V} h^{V} h^{V} h^{T} V_{d} h^{T} j h^{V} e Z H Z X H e Y Z \\ & A h W h Y e Y V c^{T} L h^{V} h^{T} J h^{T} V_{e} Z H Z X H e^{V Z V H e} V Z \\ & X h U Z e V c e^{T} d h R_{V} T_{d} Z V e^{T} J h^{T} J h^{T} J h^{T} J h^{T} J h^{T} h^$$

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:\_cVJRZ\_e`cVJZZ\_LeVVCVZlhZUVďaa`ceVvC VXVU^ `VVh`cdYZdŽAVa]Vd3jeYReR]cVJZZ\_d `fXYee`SVCVdaVT&UR\_UgRJfVURZVVVceYVZ: T\_ecZsfeZ\_e`dTZV6jŽ>R\_jaVa]VT\_dZVVL Y`hVgVLeYRehYV&Vcd^V\_VZlcVJZZfd`c \_`eZlRCVRd\_VcUZTCZ\_ZRZ\_Ž2TTdZXe` eYVd?VdfcTVL&" ~ RXCVhZYeYVdXXvdZ\_ eYReyd^V\_VhY`acRTeZtVdRvUZYZ\_Zl^`cV efdh`ceYjeYR\_R\_REVZD#Z

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2 ^ R[`cZej R]d cV[VTe TV\_d cdYZa R\_U d aa`ce eYVV3WU ^ e` af S]Z1]j Vi acVdtlR]] R\_U R\_j ZJNRL SV eYVj cV[ZsZ f d`ca`]ZsZ1R]Ž?`\_VeYV[VdLh YV\_ T\_V3/\_eVUh ZeY eVVd XXVdsZ\_ eYReyeYVCVdr`f]U SVaV a]VhY`TV\_d ch YReZddr`h\_`\_eV[VzZsZ\_L SVIRf dVhc`\_XgR]f Vd`f XYe\_`ee`SVdacVRU%Ls&" RXcWŽ

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T d.Z\_Xe`eYVV&^ V&MeeY&^ `ck!'! ~ SVJZgV& ZISV&&`e`RTV&eRS`@Z\_RdRckJZj R\_UJVXJRV e`V\_d`dV&ZfIR@ZU`fef\_U&SV&&CT\_U&Z\_d` 2eeYV&`V&`V&Y`fXY!'! ~ SVJZgVe?Ree`dV Z\_g`JgVUZ\_R\_RS`@Z\_d^f]USVaf\_ZYVUŽ

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 $^ U_c_{zj} R_UYZXVcTf = dR T_d^ aeZ_ŽEVy$ 

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RZREZ\_R\_URCV^`CVZVji e`SVWf\_UR``\_X

eY`dVhY`dVhR;d`W/ZWR:V`WeYVydej]ZkWZ\_UZL

gZLfR%R\_UyT\_eV\_eVUVR^Zj^R\_žh`^R\_‰jaVŽ

=RdejjŁRXcVReVcacVLZda`dZZ\_e`hRcUde`]VcR\_TV

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^ `TaRIjŽ

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> ¶ĩ lắz<br/>nählźh Olźqä¶²äeezä] Olátä¶%äeezä<br/>1 L; äl Qett² Olati låzønä þþ½ É

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 $2 cV 4 YZ W_{e} d^{\ C} cV c ]V dI Ze [V dR_{e} R_{e} U U dI$  $TZ Z Re g eYR_ eYy f dU e SV03 eY eYV: 5 62D$  $F_Z v ddg `V 4 YZ V #!!! Df cgy R_U eYV H`dU$ GR f V Df cgy L da VR U c gv eYv j VR d. Y RgV dg V U $RUVI]Z V Z_Ze [V dR_TV R_U U dI CZ Z RZ_ŽE Y d$  $X_V V R] eV_U V_J ZI R^ SZ RV eZ d^ V c v da V R d+$  $Ze ]V R_TV Y R U J ZI R^ SZ RV eZ d^ V c v da V R d+$  $Ze ]V R_TV Y R U J ZI R^ SZ RV eZ d^ V c v da V R d+$  $Ze ]V R_TV Y R U J ZI R^ SZ RV eZ d^ V c v da V R d+$  $Ze ]V R_TV Y R U J ZI R^ SZ RV eZ d^ V c v da V R d+$  $Ze ]V R_TV Y R U Z L R^ Z Z R Z_L R S cZ _$  $R_U R e Z U V e h R U d^ Z `C Z Z Z V_V R Z H Y V V$  d TZ łVT \_`^ ZTUZTCZ Z REZ \_ ZTT \_ TVc\_VUŁY hł VgV& Ze YRdcZtV \_Z d ^ VcVdaVTeeŽ

EYVR<sup>^</sup> SZGRV\_TVd ZV. 6Z VU Z eYV <sup>`</sup> aZ Z d UVIICZSVUYVCVd XXVdeeYRed <sup>^</sup> VRVRd\_WUe SV ]<sup>`</sup> \UURe<sup>^</sup> CVI]<sup>`</sup> dyjŽ7 \]YUbg'UfY'a cfY'tc <sup>!</sup> YfUbh]b<sup>†</sup>h Y]f<sup>[</sup> YbYfU<sup>`</sup>dYfWYdHcb'c Zc<sup>†</sup>h Yfg<sup>z</sup> Vi hih YmUfY'gf]<sup>``</sup>\][ \`m]bhc YfUbhik \Yb']h Wc'a Yg'tc 'gdYWJÚWg]h Uh]cbg'h UhWc'i 'X'UZ ZYWih Ya 'dYfgcbU`m'@\_VhRj `VR\_Rj dZ XeYZi  $\begin{array}{l} \mathbb{R}^{\circ} SZAFZej Zle T_dZUc aV a]Vd^{\circ} aZ_Z_dRS^{\circ} fe \\ \mathbb{Y}^{\circ} MIFRdZH YV_acddV_eVUhZeYeYVd^{\circ} XXddZ_L \\ \mathbb{Z} eV:562DF_ZeVdZej `VAYZV#!!! Df cgVjL \\ eYReyY^{\circ} dAIFRddY^{f}]U_{eSVR}]^{hUe} eRIY \\ \mathbb{Z} dTY^{o}]dMa^{\circ} de^{VZY} dVZeVZZHVC^{\circ} VVZTC2 ZRZ_Z \\ dTY^{o}]dMa^{\circ} de^{VZY} dVZeVZZHVC^{\circ} VVZTC2 ZRZ_Z \\ 8ZgV_eYVdReV^{V_ey.h^{f}}]U_{e}^{o} ZUZW j d_{d} \\ eVRIYVchVCVRY^{\circ} dAIFR%Z eVF?5A #!!" \\ Df cgVjLY^{hVgVL'} '' UZRXCVUZ:_ `eVch^{dH} \\ yY^{\circ} dMIFRdTR_SV dTY^{i}]eRTYVcLSfeeYVj \\ TR_^{o}eRTY^{j} d_Z \\ \end{array}$ 

4 YZVR\_ddW^ e` SVe` [VdR\_eRS`f eeYVcV[ReZ\_1 dYZad`WeYVcdRUZe`]VcReRS`feeYVZc`h\_Ž EYV&V^Rj SVUfS[VdBR\_URddReh`c\YV&VLRd ď XXVdeVUSj eYVTYRaeVć`\_T\_gVcReZ\_14 YRaeVć %Ž:e^ZXYeSVR^ReeVc`Wya`]ZZZR|T ccVTe\_Vd946 hZey aV a]VSVZ X YRaaj e`dvaVReeVV`aZZ\_d Tf ccV\_elj VRg f cVUSj TZgZTVeZbf VeeVLaRceZIf |Rclj ZW eYV/U`\_`eZ`aZ\_XVfa`\_eYVZc`h\_Z\_eVcVdedR\_U WRcdŽ3feeYZlcVgVRld^ `cVac`S[V^ ReZIR] RchVTedŽ : W4 YZVR\_d RCV  $\underline{Z}$  e  $\overline{V}$  (VR\_e  $\underline{Z}$  T \_ TCVeV dZf ReZ \_ d eYRe RWW eYV dygvelze zd SVIRf dv eyv SVIZev eYRe W\_UR^ V\_eR Rob VTed `WeYVZc ]ZeVd R\_U eYV ycZXYe%bhRj WcaVa]Ve cV]ReVe`\_VR\_`eYVc RVRedeR\VŽHYj RVeYVj hZjZXe SVe VR\_e hYVeV`eYVcaVa]Vd]ZeVdReVT\_TVc\_VUDAVeYRad `fe`WZ\_UZXWKKV\_TVLSVTRfdVyRd]`\_XRdZeU'Vd\_`e RWWTe^j TYZU: U\_e TRCV ZVZe RWWTed`eYVcCVZ 5 gYYa b 'h YfUbW' WUb a Ug 'U' || \' XY[ fYY c Zgc WU``bX|ZZYfYbWY" EYVec`f S|VZd eYRe ZVR ZUZZLI RdRcVe YRgVeYV aa cef Zi e`afccfVeYVZc`h\_ |ZEVdRdeYV/dW}eLR\_WWW.ce

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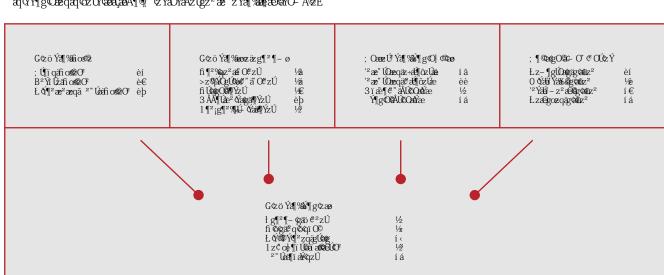
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; f de Rd dW^ Z\_X e' ]V&P\_TV TR\_T\_TVR] d TZR] UZZ\_eVEVELZ\_e' ]V&P\_TV R\_U UZTEZ Z\_RZ\_^ RJ UVEZVEVE' RUVEZVE' UWV\_U RARCEZT ]RC Z REV `V&TZE Z\_REXV dVTEZ\_d` V&TZE Z\_4 YZV WRC eYREEVVI ZEZ\_X d TZE]` dVEZTACVTRZ f d R\_UEYZ TR\_ cVET ]e Z\_R WRC `VUZZWEV\_TV deYRe ^ ZEVE TR]] Ze Z\_e' bf V&Z\_1 dV/ dS]V''!''/Z:e ^ RJ SVLEYV\_Ł eYRE Z\_e' ]V&P\_TVT\_TVR]dT\_dZ/ARS]V WRC `VEV `eYV&LSF e R\_V&V\_XVREVC WRC `VETZE]` dV/ CSVZ\_X eYCREV\_VUSj T\_~ZTEZ

$$\begin{split} & E \left[ Ver_TVR_UZe \right] Ver_TVRV_ `e[f deZ_UZZIFR] \\ & acVUZb `dZZ_d_VgV_ZVZ_eYV \right]_R_R_R_J dEleYY \\ & RVR ^ Revc `VaVcd_R ^ `dZjZjZEYY_RVXZgV_ \\ ^ Ve_ZXR_Udfaa`ceSj daVUZ_Td_TZR_Z_Rd \\ & ZdZ3j eYVdr `Ve` \V_LUVgV]`aZ_Xe` ]Ver_TVR_U \\ _ `_lUZUZZ_ReZ_RdREGVTZgZTgZef VdcVbfZVd \\ & RTf]ef dR_Z RXZ_R_j eYReccVectVXWU ^ R_UVbfR] \\ & Zj WcR] RdRacVT_UZZ_ Wc eYVVXWU ^ R_U \\ & VR_Z_ZIFRZ_R_ZUZZIFRZ \\ & VR_j Z_UZZIFRZ 


# 5 '8 = GGC 7 = 5 H98 '8 = J 9 F G + M

>¶ï Úgzna¶²äæzaj OÁÝa¶%aæzaB1L; al Ca¶²Oã≽ï Úzzonai þþ½Ê



6RcjZć TYRaeVcd R\_Rj dU d ^ V `VeYV T \_dvl bf V\_Tvd `Wiff ]ef dR] TYR\_XV Wc aV a]Vd URJ łe ł URJ Vi aVcZ/TvdLS` eY Z\_ eYVaVcd \_R] R\_U VR^ Zj daYVcV R\_U Z\_ eYVh RJ eYVj cyReV e``eYvcdŽE YV Z\_bf Zj eYReW]]`hdUvRjdh ZeY eYVh RJ WU Ub[ Yg`

H YRe ZJARU 4 YZJAR\_dYRgV`VAPAZeT f\_eqi O 6gkig S`Uj We'dR\_Z RXV`VAPAVh`dURe`f\_U eYV ŁS`eY`VAPAZeZ ^ VUZReV\_VZXYS`feY`U R\_U eY`dV hY` JZgV eYVEALR\_U`Wit TZAj Rd R hY`JVŽEYY XZ\_VRJJj RU ae hYZIYVgke V ZAZ\_X T ]]VT&ZgVZ RZ\_Rj SV&Z\_eXacAdeYAZe d'S[VTI &ZgV Vi aVEZ\_TKZ\_Rj SV&Z\_eXacAdeYAZe d'S[VTI &ZgV Vi aVEZ\_TKZ\_Rj SV&Z\_eXacAdeYAZe d'S[VTI &ZgV Vi aVEZ\_TKZ\_DYc d'Y'hYbX`he`VY`[ i ]XYX` Vmk \]WY Yj Yf`Ja U[ Y`cZh Y`k cfX`a U\_Yg` a cghigYbgY`he`hXa`Jb`h YJf`XU]`m`Jj Yg/Vm Ub`Ja U[ ]bUfm]b k \]WX h YmVUb fYWe[ b]nY` h YJf`ck b`ZYUfg`UbX``ccb[ ]b[ g" ]b dYcd Yfyr ]bX]j ]Xi U```]j Yg HYbX hc 'VY' Uggc W]UHYX k ]h 'W Ub[ Yg ]b Wc `YWfj Y ]a U[ ]bUf]Yg' 3VRZ\_XZ\_ ^ Z\_UeYVhBj d S[VF826V V aV62/\_TVdR\_U eYV]ZW`W1 TZ6j YR6VTYR\_XUL eYVW]`hZ\_X TYRaeVcdhZ] ]``\ Re eYV UZWCV\_e Z RXd`W1 TZ6j eYRe 4 YZ/R\_ddYRVŽ

EYV ^ ` cV Rda VTed R a ZTef cV ` WEYV T f \_ ecj Z\_T]f UVL eYV ^ ` cVZ\_Wc^ REZVZeh Z] SVŽ2TT cL Z\_X]j LT \_ cZUREZ \_ h Z] } ccb SV XZeV\_ e` Z` RXd cMReZ\_Xe` eYcWclaVTZ; TRclaVTecheYVVT \_ ` ^ j Ld ł TZESZZEj R\_UUV ` TRRIJŽE YVCVaRceZEJ a VcTVaeZ \_ d h Z] eYV\_SVZ\_eVXCR4VUZ\_e` RXV\_VCR] ` gVcgZhŽ

EYV ^ VeY U ]`XZIR] ac`TVUfcV\_WUde`SV Via]RZ\_VUŽEYV}\_UZ\_XdT ^ V W/ ^ f]ezertZReV R\_RijdvdSRdWU`\_eYVF?5A#!!"?ReZ\_RIDfd

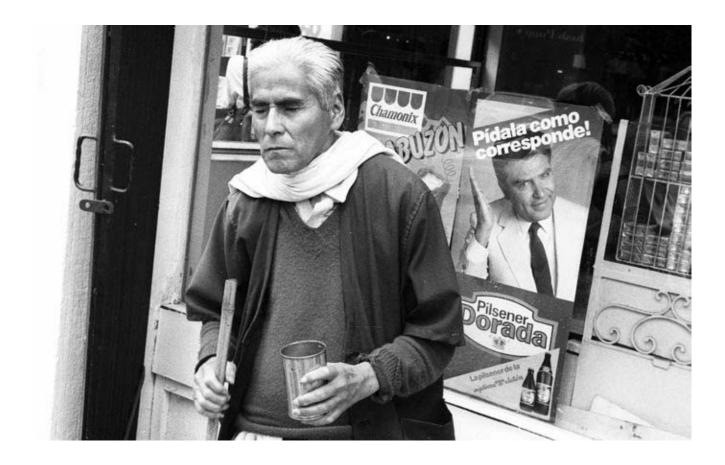
hZ] eYV\_SVZ\_eWXReWUZ\_e`RXV\_VR]`gVcgZhŹ EYV ^ VeY`U`]`XZIR] ac`TVUfcV\_WUde`S

\$'%B=ł ä ½ äq�Y¶gOæqäqozUYœaQæÅ¶¶" & YaOYåÅzUźz² æ" z Ya¶%a∰æ@AO-Å&È  $gyjZ_$  VRIY `V&YVeYCWRCNRdT\_dUC&U1eYVVT } \_`^ZTd deV & d TZSSZZEj R\_Ua`]ZZCHEVVR\_Rj dZl ac`gZLMdReja`]`Xj` `VXc`f adZ\_RIT d.R\_TVhZeY eYVZ:UZWWEV\_e`fej``\dŽ6RIYXc`f a`VZ\_UZGZ.FR]d Zly]RSV]]VU%bZEY d ^ VTYRREACZEZT WREF cVZE YV SL'!! cda`\_UV\_ecIVR]]Z\_e`UZWWEV\_eT\_}Xf deZ\_d UVaV\_UZ\_X`\_ eYVUZ`V\_dZ\_UNRJehZEYZ:\_` `eYVc h`ddLeYV dR`VaV a]V^ZXYe VR]]Z\_e`UZWWEV\_e Xc`f adZ\_VRIYRVREADEYVT ^ ^`\_Xc`f\_UR``\_X eYV`UXeC^Z\_VZEYVC/REVTVeRZ\_RW\_ZZG1ePRe RCVT\_dR\_eLY`hVgVZ2dhZ]]SVdV/\_Z\_eYV]Rte TYRaeAdZ\_eVXdReVUR\_Rj dZ`VR] eYvgRZSS[VdT\_ł dLACU jZ/UdRXV\_VRJ ej a`]`Xj\_eYReTRaeFcVdeYV UZgVcdZj`VWRIYRVREDFZVhV]]ZEYZI}\_Rj aZIEf cV d^ df a eYVRcR]`WF f\_eq Z\_RXdUCZZ\_XW/^  $eYV UZWWEV_e dvTe`cR]`f el``\dž:e dv`f]U SV dZU$  $eYReeYV UZWWEV_e ej a VdC vacVdV_e cVR] Xc`f aZ_Xd`W$  $Z_UZZUFR]dR_U_`e [f de deRezEZER] cVdF] edŽ$ 

EYVUZ9VAZEj `WREEZETUVAR\_UT ]]VIEZ9VZ RXZ \_RZACK-VIECTEVCZY\_VAT`WTTZ6jŽEYVXAVREVA eYVUZ9VAZEj `WTaVZ2/TVAR\_U`fej``\drevV^`cV Uj\_R`ZTeVVJZW`WTTZ6j hZj]SVŽ3fe\_`eR]]UZ gVAZEj ZTX`UŽHYV\_ZeZt]\_`eT`dZ\_REVUR\_U ZeVXREVUZe`d^VyT^^`\_h`d]U%LJZ9VAZEj TR\_JVRUe`UZZ\_eVXREZ\_`cWRX`V\_eREZ\_`VeVV dTZRJVR5cZIŽHYV\_eVVUZ9VAZEj`WTYZJR\_dTZ6j ZHT\_dZVAVLEVXWALEVAVZIR\_WUe`T\_dZVA hYRe`aa`cef\_ZEXAR\_UEYAVRedZe^ZVECVACACU/\_e Wc\_REZ\_ISFZUZ\_XVWACEŽ



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2\_j VT\_`^ ZT U\&\]`a^ V\_e deRev\] Te\Rev\d yXRZ\_Vcd%R\_U y]`d\cdr\"aE YZd Zd\_`eYZ\_X\_VhŽ 4 YR\_XVZdSV\_V} TZd e` d ^ VZ\_eYVdr`ce R\_U`z`c ^ VLZ ^ e\c^ Hh YZV eYVcdRvUZRUgR\_dRXUSj ZŽ H YReZddeZZ\_XZ\_eYVIRV`W4 YZVZIY`h ^ R\_j aV a]VWWJeYReeYVJ YRV]`de^`cVeYR\_eYVJ YRV XRZ\_VLZ5 VdaZeVeYVaRIV`WT\_`^ ZTU\&\]`a^ V\_e `g\ceYV]RdeUVIRU\L\UZcZh c gY ]bhYfj ]Yk YX` VmI B 8 D`gUk 'h Ya gY`j Yg`Ug`Î`cgYfg`" 6mi Vc'bhfUghž'i gh', 1 `gU]X'h Ymk YfYÎ[U]bYfg`" 4f ccV\_eT\_UZZ\_d^ RJ YRgVYRUd ^ VeYZ\_Xe`U` hZYZZYZ\_eVcgZhdch VcYVJUZ\_> RJ R\_U;f\_V #!!"LhYV\_eYVf\_V a]`j ^ V\_ecReVde`URe"!" `WeYVRIeZeVa`af]ReZ\_R\_UeYV&VhRddeZ]\_`  $dX_$ `WeYVViaVIeVUfaefc\_Ž

AV a]VdaVcNáeZ\_d`WeYV dv[gvdRcVUEVTejj Rdt TZRENU hZeY eYVZ: d TZ IVT\_`^ ZT a`dEZ\_Ž EYVYZXYCf a Z\_eYVd TZ IVT\_`^ ZT dTR]VaV a]V RVLeYV^`cV[ZV]j eYVj RVe`WVj eYRe eYVj RdV XZ\_VdLhYZVeYV]`hVcU h\_ eYVj RVLeYV^`dv eYVj WVj eYRe eYVj RdV]`dvdŽ:ed f\_UdecZeVLVi h dYcd `YNğ YWc bca ]Wdcg]Ijcb ]gbchUb ÎcV! 'YWjj YÏ `ZUWih UhYI ]ggg ]bXYd YbXYbhmicZ h Y]fgj V'YVVjj Y YI dYf]YbWY Ug ]bXjj [Xi U`g" :e Zl RTef R]jj R d TZR] T\_dec Te eYRe UkaV\_Ud`\_ VRIY a Vcd \_`d a VcTVáeZ\_ R\_U RctVdd^ V\_e `WYZd `c YVc`h\_ dEf ReZ\_ŽE YV^ VR\_Z\_X ReezSf eVU e` h`c\LeYVVI a VcZV\_TV VJRS`f ccV/ReZ\_dR\_UV&f dV V^ a]`j^ V\_eac`da VTedR:Vd^ V`WeYVVMTe`cdeYRe Z\_~f V\_TV eYVZ' RXV aV a]V YRgV`WeYV dMgVdŽ 4`^ aRcZt\_dh ZeY\_VZXYS`f ccLVI a VTeteZ\_dRS`f e eYVZc TYZU U`d Vkef cV`c eYV UR^ R`WYRgZ X R Ucf XRUUZTeZ\_eYVM\*Zj R:V`eYVcVI R`a]Vd`WeYV dR`VeYZ\_X=aV a]Vdcf S[VTeZgV\gR]f ReZ\_U`Vd\_`e \_VTVctRzZj ^ REIY eYVCK RTef R] a` dEZ\_Z\_eYVd TZR def Tef cVZ4`\_cdvf V\_ejj LR\_Raac`RIY eYRecVUF TVd VgVg eYZ\_Xe`VT\_`^Ztdh Z] f cf R]j VMZŽ

AV a]VdaVćTvácZ\_`VeYV dvJgvdRdXZ\_vdc`c ]`dvddW^ de`SV[Z\_\Ue`TvæRZ\_aVcd\_R]TYRd RTev5ZteZtőZ 7ZcdejjLcvda`\_UV\_ed`[fUX^ V\_edeV\_U e`SVXfZJUUSj Y`h eYVj aVcTvZgVeYvZcVT\_`^ZT a`dZZ\_R\_Uac`XvddReeYRea`Z eZ\_6Z\_VZAV a]V hY`SVJZgVeYVj RVUZ\_XhV]]Sj T ^ aRZd\_hZY eYVZcaRv\_edR\_URV`acZ\_ZteZTRS`feeYVVvfcdv eV\_Ue`WWJeYVj RVXRZ\_vdžDVT\_UjLcvda`\_UV\_ed Z\_RXV`VeYV`dvJgvdRtXRZ\_vdc`c]`dvdeV\_Ute`SV T ccV[ReVUhZeY eYVZcWJZXte`hRtUteYV4 YZJR\_ VT\_`^ZT dj deV~Ž8 RZ\_vdeV\_U e`Vfacvdtl^`dv T\_}UV\_TvLV\_eeYf dZdt``c acZUZ=`dvdt`\_ eYV `eYvc YR\_ULRV^`dvJZV1j e`YRS`fc WVJZXd `VZ\_d7lfcZejL]`dd`c R\_XvčZ:\_^`deTRtvdn'!" /Ł @/.łäł/pí

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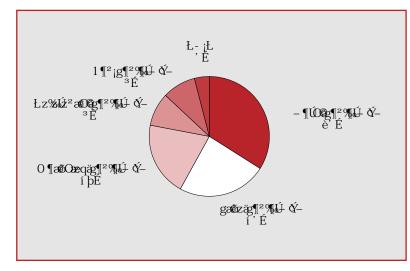
 $:eZldeZZ_XY`h ^ R_j dxda`_UV_edh8% / WMJ$  $VT_`^ZIR]j Z_dVIf dxZ7f ceYvc^`dvL`_VZ "! dy$  $eYReeYvJ YRgVWMZ_Xd`VR_Xbc`c]`dZ`_ dv`cd.$  $hfYY'dYcd'Y'ci hcZYj YfmZci f\Uj Y'fUh Yf`$ bY[Uhj Y'ZYY']b[g'UVci hih Y'W ffYbhYVc! $bca ]WgnghYa "EYZl dX_Z TR_e }_UZ X SVRd$  $`fe eYV eV_UV_Tj ZJV_eZ WUZ eYV" **) CVa`cd.$  $T ^ aZAUSWAVeYVT f_eq`dVT_`^ZTU h_fc_Z$  $2dhRda`Z_eVU `fe eYV_LeYV} Xf ddWc ^ RIc`l$  $VT_`^ ZTaVAVc^ R_TVTR_ ^ R_VZe YRUe`XRda$  $aV a]Vdd'S[VI&gV VI aVZ/TVZH YVCRdZ_"**)$  $YZXY Xc`heY deXdhVcV_`e cV-VI&UZ_aV a]Vd$  $d'S[VI&gV deZURVEZ_L`_ eYV acVdV_e`TTRZ_$  $4 YZVR_dXV_VR]j WWJZ_dVTf cVLVgV_e`SdZ$ 

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9 `h U 4 YZVR\_dRURaee` eYVUj\_R`ZTd`WeYV VT\_`^ZTd deV^02]] Z UZZJFRJdUQVJ`a deReV XZde` TRaZEVZXVRJSVde eYY TR\_LZ\_RTT d.R\_TV h ZeY eYVZ: TRARSZZZZdR\_U eYVCVd f cTVdRgPZJRS]V e` eYV^L`\_ h YReVgVc`aa`cef\_ZZJdRZDVZEYVdV RURaeReZ\_ deReVXZd ReV eVc^ UJ yT\_Vc^Zf^%Z 2aa]j Z\_XR ej a`]`Xj\_UQVJ`aVU Sj\_C`SVce > Vd e`\_L} gVVVc^ dTR\_SVUZEZ\_XFZHVULR\_UeYVdVRV dr`h\_Z\_}Xf cV8#Z

EYV acU ^ Z.R\_e derevý ZleYV \_ VeVc^ W R^ `d] T\_Wc^ Zl^ Ž2 eYZU `WeVda`\_UV\_ed RV Z UZZLFRJdh Y RLRaee eYVVT\_`^ ZTd deV h ZeY eYVd JVRZ `WI eRTEZ\_XeYVXCVReVdeR.LgR\_dRXVVc eYV dygVdR\_U eYVZ W? ZZdŽH Y Jf Wc bXi Wilg XYÚ bYX UgÎ Ua c fUÏ VYWU gY U``h YmWUfY` UVci h]ga YYHb[ h Y Jf bYYXgzk ]h c i hVc b! gXYfUhcb Zcf ch Yfg" 2\_eYc a`] XZR df UZd  $13R_{VUL} *$ WcdTZR SWRgZfchYZY ScVR\dRhR, W/^ eYV  $^{\circ}$  dR] df ]VdX gVc\_ZXZ\_eVcaVcd\_R] cV]ReZ\_dR\_U hY`dV`\_]j^`@ZERZ\_R\_UXRJZdeYVdReZURAEZ\_ `WZ\_UZ&ZLFR|R\_UWR^Z; \_WUdŽ:eZ1`WW\_eYVdv6F]e `Wef cgzeR] decReVXZkd^ `ezeReVUSj dEf ReZ\_dh YVčV VT\_`^ZTa`gVcgiŁV^`eZ\_RJUZERSZZEjŁR]RI\`W of Valk UR RSdV TV Walf ZDY V eViceo R dXdd dZ\_dYRgVac`UfTURTf]efcV`WR\_jeYZXXV6‰ R\_U ylglog`\_V Vlc eYV^ dl/glodZi e clackdl\_ed eYV  $]_R$  deRXV `WhZeYUdRhR| Z\_e` R acZeReV h `c|UŽ  $2^{\circ} R T_Wc^2 R R R R J Z Tek R U h_eYV$ d TZ IVT ` ^ ZT dIR VR UeV Ude` SV da ZReVUZ  $\mathbb{R} \setminus \mathbb{Z} \cup \mathbb{W}$  [ZEZIR]  $\mathbb{R}^{\wedge} \cap \mathbb{R}$  [ZEA  $\mathbb{Z}^{\wedge} \to \mathbb{C}$  deal  $\mathbb{V} \mathbb{Z}$  eVZd Xc`fadR, eYRea`]ZeZIdZda`Z\_e|VdŽ

\$'%B=łäí @oÅzÝð{%ag¶2¶- gäg¶2%{dĺ Ý-



>¶ilýzmailúzÅOúzqat¶²äaezai]Oívýat¶%aaezaiB1L; allOast¶²O6a>ilúzonaiþþ½É

2\_`eYVch`XcfadhYd/T\_Wc^Zf` JZdZ eYVhB, eYVfc/ReVe` `eYVcdRTTf\_eLSVchW\_ eYV^LWcRdZ ZRcac`a`ceZ\_` `WcVch`\_UV\_edŽ EYVcVZleYVRE&VT\_Wc^Zf` `WeY`d/hY`ReV hZJZ\_Xe`U` hYRe&gVcZed&Vcle`RIYZ&VhYReeYVf hR\_eZ\_JZWn#% ´ZF\_JZ.VeY`d/hY`d/T\_Wc^1 Zf`ZIR``cRLaVaJVhZeYeYZIRLRacReZ\_deReVyf RTIVae eYVVT\_`^ZfdeV^ R\_UdW\ e`RIYZ&V eYVZc`S[VTe&gVcReR\_j T\_dLSfehZeYZ\_eYVVZdeZX d]VdZEYVf REV^`chYRe&Jf cVacCdV\_eVUR`\_X eYVj`f\_XZEYV`eYVcXcfa1\*″ / ZfTYRCREVCXU Sj\_UWXeV\_e&JT\_Wc^ZfLR\_UZeZ\_TJfUVd^`cV ZdVffcVaVaJVhY`h`fJUU`R\_jeYZ\_XV1aVReU `WeYV^ Rd]`\_XRdeYVj RIYZkgVUeYVZcXRjdŽ

EYV^ `deRIZZV dedRevy Zl^ `Zl^ `Zl^ ` Zî<sup>^</sup>ŽEY<sup>^</sup>dVhY<sup>^</sup>RU<sup>^</sup>aeZeeV\_Ue<sup>^</sup>SVaVa]VhY<sup>^</sup> T } UV eji R U V eYf dZRdeZIR] ji RITVae eYV TYR] [V\_Xkd`WT\_`^ ZTUkgV[`a^ V\_eR\_Uegi e` ViecRTe eYVXXReVdea`ddZS]VSV\_VjeWV^ eYV`aa`cef\_ZZXd RgRZRS] $VZ_{e}VZ_{g}VCVda^{-}UV_{e}L^{RZ_{j}}W^{-}$ eYV^VLZE^ łYZXY decRef ^ ŁYRgVeYZI^ `eZeReZ\_Ž EYY\_^R\VfaeYVXc`fa`VyV\_ecVacV\_Vfcc%byY RcVeYVyV\_XZ\_V‰VWT\_`^ZTUVgVj`a^V\_eŽEYVdV XRZ\_VathY`RVT\_}UV\_etUV``TareZR\jj}^Z\_UVU aVa]VTRaRS]V`WTRaZRJZZZX`\_R\_UdYRaZ\_XeYV `aa`cef\_ZeZddeYVTf\_eqi`WWkdeYV^ŁT^a`dV #! ~ `WeYV dR` a]VŽEYVEV eYf d dW` d e` SV [Vdd `WR\_ yV\_ecVacV\_Vf cZR] TF ]ef cV%eYR\_ ^ ZXYe SV ViaVTeVUZ\_RojdeV^SRoNU`\_acZeReVV\_eVcacZeNŽ :WeYZIZIT\_} c^ VULeYVVT\_` ^ ZTTF |ef cV V4 YZV T f ]Uac gVe SVR\_ `SdeRI]Ve eVVT f\_eg dUM gVj`a^ V\_eŽ

EYV} WY Xc fa `WWa`\_UV\_ed Zd d` R]  $1^{*''}$ /L Sf eYRdRd/Ra jj UV\_\_VUac`} ]V+eVd/ReVeYV\_`\_ł T\_Wc^ZteŻEYVZc gRJf Vd T\_~ZTe h Zey eY dV`W eYVac\gRZZ\_XVT\_`^ZTd deV ŽEYVJ UZZUVZ\_e eh`eV\_UV\_TZdŽ@\_ eVV\_VYR\_ULeVd/ReVaV a]V h Zey dec`\_XWWZ\_Xd`VR\_Xc R\_U]`dde h Rd deYV VT\_`^ZTd deV ŽEh`eYZUd`WeYV dJ eYReeYVJ YRgV]`de`f e R\_UUZa JB, RYZXY UXCW`Wa`h Vd ]Vdt\_VdŽ2\_JRXV\_f^SVc`VeYV^LY`h VgVLRVZ\_ eYV^VLZ^ YZXY d TZ VT\_`^^ZTSdRI\_VeŽ

## CC 7 =5@B5H F5@4\5H€ B 5B8 H 9 M95FB=B; ∴ C F 97 C ! BC A =7 7 < 5B; 9

 $: \_ UZ = Z L f R ] d U \_` e R U ae eY d V de ReVXZ d Re$  $d R_U^, eY j`ae Wc Ra Roe Z f ] R ch R ` V R L Ra e Z X$  $e` eY V U ^ R_U d` V e Y V T _` ^ Z T d d V S V R f d L$  $R` _ X` e V c e Y Z X L e Y y Y R v V c ^ U Ra Roe Z f ] R c$  $Z V R` V e V Z c RS Z Z j e` Z ~ f V_T V e V a c T V d Z : e Z l$  $e Y f d h` c e Y y ^ V e f c Z X & e Y v j a V ` W R e Z _ e Y R e$  $a V a ] V S V Z e Z l a` d Z S ] V e` e R V Z _ c Y R e$  $a V a ] V S V Z e Z l a` d Z S ] V e` e R V Z _ c Y R e$  $a V a ] V S V Z e Z l a` d Z S ] V e` e R V Z _ c Y R e$  $a V a ] V S V Z e Z l a` d Z S ] V e` e R V Z _ c Y R e$  $A V a ] V E Y A C R Z _ R e$  $a V a ] V S V Z e Z l a` d Z S ] V e` e R V Z _ c Y R e$  $A V a ] V C V Z e Z l a` d Z S ] V e` e R V Z _ c Y R e$ A V a ] V S V Z e Z l a` C Z S e Y eA V a ] V S V Z e Z l a` C Z S = V eA V a ] V S V Z e Z l a` C Z S = V eA V a ] V S V Z e Z l a` C Z S = V e $A V a ] V S V Z e Z l a` R a S ] V ` W Y R _ Z Z X e$  $` a e Z _ d T ] ] V I E Z V R I E _ T R a R S ] V ` W Y R _ X Z X e$ 

eYVddeV LRT\_TVaeZ\_`WeYVddeV RdRdTZR TeVReZ\_LR\_URgZM `WeYVddeV RdaRce`WeYV \_RefdR]`dU/c`WeYZ\_XZŽ

H YVEV eYV VT \_`^ ZT ac`TVEH ZHT \_TVc\_VLL && `V&Y`dvZ\_eVcgZh VUeY`f XYeeYReyRTeZ\_XR] e`XVeYVLh VTR\_TYR\_XVeYVVT \_`^ ZT d\_deV^%Z2 eYZU eY`f XYeeYRe eYZHd\_deV^ YRUSW\_Z`a`dvU `\_ eYVT f\_egi Sj Rd`R] ^ Z\_`CZgLR\_U[fde(" eY`f XYeeYVVT\_`^ ZT d\_deV^ hRdZ`^ fetS]VZ:\_ `eYVch`ddeLR^R[`cZej`WaV a]Vh`f]U]ZVe`dW eYVVT\_`^ZT^`U]TYR\_XUL:aReeZff]Rcjj aV a]V ReR]`hVcdTZIVT\_`^ZT]VgYR\_UeY`dvZ\_d`cR RVROŽ2^`\_XeYVa``cVdELeYVcVdW^de`SVR\Z\_U `WVT\_`^ZTyjVRc\_Z\_X%eYReSVRd\_`CJReZ\_e` eYVzCRTeFR[RSZZej e`RWWTe eYVcVZL\_`CVR]hZ] e`^RVeYZ\_XdUZWWCV\_eL`\_]jR\Z\_U`VhZhVN] eYZ\_\Z\_XZAV a]VRV\_`eT\_dZVcZ\_XhYReRTeZ\_ eYY\_TR\_RTeFR]jeR\VLSfeRV^VCVJjVacVdZ\_XR UVdZVVCTYR\_XXŽ

EY dVZUZZUTRJdhY SVJZZVeYRe VgVcjeYZX YRdX\_V\_eYVdR^ VLUVdaZeVeYVTYR XvdLeV Ue` SV^`deV\_eYfd2Rde2TRS`feR\_VhdeRce2EYVhR eYVj af e Ze Zdc`f XYjj +yDWZ\_XeYRe eYVVT \_`^ ZT djdeV^YRd\_eZ`ac`gVU^ja`dÆZ\_ŁZe`fXYee` SVTYR XVLŽ%3feeYVjVRcZXVkcTYRXVRdZł ToURONAT\_ac`a`ceZ\_e`eYVWMRcaVa]VYRgV`WY\_ł ~ZTeŽEY dVcVda`\_UV\_edhY`^`deUVdZCVe`Rg`ZU T\_~ZTeRCVR(d ^ `de)ZV(j e` ViacVddRUVdZVVVc TYR\_XIŽEYVT ccV[ReZ\_df\_UdaRcRUiZR]+eY dV hY`WACT\_~ZTehReTYRXXŽE`afeZeR`eYVc hRjŁhYV\_aVa[VU\_`ehR\_eTYR\_XłZeUVd\_`e dW^ e` SVSVIRfdVeYVj WRcT\_~ZIeŽH YReeY dV hY`U`hR\_eTYR\_XVdW` e`SVdVa`\_UZ\_Xe`Zd eYV} code a Roe `WeYV` a eZ\_+y2 TeZ X R] e`XVeYVeL hVTR\_< %;VVTYR\_XVZtUZgV\_ Sj R]]LeYVeVZt\_` WUe`WMRcT\_~ZTeŽ

3j T\_eRRehZey eVVj VRc\_Z X%dW\_Z  $dReZ_$ e TYR\_XVZ eVVVT\_`^ Zid deV E UZc ZU``h Y`7 \]YUbg]bhYfj ]Yk YX glUhYX h UhÎ gc VJU`]b! Yei U`]hJYg`Uj Y`U`k Ung`Yl ]ghYXž UbX`h Ymi U`k Ung'k ]``I`'= VdleYR\_ReYZU1S'' / SVJZgVeYJ TR\_TYR\_XVeYV R\_U'' (″  $eYZ \eYJ$  RVRac`UTE `V&YVVT\_`^ ZI'd  $deV ZE YZI^{A}$  R[` dzj daa` ceVceYVac`a`  $dEZ_ eYReZ Vbf RZj ZIZ ^ f <math>dS$ ]VTR\_ SVZ\_eVacVeVU Rd  $eYVy_Ref dZReZ_%$  VR d`TZR]  $dEf ReZ_ZEYVAVAV a]VeV_U e`gZh d`TZej RdR$  $_Ref dR] aYV_`^V__ eYRe ZISVJ`_U eVVT_ec`]$  $`V&YVYf^ R_hZJZ$ 



2^`d?JZA`R\_UR\_REFORJZAVU dEREV`WEYZ\_XdTR\_ SVdW\_Rdeh`dZUXd`WEYVOR`VTZ\_ŽE`R]VdAvc VFeV\_eL^V`SVcd`WEYZEJXc`Fa`aeWc^`eZGREVU T\_Wc^ZA`Ž\_eYZETRALEYV\_REFORJZAVUd`TZR]`d UVcZddW\_W7^RgVcjUZWWCV\_eaVcdaVT6ZgVŽEYVdV REVZ\_UZGZLFRJdhY`WVJeYY\_RCVVT\_`^ZTXRZ\_Vcd R\_UhY`RV^`eZGREVUe`dZ&VVgVcj`aa`cef\_ZjŽ 7`c eYV`Ld`TZR]YZVCRCYZVdCVERZ\_eYVRFOR`WR y\_REFORJ`dUVC%Z

ER.Z\_XeYVXc`faRdRhY`]VLR]RXVac`a`œZ\_ Zl^RUVfa`VWLf]eZ\_UZgZtfR]dReR\_ZeVc^VZ ReVdTZIVT\_`^ZT]VgY]hY`]ZgVZ\_fcSR\_RVRŽ ?Refd?JZRZ\_LeYV\_th`f]U\_`edW^e`SVd\_`\_ji ^`fdhZeYeVVZ\_U`VycVZX\_RZ\_%cvJNRZC^% `VW\_RecZSfeVUe`]`hIZ\_T^Vd/Te`cdŽ:eTf]U deYVccV-VIeRT\_d/cgRzgVT\_TVacZ\_`VdTZd cVJRZ\_d+yZcdR]hBjdSW\_eYZthBjLR\_UeVvcVd \_`eYZ\_Xe`SVU\_VRS`feZ%ZEYVY`]UeYReeYZti y\_Refd?JZRZ\_%0VeYVdTZd`dVcYRd`\_aVa]V dfXXdddeYReeYV^RZ\_`SdRT]Vde`UvgV]`a^Ve Z\_4YZvTf]USV`WRTf]efd?]\_RefdZ9`hTR\_ RdTTVdtM]\_RZ\_ISfZUZ\_XVWVceSV^RUVhYV\_ 4YZJR\_dTcVRzgVV\_V3jZlaRRJjdUUSjR\_Refd?] ZXUgZh`VeYVh`d[U0

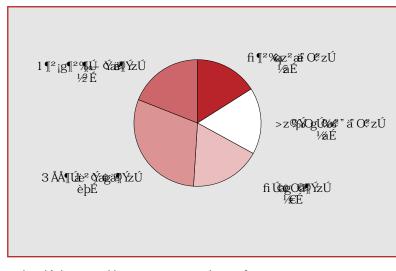
## =A 5; 9GC: Ht 9 97 C B C A = 7 GMGH9A

EYVLÆZLVSVENW\_VT\_`^ZTXRZ\_VcdR\_U]`dvcd ZleYV\Y }\_UZ\_X`VeYZITYRaeVcŽEYZlUZIY`e`^j \_WLde`SV^`UZ\_VLY`hV&vESj ScZ\_XZ\_Z\_eV `eYvcUZ`V\_dZ\_dcWvccVUe`ŽH YV\_eVVUZWvcV\_e gRZFSJVdRcVT ^ SZ\_VLL}gVT]]VT&ZVZ\_Rd ZdV^VcXvŽEh``VeYV^RcVYVJUSj XRZ\_VcdR\_U eYcWSj]`dvcŽ

#### H 9 7 C B: = 8 9 B H; 5 = B 9 F

 $EYV \} cde Xc fa `VXXZ VcdZleYV d` R]Vde `VeYV \\ gVET ^ acZZ X''' `VXVda `_UV_edZ ed^ V SVcd \\ ReV Z UZgZL f R]dh Y T _dZVc eYV dAgVd XXZ Vcd \\ R_U UZda ]R dec `_X VXYZ Xd `VXT _} UV_TVL acZV \\ R_U UZeh RG dEc ` RS `feeYVVT _ `^ ZT d deV ŽE YVJ \\ R_V h Z _ VcdeYc f XY R_U eYc f XYLdy VXVdf dVUR_U \\ \end{tabular}$ 

$$\begin{split} & \text{S'\%B=} i \ \ddot{a} \ \dot{e} \\ & = z \ \dot{A} (\dot{z} \ \dot{Y} z^2 \ \textbf{e}) \\ & \text{General} \|^2 \ \dot{Y} \\ & \text{General} \|^2 \ \textbf{General} \|^2 \\ & \text{General} \|^2 \ \textbf{General} \|^2 \\ & \text{General} $



> ¶ĩ lắz nă lźÅ Oźqä ¶² äcezä Oź<br/>Ý Čá ¶%äcezä B1 L; äl Oct ¶² Oão ĩ lắz orai þ<br/>þ½ É

hZeY\_`UfSedRS`feeYVZc^VZedŽEYVjRcV^`eZ gReVUSj TYR]]V\_XVdR\_UdW\e`RLRaeZ\_RTcVReZeV R\_UV\_ecVacV\_Vfc2R]hRje`VT\_`^ZTUV^R\_UdŽ EYVZc^`dedRJZ/eWRafcVZdeYVZcgZh`WdTZkj+ eYVj cVXRcUS`eY eYVVT\_`^ ZTd deV^ R\_Ud TZR  $\mathbb{Z}$  Vof RjæZdRd\_Ref dRj a YV\_` ^ V\_RŽE YVZca` dÆZ\_ Tf]USVd^^ WfaRd+yDWZXeYReeYZdTZR `dVcdfZed^VLZe^fdeSVRX`U`\_VZ%?`eVeYReL Z\_ eYZITRALeYVT\_TVae`VeYVyRTe`c%ZIWf\_U Z\_Rdd172ReZ\_hZeYRT\_dedRZ\_e`\_eYVya`dd2S]W2G  $? VZEYVceYVVT_^ ^ ZTddeV^ _ ceYVZ_VbfRZEZd$ Z\_d TZA (TR] WC TOZZZA ŽE YZI dy WROOT CR\_TVZI Rď SROU`\_`eYVć TYRCRIEVÉZEZIČŽ> V^ SVcd`W eYZIXcfaeYZ\eYReTfccVedTZRTYRXXdYRgV RTJVRcUZEVTEZ\_R\_UWWJdfcVeYRe^`cVYRdSW\_ XRZ\_VU eYR\_ ]`de Sj eYV^ Ž:\_ XV\_VCRJL eYVj RcV YZXY |  $dMVT_{U} e aV a V VX^{A} eYV YZXY R_U$ ^ VLZ ^ łYZXY decReft RXVU`gVc \$&R\_Uh ZeY RXVRe UVR] ` WUF TREZ\_R] TRAZERŽE YV/ h ` c\ Z\_ DR\_eZEX  $R_UZ d d R R R \tilde{Z}$ 

#### H = G = G = F = F = F = F; ; 5 = B = F

EYVol/T\_UXc`fa`VWARZ\_VcdZd[fdeRWARTeZ\_ ]RcXlc1" ( ~ /Ž:ed ^ V SVcd.]ZVeY dV `WeYV} cde `VLdWeYV`dMgVdRdXRZVcdRUWWTT}UVe R\_UV\_eYf dBrdeZTRS`f eeYVVT\_`^ ZT d deV^ ŽEYV chef je Zieł Reevy Rcv Rieżęnji T\_Wc^ ZieR\_UdW e TcVReVRa | RIVV/ceYV d/gvdReR | T dedŽF\_|ZV eYV^ V^ SVcd` VeYVacVeZfdXc`faLY`hVeVLeYV RevTYRoRTeVOZKUUSj Robe`\_XjVRc\_ZXVVcTYR\_XV Z\_S`eYeYVVT\_`^jRUd`TZVejŽEYVjdRjeYVj RCVXRZ\_Vcd\_j VeeYVj h`f]UdeZ]]ZVe`dWeYVVT ł \_`^ZTdjdeV^R\_Ud\_TZRjZ\_VbfRjZeXdecR\_dWc^VU Sj RT^^`\_WWW.ceŽEYZelSc`RUUV.dZVVV.cTYR XV dW^ de` SVS`c\_`fe`WeYVdfS[VTezeVViaVeZ/\_TV `WaVa]VhY`YRgVSW\_RS]Ve`RjeVceYVZc`h\_ dzfReZ\_eYc`fXYUczgVR\_UhZ[a`hVcžEYVT\_ł T]fdZ\_Tf]USV+y=Védh`c\e`XVéYVce`TYR\_XV  $eYVdTZR_{}^{T}dVdSVIRfdV^{j}VR^{a}VdYhdZeTR_{}$ SVU Vމ

EYVekt^ ydyfWARICZ;TZ\_XXRZ\_V%26tfdvUVkceYZd Xc`fae`V`aYRUKKVeYVWRTeeYRe26d^V`SVcdYRgV ^R\_RXVUe`Xke`\_R\_USVT ^VXRZ\_VcdSj ^VR\_d

`VIRYRU decf XXIVŽE YVj REVXRZ\_VcdSVIRF dv' VeYVZc `h\_WWW.cedR\_UdRIcZ;TVdŽ>R\_j`WeYV^ deRceVU feReR] h d TZ lVT \_ ^ 2T Vgy R\_URV of dR Z `c2XZ\_ŽEYYJ\_Z\_T]fUVRY2XY\_ac`a`ceZ\_ `W`h\_ł RTT f\_eh`c\ValY f dhZ $VdR_U4$  ReY ]ZdZ2  $dZ_$ eYV} cce Xc`faŁeYVj eV\_Ue`SVj`\_Xa`]ZeZTR]j e` eYVTV\_eeVR\_UTV\_eeVI]W&Ž:\_ eYZ:17ReMLY`hVgV&L eYVdVa`]ZEZIR] a`dZEZ\_dU`\_`eeeR\_dReVZ\_e`RT]VRc Rdt  $V_e$  Va TZR  $TYR_XZ > R_j Z UZZLFR dZ$ eYZEXC`f a SVJZgVeYReTYR\_XVYREJSW\_SV\_Vj TZRJŁ Sfe^R\_j `eYVcdSVZZgVeYReeYZ\_XdYRgVX\_V `\_ eYVdR^ VŽEYV\Vj a`Z\_eLeY`f XYLZleYRe eYV ^ V^ SVcd` V&YZCIXc`fa XV\_VcR]jj UZca]Rj R]`h [VgV] `VR^``dRJZh` R\_Ua`hVdJVdd\_VddŽ4`\_gVddJjŁeYVj RcV Wef cVI ` cZV\_eVUŽE YZd d<sup>\*</sup> XXVded R a ` [ZeZIR] ji  $Z^{*} a^{*} ceR_e T_T f dZ_{+} bX_{j} X_{i} U^{*} g^{*} Z_{c} a^{*} h Y^{*}$ `ck Yf ghfUh a `k \c 'UfY'Z h fY!cf[YbhYX'Xc' bchX]gd`UmU`\][\`YjY`cZdckYfYggbYgg` UbX Ua cfU ]ga ": WeYZ Z d LZ Z T T TZ Wc af S|ZTa`|ZZZde`YVJa XV\_VCReVRVKefcVI`cZV\_eVU `fe]``\Ž

## Ht 977F+H75@@CG9F

 $EYVTCEZTR[]`dvdXc`faT^acZtvd")" ``VR[]$ eY dVZ eVcgZh VLŽ2aRce VV ^ UV \_ Z XeYV dvgvd Rd]`dvcd.Zed^ V^ SVcdU.Zeb.]R, WWZ\_Xd` WZ\_dVTf cZej  $R_U R_X c e^{h} R c d e^{V} V T_{-}^{A} Z f d e^{V} R_U W$  $UZZ f dZ_^ VeR_UR_X ce hRddeyVTYR_X dZ$ XV VRŽEYV eV Ue`S]R^ VeYVvd deV %WceVVZc acVUZIR^ V\_eŽEYVeVc^ yTcZeZIR]%Zelf dVU SVIRF dV  $eYVdV aV a]V dW eYV VT _`^ j R_U Z_V bf R_ZZd$ Rdd TZR ac Uf Ted Z a dW Sj R d'R] ^ Z `cZejŁ  $R_U Ze dW d[ZV] eYRe eYV ^ R_V eYVW] hZX$  $]Z \rightarrow yHVRcV$  dd SVIRf dV WeYV d deV eVV YRgVZ'a`dVU`\_fdŽ%2d^ZXYeSVViaVTeVUW/^ eYVZcTcZeZTR] deR\_TVLaVa]VZ\_eYZtXcfaeV\_Ue` devide/ReeYVTYR\_XiddW\_Z\_4YZVYRgV\_`T]VRc  $RZ^{*} \subset U de Z_R e Z_Z Z 4 \subseteq d b f V_e j L d^{V} We V$ UZA]RJ R\_`\_łT\_Wc^ ZeReezer UVe hRddeyVVT ł \_`^ZTd\_deV^Ž2]RcXVcac`a`ceZ\_`VVeVV^ acWWc RoteRevXi `WeVIReZ\_RIT\_We^Zh hYVeVSj eVVi egi e`RIYZkgVeYVZcXR]dSj VM}]]Z\_XeYVViaVTeR eZ\_d`WeY`dVhZeYa`hVeZ:eZelZ\_eVeVdeZ\_Xe`\_`eV eYRe yTCZEZIR] ]`dxcd%eV\_U e` YRgV R YZXYVc [VgV] `WZ\_T^VR\_UVLfTReZ\_1T^a]VeVdVT\_URg`c eVTY\_ZTR|VUFTReZ\_/eYR\_eVV`eYVceh`ejaVd`W



]`dkdŽeZla`ddS]VeYReeYY\_^ZXYeYRgVYRS`fcVU ViaVT&&Z\_d`WYR\_XV^\_]je`dWeYVdVWfdeReWLL eYVcVdF]eSVZ\_XTcZeZIZI^eYReedR\_dReVda`]ZeZIR]jj Z\_e`]W&hZ\_Xa`dEZ\_d`cUV&RIY^ V\_eZ

## H± 9°C DDC FH B=GH=7 °C C9F

EYV ]RCX&& Xc faLT ^ acZZ X S!  $\vee$  WeY dV Z ekogZh VLL dYRCVd R\_Z RZ RZ RG TYRCRIEVSZKU Sj h YRe ZleVc' VU yR' CRZA %Z . `eYVch ` dLLR d cgZgR] deReVZ hY YZ J čh V/WEV Sj R\_j ^ VR\_d eYVz ` h\_ ` c eYVZ VR' Zj čh V/WEV Sj R\_j ^ VR\_d eYVj dW} eŽ:\_T\_UZZ\_dh YVCVd TZR] ^ Zdef de Zd YZXY R\_URITVdle [f dzTVf\_TVcHZ\_LEYZIR\_SVRcR eZ\_R] deReVZ VVceYVa`` cVdEXc f adŽ2\_UZ\_UXUL yR' CR% dXdeV\_U e`SVV0' ^ eYV]`h VcdeRef ^ L f d R]j RXUSVch W\_S&R\_U%dh ZeYT ^ a]VeVacZ ^ Rj VLFTRZ\_R\_U]ZZZ XZ\_Rac`gZ\_TZR] e`h\_` c TZg Ž2dh V] Rd ^ R\_f R] JRS`f cVcd R\_UY`f dh ZgV&L R]RcXVac`a`ceZ\_`VeYV`RcVaV a]V]Z\_VUh ZeY d` R] R\_U^ VLZ ^ h dXvUZ\_LF dej R\_U eRUVŽ

 $2aRe W/ eVZcR^{d}T_Wc^Zt^Z_dNRZ_$ e' eVVT\_^^ZT\_deVL'aa`ef\_ZteZ\_]`dvdRV TYRCRIEVZtVUSj eVZcR]^`de'eR]jj \_RefcR]ZtVU gZh `WdTZtejZ?Z\_V`fe`WkgVcj "! ^ V`SVcd @∕.łäł/pè

; ¶@@O@q&O%agæ¶2 ä0° qäzg¶2¶- &ä- 0' & O\z YaÇAz (ýz2 æ)' z YÈä

> ¶ĩ lắz<br/>riál lź. Å Oźqä<br/>[²äeeeä] Oź<br/>Ýát<br/>[%äeeeä B1L; äl Oxt<br/>[²O<br/>8» ĩ lắzø<br/>ai þþ<br/>/ $\hat{\mathbb{E}}$ 

> `WeVVXcfaeYZ\eYRedTZAJZWofRJZZAdRhRJd VIZEŽ4`\_gVcMjL^`de`WeYV^RJdeYZ\eYRe eYVVT\_`^ZTd\_deV^YRdSW\_Za`dvUSjRd\*RJ ^Z\_`dZjŽEYVdVaVaJV^RJSVdfaa`dvUe`dvRd\_ RdW]`hd+y8ZgV\_eYRehVTR\_eTYR\_XVeYVVdESS JZEYVU`dvRLZedVgVcj`\_VVceYV^dMgVdŽ&EYV WWJZX`VZ\_dVTfcZcjR\_Ua`hVdVdLVdUZaJRJVU SjeYVXcfaa`ZedZ\_eYZdUZVTeZ\_Ž

## 

=Rdelj ŁeVVekć^ Raa JZU e`eVV} V&Y Xc`f ałh YZIY T^acZMd"\*~``Wotda`\_UV\_edŁd`^ RzXtdeh` g&R T^a`\_V\_edŽ@\_ eV`\_VYR\_ULV&Xe`fe`W VgVg "! ^ V`SVd`WeYZLXc`fa dWeYV`dJgVd Rd]`dVdZ\_eVVVT\_`^ZTac`TVdtR\_UeYZ\^`cV YRdSW\_]`deeYR\_XZ\_VUSj eVVTYR\_XdeYReYRgV eR.V\_a]RIVŽ@\_ eVV`eYV&LeYY\_RVUZEZ\_XfZhVU W^^`eYVc`]`dVdSj eYVZcYZXVcUXcW`W`\_1 T\_Wc^Zh`ŽEYVZcgR]fVdRvV`aa`dVUe` eYV VT\_`^ZTd\_deV^LhYZY eYY\_gZh hZeY WJZ\_Xd `WY ddR UR XXZ

 $> R f R h^c V d R U j^f X R U f e d W ^ e V j^h h$ VcdedRef ^ RcVd ^ Vh YRe `gVdcVacVdV\_eVUR^ `\_X  $_{1}^{T} Wc^{2} = \frac{1}{2} \frac{$ Xij R\_UUVêVc^ Z VUe` TYR XVeYVVi ZeZ X`dVc` W eYZ\_XOŽEYV(U\_`eckoZX\_eYV^dMgVd`cecje`}\_U R\_Z\_UZ;ZUFR]d]feZ\_e`eVVZcacVUZIR^V\_eŽ@ał a`dÆZ\_e`eYVyd\_deV^%a`eZeReVdeYV^e`TYR\_XV ZŽ=Z.VeYVdMWRICZ TZ XXRZ Vc Xc f aŁeYZlej aV `W/dxcdjdeYReZWgVg`\_Vh`c\We`XkeYV&S`eY  $eYVVT_^ ^ T deV R_U dTZR Z_V bf R ZZ dT f U$ SVTYR\_XVLŽF\_1ZVXRZ\_VcdLY`hVgVdLhY`ViacVdd  $V_eYf dZ d^R R_UT_{UV_TVZ_eYVhR_eYVT f_eq}$ ZIX Z XL ` IT \_ WA^ Ze]` dkadWW dey var \_ WAVŽ EYY/U\_`e\\_`h hYRee`U`ŁSfeeYY/h`f]USV hZjZ\_Xe`eR\VRTeZ\_ZVeYvj hVcV`VWcVURX`U Revé\_Rezevil dvardu [Vdd ` Va` ] ZEZIR | R\_UZIV | ` XZIR `cZVeReZŽ



## D5 H9FB G C : CC 7 - 5 6--@HM



EYZ1TYRaeVc]``\dReaReeVc\_d`WdTZRSZZEj  $\mathbb{R}^{2} \times \mathbb{Z}^{2}   $\underline{Z}$   $\underline{U}$   $\underline{U}$  aRdNdS`eYeYVadRIeZIRJZZNd`WWJReZ\_dYZadR\_U  $eYVZcd^{T}ZR_{c}d^{T}ZR_{c}d^{T}ZR_{c}d^{T}ZCR_{c}R_{c}$ Z\_UZ&Z\_FRZRRZ\_dY hVUe/Red TZRSZZEj RaaVRde SVdecf Tef cVUR)^\_XR\_ R ZIT \_\_VTeZ\_XeYVVR^ Zj `\_ eYV`\_VYR\_UhZeYd`TZkej`\_ eYV`eYVeZEYZd ac`gZUVdeYVZ`RXZ\_Rg`V&R`Vh`c\hZeYZ\_hYZIY

VRIY Z\_UZZLIF R] gZ/hd`eYvcdŽEYVhRj d`TZRSZZZ; `aVdReVdZ\_adRTeZTVTR\_SVT\_dZVdVUSj\_^VR\_d `VIRd`TZR] eef dež^Zdeef de RiZdZ UZTReZ XY`h`aV `cT\_decRZ\_W\_cV\_ReZ\_dhZeYeYV`eYVcRcVZHYV\_ Df cgy/LeVVT ^ SZ\_RZ\_ `WeVdVeh` R Vdj Z/Ud WfcT\_}XfcReZ\_dŽ6RIYXc`fa`WeVda`\_UV\_ed V^S`UZ/dRdzVIZ/TT^SZ\_RZ\_`WarRTeZIVdR\_U cláckál eReZ dŽ

#### 5 GC 7 = 5 @DF = J 5 HGH

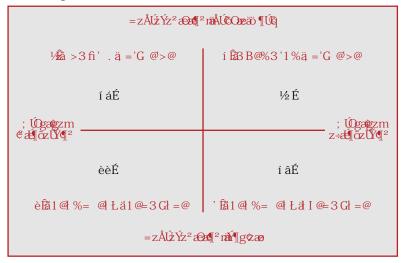
 $EYV \} cde Xc f a T ^ aczMdyRd TZA aczgRezded%R$  $eVc^ eYRed ^ RezKVdeYVT ^ SZ_ReZ_ `VWR^ Zj ł$  $TV_ecVUZ RZ_Rcj R_UhZeYUCRh_ YRSZedTYRRI$  $eVczdeZT`W ZdecfdeWJ aV a]VhZeY f e VZV_UdR_U$  $hZeY f ed TZA aRceZTZREZ_ŽAczgRezde4 YZVR_d]ZgV$  $Z_R_UVceYVZc VR^ ZZCH-y2d]`_XRdeYZ_XdRVX ł$  $Z_XhV]] ReY ^ VL: U_`eTRCVhYReYRaaV_dZ_eVV$  $T f_ecjZ6EYVJ RCVcGeZZXSVIRfdVeYVZc VaVcZ$  $V_TVZdT_}_Ue` eYVcCdeZZeVUY`cK`_`VeYVZc$  $_VZXS`f cY`UR_UeYVacCd/_eZ3VIRfdVeYVZc JZgVdL$  $hYReYRaaV_dZ_d TZAj ZLRZV_e` eYV^Ž$ 

y2d TZR acZeRezted%acVdV ed ^ VolaVIZ TecReetŽ E` SVXZ\_ hZeYL'! `WaV a]VZ\_ eYZdXc fa RcV  $h^{V} = W^{A} e^{V} h c de Ref^{Z} + Z d LZ M R U$ eYVcVJRezevjj YZXY RevCRXVRXV`VXXc`fa^V^SVcdL  $T f USV Z VU e R^ HR R HR T_1$ We^ Zh  $\underline{Z}$  eVVVT \_ ^ A Zh daYVeVŽD ^ V  $\underline{Z}$  W eYZd.Xc`fadW.ViT]fdZgVjje`XRZ\_eYV.XcWReVde RUBR BRAVVIC BYV MIGVER U BYVZC VR ZZEČZ\_U eYZdeV\_UV\_Tj\_VieV\_Ude`a`]ZeZTdLhYVeVVdR^V ac`a`œZ\_dr`h eYV`dv]gvde`SVZ\_UZXWKV\_ee`  $UV^{\uparrow}TRIJZ3VHUV VT_{\uparrow}R^{\uparrow}RJHVHVT_{\downarrow}R^{\uparrow}RJHVHVV$ a` ]ZZIR] UZRWWIEZ\_ŁEYV^ `deac`^ Z\_V\_eTYRCRI} eVezdezt Zeley VWWZX`W'ddžeh` eyztud`WRd TZR acZeReZtedT\_TfUVeYReeYVjYRgV]`de^`CVeYR\_ eYY YRgVXRZ\_VUSj 4YZVdcVTV\_eUVgV`a^V\_eL  $R_U$  gvc YR]VaVcTVZgVeYV^ dv]gvdRdVT \_ ` ^ ZT]` d Važer V R] e XveyveLeyvelv Tyrerievezezidavevr eYVvgvg UBJ ViaVcZV\_TVeYRef\_UVc]ZkdeYZdg aV`W d TZRSZZEj + d TZR] VIT]f dZ \_ Ž: \_ ZELeYVVBRZ\_Vdd`W eYVd TZR S`\_UZd^ R\_ZWEWUŽE YZWRXZZEj TR\_\_`e SVReecZSfeVU`\_]je`VT\_`^ZTTRfdvdŽ7Rc^`dvL Ze ZdUFVe eVZ RXZ ReZdeYRe 4 YZVR d TZKej TeVRevel RS`fe Zed MV Red RT || VT&ZeV`d WŽ

#### -BH9; F5H98'9LHFCJ9FH

 $2eeYV eYC VleeV VLeY dVZ eYV yZ eVX ReVU VleeY dVZ eYV yZ eVX ReVU VleeY dVZ eYV yZ eVX ReVU VleY a RVT ^ a VeV j T_dZ eV e Z UZa RJ Z RXZ Rj R_U eYV YZX UVX W VI TZA T_eRIE eYR TYR RIE XX d$ 

\$'%B=łä' @vÅzÝä¶%奶g©] ©@ø



>¶ï Úgzn**a**, ÚzÅOÚzqa¶²äaeezä) OÝÓ?a¶%äaeezäB1Ł; äl Oze¶²O6a>ï Úczonai þþ½Ê

#### CIH, C=B; DF=J5H+GH

H YV\_ZET ^ Vde`d TZR]  $cV_REZ_dA YZ_{VR}$  TF] ef  $cVIR_$  `eSVUAZTEVURdS]RI\ R\_Uh YZALZ\_R\_U `f  $eZdYRdSW_dW_{LeYVVZ}IR dYRaLT_dZEV_e$ T\_eRde SVeh W\_ eYV yRd TZR] acZgReZEV&R\_U eVV yZ\_eVXREVU Vice`gVceZa A`\_gVcdNjLXc`f ad # R\_U SZ\_eYVS`iL^ R\_ZXf a R]^ `deYR]WVEVVdR`a]VL cV\_REVe`d TZG Z\_R]VddT]VRd TF eh BjZD^ VcVi da`\_UV\_edLh YZ\_Va]RIZ\_XeYVVR`Zj\_ReeYVTV\_eV `V&VVZc]ZgVdLRd TF]eZgReVd^ Vd`TZG eZdZ@eYVcd YRgVR\_Z^ RYZ\_Rj\_`Vdi TZG ERVF\_VRJ\_RS`f e d TZG cV\_REZ\_dYZaZ



8 c fa # ZleVVď R]Vde `VeYVWfc1"% / R\_U Zd ^ V SVd RV ý feX Z X acZgREZhťŽE YV ekć V aYRŽ&deVT ^ SZ REZ\_`Wh`hBjd`WMREZ X e d TZ/g eYReRVX/VR]j cVRdUVURUZWKV eŽ > V SVd`VeYZLXc`fa T ^ SZ VV/V V\_ed`VeYV yacZgREZł% g aV hZeY V/V V\_ed`VeYV y4 ce`gkte‰ g aVŽ=ZVRd`TZRj acZgREZheLeYV/VZ UZZLfRdRV XV\_VR]j T\_TV\_U`\_]j RS`fe eYVZ VA`Zj R\_U Y ^ VŽEYVJ RJd d/RVRd TZRJ ac`}]V4`]U/cRUf JeL ]`hVcdeRef ^ L^ R\_fR]JSS`fc/dR\_U`h\_HRTT f\_e h`c/VdŽ2e eYV d?`VeZ`VLeYJ c/dV S]V yZ\_eNJ XREVU V ec`gkte%ZZ eYVZ.`feX Z\_XUZa`dEZ\_Ž EYYJ YRgVa]V\_g``VWZV\_ULR\_UeYY aReZIFJRCjj ]ZV^ ZZ\_XhZEY eYVZ\_VZXS`fcdR\_UaReZIZAREZ X Z\_d TZE]`cXR\_ZREZ\_dŽ

EYVaRce2ff ]R:Zej `WeYZIXc`faTf]USVeYVcVdf]e $`Weh` Welle`cdej aZIR] `WeYVy`feX`Z_XacZeReZEPZ`a$  $7ZcdejjLcV]ZZ_+ZeZddecZZ_XY`h^R_j`WeYV^RcV$  $adRI&ZZ_XSVJZ&gVcd:S`eYV&gR_XVJZIR]R_U4ReY`JZŽ$  $AV a]VhY`adRI&ZV/RcVJZZ_XV_VR]j YRgVR_$  $RW_Zej hZeY VR^Zj gRifVdR_URd`TZR] JZWSRcMU$  $Rc`f_U eYVTYfcTYZDVT_UjLeYVcVZIeYVcfcR]$  $`cZZ_`W^R_j`WeYVXc`fa`d^V`SVcdŽ:_eYV$  $Tf_eej dZJVLeYVecRUZZ_`VVI]`dvLVR^ZZRc`d/R$  $eZ_dYZadhZeY_VZXS`fccle/Ude`YRgVcfcgZgVU$  SVévé éYR\_Z\_TZZKŐZE YZIS VZ\_XéVV IRMAL AVZZ f d adRIEZTV R\_U éYV f cR] dkézZ X dW^ é` WWC R\_ Via]R\_ReZ\_ Wc éYV R^ RJXR^ ` WyWR^ ZZI^ % R\_ U ]`IRJZI' éYRe IR\_SV df ^ VU f a Z\_ éYV a YdRdA yE YR\_\ 8`U: `gVX e éYV\_VZXYS` f cd é` YVJa ^ j WR^ Zj af ]] eYc f XYŽ% a` \_ dZ M Z\_ X eYRe éY dW Z UZZZIF RJd.` ]U/c RUF ]ed W/ eYV]` h Vc derRef ^ Ł U \_` ef df R]j ded j` f edZ VéV VZC Z ^ VUZ éVV\_gZI c` \_^ V\_eL éVV]` TR] T ^ f \_Zj TR\_SV dW\_Rd R\_ V éV\_dZ\_ R\_U dZ WCIV^ V.e` WWR^ Zj ]ZWŽE Y dV Zd\_` XARE XRa SVéh W\_ éVVY ^ VR\_U éVV ded WéL SVéh W\_WR^ Zj d TZSZZEj R\_U cV]ReZ\_dYZ dW CXU Z\_ ]` TR] TYf cIY` c\_VZXYS` f cY``U` cXR\_ZREZ\_dŽ EYXdV a ]V^ RJ SV dZU é` SV éVVY VR é% WéVV ]` TR] T ^ f \_Zj Ž

### --BH9; F5H98 -=BHFCJ9FH

8 c`fa \$ ZdeYV]RcXkdeLT\_dRZ\_ZXReYZU`W cVda`\_UV\_edŽEYV eVc^ yZ\_eVXdReVU Z\_ec`gVce‰ YZXY [ZXYed eYVT ^ SZ\_ReZ\_ `Wel TZR] Z\_eVXReZ\_  $R_U Z_{ec}$  gVcd $Z_Z E YV Rdt TZRe Z_Z R_ UU _VL$ SVIRFOVZE]Z\_\dRT]]VI6ZEVZ\_RZ\_Rcj `WoTZkij hZey Rolyf TeR\_TVe`YRgVUNRZ\_XdhZey`eYvcdŽ@\_ eYV \_ VYR\_UZd^ V SVdRVyZ\_eVXReVU%SVIRf dV eYVj dY h R\_Z eVcVdeZ eYVhRj eYVT f\_eqj ZdX ł Z\_XthZeYfeSVZ\_XTYRfgZ\_Z6Z7ŽEYVVR\*ZjY]UdR ]VddTV\_eeR] a]RIVZ\_eYVZc]ZgVdZ@\_eYV^eYVcYR\_UL  $aVaVZ eYZW fa Wa eVZ UZ R_TWA eY dV$  $Rcf_UeVV + y, fdeSVIRfdV: \land ZeVeVeVUZ Yh$ eYVT f\_eqi ZlU Z\_XLU Vd\_e^ VR\_: YRgVe d\_ hZEY eYVTc`hUŽ62\_VgV\_]RcXkcac`a`ceZ\_`WeYVdV aV a]VeYR\_ `VyRd TZR] acZgReZded%65 \_ `edWeYVZc \_VZXYS`focLU`\_`eaRceZIZaReVZ\_`cXR\_ZkReZ\_cL  $R_UWW f_T \wedge We S VRc f_Ua caV a VZ$ 

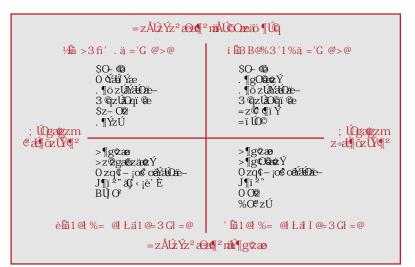
EYV R^SZAF f d a Reek UZta ]R UU Sj yZ eki XREU Z ec gked%  $\delta$  bf Zkd ^ cV U kRZ UU kra] i REZ \_ŽH ZeY f e h ZhZ Xe ]NR\_ e ` YNR Zj ` \_ eYV f cgy } \_UZ XER TRWM  $\delta$  KLZ X` VEV  $\delta$ /TR\_ dYU d ^ V ZX'e ` \_ eV ^ Reek Z4 ` ^ a RZt \_ h ZeY yRt TZR aczgRzZtet% ot ^ h d eYRe h YfY UfY 'hk c ` hmd Yg c Z gc WU` ]bhfc j Yfg|cb'': \_ eYV TRV ` W Z ek REW Z ec gkeet Ze Zlg ]f \_ eRg R\_UZI ^ R\_Z WEE UZ d NTEGV d TZSZZE eYRE Wc^ d a Ree ` VR Sc RU ckack / eRZ \_ ` Wt TZk Z2 d TZR aczgReztet ` \_ eYV eYK YR\_ULU \_` ef d R]j WcX/R\_j d TZR S`\_LUSVIRFdVeYY eV\_Ue`SVaVa]VhY`RcV \{`T]fUVU€\{aV]]\U€ W}^ d`TZA]]ZWŽEY\Zc`\_]j RTeFR]\{a\Z2\_TV`WoTZA;jZleY\VR^ZjŽ

H YRe Z\_~fV\_TV ^ ZXYe yZ\_eVX0ReVU Z\_ec gVcet‰ YRgV \_ eVV JZW W4 YZyR\_ d TZ4j OE YY dvacvdv\_eR eYZU`VM] eY dvZ\_evcgZh VUR\_UR RcXvac`a`ceZ\_ `V&YV ReVj`f\_XRUf]edi#&1\$%/SV]`\_XZ\_Xe`eYV ^ VUZ ^ HYZXY dcRef ^ R\_U JZ5Z\_XZ\_fcSR\_ReVRŽ EYY RCVeYf dZ\_Ra`dEZ\_e`Z\_~fV\_TVaRevc\_d `Vd TZ5SZZ6jŽ> fTY hZJ UváV\_U`\_ eYV dyReZ\_ł dvZa eYReZkdef T\ fa SVeh W\_Z\_eVx0ReVUZ\_ec`gvced R\_UZ\_eVxReVUV ec`gvceLcZ\_TVSVeh W\_eYV eYY ^ R.Vfa'! '`` V&YVcR`a]VŽ

:\_ T \_TJf dZ \_Leh` RdvVIed \_WU e` SVV^ aYR dXwZ7Zddji LeYvVZlR } \_UZ XeYRe Zd dX Z TR\_e ZweYv UZWWCV\_e T ]]VIezgvZ RXZ RcZd RcV e` SV f \_Uvde` U+ VT \_`^ ZT ^ Reevid RcV` W \_Jj cVJR ezgvZ a` dR\_TVŽE YVZ RXVeYRe aV a]V Vc^ `W eYv dvJgvd Rd yXRZ Vd% c y]` dvd% Sj VT \_`^ ZT UvgvJ` a^ V\_eLR\_U eYV XV\_VCR] dv\_dv` WYRgZ X XRZ vU`c]` deSj eYvd TZAJ TYR\_Xddw\_ Z 4 YZvL ZIR^ Rc\VUTYRCRIevizeETRe VZeYvc V\_U` WeYVdaVII eff^ +Z\_eVXRevU V ec` gvded R\_U Rd TZAJ acZgNezdeŽ 3f eeYZddyWaVCTváeZ \_ZL` eRUVevc^ Z Z XWR c Wc eYV` eYvc da` Xc`f adŽH i gz`Jh WUbbc h VY` 'UJX Xck b UgUfi`Y h UhdYcd 'YĨŷYWc bca ]W gY'ZdYfWYdhcb d'UngU XYhYfa ]b]b[ fc`Y]b` h YJf`gc WJUV]`]mn'

 $EYV dVT \_ U`Sdv&gReZ \_ T \_TVc\_deVV UZWWeV_e$   $]Z \ dSVeh W_ T \_TeVeV R_U Z'RVZ_RG V_a VeZV$   $V_TVZ: \_ `_VTRMLeVV a ReeZUZReZ \_ `Wy f eX Z_X$ 

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>¶ï Úgznä). ÚzÁCUźqä¶°äcezä] OYÓä¶%äcezäB1Ł; äl Cus¶°O&sï Úzzonai þþ½Ê

acZeReZtec%Z\_eYV]`TR|T^^f\_Z; SRR\_TVdeVVZc yNR^ZZEZT%Z^RXZ\_RcjŽ:\_eYV`eYVELeYVd`TZRj Z'RXZ Rcj `WXZ eVXcReVU Z ec`gVced%a]RIVd eYV dyVTezev\_VddevVj fdFR]jj UZda]Rj Z\_ eVVZcUVRJZ\_Xd hZeY`eYVcaVa]VZR\_Vh |ZeYeŽy2dTZR| acZeR eZtel% ReVh`ceYT\_dLVcZ\_X dvaRcReVjjŽ>RcXRcVe  $E Y Ref V (cdh V) | \ (h UZ) (cdh V) | \ (f T Y)$ eYZ\_XRdd TZkjŁ`\_jj Z\_UZcZlf RdLZlRaa ZIRS [Ve` eYV Ž3fehZeY fectWkV TVe RyH VZeZUZWIfe e`TeVReVeZd`Wa`[ZLReZejŽEYVd`TZR]S`\_UZde`` WARZIE TaVhZEY^REWCZRJZ\_dVTfcZejŽF\_TVceRZ\_ej RS`feeYV^VR\_ZX`WZWZ\_d'TZkej ac`gVde`SV ^  $CVZ' a = def[Zy@_e] XIR Z_dVIf cZe <math>\infty$ 18 ZUV d." \*\*" / Ł|Z \Ue`eYVYf^R\_T\_UZZ\_Ł Zd ZV ji e` RWWTe Z UZeZLF Rd^ ` cVdec` \_ Xji e` eYV VieVeeYReeYVihZeYURhZe`RacZeReVh`dUŽ



## DC @= 175 @= A5; = B5F = 9G



EYVd. VéIY `W4 YZVdTF ]ef dR] ^ RezZ. ackdV\_éVU Re eYV `f edvé Z TJf UVU R dr `œ UV:TkZaéZ\_``VeYV T f\_egi da `JZZIR]Z RYZ\_RZXÁŽCUWEV\_TVh Rd^ RUV e` eYV VJV V\_ed `WT\_éZ fZgi R\_U UZT \_éZ fZgi TYRRIEV:ZKZ\_X R \Z U `WyZ RYZ\_Rgi `W d.Vc%Z 4 YZJVR\_ YZE ġ ŽE YV ackgZ f d C Va`œ e` RU UCV:dNU eYV d'S[VIe `W d.Vc Z\_ af S]ZT `aZZ\_ 1F ? 5 AL#!!!! RZ@\_ eYRe`TIRZ\_ŁRaRCRU i ZIR] dEf REZ\_h RdZLV\_éZ VUZH YZVeh `eYZU:U VeY`dV Z ekcgZh VUZ\_eYV'' \*\*\* Df œYV Vbf ReVU`d.VchZeY RXXNe Y f d/Sf Ze Sj eYVT ^ ^ `\_ WW:ced`VR]JL ^`cVeYR\_YR]VVVeYV dRh UZWWEV\_TVd`VZ\_eV:vide R\_U`aZZ\_dRdU/ez? V\_eR]e` eYVT f\_egi df\_ZjZ EYVT\_TJf dZ\_h RdeYRev:da`\_UV\_edV\_gZRXV`d UVcRdRT ]]VTeZeVT \_dedTeLSfeeYVjRddW^e WRcalfdZgRdd^VeYZ\_XUZZZZZZŽZ\_`eYVch`dUL eYVf\_Zg``WdTZR]`dUvcYRdSVT^VRac`S]V^%Z EYZdac`S]V^RaaVReVUR]]eYV^`dVfcXV\_eZ\_eYRe eh` eYZUd`WAda`\_UV\_edSVZZgVU eYReZ\_4YZV eYVcVhRd^`dVUZZZ\_XaV a]VeYR\_eYVcVhRdf\_Zd Z\_XeYV^ŽEYZJSRIVXc`f\_UZIRfdWN]dV^Z\_UVc`W Y`hZ'a`ceR\_edTZR]Z`RXZ\_RZZdTR\_SVŽ

 $4 YZVR_dYRgVR_Rc^{*}d|V_XeYcVReZ_dYZahZeY$ UV  $TCRIJZ4 \ C Z XacVeZ f dF ? 5 A UZ XeL$ % `WeY` dVZ\_eVcgZhVUVi acVddVUf\_deZ\_eZ\_Xdf al a`ceWcUV``TcRTjŁhYZV")″ eY`fXYeeYReLZ TVentZ\_TZETF ^ deR\_TVeLR\_ Rf eY cZERZR\_ X gVc\_ ^ V\_e Tf]USVSVævčŽ?`]VdddŽLŽ;TR\_eZdeYVZ\_UZWVd V\_TVe`eYVTfccV\_ea`]ZZTR]d\_deV^UZa]R,UUSj R eYZU`W4YZWR\_ďŽ2]^`deReYZU`W9Y`dVdf cgYjW  $RVyZUZWKCV_CR_UeYZ \setminus Ze^RVd_ UZWKCV_TV$ hYVeYVceYVXgVc\_^V\_eZUV^ `TcReZT`cRfeY`cZ eRc2R\_ŽEYVeV}\_UZ\_XelSVRc`feeYV}XfeVelVeV^ `eYVcd`cgVjdud`TYRdeYV=ReZ\_`SRc²^Vec`/eYRe ZUV eZ4V4 YZVRd` V`WeYVT f ecZkdZ eYVkWZ hYVeVofaa`ceWcUV^`TeRIjZel]`hVdeŽ

2dRX/\_VR of JVLZeZelect Ve`dR eYReh Y a cfY. ]gc `UhYX`UbX`k ]h XfUk b`dYcd`Y`UfYž h Y` a cfY<sup>-</sup>h Yma |gfi ghch Yfg UbX<sup>-</sup>h Y<sup>-</sup>a cfY<sup>-</sup> `\_Y`mih\YmUfY`hc `VY`Ya chcbU``mi bWca ! a IntX hc XYa c WUWM 2e eVV eV/c Vi eV/ VL eYVXXReVdedfaa`ceWcUV^`TdRTjZdWf\_UR^`\_X  $aVaV_{Z}RX`U\}_R_TZRa`dEZ_R_UhZeYRYZXY$ UVXCW WITZRZ Z EVXCREZ ŽEYVT ^ a VI CVIREZ 1 dYZaSVehW\_aVa]VdReeZefUVde`UV``TcRTjRU  $eVZcVT_^ ^ TUUUTZR a UUTZR A$ SjeYVXc`fa`WeY`dVhY`SVJZkgVeYReR\_Rfł eY czercze: X g/c ^ V e TR SV SVee/c Z TVceRZ dÆfReZ\_dŽ> V^SV:d`WeYZdXc`faeV\_Ue`SVj`\_X e`eYV^VUZ\_^łYZXY decRef ^ SfeWWJeYV^d/gVde` SVVT\_`^ZT]`dvcdŽEYVcVZdR^Zch ReTYSVchW\_ eYVZcdTZłVT\_`^ZTa`d&Z\_R\_UeYVaVcTVaeZ\_ eYV YReV VXEZ@\_ eYV \_ VYR\_ULeYV RCVZ\_ eYV YZXYVćZ\_T ^ VSdRI\VedR\_URcVhV||V\_U hVUhZeY eYVd.Z]dcVbf ZVUV/c^ `UVc\_ZREZ\_ ac`TVd1/dŽ@\_ eYV`eYVLeYZlfahRUJj^`SZJVXc`faZleYV^`de dV dezeve evvr ^ avezev vdi va Tza cvrez d e`URjŽ:ed^V^SVcdhR\_ee`SVSVeeVceYR\_`eYVcdL `cRe[VRde\_`ee`VR]SVYZUŽAVćYRadVvćeYZdcVRd eYVj f d R]j VeZ TVeYVYZXYVe dReVd`VZ dVTf cZej Z\_cV[ReZ\_e`eYVVT\_`^ ZTd\_deV^LR\_UeYVj\_eV\_U e`eR\VR\_VXRezeVgZth`WerVhRjeYVZcaVcd\_Rj  $R_TZR | a \in Z_T YRdUvgv| a VUZ$ 

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Z~fV\_TVUSjeYVhRjeYVjgZvheYVdTZRjS`\_UŽ EYVa`eV\_e2R]jjyRfeY`c2ERc2R\_%Xc`faU`Vd\_`eWWJ a`hVc]Vcd`cUZETCZ`Z REVURXRZ de |Z.VeYVyZUZW WKV\_e%Xc`faŽ:ed^V^SVcdWWJeYVJRcVVMJjaRce `WalTZAGELR UeYVJ REVRS[Ve`]``\e`eYVVAAG eVŽ 4`\_UZEZ\_deVfddW^ e`SVWrgfdRS[Ve`dTZR] S`\_UZXŽ?`\_VeYVVdtLeYVYUZAJRJ VeVVd`VdTZR ^Zelef de R\_U R^ `dR/Zh^ dZ'ZRc e` eY`d/Wf\_UZ\_ eYVyZUZWWCV e%xc`faŽeYVVXRZ,Vdd`VeYZdd`TZR S`\_UZdaVcYRad`\_V`WeYVdec`\_XVdecVRd`\_dWc acWWkcZXR RfeY cZERCZR cWZ VŽEYV aa deV

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 $5 V^{T} T dR_{J} Z_{1}^{e} [f de R dZ_{J} V T_{V} e Sf e R$ ^ f ) e XRIV e VUVI a V ZV\_TVŽ\_UZe XLF R dVI a V ZV\_TV e YV UN `TOREZT` dU/cZ gVg UZXWKCV eh R dR UReeRIY gvg UZWWEV\_e^ VR\_Z\_Xde ZEŽ9 Ze cZR] Via v 22/Tvd R\_UWRcdZ\_ eYVacVdV\_eLeYVejaV` WrVefcVUVdZVU  $\mathbb{R}$  U vývá UR hR d` WZZZXR Z~fV TVeYVZVRd eYRe4YZWR\_dWc^RS`feUV^`TdRIjŽ7`fcZ'RXXd `WW^`TCRIjŁWć^f]ReVU`\_ eYVSROZI`WeYVDf ceVj }\_UZ\_X&RCVacV&V\_eVUSVj`hŽ

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EYV acWWACVUZ RXVZd`WRXR^V`WIYR\_TV hYV&V^R\_j a]Rj SfeWhhZ\_ŽEYVyUV `TcReZT XR^ V%ZddW\_ Rdd ^ VeYZ\_XV&/ ^ hYZY`\_]; Rd^ R] VZEVSV\_V}eeLhYZVeYVSf \`WZEZKV\_deR\VaRce hZeY`fe^R\Z\_XR\_j c\R]Z`aRTeŽEYZclVjZeZegZh  $eV_Ude$   $acVU^ Z_ReVR^ _Xj f_XcaVa]VR_U$ eY`dVW/^ eYV]`hVcVT\_`^ZTdecRef^Ž:eZdVM/ bf V\_ejj Wf\_U\_`e`\_]j R^ `\_XRd TZRJ Z\_UZezLf Rjd  $R_U$ ]`d\ddLY`h\g\dLSfeR]d R^`\_XaVa]VhY` WW eYV RVZ eVX ReVUZ e 4 YZVR\_d TZK R\_U hY`UZAB]RJ RYZXY ]VgVJ`WAMWWAAA^Z\_ReZ\_Ž  $EYZd d' XX/ded R a`h VX/M T_Tf dZ_+ [fYUhYf']$ |bX|j |Xi U`|nUhcb XcYg bch YUX Vm |lgYZ

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@\_VZ\_WfccVda`\_UV\_edV\_gZRXVUV^`TdRIj RdRWeSR]^ReTYhY&VaVa[Vecje`hZLSfe hYVeVeVVcf [VdReVeYVcR^ VVvc VgVcj S` UŽE YZd gZh YZXYZXYedeYVTV\_ecRjZg``V&c`TVLfcVdZ\_eYV ]ZSVAR]łcvacvalv\_eRezgVeeRLZEZ\_`WW^`TARIjŽEYZd Xc`faZd\_`eY`^`XV\_VfdVZeYVoŽEY`dVhY`dYRcV eYZdgZhZ\_T]fUVS`eYaVa]VhY`RcVYZXY]jZ\_eVl XCREVUZ é d'TZR JZWR UZ UZeztf Ridh Y UZA R Rd SdeR\_e2R UVXcW Vac22Re2Ch ŽEYV^ `deZ`a`d  $eR_e$   $UZ_XT_Tc_deYV$   $f_XZeZd$   $f_XaVa$ eY dVRXU") e` #%thY`^`deZV\_eZ(VUV``TcRIj hZey RXR^ V`WIYR\_TVŽ:eZdRd eVV hY`SV/ZdeV eYReZedeR\_UdRS`gVR]] Wcycf [Vd%eYReR:VeYVdR^ V WcVgVgS`UjŽeZdh`œYcV^V SVcZXRXRZ\_eYRe yeYVj`f\_X%RcV\_`eRf\_ZVkc^ dve`VvaV a]VŽ

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EYV eYZU acWWCV\_TV Zd eYRe `WeYV Xc`fa `W aVa]VhY`ZV\_eZWVV``TORIj hZeYRolYZa`\_ hYZY Vývý`\_VŁW/^ eYV TRaeRZ\_ e` eYV dRZ^dŁ af]]de`XkëYkŽEYZdTf]USVekc^WRyT\_dV\_ł ďR%Z RXV `WUV` `TaRIjŽEYVyUV` `TaRIj` `W T\_dV\_dfd%aV\_Ude`acVU`^Z\_ReV^`cVeYVYZXYVc faZ\_eYVdTZłVT\_`^ZTdTRVeYVcVda`\_UV\_ed RVŽF\_ZVeYVacVeZfdXc`fadLeYZd`\_VZUVRZdj Y^^`X/\_V f dŽEYVT \_d/\_df Rj gZ/h `W/V^`TdRIj eV\_Ude`SVd/RcVUSj eY`dVhY`RcV^Rc\Ulj Wi ef cN^ cZ/\_eVLLWWJ eYVj RcVVT \_ ^ ^ ZT XRZ\_VcdR\_U RCVVM]jj Z\_eVXReVUZ\_e` eVV]ZVV Vol TZkejŽ3j R\_U ]RCX/LeVV/RCVRUF]eR\_U]ZeVZ\_DR\_eZRXLhYZV a`]ZEZIR]]j eYVj dfaa`ce eYV 4`\_TVceRIZ\_ 1eYV TV ecVI WAAT RZEZ\_ TF ccV eji Z a`h Vc/Ž

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ezgVaVcTVaeZ\_`VVeYVzc`h\_VT\_`^ZTa`deZ\_Ž EYVReeZfUV`WeYVa`]ZeZTRJT\_df^VcTf]USV UVcTc2SVURdeYRe`VRyac2gRezdeXRZ\_V%Z

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AV a]VeV\_Ue`YRgVR^`\_`]ZYZLdReZTZNR`W a`]ZEZTELRdeY`fXYZehVeV`\_VoZ\_XJVLf\_TYR\_XZ\_X eYZ\_XŽ:eZd`\_ eYVSROZd`WeYZdT\_TVaeZ\_L`WeV\_  $R_ZNRZW$  \_VLeyRe TZZT a RozZZARZ \_ Zdf d R]j y^ VRfcVU%Z3feUV `TcRIjZL\_`ecVacVdV\_eVUSj  $RdZ_XVZ RXL_cR_a^JZZdSVT_UV_dVUZ_e^J$ R dZ X VZ RXZ R d Z4 Z Z K d V a V Z V a Z Z R d Z Z Z R d Z Z R d Z Z Z R d Z Z R d Z Z Z R d Z Z R d Z Z R d Z Z Rac`TVddVdUZWWEV\_ejjŁUVáV\_UZ\_X`\_ eYVdTZRJZRł eZ\_eYV{YRgVYRUZ\_eYVR^Z; R\_URedIY^`], `\_ hYVeYVceYVj YRgVYRU^`cV`c]VdtT\_eRTehZeY a`]ZZTdLR\_UhYVeYVceYZtYRdSW\_XReZtVZ\_X`c edRf^ReZT, R\_U`\_eYVgVq UZXWKV\_e^VR\_Z\_XdeYRe T^Ve`ReeRIYe`V&WU^ŁVofRize;RU[fdeZIVZ eYV]ZW`WKRIYZ\_UZeZLIFRJŽ@\_ eYVSRdZI`WeYVdV  $R_U$  eYVc Vi a VZV\_TV2La ReeZIF ]Rc Z' RXVd ` Wh YRe a` ZZZdZdR\_U`fXYee` SVRcVd/RaVULaZtefcVd eYRe ReVfd/URdToZeVoZRe`XfZ/VeYVhRjaVa]V V\_XRXVZ\_a`]ZEZIR] RWWRCdZ4`\_dVbfV\_ejjŁdReYVc eYR\_ RefTVeeRZ\_Z\_X h YVeYVc eYVcV Zd ^ `cV `c ]Vdd aRceZIZaReZ\_ŁZeddW^ dh ZtVe` UZebZ\_Xf ZtY R^ `\_X UZWWEV\_ehRjd`WaRceZIZaReZ\_XŽ

EYV|RcXxdeXc`fa1#( / `WeYVdZ ZleYVyUZRW WTeVUaRceZTZaReZ\_%Xc`faŽ:\_]Z\_VhZeYeYVeV\_ł  $UV_TZd$  Solveg  $UR^{-}_XeY$   $dVUZh[R] Z_XyR^{-} dR$ T\_We^ Zh  $\& \mathbb{R} \cup \mathbb{R}$  aczerie ( $\mathbb{R} \cup \mathbb{R}$ ) aczerie ( $\mathbb{R} \cup \mathbb{R} \cup \mathbb{R} \cup \mathbb{R}$ ) aczerie ( $\mathbb{R} \cup \mathbb{R} \cup \mathbb{R} \cup \mathbb{R}$ ) aczerie ( $\mathbb{R} \cup \mathbb{R} \cup \mathbb{R} \cup \mathbb{R} \cup \mathbb{R} \cup \mathbb{R}$ ) aczerie ( $\mathbb{R} \cup \mathbb{R}  ) aczerie ( $\mathbb{R} \cup \mathbb{R} \cup$ cVda`\_UV\_edSVjZlgVeYReyVgVq``\_VYRde` XVeSj eYV SVæeYY TR\_ŁSVTRfdVa`]ZZTdZda`Z\_ejVdVZEYVdV Revervy]`dka%z\_4YZVdUvgV]`a^V\_eac`TVdL\_`e d ^ f TY Z\_ ^ Rev(2R] eVc^ d€cVda`\_UV\_edV0/^ eYV ]`hVcdecRef^ RcVRIefR]]j\_`^`CVYVRgZjj cVacVi dVeVUeYR eY`dVWV^ eYVceh`Xc`fad€Sfe d'S VIEZV jŽE V j dWeVV dygvdRdUZRUR eRXU SjeYVVT\_`^ZTdjdeV^R\_URCVR\_XcjRS`feZeL  $R_U eYV_1 dW eYV_2 dMgVdRdYReZX_1^be^feW_2^$ d TZR] TYR\_XVLR\_UR:VgVq UZZ]f dZ\_VUhZeY eYZŽ EYY WW VITH UW R\_URSR\_U\_WZ2S`fe VZXYe Z\_"!`WeYZdXc`fa`d^V^SVcd^Zeefde`eYVcdLRU RolZ'Z[Rcac`a`ceZ\_RcVT\_TVc\_VU`\_]je`^We eVVZc`h\_\_WUdRdSVdeeYVj TR\_Z\_RdTZVej eVRe YRCROWN ŽE YV ZUR eYRe a` ZZZ d Z da` Z e Vdd  $dW^{\circ} de dacZ XW^{\circ} eYZ W aVZ/TV^{\circ} W dR_U$ YVJa]Vdd VddŽ



eZZaReZ\_%ZdT\_}\_Ue`eYVT^^f\_ZejŽ@gVc YRW Ked^ V^ SVcdSW \_\_Xe` eYV]`hVcdecRef^ R U RCVW/RJVŽEYVdeReV/V\_eeyReUV}\_VdeyZtXcfaZt yj`fYRgVe`XVeZg`]gVUZT^^f\_ZjRWWKZdLSfe hZeY feXkeZX^ZWUfaZa`]ZZZCZZ5VeAZeVeYVZc ]`hd`TZ`lVT\_`^ZT]VgV[LeYVdVaV`a]VeV\_Ue`WW] eYReeYVj RCVXRZ\_VcdŽEYVj UZba]Rj XcVReWRc`WY\_ł ~ZTELY hVgVELR\_UeVV ac`SRS]j ZLV\_eZtVa`]ZEZTd hZeYdedRZ\_dR\_UUZezZZ\_dŽEYVdVWRedYReVe`U hZeyeYVZ'a`ceR\_TVeYVj RdZX\_e`eYVVR^ZjŽEYZd ZłdW\_ RdRcWWXVW/ ^ RJZY\_R\_eWćTVdud TZkj/Ł  $R_U YRde SVUWW_UVURXRZ_de dX_d WUZZZZ_$ 1a`]ZZIdŽ5VdaZeVeYVTV\_ecRJZj`VeYVVR^ZjŁeYVZc ViaVZZ\_TVU Vd\_`e]VRUeVV^ e`vR^ `dR] VR^ ZZA^ ‰ Sfee T\_Tk\_ WceYVT ^ ^ f\_ZjŽEYZdacWWcV\_TV Ztl[fdzZVUSjeVVZcaVcTVaeZ\_eVReeYVjYRgVd^V  $\langle \underline{Z} U W _{ec} \rangle$  globel VZCZ ^ VLZReV gZc \_ ^ V\_eL  $R_UeYZd$ ] TR T\_ec ] gvc eVZc h\_ RWRZdZdeYV `aa`dEV`Wa`]ZEZIC1ZieZieYidZ\_eYV\_R^V`WR\_ Ra` ZZZIR ReeZef UVeyReeYZdXc`f a VRg`f cda` ZZZIR aRceZIZaReZ\_ReeYV]`TR]VgVJŽ

? Vie T ^ Veh` Xc`f ad`Wybf R] dZv1"'  $/ TYRRIAZXU Sj R_ Z_eVXde Z_ a`]ZZDZ'SVeh W_ eVV eVVj Wc^ ReVZU`WeVVd?^a]VR_UeVVT dV$ 

`Wa`]ZEZIR] a RoeZIZaReZ ŽE YV UZWWCV TV SVeh W eVV [ZdZ\_eVZ a`ceR\_TVeVV ReeRIYe`aRceZdŽ > V^SVcd`W\_VXc`faWWjcVca`\_dZSjVVVceYVhR eYVT f\_egi ZdX Z\_XLSfe^ Zdef dea`]ZeZTR] a RoeZdŽ @\_V^ZXYeolaVR\`Wy\_`\_łaRcej aRceZIZaReZ\_%Z EYV`eYVcXc`faŁSjT\_ecRdeLU`Vd\_`ed/RcV eYZdf\_VRdNŽ:ed^V^SVcd^RZ\_eRZ\_f\_cVdVcgVUjj eYReyj`f YRgVe`eR\VR\_ZeV&&eZ\_a`]ZEZTde` SVRS [Ve`TYR\_XVeVVhR] eVVT f\_eej Z1X Z\_XZ 3jgZefV`WeYZIRTeZyVUZa`dEZ\_ŁeYZI^ZXYeSV TRIVU eYV yTZgZT a RceZTZa ReZ \_%Xc f aŽ> V\_ R\_U aVa]VW/^ eYVZeVc^VLZeVR U^VLZc^łYZXY decReRacVU ^ Z\_ReVZ\_ eVVeh` Xc`fadLR\_Uj`f\_X aVa]VRXU") e`\$%RcVYVRgZjj cVacVdV\_eVUŽ HZEYZ\_ eYZCIT ^ ^ `\_ WR Wh `c\ eYVCVRCV gRCZR eZ\_dŽEYV} odeXc fa 1RXRZ\_de a RoeZd/ RaaVRode` SV^ `cVdIVaeZIRŁZ UWUT \_\_VAdVURS`feTYR XXd eYRe Raa VRc e` SV UZ VTeZ\_[VddŽ: ed^ V^ SVcdeV\_U e`SV^`dVhZeYUcRh\_ŽEYVd/T\_UXc`faL`\_eYV `eYVcYR\_UŁWRg`fcdR^ `cVViec`gVceV\_XRXV^V\_e hZeY d'TZkajŽ:ed ^ V^ SVcd Vi acVcd XcVRe d'TZR T\_}UV\_TVR\_UT]RZ' e`YRgVdec`\_XV&V\_UdYZadŽ EYVZcgZh`WeYVTYR\_XdZ\_ac`XXddZdaVc^ VReVU SjeYVZc`aeZ`Zd`Ž

EYV} WY Xc fa YRdR  $^ dVT _dvgRegVZ RW$ `Wa`]ZZZZ 7 c " S" `WVda`\_UV\_eeLyX Z\_X fe R\_U g eZ\_XZ leVh J e aReZZARVZ a ]ZZZZ EYZI RJ SVeVc WeYVyVJVTe cR] aReZZARZ \_% Xc fa Z\_eYReZd V SVcdeV\_Ue cVRUVVTZ\_d RdeYVVdV\_TV WZgZ aReZTZ REZ\_ŽEYZ lgZh `W a`]ZZZ dZ Wf\_U aReZT [Rc] R^ `\_X cVda`\_UV\_ed W^ eYV VLZ ^ YZXY d TZ IVT \_` ^ ZT]VgVL ]UC RUF ]edR\_U acReZZ X4 ReY [ZCZE YY cVe7Z\_RIZGZT ecRUZZ\_Z\_h YZYY JVTE cR] aReZIZARZ\_ZIR\_Z cVe7V CUZ ^ YZXY d TZ IVT \_` ^ ZT]VgVL ]UC

TZj`VANVAAIfcTVAR97ZFSJVe`AV^ JVALAAVV e`TRdeRc`f\_UVAcR\_jZ\_def^V\_eA/Re^ZAYeSV RSJVe`Z`ac`gVAYVNVJVAV`VANZCVA^ZZAZZ7f]]j RhRVA/ReeYZc`h\_UVIZZ\_dU`\_`eT^VZ\_e`AV ^ReeXLeYVAVaVa]VRVZ\_AAAAU\_`eZ\_a`]ZZTR] aRceZTZARZ\_ŁSfeZ\_eYVWWWOEgV\_Vdł`Va`]ZEZdŁ ZedRSZZEje`ac`gZLVd]feZ\_de`eYVZ.VgVcjUBjUVi ^R\_UZŽEYVZ\_decf^V\_eR]Z`RXV`Va`]ZEZdZd^`de V&VbfV\_eljWf\_UR``\_XVgR\_XVJZRJd-Z\_YRSZER\_ed `VVZR\_6ZEX`Łh`^V\_R\_Uj`f\_XaVa]VŽ

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H YRe ZNRUU 4 YZNR\_d YRgV`Vá`]ZZRDEYV bf VáZ\_ZIR aRceZIF ]Rcjj Z`a`ceR\_e`\_VZ\_eYRe UV``TCRIj ZleYVacZ Rcj RtV\_Rh YVAVUZWWAV\_eZ\_ł eV&VdedR\_U`aZ\_Z\_dRVRZAUaf S]ZI]j  $\pm$ T\_~ZTedRtV dvéqVUR\_UT^^`\_Ztif VdRvCvd ]gVUŽ^RZZRd Zd`Vá`]ZZIdeYf dYRgVT\_dZVARS]VZ\_f V\_TV`\_ eYVT\_decf TeZ\_`WAVyH V&R\_UZedTYRRTeVZdZZZŽ 4 ZZXV\_deV\_U e`Z\_g`]gV eYV`dv]gvd e`R X&VReVc `c]Vdhć UVXWZ\_af S]ZTRWRZdRdeVZc UZWAV\_e gZNhd`Vá`]ZZIdUZIREVŽ9`h hZ]Z\_XRVTZZXV\_d e`UZEIF ddeYVZc UZgVcdZj R\_UUV}\_VRh`dJUeYRe ZdT^^`\_e R]JO

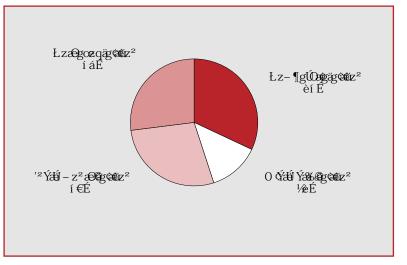
EYVRaac`RIY eR.V\_Sj eYVF?5A #!!"Dfd gyj hRde`Xc`fa eYVeYcWeja`]`XZdRS`gVZ\_e` Rd\_`aeZTTYReŽ2deYVTcZeVcZr`VRdt`TZReZ\_RV UZWWEV\_eLd`e`RCVeYVXc`fadeYReV^VcXVReeYZd ]\gy]`VRXXCVReZ\_Ž

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2 eYZU`WeYV4YZVR\_dZ\_eVcgZhWUdYRcVhYRe ^ RJ SVEVE^ VUEYVZ RXZ\_Rj `VRUV^ `TEREZTZEZ kV\_+f\_T\_UZZ\_R|dfaa`ceWcUV`TCRIjŁRgZh `Wa`]ZZIdTYRCRIeWZKVUSj TZeZTaRceZIZaReZ\_R\_U  $RT_dV_dR_Z RW WV T dR_JZAfeZ_e \} Xf dvd$ Z RTT d.R TVhZey eVVd cgV dvd led eVZdXc fa T^acZtkd`g\c)! ~``WeY^dvSVj`\_XZ\_Xe`eYVTZeZT aRceZIZaReZ\_Xc`faŁ(! ~``WeY`dVcVda`\_UV\_edhY` `aeVUWceYVZ'RXV`WRdYZaR\_U'!″``WeY`dV dfaa`ceZXUV``TcRIjŽ2 gVg TJVRcac`} [VeYfd  $V^{V} = V_{T}^{T} aRdR RW$ ac`a` $ceZ_$ `WaV a]VZ\_ eYV^ VLZ ^ }YZXY decRef ^ hY RVhV] V\_U hVU hZeY VLFTReZ\_R] TRaZER]Ł ^ V\_ RXVU`gVc%&LR\_UeYVfcSR\_ a`af]ReZ\_Ž 3VollAdeYzdUV^ `XoRaYZTac` } [VL`eYVc gRcZRS]Vd \_WUe`SVT\_dLNAVŽ

7Zcdejj ŁeYV yUV `TCREZT TZERKY\_%Z`RXZ\_Rcj Zd dec`\_Xj c``eVU Z\_ aV a]Vd d TZR] acRIEZTVZTH Y` a cfY']bhY[ fUhYX']bhc 'h Y'`[ZY'c Zgc WYhmUb' ]bX]j ]Xi U``]gz h Y'a cfY'`]\_Y'm\Y'cf'g\Y']g' hc `\c`X'U'XYa cWUh]W]a U[ ]bUfm" 2d eRS]V "! ( dY h dL^ V SVd`WYZIXc`fa RVyZ\_eVXREVU





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EYVeYZUTYRRIekZEZT`WW``TREZTZZKU dZl eYVZ:\][\Yf`XY[fYY`cZ]bX]j]XiU`]nUhcb":\_ `eYVch`dtLeYVj eV\_Ue`SVaVa]VhY`VZTV ^`dvd,/WhRV\_VdLd,/WUAC^ZRZ\_R\_Ud,/WA RZRZ\_RLZZZLFR,da`df]RevereRt1TZRedUV`TRTj hZYZUZZLFR a`df]RevereRt1TZRedUV`TRTj hZYZUZZLFR R`e`\_`jZlS`c\_V`feŽEY`dvhY`SVZgVeYRe eYVZ:JZgvdRvX gVc\_VUSj eYVZ`h\_UVZZ\_d R\_UeYReeYJ TR\_TYR\_XV`cRe]VRdzZ~fV\_TVeYV dTZR`dVcRvSVevca]RIVUe`T^Ve`eVc`dhZY eYVf\_TVerZ\_eZdZ\_YCV\_eZ\_UV`TREZTa`JZZTZ 3j T\_eRRHZEdW`de`SVYRUVcVcaVa]VhY` WJ^REXZ\_RZXUR\_UYf^ZZRVUe`ARVd\_d/`W eYV^ŽEYV\_f^SVc`VaVa]VhY`WWJa`hVc]Vd  $18#'' / ^fdeeYfdSVRTRfdVVcT_TVcZ$ 

=RobjLeYVT ccV[ReZ\_SVehW\_aVa]VdUV``}  $TCREZTZ' RXZ_RG' R_UeVVZc \}_R_TZR' a` dZZ_ dY` f |U$ SVV aYROKKUŽ5V `TCROZITZOKV\_deV\_Ue`SVZ\_UZ gZLfRjdhY`WWJeYVJRVXRZ\_VcdVT\_`^ZR]jłhY` UZalR, dec`\_XT\_}UV\_TVZ\_eVVT f\_eq`dVT\_`^ZT UvgV a^ V\_eR\_UhY RVYZX/j ^ `@2RevUSj eYV `aa`cef\_ZZXdeYReVR(]e`eYV^ŽEYZdU`Vd\_`e^VR\_ [f de eYV^`dVV\_eYf d2Rde2T`c yT\_}UV\_e%ej aV`W XRZ\_V; ^ `de`WeY`dvSV]`\_XZ\_Xe`eYVydy]WrRt62;Ti Z\_XXRZ\_Vcd%JReVX g R]d ]VR\_ e`hRddeYZdd TZR] dáddy\_ePez\_`Wá`]ZZTČŽEYVZ adddZ\_XZVL eV\_ŁZłeYReVT\_`^ZThVj]łSVZ\_X^R, SVRacVcVbł fZEWWeW``TertjŽ?`\_VeWyVeHerSJV"!) d'XXVed eYReeYVdfaa`d/UT ccV[ReZ\_SVehW\_a`]ZeZIR|R\_U VT\_`^ZTZ`RXZ\_RZXdZd\_`eS`c\_V`feSjR\_jdec`\_X eV\_UV\_TjŁViTVaeZ\_eVVViecV\_VTRdvd`VeVVUV\_`} TOREZTIZEZKV R UCYVUNERIYVUTZEZKV Ž

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@eYkVJV V\_edRdt TZeVUhZYRdc`\_Xa` JZZR ZV\_eZjERVT ^ ^ `\_ e` eYVeh` Xc`fadZ 7ZdeljE S`eYZ RZZRZdRVWf\_U^`deVWbfVej R``\_X aVa]VW^ eYVZeVc^ VUZeVR\_U^ VUZ ^ HYZY deReR hZY d'SdeR\_eZg VUFTREZ\_R TRaZERZDVI `\_UljEaVa]Vd'Sdt2SZ\_Xe` VZeYvc` VeYVeh` Z RZZRZdUZeb]Rj R YZY UVCW` Ve`]VR\_TVE T ^ SZ\_VU hZeY]`h ]VgVd` VWJVTe`dE] UZRVW1 eZ\_EYR``dR]Zh`%R\_U a`hVc]Vd1\_Vd1ZE YZUJjE S`eYZ RZZdRZdRCVacWVcCU Sj yZ\_eVXeVV‰ Z UZgZLFR]dTYRRTEVZXVUSj eYV`aV\_Vd1`VeYVZ Rezef UV e`hRddd TZGjZ2e eYZIa`Z\_eLeY`fXYE

> Złef dłuj TZZKY\_dRVI]`dkće eYVyZ\_eKARAU Z\_eć głódźi.\_ `eYkć h`duł.eYY aRceZIZARAY Z\_ d TZA]\_kh`chd.Sfe dłyVłóżgłyjŽi.\_ eYzł Xć fa Zł Wf\_U`\_TVRXRZ\_ eYVZ\_T\_Xf`fdT ^ SZ\_RZ\_ `WY V^ SłódYZa`WR^ VLZ ^ łYZXY deRef ^ R\_UeW dłyWZ RXV`WR]`dkŹH Y ja U[\_jbUfmicZh Y a ]g! hi głź `WłhYb łłyb Xghc VY a c głik [XYgdfYUX` @/.}}äጶ³ ;¶@@@@~O`¢Oĺ#O`qäŶ@@@O&qz²æŠgOx¶²äÅzĺýz²æ)′zĺŶÈ

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3 ÅÅ¶Ýæ¶² ännannann	aaaaa€aaaa	aaaaaa aaaaaa	aaaaa1∕paaaa		aanaaa1∕eaa
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@[æ	aaaai 1∕pþaaaa	iiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii	aaaa1∕pþaaaa	aaaal∕pþaaaa	₩₩₩ä <sup>1</sup> ∕pþä

>¶ï lýznählźhOlźqä<br/>[²äæzä] Oláát |%äæzä<br/>B1L; äl Oxt |²O<br/>%>ï lóz<br/>z<br/>at  $bb^{1/2}$ 

 $\label{eq:constraint} \begin{array}{l} Ua \ cb[\ \ 7\ \ ]YUbg`k \ cgY`gc W[c \ YWc \ bca \ ]W \\ \ Yj \ Y`g \ ][ \ Vi \ hk \ c \ Uhl \ Y`gUa \ Y`la \ YZY`` \\ h \ YmUfY``cgYfg' \ EYY \ WW] \ eYY \ YReV]`de`feZ \\ eh \ h \ hg \ dsj \ d\ TZR \ TYR \ XWLh \ YZYT \ WddeYV` \\ R_USj \ eYVVT \ `^ \ ZTd \ deV` \ Lh \ YZY \ R \ VdeYV` \\ WW] \ Z \ dVff \ dZ \end{array}$ 

EYVR'SZAFZA WAYZIX: fa ZIRICI CV-VTAUZ `eYVE WRAF CVŽ7ZcaLJENY VEVZIEVV\_VRAZOVRHADI ^ V\_eZcd^ V'SVcd^ R.V'WAYVTYR\_XVCZ ac XXADŽ EYVJ eV\_Ue' eYZ\_\eYRALSJ R\_U]RCXVLTYR\_XVYRCI SW\_UZEVTEZ\_JVADŽDVT\_UJEA `de^ Zahef davl) TZZZ RV\_dREVyf\_df CVTS` fe 4 YZJV&R\_UU'f Seh YVEYVE eYVJ REVARCE` VR\_j \_RZ\_RJZV\_EZ JŽEYVCJ^ S` ]CI R\_UCZX\_deYReT f]USZ\_UEYV^ e' eYVT f\_ecj YRgV SW\_TRJVUZ\_e' bf VAZZ\_LCI eYVVR' V'WWWEV\_TV WEUV^ `TRAZTA` JZZTCIYRCISV\_ f\_UKC^Z\_VLŽ

#### H≰9<sup>-</sup>-BGHFIA9BH5@7-+-N9B

EYVadvýZ f ddvTeZ\_dYRgVdr`h\_ eYReaVa]V d'SdTcZSZ\_Xe`Z`RXZ\_RZXdRdUZWWcV\_eRdeY`dV`W eYVyUV^`TcReZTTZEXKV%R\_UeYVyV Zdecf deW]TZEZ kV\_%deZ] d/ReVTVceRZ\_WRef ckdŽ2]`\_XELV eYvdvL Y`hVgVdLeYvEVReVR\_`eYvc`dh`Z`RXZ\_RCZdeYRe eV\_Ue`SVWf\_UR^`\_XeY`dvhY`ReVZ\_UZWWcV\_e e`a`]ZEZTR]a`dEZ\_dLR\_UVgV\_e`UV^`TcRtj ZedNVŽ/ @gvcYR]WVRJ]cvch`\_UV\_edReV`WeYvyZ\_decf^V\_ł eR%cvUvRIYVU%ej aVŽ

VUFTREZ\_R\_UR^V\_eR]Y CZk`\_eYReUVd\_`e VI eV\_USY`\_U eYVZ ^ VUZEVZEYYJ [fUXVeYRe eYZ\_XdRvV\_`eTYR\_XZ\_XR\_UeYJ WW]YV^ VUZ R\_Ua`hVc]VdbZAVcYRadVc eYZdCRd\_ eYY eV\_U e`hZeYURh Z\_e`eYVC acZgReVh`c]UR\_Ue`dr`h \_`Z\_eVcVdeZ\_afS]ZT RWKKCZZ ]RcXVac`a`ceZ\_ `VeYV^RcVh`^V\_R\_UVgR\_XV[ZR]CZ5 VdaZeVeYV dZ ZRZZZdR``\_XeYV`LeYVCVIZZKV\_dRcVxc`faVU Rc`f\_Ueh`T]]VI6ZgVZ RXZ\_RZCZHYJ RCVeYVcV eh`cVacVdV\_eReZ\_dLhYV\_S`eYXc`fadRcVZ\_UZV WEV\_ee`a`]ZZ7D0

:\_ eYVZ`RXZ\_Rg``WeYVZ\_ded^V\_eR] TZEZKV\_ 1#) ″/Łeh` V/V V ed RcV `SdvcgVUŁ RaRce W/^  $\underline{Z}$   $\underline{U}$   $\underline{Z}$   $\underline{U}$   $\underline{W}$   $\underline{V}$  a`]ZEZIR] daYVEVe`]`TR] R\_UZ\_decf^V\_eR] aRceZIZI aReZ\_ŁR\_UeYVZIV\_eZ/TReZ\_`WUV``TcRTj hZeY ac TVUF cVdR ULe R]VdN cVf eV eLh Zey Rof a Vc^ Rd \VěŽHZEY dVARdU e`eYV} cde`VeYVdVLZe YRdSW\_ dW\_eYReWc^`de^V^SVcd`WeYZtXc`faŁaVa]V  $W^{\wedge} eYV$  hVc decRef ^ LeYV TR T ^ ^ f\_Z; Zd eYVMR V WWW.TVŽ2\_UVgV\_eY dVhY acWW. e`aRceZIZaReVyRa`]ZeZIR]]j%Z\_eYVZc]`TR]T^}  $^{f}$  Zej  $^{R}$  hV] gRf Va` ZZdW/ eVa` Ze` W gZkh `VZedW\_TeZ\_R]f eZZejŽ3j T\_ecRetLeYVeYZU T^a`\_V\_e`WeYVZ'RXZ\_Rcj ZddecZZ\_X+eYVZ'RXV `WUV^`TORTIŽEYVZ decf^VeRITZEZKV eV Ude` ZUV\_eZyVUV^ `TCRIj hZeYyRW eSR]] ^ ReTY hYVCV eYVcf VdRveYvcR^ VVcvgvcj S`U %Z

Eh` eYZ\_XdT f]USVReh`c\ YV&Z7ZcdejjŁĨ]b! ghi a YbhU`WhnYbglžYj Ybh\ci [\h\YmUfY] [YbYfU``m'Zca 'U'`ck Yf'ghfUhia 'h\Ub'h\Y' ch Yf [ fci dgžgYY h Ya gY j Yg Ug [ U]bYfg"  $F_{ZVY} Z e f dev f TZZKV_d h Y d X U _R_TZR$ a`dEZ\_ZdRe`UUdhZeYeYVZcZ`RXV`VeYV^dygvd Rd]`dvaLeYV^V^SVad`WeYZdXc`faLVgV\_eY`fXY a``dLeV\_Ue`WW]^`cV]ZVydy]WRIcZ;TZ\_XXRZ\_ł Vcd/ZEYY RcVaVa]VW/ a``c\_VZXYS`fcY``Ud hY YRgVSW\_RSJVe XVe \_ R\_U^ R\VRa]RIVVc eYV d/gvdŽ2]`\_XhZey eYZld/WavcTvaeZ\_ŁeVy WW] T\_} UV\_TVZ\_ eYVVT\_`^ ZT dj d $eV^ R_UYReV$ RI6ZeV de ReVXI dWc`aV REZ\_XZ\_ZZT`ceYV`ŁeYV VIZEV\_TV Wef VerReReverver VVerVer VVevevej S`U % U`Vd\_`e^VR\_eYVZ\_deZefeZ\_RZAReZ\_`WY`\_~ZTeeŽ CReYV&LZecVacVdV\_edRXfRcR\_eWeYRea``caVa]V hZj SVRSjVe`\Wa eYVXRZ\_deYVj YRgV^ RUVŽ

EYVOUT \_UeYZ\_XZOUYVEV\_UV\_Tj e hRoudyRd ł TZR] acZgREZC % CYRE TYRCRIEWZAWO Z\_obcf ^ V\_eR] TZZW\_CZ 4 `\_OZOV ej hZEY eYVZ: acWWCV\_TV Wc hZEYUCHAZ\_XZ\_e RacZgREVh `cJULEYVJ eV\_Ue SV T\_okgREZgVR\_UZ\_e ]VcR\_e `Wt TZR] UZgVoZej Z:eZd RobVTZCH `WacZgREZC eYREODT \_ a VEZZ\_ R\_U T\_~ZTehZEY `eYVCZE YZISVZ\_XeYVIROMEYVacWWO V\_TVWc yUV `TCRIJ Rolac TVUT cW6T f ]U VI acVcH RUVCZEVe `y\_Vf ecR]ZzW6a `]ZZTCZ:ea `Z\_ecle` Rej aV `WUV `TCRIJ Z\_ hYZIY eYVCVZd\_`\_WU e` SR\_U e`XVEYVcR\_UER\_VCZUVZ

#### $H_{2}^{+}9.89H_{2}^{-}7 < 98.7 = H_{2}^{-}9B$

EYVZ RZ\_Rj `WYVyUNRIYU TZZKY%T ^ ł SZ\_VARUZRWWANUGZA `WY` ZZTALZY OVZUROTRE UV` TARIJ ZIVZZZER\_UŁRARONU \_` OUŁZ\_UZWA V\_TVO UV` TARIJ RAROJ OV Ž2]OY f XY OVOVRV OZ ZRZZZALAZY OVZ RZ\_RJ `WYV^ ZDEF ODAJ TZZKYŁRUZWWEV\_TVIR\_RJA SVAVETVZGVIZH YZAE \_VZYVE XC fa ZIZ\_d ^ AROY hZY OVZUNRA `W UV` TARIJ ` c aRoj RM/ZGZ\_ŁUNORIYU TZZKY\_d XV\_VRJJ YRZVOV^ ` CV\_VRZZVZ RX40YY VI AVIE \_` OYZ XW'^ VZYVE UV` TARIJ ` c a` JZZTOŽE YY U \_` OVOV RYRZ\_XR\_Z ODF^ V\_OR foZZJZ

EYV^ V^ SVcd` VeYZClXc`fa1#(″/fd`R]]j YRgV  $\mathbb{R}^{1}$  VLZ[ $^{1}$ ] h d TZ  $\frac{1}{T}$  ZT  $\frac{1}{2}$  ZY  $\frac{1}{2}$  RV eYfdd^ VhYReSVeeVc`WWeYR\_aVa]VZ\_eYV`eYVc XcfaŁR\_URJdeV\_UeiSVjif\_XkZ3VIRfdvR]RcXV ac`a`ceZ\_`WeYV^ ReVRXVUSVehW\_") R\_U\$%L eYYj ReV^`eVe`]VeR\_e`\_ eYVhY`]VR\_USVeeVc VofZaaVUe`aRceZZZReVZ eVVac`TVdd`WIYR XŽ 2eeWdR VeZ VLeY f XYLeYZdX fa YRdYRUR  $V^{SZeVZ}XV_aVZ_TV^W_1]fdZ_Z6T_^{2}ZR]jL$ Zed ^ V^ SVcdReV\_`eyeMVVRTcZ;TZ\_XXRZ\_Vcd%Sfe TIVRC) dvcdŽD TZRIJI Lei Leyvi WM VITIFUVUŽE YV ^ `de ac` ^  $Z_V_e$  WRef d'd` WeYV Xc`f a YZXY/ZXYe eYVZcdeReV WVAd [ReZ\_ŽEh` eYZLd` VZed^ V SVad SV[ZkgVeYReeYV] YRgV\_`eSV\_V} eVUReR] W/^ eYV TYR\_XXd` V&VTV\_ej VRcd:R\_UeYVj RcVdZf ReVUReeYV faaVcV\_U`WeYVa`hVcjVdd\_VdddTRjVŽ7fceYVc^`cVL VZXYeZ\_"! yUVRIYUTZZKV\_d%JZa]Rj RYZXYUVXW `VR^^`dR]Z1^\_R\_U^Zhecf dee`hRdUd`eYVcdŽ

:\_ eYVdV aV a]Vd h`c]U eYVdV Zd\_` a]RIV Wc

a`]ZZIL`c Wc 4YZIZ>`de`WeYV ReVaVa]VhY`ReVyR\_Xg RS`fe 4YZIV‰c yf\_d dVRS`fe 4YZIV‰aadWkcZ\_XLZ\_ eYV]Reek: TRALe`d daV\_U eYVZ:V`eZ\_R]RJNJZEZ\_Ž2\_USVIRFdVeYV\_REZ\_ ZL\_`eRa`Z\_e`WeWKV\_TVWceYV LeYVdVTZEXV\_d R]d ]RI\eYVWR^Vh`c\eYRefd'R]j XZGVd^VR\_ZX e`UV`TRIJŽ

6F=9: °C J 9FJ =9K

CVgZhZ\_XeVVUZWWCV\_egZhdYVJURS`feeVV VT\_`^ZTdjdeV ŁdTZKSZZEj R\_Ua`]ZEZTdLd^V dX\_Z;TR\_eeV\_UV\_TZdTR\_SVZLV\_e2;VUŽ

7ZddjLeYVUZWWCV\_e`cZ\_dRZ\_dZV\_eZ\_VUZ\_ VRIY RVR eV\_Ue`Xc`fa eVV dvjgVdRc`f\_UR\_ RZŽ:\_cVjRZ\_e`eYVVT\_`^ZTd\_deV LeYVVZi RdeZZ\_Xjj TjVRcUZdZ\_TZ\_SVchW\_eY`dVhY` WWjeYy RVXZ\_VdR\_UeY`dvhY`dWeVV dvjgVd Rdj`dvdZEYV]ReVcEYRJWVRJ]cVch`\_UV\_edEeV\_U e``aVcReVSj R\_VT\_`^ZTTfjefcVeYReacVgV\_ed eYV`WV dVZ\_XeVV dvjgVdRdRTe`cdTRaRSJV`W TcVRZ\_XR\_UV\_[`jZ\_XRhZV cR\_XV`Va`dZSJV `aa`cef\_ZZVZJ6ed ^VUZdZ\_TZ\_dRVTR]VU WZDW\_WV^TJ`dVe`LS`eY XRZ\_VdR\_U]`dvcd T ^acZEVdzVZTXc`fadŽ

? VI eL VI R^ Z ReZ\_ `VVI TZKSZZEj a ReeVc\_d cM gVR]dR\_ RIZUZEZZ X cVah \_UV\_edSVeh W\_ eY dV `cZV\_eVU Sj R\_ Z RXZ\_Rcj `VVI TZAG R\_U eY dV `cZV\_eVU Sj R\_ Z RXZ\_Rcj `VVI TZAG R\_U eY dV `cZV\_eVU Sj R\_ Z RXZ\_Rcj TV\_ecZ\_X`\_ eYVacZeReV h`c]U R\_U eYV VR^ ZjZD ^ VUZEZ TEZ\_d\_WU e` SVUCRh\_ YVEVE` ŽH YV\_ T\_cZLVCRZ\_ ZLXGV\_ e` Y`h`aV\_ aV a]VRVZ\_eYVZccV[ReZ\_dZadhZeY `eYVcLeYVXc`f adeYRe V VCXVT ^ SZ\_VR gRcZkgj `WYRRTEXCZEZCZA`]ZZIR]Z RZZ RZCL[RebjLdW e` SV cdcf Tef cVU Sj eYVUXcW`VVF aa`ce Wc`c Z\_UZWKCV\_TVe`UV^`TCRIjŽ

:\_VRIYdaYV&VLXV\_VGR]jjdaVR\Z\_XLeYV&VdW^e` SVeh`Xc`fad`VZ\_UZgZLfR]dhY`eR\VeYVViZdzZX @/.lä%Apä %򦕁ÝäG66¶ïÚ0}@äa∯äcë-O°äqzõz¶Å-z²a6jÅzÚgz²a6jzÝÈ

fi¶²Šqz²æB°qaŹ⊈¢ÁQEĺŠg∉" ä" O⊄zĺÝa <del>uuuuuuuuuuuuuuuuuuuuuuuuuuuuuuuuuuuu</del>
<sup>'2</sup> æ" Í Óæqiz ÷Æ őz Í ÁB giz Æ Í őz Í ÁÉ annunnunnunnunnunnunnunnunnunnun « <sup>3</sup>
$Lz-\Pg$ Í Dægi D'qä- Ý H Ý H Gecz² Ý annun munnun munnun munnun munnun ' <

>¶ï ÚgznäÁlźÅOÚźqä¶°äæezä) OÝÓá¶%äæezäB1Ł; äl Oz€¶°O®a>ï Údzonai þþ½ða

@/. 1 ä&&2 %Újî ÅÝä ²%6ðjĩ ÚO @ä&jäcë – O°äqzőz@Å- z²aĕÇÅzÚgz²æ9 zÝÈ

3 ÅÅ¶Úæ² Ýæjä¶ÝzÚÝä <del>nnun nunnun nunnun nunnunnun nunnunnunnu</del>
ÝĮgO¢Åĺ¢O•Ýǽ <del>annannannannannannannannannannannannann</del>
Łzægoząägæz²Ýä <del>nnunnunnunnunnunnunnunnunnunnunnunnunnu</del>

>¶ï LýzräÅlźÅO. Źqä<br/>[²äæzä] O. Ý<br/>Ýä !%äæzä<br/>B1L; älO.<br/>4<br/>?O<br/>&<br/>ï L<br/>ýzøni þþ<br/>½ $\hat{\mathbb{E}}$ 

`dUć Wć XAR\_eVUŽ@\_VXć fa U Vdd SVIRfd/Zed ^ V`SVcdeV\_U e`dW eYZd`dUć RdeYV]VXEZ ReV `\_VLR\_U e` ^ R.VZeeVZc`h\_, eYV eYVćSVIRfd/Zed ^ V`SVcdWWJS`eYV TJfUVUR\_Ua`hVcJVcde`RjeVć ZEYVVVć^VcRdb/ceeYV dvJgvdRdRTe`cdcVRUj e` TRaZEJZAV\_\_eYV`aeZ\_dRZZZ\_X`fe`WeYVT f\_eg`d UVgY`a^V\_eL.hYZV eYV]ReeVcWJ eYY\_YRgV\_` d`TZEJ cvd fcTVdh YReVgVc R\_UREVeYfd`SJZXU e` XVeSj`\_eVV2c`h\_Z\_JZWŽ

3VehW\_eYVdV/eCV\_VT\_}XfcReZ\_deYVC/RV `eYVc^`CVR^SZGRV\_eZ\_RXdET^SZ\_XUZWWC V\_eVJV\_V\_eCŽ

DVT\_UJjŁRd\_`aeZT Raac`RIY ckývRjd R XcWe UZgvczEj`WgZhcZSfeZde/ZdUZgvczEj\_`eRVARM ^V\_eAU`\_VR^f]eZaJZZEj`WaTZRJZ RXcdR\_U`cZ V\_eReZ\_de/RedW`e`YRgV\_`T\_\_VIEZ\_R``\_X eYV`dv/gvcDEYVIF]efcRJXRa SVehW\_XZZ vcdR\_U ]`dvcd\_SVehW\_eY`dVhY`RcVcTZRJJjZ\_eXAReAU R\_UeY`dvhY`hZeYURh Z\_e`eYVh`dU`V&YVR^† ZJHR\_USVehW\_UV`TREZTZZEZV\_dR\_UUZHXMMEAU TZZEZV\_dTTfJURIEFRJJjSVe``XcVReVceYvCVe`SV R\_jT^^f\_ZREZ\_SVehW\_eYVT\_decTEZ\_`W

Î 5 'fYbYk YX 'UddfYWUhcb'cZdc'hWgzU'fYbYk YX 'Y[]ha UWnż g bXgdYbgUV'Y 'Zh\Y'Wci bhfmig'nc 'VY' a cfY'h\Ub'U'[ `cf]ÚYX'U[ [ `ca YfUhcb'cZ]bX]j [Xi U'g' UbX'YbhYbW\YX']bhYfYgh [ fci dg'k ]Y'X]b[ `dck Yfz k ]h bc dUghh Uhh YmWUb fYWc [ b]nY h Ya gY j Yg]b UbX h i gk ]h bc Z h fY UgU Wc a a i b]mjb U [ cVU ! ]nYX k c fX'Ï

A Ubi Y``5 bhc b]c ; UffYhfbž&\$\$&"

eYVyH WŽa eZleYVZ' RW' WHVyH WaYReeAjjdeYV Z UZgZLFRJ 4 YZJNR\_h YReZd4 YZJNR\_R\_Uh YReZd\_`dL h YReZa' VR\_de`SV4 YZJNR\_R\_Uh YReZda'f JUSV JZ VŽE YZJU Vd\_`e^ VR\_ŁY h VgVdR\_REZ\_RJ ZJV\_ł eZj eYReZddeZ\_de`\_VŽ?`cU VdZeZ alj RcVefc\_ e`eYVZ RZ\_Rj`WdVceYRehRd]`\_XeYVXF RR\_ł e`c`Wy\_RZ\_RJ f\_Zj %ZE YV UZgVdZj`W4 YZJNR\_ d TZdj e`UJ ZIRXZZ eYRe\_WUde`SVUWLUVŽ H YfY WUb dYfZ/Wimk Y``VY U'a i`hd`JWJmi cZÎ K YŘJ z cZh'b We bhfUfmihc`cbY Ubch Yfz' dfcj JXYX h YfY UfY W UbbY`gc ZWca a i b]! WUhcb UbX'hUbg'Uhcb Ua cb[ h\Y X]ZZffYbh [ fci d]b[ g' EYVac`S]V^ JZd\_`eZ\_gRZZj Sfe Z eYVRSZZj e`T&ReVUZj`Xf VR\_URdaZze`VXgV R\_UdRVR``\_XeVUZWKV\_eyH VCZ EYZUJj Łetv UZ kodzj `Wfej``\d\_WU le'SV T\_dZ V ku Va'^ eYVa`Z e`VgZh`VetvZt T^ł aRezS Zzj hZ eY ff^R\_U kyj`a^V eZ\_4 YZ v Z Eh` eV\_UV\_TZ dIR\_SV UZ EZ XfZ hVU Ž 7Z delj ESV hW\_R eYZUR\_UYR WWYVCR`a]VeV\_U de'Xc'fa Rc'f\_U d TZ kack dy\_eR Z\_deYR Eh Z eY TV et Z\_ck kygR eZ\_d R kv Wg'f dS]Ve`Yf^R\_U kyj`a^V e Z E YV d TZ ky R Z dIR RS JV W`eZ R Z KI E Z kU kyj Z R Z R Z dIR RS JV W`eZ R Z KI E Z kU kyj Z R Z R Z dIR R S JV W`eZ R Z KI E Z kU kyj `\_U j Eh Y YI d Y f]Y bW c Z U'a c g hh fYY ] b H b' fYgd c b XY b g' VZ L'A c g hh fYY ] b H b' fYgd c b XY b g' VZ h Ya '' E Y kV a JV e'\_U e' a k I VZ ky e YV T\_`^Z E d TZ R L a`Z Z d dev^ W/^R\_R R TZ de La`Z e Z

# $7 < 5 \text{ DHPF}^{\cdot}$

# =A 5; 9G<sup>·</sup>C: <sup>−</sup>H<sup>\*</sup>9<sup>·</sup>7 C I BHFM<sup>·</sup>5<sup>·</sup>: F5; A 9BH98<sup>·</sup>8=J 9FG+M



EYVW]]`hZXTYRaeVchZ] ac`TWUe`ZeVXReV eYVZ`RXZRZdZV\_eZWZ eYVeYcWRARR\_R ]j dVŽEYZdVVCIZVhZ] YVJa cVgVI] hYReZ RXV 4 YZVR\_dYRgV`VeYVZcTf\_ejŽ

5` 4 YZJVR\_d dYRCV R ^` cV` c ]VdH T ^ ^`\_ Z RXV` V&YZc T f\_egi O@dLe` af e Ze ^` cVTRf ł eZ f dj +h YReZ RXdRcVeYVV` V& YZJVE YVVRcjj TYRaekdda` h WLeYRe ^ R\_j 4 YZJVR\_dh V&Vf\_RSJV e` Vc^ ^` cVeYR\_ R VKZcjj gRVf VZJVR` Vh YRe Ze ^ VR\_ee` SV4 YZJVR\_Ž9 V&Le` X&JVR\_` gVgZh ` W eYVUZWWC/ eZ` RXdLeYVgi a` ]` XXdac` Uf TWhZJ SV Xc` f a W Z\_cMReZ\_ e` Wf c Rta VRed+7 \ ]`YUb` [XYbHmžgc WUV]`]mžh Y YVc'bc a [WgngHYa ` UbX`dc`]hJVg" EYVdVej a` ]` XXdWc^ VURdvT\_U ]V&JZ\_cMReZ\_e` eYVf\_UVdj Z\_XgRzBSJVŽ@\_eYV SRZEL`WAYVAJARGEZIJ (ej a`]`XZAERET^^ Rij TYRCe`W eYVEYZUJV(gy]hZj]\_`h SVacVAV\_eVUŽEYZL(g a`]`Xj Z\_T]fUVA`\_]j eY`dvRchVTedZ\_T]fUVUZ\_eYVATcgYJL `WT fcdVZ:eSj \_` ^ VR\_dXZgVdRT ^ a]vEvaZTefcV `VEYVZ`RXXA`VAYZVEYREVIZEZ\_eYVT f\_ecjŽ ?`\_VEYVJVdLZeZIR\_ReeV`aee`eRvVR\_V`aZZTR ]``\ RecVacVAV\_eREZ\_d`VEYZI\ZUŽ

EYV^ RZ } \_UZ X`WAYVV VCZAVZIY`h UgVdV Z`RZ RZdRVŽEYVTYRedY`hdeYReeYVUZWWAV\_e Xc`fadZ e`hYZIY Z\_UZGZIFRJdUZGZWUZ\_dV[RZ\_ e`aRceZIF]RcaRceZIRAVRed.dTYRd4YZVR\_ZV\_ł e&jŁd TZAjŁeYVVT\_`^j R\_Ua`]ZEZIŁCVAc`fa Z\_ R T\_dZeV\_e hRJŽEYV d\_`aeZTTYRceVeRS]ZMVd eYReeYV&VRV}gVXc`fad`VZ\_UZGZIFRJdLVRIY hZeY RUZCEZ\_TEG2Vac`}]VR\_URaRceZIF[RcZ`RXZ\_Rj`W eYVT f\_egiŽE YZdCVF jecV-VTed\_`e[fdeRdeRezdeZTR] `aVReZ\_ SfeeYV WRIeeYRecVda`\_UV\_edcVR]jj U dYRCVaRceZTf jRc`fej``\dŽ6RTYXc`fahRdRdzX\_VU RjRSVjYZXY/ZXYeZ\_Xd^ VTYRCRTeV/ZdeZTeYReUZdeZ\_ł XFZHVUZEWI^ eYVOOREZ\_ VRIYTRALe`LeYVOVZI R\_Z\_UZREZ\_`WAYZIYyoVTE`OR%ZFRZZOLEYY YRgV^`oERAV\_ZAJ hZEYZ

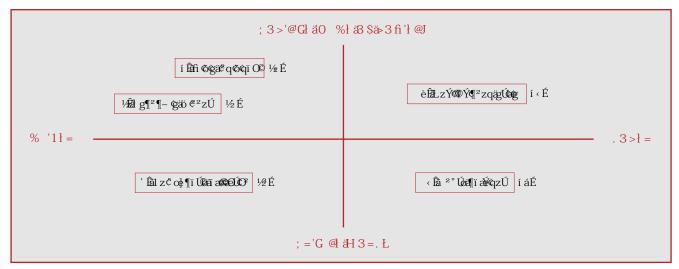
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HYV\_ cWWkV\_TVZl^ RUV e` R\_ Z' RXV` WeYV Tf\_eqiLeYZdZd\_`ee`Z`a]j eYReeYVCVZd[fde`\_V dZ\_XIVZ RXZ\_RqjŽ4YZIVR\_d`SgZfdj YRgVUZWWCV\_e Z'RXVd`WeYVZcTf\_eqŽ2VeVcR]LaVa]VdURZj ViaV2Z/TVdRcVUZXXXCV\_eLeYV2c\\_`h|VUXV`V4Y2V R\_UZedYZe j gRcZkłeYV YRgVR] d ced WWZZkł RS`feeYVdZfReZ\_`WeYVTf\_eqiLR\_UeYVZcgRfVd  $R_U V_i a V = \frac{1}{2} d U Z W Z H Z Y e Y Z A Z e C V V V V V$ ^ V\_eeLeYV T\_decf Te R] d ced`WVacVdV\_eReZ\_d `WeYVolTZKejeYyj]ZeVZ\_ŽEYZolUZeVodZej^RjSV T VTeVUfaZdTYRhR, eYReT^^f ZTReZ  $\mathbb{R}^{2} = XeYVUZWWCV_ed^{2}ZR_{2}Xc^{2}fadZd^{2}c^{2}c^{2}Wdd$ ~fZLŽW`ethYReViZedZlRdvX^VevUUZevcdZiZ hYZYYRIYX° fadW^de`SVdveRaRceSjeYVhR ZegZhdeYVh`clUŽEYVUZbZTeZ\_ZdZ'a`ceReZWZe ZIRITVaeVUeYRed ^ VZ RXV VeYVyH V%ZicVbf ZVU WceYVeVe`SVcVJReZ\_d`WebfdeR\_UT`aVeReZ\_  $\mathbb{R}^{\times} X4 YZWR_d \check{Z}E YVeYVd \check{Z} WeYVCVa cet Z_WATEL$ ZdeYReeYVTYR]]V\_XV`V&YV3ZIV\_eV\_Rcj Zde`f\_UVd eR\VR ReZ ISf ZUZ Xac` [VTeLR UeYZIhZ] Zg` ]gV

JZ\_\ZXfaR\_UT\_\_VI&ZXeVVUZWWCV\_eyHVC/ eYReT VIZeZ\_4YZ/Ž?`hŁeYVO/RCTYV/ca`ddZSJV SoZLX/dR``\_XXc`fad</gVRJdeh`W\_UR`V\_eR]UZ gZ/VELR\_UZeYRde`SVRA\VUhYV&Y/ceY/dV^ZX/e \_`eSVRdZ4\_`VWXX^V\_eVUUZg/dZgZ

H, Y g fj YmfYj YU'g Ub' [b]HU' X]gHbWhcb' VYłk YYb' [bX]j [Xi U`g k \c '\Uj Y'U' gc W]U'' fYdfYgYbHJhcb'c Zh Y' Wci bHm UbX'h cgY' k \c 'Xc 'bch' EYVWc' Vc ^ R.Vfa &% ` VCM da`\_UV\_edR\_UeYV]ReeVc'% ~ ŽEYf daV a]VhY' YRgVd ^ V\_RZ\_R] ZMRdZXYejj `fe\_f ^ SVceY dV hY' U \_`eŽ2 ]``\ Re} McV& Z\_UZReVdh YZY ej aVdW[] Z e' eYVdVch` TR' adŽ8 c' fad" L# R\_U\$ R] YRgVZ RXd' WI TZGHRSVZe' aa`dZ X`\_VŽ3j T\_eRRH2Xc' fad%R\_U&U`\_`eYRgVRcVácVdV\_eR eZ\_` WI TZGŽEYVZc h` dU ZIeYV cVdæZRVU`\_V 'VeYVW? ZjŽH YReU VdZe^ VR\_WceYVZ' RXV`W eYVT f\_egi hYV\_d ^ R\_j aV a]VRaaVRce' YRgV





2df^ZXeYRee`T\_defTeeYZdZeZd\_VTVdRg e` <u>|Z</u>\faeYVL**ZWW**EV\_eT ||**VTe**ZEVZ` **R**×Z\_**R**=ZELeYV ac`S[V^h`f]URaaVRce`]ZVZeYVXRaSVehW eYVXc`fadeYReYRgVd^VZ`RXZ\_Rg``WdTZXg`R\_U eY`dV€eYVy\_VZXYS`fc]j feZZERCZR\_%R\_UeYVyR\_ł Xq`fedZVC%GeYReYRgVhZeYURh\_Ze`RacZeReV  $h^dUZ@_VhR_VXVh_eYZ_1Z_1]ReZ_$ h`f]USVZWeYVeV`Xc`fadhVeVRS]Ve`TeVReV WceYV dygvdRcvacvdV\_eReZ\_ `WeYVSc`RU/cd ł TZKejeYY JZEVZ\_ŽE`U eYZLeYY h`f JUYReVe` RTef Riji ViaVZV\_TVhYRed TZKg ^ VR\_dŽEYVZca``c d TZ IVT\_`^ ZT def ReZ\_ZIR\_`SdeRI]VLY`h VeVeL e Xourelo Zelvarez Ze evo d TZR WAScZIŽ3j  $R_U$  RCX/LeY/CVZIR\_Z gVcdVcV/ReZ\_dYZa SVeh W\_  $VT_^ AZT_UZZ_dR_UeYVa dVdZ_ WaTZR$ TRaZRJŽE YVa``dvcaV a]VRvLeYVWh vceZdeYV eV Ue`YRgVhZeYd TZkjŽEYZdhZeYUcRhR dW^d e`SVcVgVcdZjVLY`hVgVLRejVRdeZ\_eYVTRdV`VeYV y\_VZXYS`fdjfeZZERCZR\_%Z2deYVZ\_Wc^ReZ\_XEV\_ Z\_VRC/Z/CTYRaeVcddY hdzy\_VZXYS`fdjfeZZRCZR\_d% eV\_U e`SVZ\_g`]gVUZ\_eYVZc]`TR]T^^f\_ZejŽ 6gV\_ZWYZIaRozZZRZ\_ZIfeZZRZ\_ŁeVVVZI d^VdTZRJS`\_UZ\_g`]gVLŽ:eZdeYfdR^ReeVc`W deV XeV Z XeYZI TR Z eVXReZ R USV XZXd eYReeYV(XRUFR)); XRZ\_RSc`RUVcV(aVcZV\_TV`W d TZKġŽEYZlobeReVX, TfUSVeZUZ hZeY^VRcfcVd cMReZ\_Xe`eYVdvT\_URiZEŽ

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gc WYmiUbX gYY h Ya gY j Yg Ug Î [ U]bYfg UbX h c gY k \c hYbX h XYÚbY h Ya gY j Yg Ug î c gYfg "8 c f ad" Ł#R\_U%IJf devcRc f\_UeVV yMZ\_Vcd%/U`WeYVR ZLh YZVXc f ad S R\_U&W] R]`\_XeYVy]`dcd%/UŽEYVdC a]VU&ZUVdf a Z ^ f TY eYVdC Vh B Rdh ZY eYV} cde R ZLSf eh ZY eYV`aa`d&VV aYRXEZH YZV%) ~ `WeVa`\_UV\_ed RVI]`dce`RyXZ\_Vcd& RZ\_Rj L&# YRgV^`cV Z\_T^^`\_ hZY eYVZ RXV`WeYVy]`dc%Z

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>¶ï LýzräÅlźÅOLźqä¶²äcezä] OYÓ?á¶%äcezäB1Ł; äl Ozo¶²Oã>ï Lózorai þþ½Ê

eYVyVT\_`^ZThZ\_V&ZEYV&VU VddW^ e`SVR SRUZLeYV&W&VLWcUVgY`aZ\_XT`^^f\_ZReZ\_ R``\_XeVV&VeYVXCfadŽ

EYVONT\_US]`T\Z eYVePS[VolY holeYVLZbez8f] eZ\_`WeYV}gVZ`RXZRZZdZ\_cV[ReZ\_e`aRceZff]Rc WWJZ\_XdŽAV a]VdZ RXV^ WAV^ dygvdRdXRZ\_Vd c ]`dvcddW^ de` SVRd1 TZReVUhZeY eYVWWZ\_XdeYRe  $4 Y_{Z}V_{R}U_{Z}d_{V}T_{^{T}} T_{d}d_{V} Z_{d}Z_{V}Z_{e}V_{Z}$ :eZlderZZ\_XeYRe eYVXc`fadRc`f\_UeYVy]`dvt‰ V\_U`WeYVR Zl€eYVyUZZ]f dZ\_VUTcZeZI%R\_UeYV yR Xcj `fectUNC%G RCV WRC ^ `cV |Z.V/j e` UZda|Rj \_VXRezeVV``eZ\_dŽEY`dVhY`eV\_U`e`WW]eYRe eYVj RcVXRZ\_VcdLSj T\_ecRddLdV h R YZXYVc [VgV] `WT\_}UV\_TVŽ@\_TV RXRZŁeYV Xc`fa |RSV||VU yUZEZ] foz\_VUTczezto%deRUd`fež2]eY`fXYeYVdV Z\_UZezZ\_f\_R]deV\_Uei\_SVj`\_Xei\_eYV^VUZe^}YZXY  $deRef^{t}$  LeYV YRVeYVYZXYVde VYZXYVde VZZZ f  $dZ_{t}$ ^V\_eLT\_WWZ\_R\_UZ\_dWTfcZejŽEYZdcV^Z\_Udfd RXRZ\_eYRe aV a Vd d TZ IVT\_`^ ZT decRef ^ YRd `\_]j ]Z ZAVUZ a]ZIRZ\_dWceYVZcZ RXZ\_RZAd`W eYVT f eq ŽE YVVU ZZZI f dZ VUTCZZZI% R U eVVVR ł  $R_UeYVVT_^ ^ T deV EReY f XYeYV coeZh CV$ ZVj e SV \_ Xe eYV^ VZ ^ YZY decRef ^ R U eYVdVT Ue`eYVl`hVcdedRef^Ž

7c`^ eYVhRj eYVLZWWZ/eZ RXdUZGZVfaZ\_ cMRzZ\_e` eYVWfcRdaVRdT\_dZXdVI4YZ/R\_ ZV\_eGjŁdTZGjŁeVVT\_`^j R\_Ua`]ZZdŁeh`

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<sup>1</sup> /Âd g¶²¶− göö ℰ²zÚ ½É ; Újï qa¶%ã cœ '²æ" Юæqæ:±∰özlåe fi¶²‰z²ãðz%Aglŵge″ ä O∉zÚ Łz−¶glûæjaçœiz²	í Îsh ©ga² q ©qi O© ½ É ; Úĩ qảĩ%h con '²æ" ứơ qặĩ%h con '²æ" ứơ chiế đế đế cá tác fì ¶²%g2° đế 2Ú Łz− ¶gữ độ các²			
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>¶ï Úgzn**ä**, ÚzÅOÚzqä¶°äæezä), OÝÝä¶%äæezäB1L; äl Oæ¶°O®a>ï Údzonaĭ þþ½Ê



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HYj ZdeYV3ZIV eV Rj RaReeZIF [Rc]j d ZePS [V eZ Ve`UVSReVeYVT ]]VIeZeV ZW`W4 YZVR dD:eZd `WI`fcdVRd\_^S`]ZTUReVeYReT^^V`dReVdeYV Eh`Yf\_UXUjVRcdRXLeYVTf\_eqjYRU\_`eSVI Xf\_eYVeRd\`Wa']RIZ\_XR\_Z\_UZeZLfRjLZ\_UVaV\_UV\_e deR^a`\_Zed]ZWRdRdTZkġŽEYZd`fel`WeYVIhRj TcVc`WeYVT\_eZVehRdaRce`WR\_V`aZVŽ  $EYVWc^{h}d^{WT}^{h} f_{Zj} ]ZWR_U eYV_{c}^{h}d^{W}$ d TZR Z\_eVET f cdV eYVEV h VEV ]ReXVjj SVj`\_U eYV T\_ec`]`WzedZYRSZER edŽEYVT]`\_ZEJaVcZU]WeV Zed^ Rc\LSf e Zeh RdRe: \_ UVaV\_UV\_TVeYRe4 YZVR\_d dvé`fee`UVTZUVLVVceYV^d/gVdR\_UReeYVZc`h\_  $Z\lambda hYRe ZU WT f_eq eYV hRe V2 V XZ2e$ eYReeZ VLhZYUZXWZZXUVXCWd`VRhRcV\_VdLeYVj UVIZINU e T\_ded Te eYVZc ZIV\_eZej  $R_UUV_J$ \_VR yHWZ67c`^ eYV\_`\_ eYV4YZWR\_ \_ReZ\_ hRde`  $SVRh`c\ Z$  ac`XVdLVgVdTYR\_XZ\_XLTYR]]V\_XVU Sj Viekć\_RJ R\_UZ\_ekć\_RJ WćTVŁSj ZNReŁgRJf Vd  $R\_UZ'$ RXVd $T\_def$ TeVU $\underline{Z}\_T^{\ \wedge\ \uparrow}\_\ \uparrow c$ RU aeVU W/^ `fedZUVŽEYV\_ReZ\_TR^Ve`SVeYV[ZW/de`qi eYReR]] 4 YZWR\_d^ RUVeYVZc`h\_ŽedRIYZgV^ V\_ed R\_UdveSRT\dhVeVeYV^feT ^ V^WeYVZe`h\_WWW.ced  $R_UT_{Zed}$  Zed VJRee Adde AZe WR\_TVLLZWWCV\_TVd`cR\_ZRSZZEje RXCWŽEYV We^ Veh VeverV` WateZ X` WievRezezej LevrevU WV Wee<u>R</u>UdRidZTVŽ

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 $\begin{array}{l} H YV_eYJ ]`` SRI\`_eVeh` Yf_UVUj VRd\\ dZ_TV:_UVAV_UV_TVLeYV_Lh YRe 4 YZVR_d ReV\\ T_WO_eVU hZY ZI eYV^ dMgVZEYVZ VKef cV hZJ\\ UVAV_U`_Y h eYJ aVCIVZgVeYVZ RXVeYV^ Zc`c\\ cV-VIedSRI\ ReeYV^ LR_U`_Y h eYJ cV_Vh eYV\\ TYR]V_XV` VSVZ_XeVV^ dMgVZ3f e h YReU eYJ\\ aVCIVZgVO> R[`c RIYZGV' V_edLSf e R]d R`SZGR\\ [V_TVLUZgVdZj R_UVKXX' V_edeZ_Ž\\ \end{array}$ 

4 YZVYRITYR\_XUŽE YVJVRIZA V V ALARHEL d^V `VRYV`gZRJE`eVdd\_`]`\_Xić d ERV\_`h SVZ\_X dfaa]V`V\_eVU Sj R e`ccV\_e`W\_Vh WRFf cVd R\_U Rezzf UVČE YV cVd ]e Zl R UZSVcZEj eVRe Zl UZSVI f ]e e`cVLFTVe`RT'^^`\_UV\_`^Z Re`čZYV^Zc`c

dv-VTedR R^ SZERV eZ RXV, Zed Z VR^ V edTYR XV UVaV\_UZ\_X`\_ eYVR\_XJVW/^ hYZYZeZdgZhVUŽ DW\_W/^ `\_VoltNtRotec`\_Xtd' [ZJ\_ReZ\_R] ZV\_eZej  $Raa V Rcd Z 3 f e d W_W ^ R_ e V U W ^ e V a V c a V 1$ Tf\_eqi eYRe WWJdYf^ ZZReVUSj Zed`h\_ gZ]V\_e T\_~ZTed R\_U ZccVT\_TZRS | V YRecVLdŽD ^ VeZ Vd vHVLeYV4YZVRd%RcVacfUjjUVdTcZSVURd hVjT^Z\_XR\_UWX2/UjjŁ4Y2/VRdRTf\_egie/Re Zd W/VTZV\_e R\_U ac`XXVdtZ\_XŽ2e`eYVc eZ`VdLZ\_ ^ ` ^ V ed`WWWTeZ\_Ł4YZWR dRXVTYRCRIeWZKWU Rd]Ry R\_Ud`gV\_JjL]RI\ZXZ\_ddaVTeVc`eVtdL ^ VR\_łdaZZEVU R\_U V\_gZ f dŽD ^ VeZ Vd eYV/ RcV TR|WRSdRgvLeifXYaVaVaV, Re`eVvceZvdZwW WITE R R\_UTYRERIEVEJVEDŽCVIR]Z\_X\_REZ\_R VAZTEL aVa]VRWc^ eYVViZeV\_TV`VRf\_ZeVZzeVXReVU ReZ\_Ž:\_\_`eYVcTZETF^deR\_TVeLeY`fXYLeYVf\_dW 4 YZV Rd R T f\_egi eYRe UVIVZgVd ZedyVSVIRf dv Ze X)`ddvd`gvceYVURc\vcdZV`VXedYZde`qŽ

E` d ^ VVI eV\_eLR' SZERV\_TVZIR\_`c^ RJ aRee `VUIYR\_XVEYV ef cSf JV\_TV YRd dYZAVU eVV dR\_U4L R\_U eVVT ^ Z\_XdrRaV` VeYZ\_XdZd\_`e VRdJ e` UZd TVc\_Ž3f e eVV2Zd^ f TY ^ `dVe`Ze eVR\_ eYReLR\_U eYZ\_XdhZJ\_`e SVd\_VRdZj cVd` JgVUZ2d YRdSVV\_ dr` h\_LeYVT ]]VI6ZgVZ\_RZ\_Rj `VeYVyH V6Zddx6Z `f dj h VR\_V\_VLLR\_U eYVVRX^ V\_eVLLR' SZERJV\_e Z\_RYZ R2ZdeYRe YRgVV VCXUUV/^ eVVUZWKCV\_e V a V6ZV\_TVd` VUYR\_XV R2VUZWIF ]e e` cVRdM^ SJV Ze` RT ^ ^ `\_ Z RXZZ

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4 YZVh RdRSJVE V V KXVRdR\_Z U kav\_UV\_e\_R eZ\_SVIRF dvZeZ RXZ\_W ZedyVRdeYVRF er c V Zed U ktz\_j Z 4 ZEF ^ dtR\_T kd YRgv TYR\_XV Z E YVR te ct. eYVUV R\_U te eYV kt f cT kd RcvR to UZ W Zed YVR e Z f e eYV TYR JV\_XvZ te YVR V KZ Ze c ^ R V e V aa ` cf\_Z eZ kd ` Ve YV kt f c V Zed ` h\_t 4 YZ V\_W kd R\_Z ` R XV ` W Zed W R U kd K W R\_U a ` dd S |VT ^ ^ f\_Zej Z

  $\begin{array}{l} eYV") DVaeV^{N} & SVER^{R} RefY a]R^{N} USj eYV_ReZ_R^{R} \\ eVR^{L}R^{R} Rc^{T} f dV dYR^{N} UV^{S} eZ_{Z} ZEYV CVa^{C} ce \\ cVgVR^{L}C^{T} h VgVE eYRe R VGR^{N} V_{eVU} UZgVadEj ^{N} \\ ReZ_R^{R} Z^{R} RZ_R^{R} Zd Zd eYV dEf ReZ_ acVgRZ/Z X \\ e^{T} UJ^{2} ^{S} _ VeYVVELZeh^{T} USVhc^{T} e dWeYZd \\ RdZ_VgZFS_{VL} Uf_R^{R} def SVZ eZd^{T} e RXR^{N} V^{N} VM] \\ c_^{e} eYZ_X^{Z} f de RdeYVEVZd^{S} ZV_{e} eJ T_{de}Zf eVU \\ Sj d^{V} VeZ^{V} VVELY^{^{S}} XV_{E} td R_{U} aVc^{N} R_{V} e \\ 4 YZVR_VEVTVL_c Zd eYV dVC R aVc^{N} R_{V} e R_{U} \\ f_{}]]RS_{V}gRIFf^{Z} e eVdV_{C} d^{^{S}} VeYVYH VZdA YZV \\ ZIRh^{C} Z ac XXdtZ \\ \end{array}$ 

EYZL RZ\_ISTZUZ Xh`c\TR\_`e\_`h SVRSR I U\_VUhZY`fe[VaRUZZ XeV`aa`cf\_ZZXdeYRe |Z/R/VRUŽZ T]]VIEZVZ RZ\_Rj ZL\_WUVLR``\_X `eYVceYZ XLe`dkeeYVdR\_URUdeYRehZ] XfZ/V Yf^R\_U&yY`a^V\_eZ WEZle`RE`\_Zd`aa`cf\_Z eZdLeYVT f\_eg \_WURGZZ\_`V&YVVKfcVeYRe UMZ\_VRevdeYVT ^^`\_ hVJVKVZE UVZVZE:eRd cvbfZvdR\_Z RV/VZeMVVVKfcVeYRe UMZ\_VRevdeYVT ^^`\_ hVJVKVZE UVZVZE:eRd cvbfZvdR\_Z RV/VZeMVVVKfcVeYRe ZdL]Z ZREZ\_dR\_Ua`eV\_eZZZdeYV#!!! CVa`ce a`Z\_eVU`feLYf^R\_U&yY`a^V\_eV\_eRZdT ]]VIEZV RbZREZ\_dR\_URa`dEZVZ RV/VK1TZ6j~dRSZZj e`cKRZVeYV^Ž

3feRT]]VTeZeVZ RVZ\_RcjZtRjd\_WUVUe TaV hZey eYVTYR]]V\_Xkd` WeyVacVdV\_eŽE YZdCVa` ce YRd d/`h\_eYReeYV]RI\`VIRT ^ ^ `\_Z' RXZ\_Rg' d\ff ]ed Z\_eV\_UV\_TZXde/RehVR\V\_dTZXejŽHZeY`fe`\_VL  $\mathbb{Z}$  Uzez If RJZReZ \_ ac' TVdtVd YReV \_ 'eYZ\_X e'  $|\mathbb{Z} \setminus$ eYV e XeYVŽ: UZeZUFR ZEVdSVT ^ V d ZEROj R\_UT]]VTezeV]ZWSVT ^ VdRdfcTV`VZ\_dVTfcZej dReYVc eYR `WT ^ a]V V dReZ ŽEYV ] dvcd RcV ZUZęZUFRIdR\_UdTZKajRdRhY]VŽHZeYfeR\_ Z'RXV`WeYVT f\_eejŁhZeY`feeYVacRieZIR]SfeRjd  $d^{S} Z V a Z TV V V Z X a Re V RyH V Z Z d$ gváj UZI/VIF lee TčvRevRdec Xd TZR VRScZIŽD TZR TRaZERJLhY`dVZ`a`ceR\_TVWcYf^R\_UvgVj`a^V\_e hRdRTV\_eeR] eYV^ V`WeYV#!!! CVa`ceLUVaV\_Ud \_`e`\_]j`\_ eYV decV\_XeY`Wd TZRJ`cXR\_Z&ReZ\_d SfeRjd LR\_UaRce21f ]Rdj L`\_ Ra]Rf dSjVZ' RXZ\_Rg `WeYVyH 1926

=RelijL`\_jj Rolec`\_Xd`TZkij R\_UZ\_UZgZLFRJdhZeY RdV\_dV`WT`]]VI&gVSVJ`\_XZ\_X'TR\_UVgVJ`ad`TZki ^ VR\_Z\_XdR\_UgRJFVZŽ9`holec`\_XgRJFVdRoVUVI aV\_Ud`\_eVVVieV\_ee`hYZIYRd`TZkij ZdhZJZ\_Xe` dVT X ZEVEYV RdaRce` VZEd MVLR Ue` UVW UeYV Ž ;fdeRdeYVEVZd\_`aVcd\_R|VeYZThZeY`feRdec`\_X d/d/ WZ UZCZLF RZEIŁA CYVCVIR\_SV\_` A TZR VCYZT hZey^feRUXdZeVUZ\_RXV\_VeYVT]]VIezeVdAJVŽAfS]ZT gRfVdR $VR_VacVdZ_VAVVRWWAZ_Z$ hYZYRd TZK Y ULIZAN WEYZIYR Rd WUZ a ZR eZ\_WceYVTYR]V\_Xd`WeYVacVdV\_eŽ7ZdejjŁZe R]`hdeYVWWWed`WaczgRezch``\_T^^`\_]ZWe` SVT\_cc`]|VLŽEYZ\_Xd|ZVT ccfaeZ\_R\_UTcZ V TR\_\_`eSVT\_ee`]]VUhYV\_T]]VTeZeVcWWeV\_edReV hVR\ŽDVT\_UjiŁafS]ZTgRJfVdRvRcWWeV\_TVa`Ze WcWWkade`ckataRZ\_eYVeV\_UV\_Tj`WajdeV^dR\_U Z\_deZfeZ\_de`dWeYV^dMgVdRdeYVViTlfdZeV`S[VTe eYVeV\_UV\_Tj`W^`UVc\_`cXR\_ZkReZ\_de`cV/VTe R\_j ToZeviZ\_ Vievic\_Rje eYV dvjgvidh YV\_eYVj dvé eYVZcacZcZeZdZd`\_V`WeYV^RZ\_WRTe`cdSWZU eYVhVR\V\_Z\_X`WT ||VTegVd`S|VTeggejŽ

4`\_def TéZ\_XR\_ReZ\_RJ Z'RZ\_Rj Zł}  $de R_U$ WéV``de R Tf ]ef d?] eRd ŽE YRe Zlh YRe Tf ]ef dVZł WR`Z\_Z\_XR\_Uf\_U&dR\_UZ\_XeV/ZW'U/ fc`h\_ d TZkj łj`f cd/R&U/i a VZ/T/dR\_UeV/UZWWEV/T/d eYReUZjZU/j`f R\_UL^`de Vda VTZ?]j łf dZ\_Xe/Va]f ł d?Zj``V/ZWYZĖ cZ/dR\_Uh Bj d`V/ZWe`d/Ra Ve?V d TZł] YRc^`\_j Rda ZWU e`ŽE YZł Tf ]ef d?] eRd YRd \_`h SVT ^ Vac`S]V REZRŽH YV\_ZE Zd/CVT X\_Z&U eYRe UZj/dzEj TR\_d/f ]eZ\_WRX^ V\_eReZ\_Le?Vf d X/\_Tj`W?VIf ]ef d?] TYR]V\_X/eYRe4 YZ/VYR/R/VRU TR\_SVRaac/IZZE/UŽ9 f ^ R\_U/g/J`a^ V\_eZ\_4 YZ/V eRE/UZ\_ac/dZ\_X\_WU`WF ]ef cZH YReZIRedR/V R/Ve?Vh Bj dZ\_h YZIY aV a]VIR\_SVT ^ Vd/Wc/JZ R\_eRX/\_ed`cyd S[VIed‰/Wg/J`a^ V\_edd TZSZZGj R\_URd f\_UU/`TRIJŽ

# 8C 9G HA 5?9 C9B C9 HC CD95? C: 7I @H F9 =B 5B 5; 9C:; @C 65 @N5 HC B3

EYV #! "!  $3ZIV_eV_Rcj ZlT Z_TZIZ_X hZeY R$ TYR\_XV`WVa`TY eYc`f XY`f e eYV h`c]UŽ 8]`l SRZREZ\_Zlac`Wf\_Uj eR\_dVc^Z\_XUB le`lUB [ZWVgVcj hYVcVZ:e ZlRd RTf]ef cR] ac`TVdLR\_U Z\_eYZlRCVR ZeZlTcVReZ\_X hY`]]j\_Vh Uj\_R`ZdŽ 7RIVU hZeY eYZlZcVg`TIS]VcVRZej LZeZlcVRd\_RS]V e`Rh hYVeYvcZe^R\_VddV\_dVe`daVR\_`VR\_REZ\_R] Z\_RXZ\_Rcj Z\_R\_RXV`VNj`SRZREZ\_Ž

7° cd ^ VLeYVd S[VTe` WTf]ef cVZd\_` ^ `cVeYR\_



RaZ/TV`W\_`deRX2Rac`aRXReVUSjdTZ]`X2ded`c R\_eYc`a`]`XXdedLR\_Ud`^VeZ`VdYXde`cZR\_dŽEYVj dWTf]efcVRdYReZX]ZejVcVjVeR\_TVe`eVV\_Vh TYR V\_XdeYRe^ ReeVc+eYVVT \_`^ jŁZ\_eVc\_ReZ\_R cV]ReZ\_dLeVVRIezezzd`WI`^ aR\_ZdLeVIY\_`]`Xj R\_Ud WeeYŽ\_RS`dJvdJvddh`dJUhYveVac`UfTeeL eRelvel ZURCHR UgRIF VolTZEIF IREVF Z a VUVULEVV  $dW_ReZ_R$  | ZWR\_U Zed Tf | ef dR | SRdZ Rd  $dZ_X$ deVRUZji Z\_e`ZcV/VgR\_TVŽ:eZlecfVeYReXj`SRJZR eZ\_TeVReVd\_Vh\_X1`SR] ac`S1V^d\_eYVd`]feZ\_dL Y`hVgVLhZ]T\_eZfVe`UVaV\_U`\_hYRecVR T^^f\_ZZXdRcVRS]Ve`U`hZeYeYVZc`h\_daVIZ;T TRaRSZZZZCZE YVW]`hZ\_XR\_VIU eVhZ|Z|f decReV eYZŽ2]R\_8cW\_daR\_`\_TVViacVdbUXVRe`aeZ  $^{\text{Zh}}$  RS`feeYV VdeRS |ZH  $^{\text{V}}$  U e`WIRaZER Zh Z  $Cf dt RZ 5 V ds ZeV Vg V g eY Z_XLYV eY f XY eL^ R_ Zd$ \_Ref cR] j TRaZERZEŽ2 Wh j VRcd Revelev V UZREVC eYRehRdeYVCfdbR\_VT\_`^j]VUYZ`e`T\_T]fUV eYReeYZty\_Ref ct%6xZU\_`eViZteR\_Ue`RI\\_`h]VUXV eYRehYRe^ReeVolUZ\_eYReTf\_egihRde`}\_UR hRj`VXXeZ\_XViacVddZ\_e`eYVV\_`c^`fdhVRjeY R\_UgRcZkij `WzedTf]efcRJSRdvZvZedVT\_`^ j hVcV e``aVcReVReR]]dfTTVctMfy]j 19RccZtl\_R\_U9f\_ł eZ\_Xe`\_Ł#!!!∕Ž

? `S`Uj U f SedeYReXj`SRJZReZ\_ZiUZi`R\_eJZX

eYVZNR`VeYV\_ReZ\_lDeReVeYRe`aVcReVURdRTV l ecR acZ TZa V WZ ebc ReZ R dVcW  $eVV_Z V$ eW\_eYTV\_efg`\_hRdŽ3feeY`dVhY`U`fSeeYV dZX\_Z;TR\_TV\_WIF]efcVZ\_eYZL\_VhT\_eVieRjd\_dW^ e`YRgVWcX eeV\_cVTV\_eYZe`qiŽeZdZ\_cVTV\_eeZ`Vd eYReeYVh`dUYRgVdW\_eYVV`VcXV\_TV`VR\_V\_`d ^`fdac`]ZWGReZ\_R\_UgRcZkij`W\_ReZ\_R]DeReVd Ze ZdV\_`f XY e`\_`eVeYRe eYVF\_ZeVU? ReZ\_dYRd `gvć")!^V^SvćDeRevĆŽDIRcTVjjVgvćSWVćVYRd eYVEVSW of TY REVERCENTY VILV EEXCER ` X UZXWKV\_eVeY\_ZTXc`fadR\_UZ\_UZXV\_`fdaVa]VdŽ EYVEVZER\_Vh RaaeVIZReZ\_`WY`hZ`a`ceR\_eZeZel e`dfdeRZ\_eYZdUZgVdZgjŽHYRejVdeVdLRjdW^Ue` SVgR\_ZYZ\_XSWWV`fcVjVdZd\_`hgRjfWURdeYV hVRJeY`WXf^R\_ZejŽ7fceYVc^`cVLTf\_ecZvdeYRe WcUVIRUNddfXYee`efc\_eYV`dMgVdZ\_e`XNRe f ZRcj DeRevelyRevyRUe jZ/USWkevevvuZevkoZej `WeYVZcZ\_eVc\_R|TF |ef cVdŽD`^ VŁdTYRdDaRZ\_ŁYRgV dval ]gvUeYvdzf Rez\_df TTVadury]j Ž@eYvaL]Z.VeYv WC^ VCD gZleF\_Z\_LYRgVSW\_ [VdtWcef\_ReVZ

EYVT VIZEV\_TV`VSfcXV\_ZXUZEVAZE hZY eV\_UV\_TZde`hRddY^ `XV\_ZREZ\_ZIRdfcTV `WUZEWIF]ejŁ`\_VeYRea`dddXj`SRJZREZ\_ hZY Zd`h\_Tf]efd?]TYR]V\_XVZEYVZ`a`ceR\_eeYZ\_X e`dVT X\_ZXVZleYReeYVd]feZ\_e`eYZETYR]V\_XV ZdZ\_ddaRHS]VW^ eYVd]feZ\_dWf\_USj\_VRIY Tf\_eej`cVEY\_ZTXcfae`Zd`h\_Ž8]`SRJZREZ\_ U Vd\_`e^R\_V\_REZ\_lSfZLZ\_XR\_j\_]VdlfcXV\_eR eRth\_Wc4YZVZCREYVEZe^R\_VdZeM\_VR\_UWcZed \_VTVdRej\_aRceZIZREZ\_Z\_eVVXj`SR]T^^f\_ZjZ

71 @H F9`5:H9F`H{9`9J 9BHG`C: %%C9DH9A ! 69F`&\$\$%

 $\label{eq:crew} CReV[j YRdeYVh`c]USW_d RhReV`VeYV \\ Tf ]ef dd] dedZ_d`VXJ`SRJZReZ_RdZehRdReWCeYV \\ VgV_ed`W" DVaeV^SVcZ_HRbYZXe_R_U? Vh \\ J`c\Z`7WJZXd`VVcZWR_Ua`hVcJVd1_Vd1Z_eYV \\ VRIV`VeYZdf_aRcR]VJVUT_eV^aeVvcYf^R_JZW \\ hVeVT^a`f_UVUSj T_TVc_RS`feeYVaVgVcdV \\ T_dVbfV_TVdeYReTf]URZEV/hYV_XJ`SRJZReZ_ \\ hRd_`eRIT^aR_ZUSj RhReV_Vd1`VeYVIf]ef dd] \\ TYR]V_XdZg`]gVVZ \\ \end{tabular}$ 

$$\label{eq:constraint} \begin{split} & EdRUV \ R\_U \ \} \_ \ R\_TZR \ cv \ Rez \ _dv \ Zad \ YRgv \ X \ SR \ \\ & ZAU \ Re \ R\_de \ f \_ U \ Z \ X \ dev \ SZ \ U \ Z \ XT \ f \_ de \ Zdd \ R_U \ \\ & Zdd \ R_U \ \\ & Zdd \ R_U \ \\ & Zdd \ R_U \ \\ & Zdd \ R_U \ \\ & Zdd \ R_U \ \\ & Zdd \ R_U \ \\ & Zdd \ R_U \ \\ & Zdd \ \\ & Zd$$

 $\begin{aligned} & \mathsf{d}\mathsf{WZ}\_de \mathsf{X}\mathsf{d}\mathsf{W}\mathsf{V}\check{\mathsf{Z}}> \mathbb{R}_{j} \ \mathsf{d}\mathsf{R} \ \mathsf{e}\mathsf{Y}\mathsf{Z} \ \mathsf{l} ac \ \mathsf{T}\mathsf{V}\mathsf{d} \ \mathsf{R} \ \mathsf{d} \ \mathsf{e}\mathsf{Y}\mathsf{V} \\ & ]`\_\mathsf{X}\mathsf{R}\mathsf{h} \ \mathsf{R}\check{\mathsf{E}}\mathsf{V}\mathsf{U} \ \mathsf{a} \ \mathsf{R}\check{\mathsf{P}} \ e \ f\_\mathsf{U}\mathsf{V} \ \mathsf{d}\mathsf{R} \ \mathsf{L}^{\mathsf{Z}} \ \mathsf{X} \ \mathbb{R}_{-} \ \mathsf{U} \ \mathsf{a} \mathsf{V} \mathsf{R} \\ & \mathsf{E}\mathsf{Y}\mathsf{V}\mathsf{d}^{\wedge} \ \mathsf{g}\mathsf{R} \ \mathsf{T} \ \mathsf{d}\mathsf{V} \ \mathsf{d} \ \mathsf{M} \ \mathsf{e} \ \mathsf{f} \ [\mathsf{U}_{\mathsf{Z}} \ \mathsf{X} \ \mathbb{R}_{-} \ \mathsf{U} \ \mathsf{a} \mathsf{V} \mathsf{R} \\ & \mathsf{E}\mathsf{Y}\mathsf{V} \ \mathsf{d}^{\wedge} \ \mathsf{g}\mathsf{R} \ \mathsf{g}^{\mathsf{G}} \ \mathsf{d} \ \mathsf{V} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{d} \ \mathsf{L}^{\mathsf{Z}} \ \mathsf{U} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{L}^{\mathsf{Z}} \ \mathsf{L} \ \mathsf{d} \ \mathsf{R} \\ & \mathsf{E}\mathsf{Y}\mathsf{V} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{g}^{\mathsf{G}} \ \mathsf{g}^{\mathsf{G}} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{L}^{\mathsf{Z}} \ \mathsf{U} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{L}^{\mathsf{Z}} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{d}^{\mathsf{G}} \ \mathsf{L}^{\mathsf{Z}} \ \mathsf{d}^{\mathsf{G}} \ \mathsf$ 

AV LYRad eVZI [f deZ VU`aeZ Zh``Sdff cVU eVV T\_d\bf V\_T\d`\Weh` RaaRcV\_ejj dZ`a]V WXTedŽ @\_VZI eVRe eVV]`dd`\VZ\_YVZEVUZV\_62ZATCAReAd Z\_d\Tf cZg ZE YV"\*\*%H`d]U9 f^R\_5 \gV]`a^ V\_e CVa`cea`Z\_edeYZI`f e+y>`deaV a]VUVZgVd\Tf1 cZg W^^ eVVZ Zg`]gV^ V\_eZ\_RXc`f aLR W^ ZjL RT^^ f\_ZgLR\_`CXR\_ZARZ\_LR dRZE]`c \eY\_ZT Xc`f a TRaRS]V`Vac`gZLZ\_XRTf] ef dQ ZV\_62G R\_U R d\e`V\gRf Vd eYRe TR\_^ R.VeYVZ\_UZgZLFR] \WV] d\Tf cVm4F? 5 AL "\*\*%Z8]`SR]ZREZ\_ TC\ReAd f aYVRgR]dZ\_TF] ef dQ ZV\_62ZVZ`X\_`cZ\_XeYZITR\_ EYV `eYVc WATE ZI eYRe eYZI Z\_VgZePS |V TF |ef cR  $\underline{Z}$  dVTf  $\underline{Z}$   $\underline{$ T\_TOVEV`aa`cef\_ZEXd`WWWOVUSjX]`SR[ZEREZ\_ R\_UZedcháchák/\_eReZ\_RdR\_Z'RXZ\_Rcj `WeYVWM ef cVŽ3f eZe^ f deSVcVT X\_ZkVUeYReeYVcVackdV\_ł eReZ\_`VXI`SRIZEREZ\_RdRac`^ZeVV/ceYVV/vefcV YRd YZEYVœ`SW\_WWS]VŽ8]`SRJZKREZ\_YRd SW\_  $Uczev_Sj \ W_ \} VcTV_j T^aVez_X^f ez_Rez_R$ T ca`dReZ\_dhZeYgVq UZXWKV\_e`S[VTeZgVq ZeZq\_`e j Ve SVZ\_XT\_decf TeVU Rd R T ^ ^ `\_ ac` [VTe eYRe TR T^^RUXVVRdfaa`œŽ:eZd^fTY^`dV hZMj aVčTVZeVURdRac`TVddeYReZdXV\_VcReZ\_X\_Vh  $R_UUWaVcZ_VbfR_ZZdZ8$ ] SRZRZ\_ZRTf]efdR ac`TVdde/ReZITYR\_XZ\_XTf ]ef cV, aRce`V&dURf\_eZX TF Jef cR TYR V XVZde` UVR hZY eV dv TYR XdZ RhRjeYReeR\VdRTTf\_e`WeYV\_WUd`WeVvd\_Rj R\_UT ]]VIezeVcfS[VIezezezkcŽ

# GC A 9'? 9M=GGI 9G

EYVeZ VYRT ^ Ve`UZIIF ddeYVTYR]V\_Xd`W \_ReZ\_ISF ZLZ\_Xe`UBJŽEYZUVSReVhZ] SV ^ `cV WFZeMJLY`hVgVLZWE dR.VdRTT f\_e`Wi ^ VTZi IF ^ dR\_TVdZ\_ eYV acVdV\_e R\_U d ^ VeV\_UV\_TZd eYReTR\_SVVI aVTeVUZ\_VVeF cVZEYVeC^ dZ\_hYZY eYVh`c\`WIRZ\_ISF ZLZ\_XhRdf\_UVce``UReeYV eZ V`WHV4V\_eV\_Rj hZ]\_`]`\_XcU ŽEYVgRf Vd Z\_daZZ\_XZehZ] SV eYV dR`V-dVJWUVEC^ Z\_RZ\_L V&WU ^ LVbF RZj Ld ]ZRZEj Lac`XxVdŽ 3f e eYV hBj deYVdV RVf\_UVce``U R\_U cVZXVU\_WU e SVRURaeVU e` eYV\_Vh\_REZ\_RJ R\_UZ\_eC\_REZ\_RJ T\_eV eŽ VEZL`ee`SVZ\_XV\_f`f deYVUSReVhZ] YRgVe`T\_dX/ceYVdeYZ dXV\_VReVUSj TF ]ef cB TYR\_XZZ3j hBj`VWI R`a]VLd ^ Vbf VdZ\_dhZ] VJa ZV\_eZJVeYVTc`dt`RURT`\_XeYVhBJZ

7ZddLeYVJZW WRZ\_dYRdX) SRJZWZ3VdLAd R] eVV eYVc Z aJZReZ\_d WeYZLX) SRJZReZ\_ ZdcUUY\_ZX SRJZ RdsVIed WRZ\_Y UŽH YZV eYVDeReVZIYRgZ X e dYRV\_ReZ\_R] d gvCvZx\_ejL `eYvc RIe`cdR\_UZ\_deZf eZ\_dReVXRZ\_Z XZ\_d TZR] 
$$\label{eq:linear} \begin{split} Z &= ceR_TVZ > R_j `WeYV` daR_RZ_RZ_RS` dMdZ \\ H Y` dn` f ]USVRS]Ve` aRceZZAReVLeYV_{Z_RZ_{}} \\ Sf Z[LZ_Xe` UR O@_ h YRe ZLAR` Wei gVdZZ_g` RdV \\ eYVZ: cZXYedR_U dVda`_dZZZEVde` SVSReVLO \end{split}$$

DVT\_UŁAV a]VeV\_Ue`SV^`ċVZ\_UZZIFRJXVU eYR\_SWAAZZ\_`eYVch`dUŁeYVZ:ZIV\_6ZZAGRAV\_`e UVJ\_WZ\_RUBR\_TVSj\_gRfFVdR\_UYRSZadVaHSJZHVU Sj\_ecRUZZ\_RJRFeY`cZZAGHeYVDHRAVLTYFcTYVŁa`ł JZZIRJ aRceZad`c d TZRJTJRdVAŽ:\_\_VV6fcVeYZIdMJW UVAC^Z\_RZ\_ŁhYVASj\_Z\_UZZIFRJdT ^ SZ\_VeYV ^`degRZUVJV^V\_ede`T\_defTeeYVZ:`h\_dMj8VL hZJSVVRIZZERAUSj\_eYVUZSVCZFWdR\_XV`W VR\_ł Z\_XdR\_U\_d^S`]ddfaaJZUSj\_T\_d^ VcTFJefcVZ HZY eVVCZX\_d`VXU/eZj\_d\_gRZUR\_U~WeZ\_XL hYReWWJZ\_Xd`VXV]\_XZ\_XIR\_SVZ\_g`\UZ\_aV a]V e`V\_XRXVeVV^Z\_RT]JVIEZVac`[VIE0

7f œYVc^ `cVLZeYRdSW\_ dW\_ eYRe^ R\_j aV a]V ]RI\ eYV^ ReVEZER\_Ud'S[VI6ZeVcVd f cTVdeYY \_WU e` eR\Vfa eYV`aa`cef\_Zej `VVJSVZ\_XeYV^ dv]gvd%Z EYVV&Vbf V\_Tj h ZeYh YZY aV a]VZ\_ eYZddEf ReZ\_ efc\_e`acZgReZt`R\_U`aa`cef\_ZdeZTT\_Wc^Zt` dr`hdeYv&VZd\_`XfRR\_eWeYReeYVXR]`VZd UZgZtfR]Rfe`\_`^j hZ]SVRIYZ&SVŽ:\_RUZZ\_Ł d`TZR]Uj\_R`Zd]ZVUX&Xf]ReZ\_V\_TfdRXVy\_VXR eZgVZ\_UZgZtfR]Zt`%ZiVeYVhBj4YZyR\_d`TZkjZd `cXR\_ZXUEV\_Ude`V\_TfdRXVaVa]Ve`hZeYURh Ze`RacZgReVh`d]ULY`hTR\_eYVdTZR]UZ`V\_dZ\_ `VZ\_UZgZtfR]ZReZ\_SVdeV\_XeYV\_UD

EYZUL EYV^ RC\VEHZ] T\_eZ\_f Ve`a]kj RTV\_eCk c`]VZ\_R]`TREZ\_Xd TZEJ dxd f cTV&LR\_UEYf dZ\_UAAd ^ Z\_Z\_XeYVacZ cZEXdR\_UcR\_\Z\_Xd`Wd TZAj Z3f e Ze YRdSW\_ dw\_ eYReeYV^ Rc\VEEV\_Ude`eR\VZed `h\_\_Z\_eVc\_Rjy]`XZ%RdR\_V\_UZ\_ZedyJXH YV\_ eYV ^ Rc\VE^ VTYR\_Zf`T^ Vde`SVdW\_RdaRce`V&V \_Ref ck]`dVc`V&YZ\_XdLZ\_UZEZLF k] R\_UT]]VTEZV `aa`cef\_ZEZde`cV dVc d TZAj RcVhVR\V\_VLŽ:e h`f]USVUZWIF]eVc 4 YZyR\_d TZAj e`RVkc^ R decZlej d TZA] acZ\_TZa]VZ\_eYVRZ`dR\_UacZ cZEZd `V&YVT f\_ecjŽEYZdZdR\_`eYVcTYR]]V\_XVVc\_R eZ\_lSfZJUZ\_XVWWced+Y`h TR\_eYVdkeZ\_X`Wd TZAJ X RJd SV cVT\_TZJVU hZeY eYV cM\_VkcVaf]ReZ\_`W

7 f œYLe`UJ, dh`dUZIR\_Veh`d``WiJR\_Vetg Z\_Wc^ ReZ\_R\_UT ^ f \_ZReZ\_eYReZIT\_deR\_ejj ReVcZ\_XeYVhB, daV a]VcV/ReVe``\_VR\_`eYVčE YV a`hVc`W\_Vh eVIY\_`]`XZdR\_U eYVRFUZ igZfR] Z\_Uf deg YRdTcVReVUR\_VI aR\_UZ\_XZ\_RAVTF]ef cVZ 3`eY ZJV\_eZZdR\_U h`dJU gZhd ReVSVZ\_XT\_ł def TeVU`\_eYVSRZd`VZ\_RAVZH YReZISVZ\_XdW\_Ł eYVeWcWZZIR\_VI eR dZ\_Rg RTTV/VREZ\_`VWZ V R\_UR Xc`hZ\_XVRX^V\_eReZ\_`WRcReZVZZ eV TYRRReVCZEZIC`VR\_Z\_RAVTF]ef cV1~`h R\_UVRXI ^ V\_eReZ\_ł ReVRWWIEZ\_XeYVT`f\_eg`dZ`RXZ\_Rg`Z 9`h TR\_R\_REZ\_R] ac`[VTehZY]ReEZ\_XVWWIedSV 72484 Let V d' S[VIEZe V I a VZ/\_TVd et Re a V a]V YRg VZ\_ et VZ VG VG UJ [ZGVdR V eR Z X`\_ RTV\_ed] Z' a` ceR\_TVZ 5 ZVIE V a VZ/\_TVLy]ZG % a VCIVAEZ\_d R\_UWWZ\_XLRVT ^ Z Xe` SVet V^ RZ\_RXf ^ V\_e Wc [f dzJ vZ xa Vcd\_R] UVIZZ\_dŽE Y VCVZ U f SeL Sj T\_ercht RS`fe XV\_VR] TZEVZR`V WRZ\_RJZ R\_U]VXZZ RIJŽD TZR cVR ZG dW de` SV ScVR d Z X WW` Wf\_ZG VcR]\_c c' dR\_UWRX^ V\_EZ XZ e` T f\_e[VcH Z\_UZGZ FR] VI a VCZ/TVČZ 4 R\_T]]VIEZEV ^ VR\_Z XdR\_U af S]ZT cRZ\_R]VSVR VC VLVGV RdZ\_UZGZ FR] d' S[VIEZEV VI a VCZ/TVČICUT X\_ZKUD

DZLEYŁEYVWC^ d`WY WZREZ\_R^`\_XZ\_WZZIFRICŁ R\_USVehW\_Z\_UZeZLFRjdR\_UdTZkejRdRhY]VL  $YRgVSVT^V \sim V^{T} V \sim TZZEVVZZ_ZHR_VR^{T}$ `WY`hZdfSdeReZRRUeVeReZeVeYVWc^d`W ^WZREZ\_SVehW\_eYVZ\_UZeZUFR]R\_UdTZkejŁ SVehW\_eYV]`TRJŁeYV\_ReZ\_RJR\_UeYVXJ`SRJŁ SVehW\_eYVaRdeR\_UeYVVVefcVLR\_USVehW\_eYV ] XZT Woldev dR\_Uaved\_R d'S[VTezzzej TR\_SVŽ EYZdeV\_UV\_Tj^ R.VdZeUZWTf]ee`gZuheVVTf\_eej Z\_TV\_eeR[ZEELY`^`XV\_V f deVc^dR\_Ue`TRdeeYV ac`[VTeRdd`^VeYZX^`\_`]ZeYZTR\_UZ\_UZeZES]VŽ 3feZeUVd\_`eURhR, hZeYeYV\_WUe`T`dZ Revervuzandev e Ngyložz TTvácz Xervuzavcozej `W 4YZV^ VR\_df\_UXddR\_UZ\_Xd TZKg RdRac TVddZ hYZY UZXWEV\_TV:1REV T\_WY\_eVUL^ VUZREVU R\_U cVT\_TZIVUŽHZEY XchZXUZXWKV\_eZReZ\_ŁhYRe TRARSZZZACI RCV RORZIRS]Ve ecr\_dRev UZWWCV\_TVdL R Uh YRe^ VTYR Zh dR VeYVEVe ef c\_eYV^ Ze Ralf dRZbZT` dVdO

# 5 7 C B HF = 6I H C B H C H S 9 H 5 G? C : B 5 H C B ! 6I = 48 - B;

Î H, Y h, ]b\_]b[ 'gdi ffYX Vmh Y 7 YbhYbUfmi bXci Vh YX'm 'U]X'h, Y'[ fci bXk cf\_'Z; f`h, Y'di V`]Wdc`]WJYg k \]W\`z`]b`h, Y`XYWUXYg h, Uh Z; `ck YXz` \Y`dYX'h; Z; f[ Y'U'a cfY'a cXYfbžZU]fYf'UbX'a cfY'XYa cWUhW 7 \]Y"'fÅ L

F]WUfXc @U[cgžCWkcVYf&\$\$\$"

EYVACVALV\_e`VAYVCVafS]ZTYRdTR]|VUVAcR \_ReZ\_lSfZUZ\_XZ\_ZZRZZVe`SVf\_UvceR\V\_Z\_eYV ]ZXYe`WeYV#!"! 3ZIV\_eV\_RgŽEYZdCVaCVdV\_edR eh WURaaVR e RJ 4 YZVR dŽ: eT TVć dVgVj ł S`U SVIRFd/LRd YRd SW\_ a`Z\_e/U`fe Y/c/Le/V Tf\_egidUZgVaZgiTR\_`\_]jSVTaVReZgVhYV\_eYV yHV%ZTlfUVdeYV@eYVcdŽ3feZeZdRdR R\_RaaVR e`R]]TZEZKV\_dZ\_eYVdV\_dVeYRe\_ReZ\_lSfZUZ\_XYRd \_`eYZ\_Xe`U`hZeYRdZ\_XJVLViT]fdZeVy^`UV]%Zo CREVVEZETR\_`\_]j SVRT ]]VT6ZEVF\_UV6R\Z\_XEYRe Zg`]gVdeYVDeReVR\_UTZeZdTZejŁacZeReVV\_eVd  $acZWR_UdTZR$   $cXR_ZRRZ_dLecRUVRdtTZRRZ_d$  $R_U e YV RIRUV ZT h` d LZ? ReZ_l Sf Z LZ X e UR$ YRde`SVdW\_RdR\_Veh`c\ŁZ\_UWURdR\_Veh`c\ `W\_Veh`c\dLR\_UeYfdRdRa]fdRJZeZIL^f]eZIRIVeVU V elvacZNŽ

EYVRZ `V&YZICVà`œZde`T\_ecZsfeVe`eYZi ac`TVdl`WbfVdeZ\_Z,XLcWWTeZ\_ R\_UUVSRAZ H`c\Z,XVV^ eYVdeR\_Ua`Ze`WYf^R\_UVgY`ał ^V\_eLR\_U`\_ eYVSRAZI`WR gRcZdg` `WV^ aZZTR] defUZdEZe`WWdRUZEX\_`dZI`WI^VIF]efd]RdaVTed `V&YVd`TZS] ac`TVdIZ\_4YZIVZEYZIdVTeZ\_UHAd ReeV\_eZ\_e`d^VRcVRdeYRe\_WUe`SVT\_dZVdVU Z\_eYVT\_decfTeZ\_`VWR\_ReZ\_ISfZUZ\_Xac`[VTeL R\_Ud^VXV\_VR]TcZeV2Re`XfZV/RTeZ\_Z eYVdV RVRLhZeYVR`a]Vd`WY`h eYyTR\_SVRaa]ZUŽ

CHF9B; H≰9B=B; 5B = A 5; 9C: H≰9ÎK9Ï

 $2 \text{ acZ} \text{ Rg} = \text{ReZ} = \text{ISf } Z UZ_X \ S[VI & Z Rd eYZd CVa` ce YRd RCXf VLL YRd e` SV eVV d/RaZ_X `VR_Z RZ_Rj `VVH VLeVV 4 YZVR_d%eYRe V_RS]Vd Vgd Vg S`Uj e` WVJ a Ree`VRT ]]VI & Z VCV dY S[VI & Z RXV + YRe eYV} = UZ_Xd de W eY YVCV dY h Z leYRe eYZd Z RXV `VWYV yH W & Z l d` Z a` ceR_e SVI Rf d/Ze ac` gZV d$ 

RdfcTV`WMRWU^W\_Z\_XLViaVZ/TVdR\_UgR] fVEZ.eZIZ\_eVEVEVEVUdTZAJEZ\_ZTREZ\_deVRe aVa]V}\_UEVRd\_dWEVEFSZEMZ\_XS`\_Ud`Wefde R\_UT`aVEREZ\_ER\_UEVVEFaa`ceeVVj\_WUe`U eYZEZ.eYZIhBJ\_eVy\_TR\_^ZEXREVEVVEERZ\_d`W Z\_UZEZIFRZEREZ\_Z:eRJd\_^R\_VEZEVEVEEVC e`RXEW`\_eVVETZAJEZ\_ERJE\_CHEYE`FXYee`XFZUNR\_U TYR\_VJeVVZ\_decf^VENT

5; @C65@5B8@C75@ÎK9Ï

CVT ^ a `dZ\_XR\_ReZ\_R] ZU/\_ééj TR\_\_`eZ`a]j UVeRIY^ V\_eVo'^ eYVX]`SRJZReZ\_ ac TVdtŽ4`^ł a]VeVdV/WeTW/IZ/Tj ZL`ea`ddS]VLR\_UeYVC/VgVc hRdRyaf cWaoyf\_T\_eR`Z\_ReVU%eYZVR\_ZU/\_ééjŽ E`URJLZ\_R\_X]`SRJZ&U h`cJULh YRe ZI aVIF JZcjj y`f cd%zdeYVRcd3]`V&ZdJZ\_VZ\_Xe`XVeYvceYV]`TRJL eYV\_ReZ\_R] R\_UeYVCXZ\_R]`cX]`SRJŽEYVYH V‰ ZIS`c\_\_`e`fe`Waa`d&Z\_e`W&ZX\_@eYVcdSfe Vo'^ eYVZ\_eVc^Z\_XJZ\_X`VWcTVd`VgVcj UZWWEV\_e `cZZ\_d RYJ ScZLZReZ\_`VY\_XtdR\_UZ\_XecRUZZ\_d hZeY VJV`V\_edeR\V\_W/^X]`SR] TF]ef cVŽE`URJL `fcy`h\_%aF]ef cVZlh YRehVy^R\_V`fc`h\_%Sj Z\_eVcZ\_dZ\_XyVVcVZ\_%X`UdL]ZWdtj JVdR\_UZ`RXZ \_RZdLh YZIY eR\V`\_R\_Vh^VR\_ZXRdeYY\_RV RURaeVUe` eYVUj\_R`Zd`V4 YZVR\_d TZkjŽ

:eZłaRceZlf [Rc]j gZER] e` c\^ V`SVceYReeYVyH V‰ cVcf ]edW'^ eYVT ^ Z\_Xe`XXeYVc`VRgRcZcj`VWR eZ\_cLcV[ZZ\_dR\_UVEY\_ZTXc`fadh YV\_ŁRAWc eYV eVcc`cZeRTed`W" DVaeV^SVc#!!"L^ R\_j aV a]V RVeV^ aeVUe` cf\_Z\_fa`\_ Ry\_ReZ\_R] Tf ]cf cV‰ cW\_ RdR SRcEZ\_ f\_Ucc dZXXZ 7f\_UR^ V\_eR]ZT 1`WWgVcj`\Z\_U'ZIR WRc`WUZgVcZcj`eYRe TRFcVd aV a]Ve`W6J] SRT\fa`\_RScd ]f eVecf eYcR\_UT]`cVU ZV eEZcZ

:WeYV3ZIV eV Roj ZdR\_`aa`cef\_Zej e`Rol hY` hVR:NLeYVT f\_egi \_WLde`eR]\RS`feeYVUZXWKd Vec`feVdeYReSc`fXYefde`hYVeVhVReV\_`hŁ R\_Ue`UZENFddUZXWKV\_eZUARdRS`fehYVcVhVRcV XZ\_XŽEYVZ`RXZ\_Rgi `WeYVyHV%BrazAnd ReeYV  $\underline{Z}$  eVcd/TeZ\_`WeYVaRdeR\_UVfVefcVŽ:eZlS`c\_`fe `VIRYZEE` q` R\_UCVRJZKUZ\_ RUKEEZ\_REZ\_ŽEYVYH V‰ VíZdedhYV\_ZeZd]RdeZ\_XŽ9`hTR\_hVy^R\VeZ V‰ Z\_R\_RXVeYReZITYRCRIeVOZKVUSj eYVRITVJVCReZ\_`W eZ VR URdec`\_XWIFd`\_eYVZ ^ VLZReVacVdV eO Eh` daYVCVd`VKZT6Z\_RCVdaVIZ;TR]jj cVjReVUe`eYZd eV a`cR UZ V dZ Ž7ZdeljŁeV dV ZdeVa` ZZZd `WWZERXWŁSj hYZTYZd^ VR\_eWgWgieYZ\_XŁeR\_XZS]V R\_UZ\_eR\_XXS]VLeYRe 4 YZVR\_d TZK j T\_dZ.VkdZed `h\_R\_UeyRedvedZeRaRceW/^ `eyVcd TZ/eZ/dŽEYV a` ZZZd` WYVZZRXVT\_dZded\_`e`\_]j Z\_T\_dVcgt  $\mathbb{Z} \times \mathbb{R} \cup \mathbb{C} \times$ SfeRjd  $\underline{Z}$  Sc $\underline{Z}$   $\underline{X}$   $\underline{X}^{\wedge}$   $\underline{V}^{\circ}$   $\underline{Z}$   $\underline{Z}$   $\underline{e}^{\circ}$  eV act  $\underline{U}$ 2 d RTeZeV ^ V ` cj Ł Y VCZERXV cVacVdV ed R d TZR eZ VeYRe VieV\_UdSVj`\_U`fcT\_eV^a`dReZde` Z TIF UVeY dVhY TR^ VSW&VF dR UeY dVhY hZ[]T ^ VRAWZ

DVT\_UjŁRa`ZZTd`WZ V\_WUde`XV\_VREVR gZZ\_`WeYVWefcVZEYVa`]ZeZTR]Z`a`ceR\_TV`W eYZdSVT ^ VdT]VRchYV\_hVT\_dZVceYVUZRWW1 eZ\_UZba]RjVUSjd^R\_j dVba`\_UV\_edWV^ eYV ]`hVcdecRef^Ž3jT\_ecRdeLaVa]VhY`UYRgV  $R_Z X R^ Welv Wel CVU _ ef d R i Wel a h C Wel$ `cRTe`aa`cef\_ZbZTR]]jŽ4cVRoZ\_XRgZZZ\_`WeYV Wef cVYRdSW\_RTV\_eeR] eRd\`Wa`]ZeZTdLR\_Ud ZedY`f]USV\_`hŁhYV\_ VgVqieYZ\_XdW^de`SV Uvý fotUSjetVZ ^ VLÆeVadváv\_eŽ? `hła` ZeZIR ac`UfTeZ\_`WeYVWefcVUVd\_`e[fde^VR\_dAd  $eZ_XXR_dR_UeZ_VZ_ZdcVeRa^{1}ReZ_XTfcVe$ eV\_UV\_TZKČZ:e^VR\_dT\_decfTeZ\_X`fe]``\deYRe a]RIVd TZR] aYV\_`^ V\_R Z\_ R YZde`cZIR] T\_eVieŽ @\_VViR^a]VLVkc6fc`aVR\_Tf\_ecZkdLhRdeYV ZNR`V6fc`aVŽEYZdhRdRa`hVcM/ZNRhYZVZe V^S`UZU eYVZ'RXV`WR yH V%Z\_ eYVac`TVdd`W TEVREZ\_ŽCVUFTVU e`R\_VT\_`^ZTaRTELZeTVRCMU e`Z\_daZVRdV\_dV`V\$VJ`\_XZ\_XŽ

#### 5 DC @447 GC: GD579

Roh Rezer UZ V dZ ŽEYVZ RXV VIn YReyH VLeYV 4 YZVR\_d%RcVZdd/RaVU`gVc eZ VeYc f XY d TZR CMREZ dYZadLR UEYVWC^ d`WEYVOVCMREZ dYZad REVEZUE da VIZ Ta RIVEZH YV\_ eYV ZW VO TZE ZddaReZR]jj WRX^V\_eVUL`\_ eYV`eYVćYR\_ULT]ł [VTezeVZLV\_ezej dW^de`hVR∖V\_Ž@\_VViR^a]V ^ZXYeSVDR\_@ZRX hYV&VLRTTdLZ\_Xe`F?5A def UZVELEYV |RI\`WRT ||VTEZEVZ'RXZ\_Rg``WEYV TZEj ^ RJ YReV` cZXZ\_REVUZ\_RYZXY jj VARX^ V\_eVU f cSR\_ViaV2V\_TVŽEYZIVIR^a[VhV]]Z]f decRevdeYV TF | ef cR UZ V\_dZ\_ `Waf S | ZTa` | ZZ dŽE YVa | R\_ e` dWith af SIZTedR da eZ DR eZRX YRdReRZiej W RZ d+dReZ\_RZKZ\_XafSZTecR\_da`cec`feVdLVRdZ\_X eYV~`h`\vg\YZ]\dLUZTfdRXZ\_XacZgReVg\YZ]\ fdVR\_UcVUFTZ\_Xa`]]feZ\_Z\_eVVTZ;ŽEYVdVXRdL hYZIYR:VdZ`a`ceR\_eWcbfR]Zej`V]ZWZ\_eYVIZejŁ TR`\_\_]; SVRIYZ&WhZeYeYVT`aVReZ\_`VRIŽ 2\_UaVa[VhZ]SVhZ]ZXe`T`aVReVR\_UXgV fadM}dYWc^d`WSWRgZfcZWeYYjaVcTWZgVeYV `S[VTezzydR\_U^ VRdfcvd`VeyVa]R\_Rdd^ VeyZ\_X dYRVLd^VeYZ\_XeYReZdy`f cdYZi\_`eYVch`ddL eYVd TTVdd` VeYZlaf S]ZTa` ]Z1j hZ] aRcejj UVaV\_U `\_eYVgZXfcZeTR\_Z\_WKdVZ\_e`eYVZ`RXV`WeYV DR\_OFFX yHVZEYVVIR^a]V`WeVVfcSR\_Z'RXZ \_Rcj dfXXVdedY`hZ`a`ceR\_eZeTR\_SVe`T\_dXVc eYVIf ]ef dR] a`Z\_e`WgZh hYV\_ af S]ZTa`]ZZZdRcV SVZ XRHAMŽ

# D9C D29'B 998 'HC '9L D9F=9B 7 9'GC 7 =9HM 5 G' 5 '7 C @297 HJ 9'5 7 HC F

? ReZ\_lSf ZUZ\_XcVbf ZVd\_`e[f de R\_Z RVZ\_Rq `WeYV yH V% S f e R dVT \_U UZ' V\_dZ \_ Rd h V]]+ aVa[V\_WUe`YRgVd^VViaV2Z/TV`WdTZZejRd RT ]]VIezeVRIe ČE YVeh `RelvIedReVZ\_eVevVK 4`]]VI6ZeVZ RXZ RCZKUT\_}XfcVeYV`fe]``\`ceYV Zevlackezev T UV h Yvevsj 4 YZVR\_d yevru%R\_U ^ R\VdV\_dV`WeYVhRjdeYVj ]ZeVe`XWeYVZZeeYV dR^ VeZ VLeYVVI a VeZ/\_TVdeYReRTIF ^ f |ReVZ\_ eVVZc UR; łe`łUR; ]Zgvde`XkéYvc Z\_~fV\_TVeYvZc gZyh`W d TZKġŽEYVEVZL\_`^ VTYR\_ZTR|T ceVTReZ\_SVehW\_ ViaV2V\_TVdR\_UZ RXZ\_R2X4L`WT fockLSfeZeU Vd ^ R\VdV\_dVe` daVR\`WWTZac`TR|T\_UZEZ\_Z\_XŽ7`c  $aVa]VhY^dVURZ_jVaVzZ_TVZd^_VM1T]fdZ_$ R Ua`hVdVdd VddL`chY`YRgVSVT ^ VT\_gZTVU eYReVgVg`\_VYRde`W\_UVVceYV^dMgVdLRj`\_VR\_U  $f_RZ_VU_ZehZ_JSVUZ_VIf_ee WV_R_jd_dV VSV_I$ 

]`\_XZ\_Xe`RyHWZc3jT\_ecReHZ\_UZgZLfRjdWWjeYRe eYY\_RVZ\_T\_ec`]`WeYVZcRIeZ\_dR\_UeYReeYVZc [ZgVdR:VS`f\_UfahZeY`eYVcdhYV\_eYVjYRgVYRU cfTTVdHMJViaVZ2\_TVd`WT]]VIeZgVRIeZ\_Ž

# H:9 9LD9F=9B79C:5 CC7=9HMH:5HC9HC 6CIB8CHCH:9ÎCMCH9AÏ

2deYVZ\_eVcgZ/hddY`hVULaVa]V`VeW\_WW `g\xhYV]^ W R\_U U\yg`f c\U Sj hYRe eYVj TR]] yeYV ^ RIYZ\_VZEYZd dV\_dReZ \_ `WYV]a]Vdd\_Vdd dW de UZ ZZMŁY hvgvŁhYV\_ eYV WW eYV RcVaRce`WR]RcXlcV\_oZjeYReTR\_dleS`f\_Udle` eYVyd deV %ZyDkeZ\_XS`f\_Ud%ZdTdfTZR|hYV\_R W\_TeZ\_R]d;deV^Łd\*TYRd;eYV^Rc\VeLUVd\_`e YRgVR\_Z\_SfZeyTfel`WW%68 VTYR\_Zf^e`T\_ec`]Zed  $V_1 a R_d Z_{Z_1} dTY T R dV d Z dh c Z X dT R_V U f a$ Sj dh WaZ XRh R aV a Vdd S (VTegzej ŽF Jez Revij Ł eYZ:1Z:1UVecZ'V\_eR]e`eYVWWIZV\_eh`c\Z\_X`VeeYV d deV deYV dygVdŽEYV" \*\*) CVa` ceR\_Rj dvUeYZd Uj\_ $R^T$  ZTR\_UT\_T]f UVUeYReeYVT f\_eq dYf ^ R\_ UVgVj^a^V\_edvbfZVURT^a]V^V\_eRcj\_dV]ReZ\_ł dYZaSVehW\_eYV`aVcReZ\_`WWV\_TeZ\_R|d\_deV^d R\_Ud TZR] df S[VTezzzej ŽE YZdUj\_R^ ZT\_WUde`SV d√ V SV&USVIRfdVZeZdd Z a`œR\_ee` aV a]V e`WY]eYReeYYj TR\_dZZ\_eYVy^ RIYZ\_VZZ

CWVc^ a`]ZZZdddrf]USVR\_RjjdVUZ\_eYZdT\_ł eVieŽEYVZcdTTVdd`V&V\_UVaV\_Ud\_`ed`^fTY`\_ eYV R^ `f\_e`WcVd fcTVd Raa]ZVU e` R a RoeZIf ]Rc `S[VTezeVRd`\_ eYVZ: RSZZej e` ^ `ezeReVaVa]Ve` XkeZ\_g` |gVUR\_U^ R\VeYVac` [VTeeYVZc` h\_Ž@g\c  $R_U RS^{\circ}gV eVV da VIZ T X R ^{\circ}VeVV af S Z a^{\circ}Z$ T\_TVc\_VULIRdeZ\_XdfTTVdd1ZVdZ\_^`@@ReZ\_XaVa1V e`SVT ^ VRTe`cdZ eYVac`TVdtŽEYVViaVcZV\_TV`W  $SVZ_XaRe^WRdTZkjeYReZdTRaRS]V^WTZZX$ dTZR ac TVdtVdZIR]  $eVV^ CVZ$  a  $eR_eZ_eYRe$ d^R\_j aVa]VWWJ YVJa]VddZ\_ eYV WATV`WhYRe eYV a VETVZEVRdy\_Ref dR]ZREZ\_%WEYVd TZR]`dUVŽ HYV\_ddeV^dRcVgZhWURdaRce`WeYV\_RefdR] `dU/c`WeYZ\_XdlR\_UV/aV/2Z/TVURdR\_`gV/a`hVd Z\_Xy^ RIYZ\_V%oeYV\_ Z\_UZeZUFR]d RcV UVacZeVU `W TeVROZVZ ZZROZVŽ

GC 7 =5 @ D5 FH≠7 =D5 H+C B · 5 G · 5 · H+5 =B =B; ; FC I B8 : CF · 7 C @@97 H=J 9 · 5 7 H+C B

:\_ #!! ! " LRacVOLV\_02R TZ:TF ]Rc decVdtW eYVZ' ł



a`ceR\_TV`Wo1TZR]aRceZTZaReZ\_R\_UZedgZeR]c`]VZ\_ af S]ZTa`]ZIjŽEYZIX R] ZIRJd YZXYZVeVUSj eYV }\_UZXd`WeYVacVdV eCVa`œŽ@\_VZ}gV`WeY`dV Zelvég Zuh VU WN Ze eVV v VZXYS`fdj fez Zercz R\_‰ TReVX q ŽE YVOV RCV aV a ]VhY YRgV h ZeYUCRh\_ Z\_e`eYVZcZ`^VUZReVd`cc`f\_UZ\_XdR\_UhY`WW R\_XqiRS`feeYVTf\_eqiLVgV\_eYfXYeYVjSVjZkgV eYV/RCVyXRZ\_VcdfZ5VdaZeVeYVZcUVeRIY^V\_eW/^ a`]ZEZTeLaVa]V`WEYZdejaVeR\VR\_ZeVEVdeZ\_eVVZc ) TR T ^ ^ f Z; R UT f USVRIEZ ZŽEYV a`ddddtcVRezeVa`eV\_eZRJLR\_UeYZIT f]USVXRjeRi ZKUSj ZURdeyRedeZ f [ReVU]`TRj aRceZIZaReZ\_Ž :Wy\_VZXYS`fdj\_feZZZRCZR\_d%bhVcVV\_TfdRXVUe` aRceZZZREVZ\_T]]VIeZeVRIeZ\_ŁeVY h`f]USV^`dV ZVje č RSR\_U\_eYVZcyacZeReZ(\* %R\_UWW) aRce`W 4 YZV dd TZV éj R\_U Wef c VŽ

# GC 7 -5 @@ ÷ 9 A 95 B G GC 7 -5 @DFC H97 H€ B

:\_UZGZLFR]dU \_`e [fde RdaZV e` yXXVU ^ `W TY ZIW deYy R]d UXEV et VTRARSZZEj e` Z a]V ^ V\_e et VTY ZIV deYy YRgV ^ RUŽ2\_U et Zd Z UZ gZLFR] TRARSZZEj ZTI]`dVj [Z\_\Ue` et VTRARSZZEJ Zd `W TZZ et RhY`]VZH YV\_aV a]VU \_`e YRgVet V d TZZ et df cTV deYy \_WUe` et R]ZV`aa` cef \_ ZEX d R\_UT f\_etc et V cZh det Re UKgY`a ^ V\_e Z\_4 YZV  $\begin{array}{c} \mathbb{V}_{efz} dz_{z} Uz_{z} dz_{f} R_{f} R_{e}^{-1} j efc_d Z_{e} W ded R Z_{R} Ua^{h} V_{e}^{h} V_{e}^{h} Z_{e}^{2} R_{z}^{h} z_{s}^{h} z_{s}^{h} Z_{z}^{h} z_{s}^{h} TZR ac' eVTeZ\_ cV[ReVdRS' gVR] e' eYV^ ReVoZR T UZEZ d`WZWZEYVZ'a|ZTReZ\_`WeYVRS`gVL Y`hVgV&LZde/Re^Re/VZR]d/TfcZej`fXYee`SVRI} EYc`fXY`feeYZlU`Tf^V\_ehVYRgVdW\_eVVZl ~fV\_TVeYRe\_VXReZeVWWZ\_XdRS`fe4YZVR\_UeYV VT\_`^ZTd\_deV^TR\_YRgV`\_d^TZR\_cVReZ\_dYZadŽ HYV\_YRWVR] cvda`\_UV\_edUVI]RcVeYReLUvdaZeV eYVTYR\_Xk&VgVg eYZ\_XYRdX\_V^ \_ eYVd?^ VLeYVZc UZZ f  $dZ_^ UedW de SVeYV de UE R$ R URWWIGZEVgf] VCRSZZEj Rd^ fTYRd`WT\_`^ZT T\_UZEZ\_dŽ\_WANTELZEYRdSW\_dYh\_eYReaVa]Vd VT\_`^ZTdEFReZ\_Zd\_`eUZeVTejj T ceVjReVUhZeY eYVZcd TZRSZZEjŁ`cVgV\_hZeY eYVZcZ RXV`VeYV^ł dMgVdRdXRZ\_Vcd`c]`dVcdŽ4`\_TVc\_RS`fe4YZVR\_d d TZR d/Tf cZejŁeYVćWVćVŁYRde`VieV\_U\_`e[fdee` eYVZc^ ReVoZRI ac`SIV^ dLSfeRId` e` eYVZcdfSIVII eZeVVíaVcZV\_TVďŽ

# 7F95H⊞; 0C 7 -9HM6MCHF9B; H< 9B-B; H< 9 CC 7 -5@6C B8

:\_UZ&UFRJdR\_Ud TZAG RVA ` &UAd`WAYVA? V TZŽ\_ cVJRZ\_e`eYVUZWWCV\_eyhBjd`VJZWALAYV CVa`ceYRdUV `\_dacRevUeYV cVTZac`TRjZ a]ZR eZ\_d`VZ\_UZ&UFRJZREZ\_ R\_UeYV `cXR\_ZREZ\_ `W d TZAGŽ:\_UZ&UFRJZREZ\_ `VR\_RdTZR] \Z\_UeV\_Ud e` cVdF]eZ\_RdTZRJ VRScZTaVc^ VREVUSj ^ ZdefdeL hYZ/VRVRX^ V\_eVUdTZAG eV\_Ude`cVdF]eZ\_R``cR] `c`aa`cef\_ZdeZT SWR&Z fcŽEYV V&VbfV\_Tj hZeY hYZTY eYZd YRaaV\_d ^ VR\_d eYVcVZd R\_WUe` :\_ eYVTRV`VWUFTReZ\_R]cW&c^Ł^`cVdeVdd YRdSW\_ JRZU`\_ T X\_ZEGVJVRc\_Z\_XR\_UZedRaaJZ TRSZZEj e` eYV\_Vh h`dJU`Wh`c\eYR\_`\_ `eYVc eYZ\_XELd TY RdRTF]ef cV`WT`aVdReZ\_ R\_UTZGZT dV\_dVLeYReRCVTdfTZRJe`eYVdTZRJS`\_UŽ\_e`URJ`d TZCTF^ dR\_TVEL`aa`cef\_ZEXde`^R\VR\_UV\_YR\_TV VZV\_UDYZad`ce`V\_XRXVZ\_TCECTRJUZETFdZ\_`V&AV Z`RXXd`We1TZXg``WWXCVUSj\_eVJVGZZ\_dr`f]USV dW\_RdaRce`VWF]ef cR]a`jZjŽ

## H + 9 CC 7 - 5 @ 6C B 8 69; - B G - B DF - J 5 H 9 @ 9

5 ValZeV eYV VgZIV\_TV`WY`h ^ f TY Z' aRTe aVa]VdacZeReV]ZeVdYReV`\_eYV]ZW`WdTZkejŁ RS]R\_\\e`\W2[V\_TV`\W\_U\dTV\_Ud`\_Zdf\deYRe VgVg`\_VViaV2Z/\_TVdLSfeeYReRcV\_`eda`\V\_  $RS^{f}eZ^{i}=dW^{d}eZ^{i}eV^{i}a^{i}dW^{k}eZ^{i}X$ eYVdV yacZeReV%Zdf Vd RITVaeVU Rd ac`S V d eYRe T\_TV\_cd TZK j RdRhY [VŽ7 cd TZR S`\_Ude`SV decV\_XeYV\_VLLeYVcV\_WU e`SV`aa`cef\_ZeXdWc aVcd\_R ZWe SVT ^ VaRce VeVd ZR USREVŽ  $E YZd V_e RZd R_f^SVc We YZ_Xd ZE YVc Wud$ e`SVR acVUZda`dÆZ\_e`hRcUde`]VcR\_TVR\_U \_`\_łUZETCZYZ\_REZ\_Łd\_^aReYjR\_UT^aRddZ\_Ž D'TZK j Rjd\_WUde UVgVj`ad ZERSJV]R\_X FRXd We UVR Z Xh Zey eYVdV ^ ReeVed Z af S Z Z ^ `eV ~fZUcVRez\_dYZaSVehW\_acZeReV]ZWRUafS]ZT T\_gvcdReZ\_h`f]UXgVaVa[VXvRevccvdfcTvd WcURZ\_XhZey eVVTYR]]V\_XkdeyReRzEVeVkVZ2e eYVdR^ VeZ VLZeh`f UV\_RS[VaV a]Ve`dWeYVZc `h\_ ]Zevidev-VTevUZ\_evVafS]ZTdaYvevŽ@\_]jZ\_ eYZthR, TR\_ Ra]Rf dS]VyH V%SVTeVReVUŽ

# 5 71 @H F9C: HFI GH; 9B 9F5 H9G G971 F+HM

HZEY fed TZRJ S`\_UHZEZIYRU e`WWJ dVTf d\Z EYZEZIEYV]\vdt\_`\WEYVZ\_dVTf dZg eYReaV a]\V1 a\V d\ZTVZ\_eV\ZEY ^ \dR\_UZ\_eV\de\WEZZIEYV''\*\*) C\va`ce af eZELeYVTcZ\_Z\_RJ ZHR ^ \eRaY`c \vc eYV ^ Zhef de Rc`f d\USj \g\vgi deR\_X\vZA`\_d\vbf \/\_ejL eYv&VIR\_SV\_`WWJZ\_X`WWTfcZej hZeYfeXcNeVc ef deZ\_eVVR\_`\_j^`fd@eYvZeYZlackfaa`dvdR\_ VfaVcZyTV`WT^^f\_Zej eYRe^R\_kdZea`dvZsJVe dWdeR\_Xvcd\_`eRdReYcNeLSfeRd`eYvc^V^SVcd `WeYVyHWZAFSJZTdvTfcZej V\_eRZdRTfjefcV`W dvTfcZejER\_UeYZdUvCZevdWi^eh`Tj`dvjcvJReVU eYZ\_Xd+}cdejELWi^ eYvefdeR\_UdvJVWd&W^ eYRe cvdfjeWi^^VVSVcdYZa`VRdec`\_XyHW%oR\_U dvT\_UjEWi^ RhZJZ\_X\_vdle`eYZ\eYRehYRe UZdZ\_XfZhVdj`fWi^ eYV@eYvcUVd\_`e\_VAReV eYVviZeV\_TV`VRT^^`\_SRdZISVchW\_j`fŽ2VW }c^ReZ\_`VeYZISRdZIUvchZevUZWWCVTVddW^ d e`SVR\_VTvdRcjT\_UZeZ\_`VeYVyHWZaeZleYV ^ZdZ\_`VR\_ReZ\_ISfZUZ\_Xac`[VTee`V\_cZTYeVZI SRdZIR\_UX&vZedSdR\_TVŽ

# 5B °C DDC FH B + M: C F 89A C 7 F5 H 7 ° DC @+ F G

EYVTF ] of cR TYR] V\_XV^ZXYe SV d^ ^ W f a Rd W] `hd+eYV acRieZIR] Wc^ d`WZWZ\_ d TZkj \_WUe`SV`cXR\_ZXUZ\_ dTYRhR; eYReeYV X&V aV a] VR WYZ\_X`W1 TZR SV]`\_XZ\_X\_ReeYV d^ V eZ`VLeYVCZIR\_WUe`TCXREVeYV\Z\_U`W4/\_dVR\_U c\ac\c4/\_eRzZ\_`VeYVyH V%eYRe V\_RS]\c4aV a] Ve` RIE T]]VIeZyVj Z\_dYRaZ\_XeYV acRieZIR; Wc^ d`W eYZIT ^ ^`\_]ZWŽ

aV a]VRVUV R\_UZ\_XVI a]R\_ReZ\_dVvcgVcj daVUZ T eYZ\_XŽZ ]VR Z\_Xc` VWRhc`\_Xjj TRJTf]ReVUSZJER\_ VTVdZgVjj ]`\_XhR&Z RdfcXvcjER&Z ` WW UeYRe ZlaRde Zddd/]ISj UReVLR\_f\_[fd&Z VU eRV/T}\_VŽ @\_eYVWIV VZE eYVCH R-UdeYReU \_`eRUUf a e` eYV Z\_U` VXV\_VCR] ac`S]V^ dh YZY RVeYVdf WWVa`]ZZZŽ3f e`\_jj`\_ eYVWIV` VZE SVIRfdVeYVZ\_UZZJFR] h`dUZL` eUZg`cTVUVA^ eYVa`]ZZTR]`\_VŽ\_ eYVCd'S[VI&ZVTALR]] Z\_UZZJTR]dgRJZ.ReV`cZgRJZ.ReV`\_ Rd`R] dIRV eYVZ RXV` VUZgZTUZZ\_ZjLac` eVI&Z\_LafS]ZT`]ZW R\_UUV^`TCRIj eYRea`]ZZZdV a`f\_UdR\_U cVacV  $dV_eXZ$ : VZe ZX` cVd eYVUVaeY IRe`\_TVd'S[VI&ZV R\_UUV^`TCRIJ eYRea`]ZZZdV a`f\_UAR\_U cVacV R\_UUV^`TCRIJ eYRea`]ZZZdV a`f\_UAR\_U cVacV R\_Ud TZR]` VV R]]dIRVV aVZ/TVLa`]ZZTd^ R] WWWEZ RV RIZZZ RIJ Z\_aV a]VdV VŽ

CVT X ZKZ X eYV d'S [VTezeV R U d TZR] y cVRZej ‰ `WeYVdV VgVg UR, Via V2Z/TVd Rd ScZ\_Xd R XcVRe `aa`cef\_ZejŽA`]ZeZTdhZ|SVT`^VdZX\_Z;TR\_ehYV\_  $Zeac^{2}gZVdTZeZkV_dhZeYeYV \setminus V_d^ VZ_eVcacVeReZ_$ R\_UdX\_Z;TReZ\_eYReeYVj\_WUe`^R\VdV\_dV`W eYVZcURZji jZzvdŽ:\_ aRceZlf jReLZe\_WUde` TcVReV  $R_U c d d e e V V R_Z d e Re d Z Re TZZKV_d$ cVbfZVe` ]Z \ eYVZcaVcd\_R| ViaVcZ/TVdhZeYWV Wade To  $Reverv \setminus Z \cup WRe Z = eYRe Z UV d Z V UR U$ hZey eVVafS]ZTZ\_ZZRezeVdf\_UVceR\V\_Z\_afccfZe `WeYZŽEYZI^ VUZRe`q`W\_TeZ\_ZI\_`eUZIIYRcXW eYc`fXYeVTY\_`TCReZTZ\_ZZRezgVd`ccYVe`cZTRS`fe T ^ aRddZ\_ e`hRtLdeYVf\_Vtoef\_RevLSVIRfdvS`eY  $Wey VolvScVR e V CV Rez_drza e Re ]Z dz Uzezt R$ Via VZV TVR Ud TZR) č XR ZKReZ Že ZdZ a čer e e` d\aVReLeYV\_LeYRe Ze ZeleYR\_\de` R\_ Z' RXZ\_Rg `WeYVyHW%eYReaVa]VUZETgVcR\_UcVR]ZkVeYV `aa`cef\_ZEXIde`eR\VT\_ec`]`WeYVZcRTeZ\_dŽEYfdL eYV^`cVZeV`ScRIVdeYVTf ]ef cR| UZ`V\_cZ\_ŁeYV ^ `dVa` ]ZEZIdhZ] SVy`f cdZZ

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 $EYVYf^R_UgV^a^V_eZ_UV_195:/dW_de$  $^{\text{NR}}$  (Very Reverse ) with  $^{\text{R}}$  Transzer dz. R d TZAjŽedak\_URUKVUTYRCRIEVĆ^ VR\_deYReeYVdV ReeRZ\_^V\_edTR\_SVT ^ aRcWhZeYRX RJ e`UVeVd ^ Z\_VY`h ^ fTY ac`XXddYRdSW\_ ^ RUVe`hRdd eYZdR\_UY`h ^ fTY deZ] cV^ RZ\_de` SVU\_VŽ@W  $T f collever 0.5 : Zf _] R_ReeV ace `aVReZ_R]$ ZKVeYVXV\_VCR Raac`RIY`WXf^R\_UVgV/`a^V\_eL hYZYZIRhR, `VJ``\Z\_XRed TZR]Zdf VdeYReTV\_eeVd `\_aVa]VRdeYVdfS[VTedR\_UacZ:VSV\_V;TZRcZd`W eYVUvgy a^ V\_eac TVdžEYV95: aVReZ\_RZAVd eYV^ `de`VddV\_eZR] VJV^ V\_ed` VeYZlRaac` RTYLSf e ZeTVæRZ\_jjUVd\_`eViYRfæZZdYRdSW\_dZLŁ yeYVZ\_UM\_Zd\_`eeYVT\_Tvae%ZEYV95:ZdeYfd Z\_eV\_UVUe`T\_ec25feVe`afS]ZTUVSReVcReVvCeYR\_ e`dwlee]VZeŽEYVZ\_Wc^ReZ\_Zedfaa]ZddYff]USV  $Rdafce UZIIf dt Z_R_UW de Y dz bf Z j Z e Z j Z V$ eYVU`ce`RY`fd4\_`S`Uj hY`\\_`hd`\_]j eYV  $U c TR_dR[i] \ h eVY f dVZ_i S U dR[i]$ hR\_eZ\_Xe`\\_`h eYVY`fdVLY`hVgVLh`f]USV hVj] RUgZKU e`V\_eVc Sj eYVU``dŽi2 UVeRZVU Via]R\_ReZ\_`WY`heYV95:ZHTRJTF]ReVUhZJSV Wf UZ RaaV UZ "!Ž

2]d LeVV 9 5: Zd UVdZ\_W a ReeZff ]Rcjj h ZeY R gZh e' ^ \_ Ze cZ\_X ]`\_XleVc^ ac TVdVdŽ:e Zd ^ VR\_e e` cWWTe ded Tef dR] TYRCRTeVcZdeZTd` WR d TZKg `d UVgV]` a^ V\_e dReYVc eYR\_ da VTZ; T dY` cel ekt^ dzfReZ\_dŽezdevfdSvaee`TRTIF[Rev]`\_XeZ V dktZkd]Z.VeYV`\_VackdV\_eVUYktVŽEYZdRaac`RIY ac`gZNdR\_`gVgZh`WYf^ $R_U$ gVj`a^ $V_eR_U$ ZedRIYZgV^V\_edR\_UdvéSRI\d`gvceYV]ReeUVIRUŽ > VéY U ]`XZR]ji ŁeyVRIYZgV V\_ed`WeyVUVIRUV TR\_SVVgRffReVUW/^ eh`a`Z\_ed`VgZhŽ7ZceljiŁ eYVEV ZdeYV Xc heY  $\underline{Z}$  eYV RSd ]f eV gR]f V `WeYV 95: ŁhYZY dł-VTedeYVUj\_R^ZT`WeYVac`TVdŽ DVT\_UjjŁeYZdUj\_R^ZTTR\_SVRdAddUZ\_eVc^d`W ZedT\_eeZSfeZ\_e`eYVf]eZ`ReV`S[VTeZeVLhYZIY Zde`T^VRdT]`dVRda`ddZS]Ve`eVVZJVRJXRJ`W Yf^R\_UvgV]`a^V\_e1cVacVdV\_eVU deRezdeZIR]]j Sj eYVgRJfV"/ŽEYZddVT\_URaac`RIYeR\VdRITf\_e`W eYVWReeYReeYV^ `dVac`XdvddZl^ RUNLeYVXdVRevc  $R_U^{\circ} CVZ_ecRIeRS_V eYV TYR_V Xd SVT^VZ:_$ eYZIR\_\_VIVLeYVeh` Raac`RIYVdRcVW]`hVUZ\_R T^a]V^V\_eRcjWRMZ\_e`[fUXVeYVdTR]V^WhYRe YRdSW\_ RIYZIGVUR\_UVGRJf ReVY`h ^ f TY dv RZ\_d è SVU VŽ

7 c eV ackál\_egkáZ\_ `VeV da VIZA] 9 5 : Wć 4 YZV f dv YRdSW\_ ^ RUV WRERW/  $^{\circ}$  eV 4 2D6? "\*\*! R\_U#!!! d cgV dT \_UT TAUS j eV > ZZ dej `WA]R\_ZXR\_U 4 ``a VARZ\_ R\_U `WURER W/ eV 6aZU^ Z]`Y 5 VaRe^ V\_e`VeY > ZZ dej `W 9 VR eZ YV da VIZA] 9 5 : Wć 4 YZV ZIR ^ `UZ W g VaZ\_ `WeYV h `dU ^ VeY U ]`YJ ZGRZZS] Vd YRgV SW\_ RUUU `c cká] RIVU  $^{\circ}$  ^ R.VZe^ `cV dv\_dZgV e` eYV cki] Zdf Vd`WVgV]`a^ V\_eZ\_4 YZVZIT dJ Z Xj LeYV} Xf ckúj ZJUVU Sj ZERV\_`eZ ekc\_RZ\_ł R]j T ^ aRdS] VŽ

=Z.VhZMLeYVURR af S]ZHVUYVVRV\_`eT^1aRHS]VhZY VVZ\_R] 95: } Xf VvZ\_R] 4.22 av  $J_{2}$  `fdafS]ZIReZ\_d1F?5AL"\*\*', F?5AL"\*\*\*,  $> Z_Z Reg$  `WA]R\_ZXR\_U4``aVReZ\_IF?5AL#!!!/ŽEYZIZISVIRFdVeYVVYRgVSW\_TYR\_Xd  $\underline{Z}$  eYVhR,  $d^{\wedge} V \underline{Z} U \underline{Z} Re^{\circ} cd R V f d U 1 da V \underline{Z} T R ] j L$ a`eV\_eZR|jVRcd`WZZW]`de/R\_UZ\_eYVacZIVcReZd  $f dVUe^{-1} R_VZ_T^{-1} V$   $M cVdZ_eVc_ReZ_R i T^{-1}$ aRdS/VSj T\_gVceZXeYV^ Z\_e` af cTYRdZXa`hVc aRcZej 1AAA/eVc^ dŽEYVOVTYR\_XVdZ\_` hRj RWWTe eYVf\_UVdjZ\_XT\_TVaefR]`XZT`c^VeY`U``XZIR def Tef dv Werv95:Ž\_Wef dvZedr f [USVa`ddZs]V e`WeeYvcR^V\_UeYVgRzRS[Vdfd/UVvcTRTf]RzZX eYV95:Łe`eR\VZe`RTTf\_eeYV`aZZ\_dR\_U dfXXXdeZ\_d`WadVdV\_eR\_Ua`eV\_e2R fdvd`WeYZd Zdecf^VeŽ

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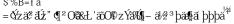
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:\_eVc^d`VRSd]feV95:gRfVeLeYVcVXZ\_eYRe ^`deZTcVRdNUZed]VgY]`VReeRZ^Ve`gVceYVUV TRUVhRd> Rf [VLhYZIY T]` dVU eVVXRa dvaRcReZ\_X  $\mathbb{Z} \otimes \mathbb{W}^{\wedge} = \mathbb{W} \mathbb{Z} \mathbb{W}$  Sj #\$"  $\mathbb{Z}_2 \mathbb{V} \mathbb{Z}_2 \mathbb{U}$ @  $^{9}$  ZXXZ\_dRtVRd R^ `\_XeYVcVXZ\_d^ R\_Z\_XeYV XVRevelac`XevelidW}XfeV#R\_UeRS]V"/Ž\_"\*\*!Ł R] eYVAV AXZ\_d YRU AVREZEW j ]`h 95: gRlf VAŽ  $ARce_{ij} RdRcVdf_{e_{i}}e_{v}cVVZ_{e_{v}}cVVZ_{e_{v}}cVVZ_{e_{v}}cVVf_{e_{v$  $^R_U$   $(2 \times 2^2 + 2 \times 2^2)$   $(2 \times 2^2 \times 2^2)$  $1Sj \# Z "! j VRadLdW} Xf cV SZ$ 

:\_ eYZd`gVcgZhLERcRaRIi R\_U2eRIR^ RdeR\_U `feRdeYVcVXZ\_dhY`dV95:Z`ac`gVU[VRde`gVc eYVUVIRUŽH YZVď SdeR\_eZR ac`XXVdh Rd^ RUVL eYVVieV\_ee`hYZIYeYVj Tj`dvUeYVXRaWVjhVj] dY ce `WeYV\_ReZ\_R] Reversivi ) Ž ″ R U " ŠŽŠ″Ł cVdaVTeZeVjj/Ž

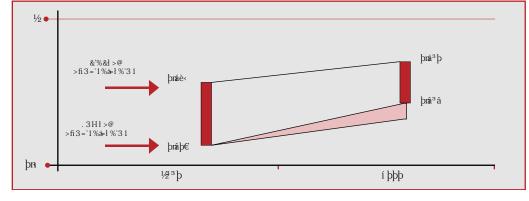
EYVON TYR\_XXdZ\_ eVV95: cVgVR] `\_TV RXRZ\_ eYReeYVCVZd `Rfe`^ReZTZ\SVchW\_VT\_`^ZT Xc hey R\_UYf ^ R\_ U/gV/ a^ V eZ72xf eV/dr hd eYReeYV&VRVCVXZ\_dhYZYYReVaV&V&^VUdZ Z |Rc|j Z\_VT\_`^ZTeVc^dSfeac`XeVdbVUe`UXXWZ\_X UVXCWdhZeYYf^R UVgYia^V eŽEYVcVXZ d`W  $2 \in RIR^{n} R R U > RXR | R Vd RCV V e CV^{n} V V R^{n} a | Vd$ `WeYZEZEYVWc^VcdRheYVWRdeVdeR\_fR|85A Xc heY gVceYVaVcZU"\*) l \*\*) l Sf eZedYf  $^R$ Uvgy a^ V\_eaVeVe^ R\_TVhRd\_ ed Uj\_R^ ZZZ@\_

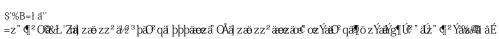
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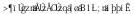
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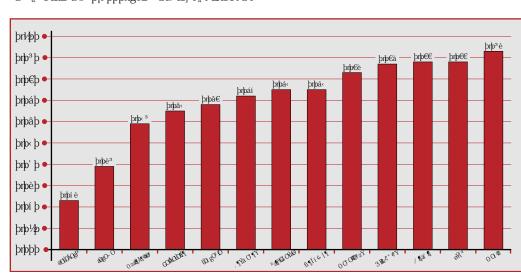
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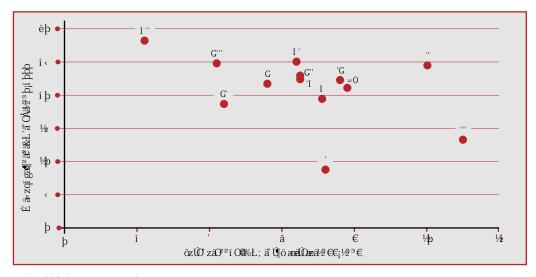






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7c' ^ eYZIX\_VR] eV\_UV\_TJŁeYVWJ hZ\_XT\_ł TJf dZ\_V VXXd+VT\_` ^ ZTXc heY ZIR\_VIVdRcj Sfe\_`edf WIZ/ eT\_UZZ\_WcZ ac gZ\_XYfł ^ R\_UVgY a^ V eZ9 f ^ R\_UVgY a^ V eZIS` f\_U fahZey eYVY ZIVIRd TZG ^ R\_VIRERXZQV eZ VL R\_UhZey eYVV aYRVdR\_UacZ cZ5ZdeYRe X ZIVZŽ :\_ `eYVch`dd ZXRd TZG ZIe Rg ZJaVaVaVf Reł Z\_XX/XRaYZIR Z\_Vbf RZZZd Ze ZI Z\_UZAV\_dSJV WcZe e` ^ R\_V RIZGVLT\_dTZ fd WW.ced e` W.devc a` eV\_eZ3 d\_ V.eŽ

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:\_eVcVXZ\_R] Z\_Vbf R]ZZXd R]d UVI]Z\_VU df Sł dR\_eZR]j ŽH YZVZ\_ "\*\*! ! "\*\*# eYVh` cde RWWEVU cVZ\_ hRd]` dZ\_XR\_ RgVRXV` W%j VRcd^` cVeYR\_ eYV]VRdeRWWEVU`\_VSj "\*\*' ! "\*\*) eYZdUZWEV\_TV YRUUc` aaVUe` #! j VRcŽ

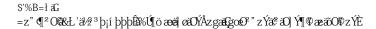
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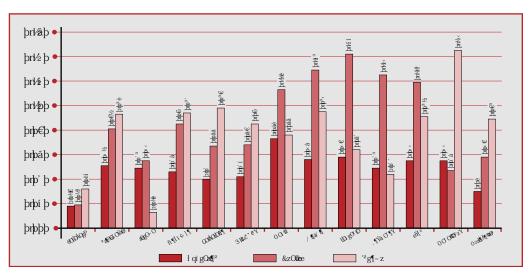
$$\begin{split} & EYV \}_{LZ} XdWc eYZdRa VTeUZU_`egRij ^ fTY \\ & W^ dWZ_ e dWZ_Z: = #!!!L ]ZeVRIj R^`_X \\ & gVd #%de`UReYZY ]VgVdZ R] dWZ_dLhZY \\ `_]j > Rf ]V]RXZ_XSWZ_UdZYej Re*! ~ Z_eYRe \\ & R^ V j VRc`gVd #%d_RZ_R]j YRU R_RVdXV`W \\ & Zig VRcd`WUFTReZ_LhYZYZdRd RX`UcVf ]eL \\ & ReY^fXY`VUF fcdVZeZdeZJ R]`_XhBj W^ eYV \\ & "& j VRcd YVJU fa Rd eYVZVRJZEYV dWZ_deYRe \\ & YRgV WeeYVe e X Z_T]fUV@`9ZXZ_dL> Rf ]VL \\ & =`d=RX dR_U2j d/2LRgVdRZ_XRS`fe VZXYej VRcd \\ `WUFTReZ_Z$$

EYVÁV Z UZIRe`cd cV/ReV e`eYV ReeRZ\_ ^ V\_ed`W aV a]VhY`YRgVR]cVRUj]WAEYVVUFTREZ\_djdeV^Ž 4`\_dNof V\_ejjLeYZIRdaVTe`VEYVZ\_UM\_Zdf aa]VI ^ V\_eNUSj T\_dZVREZ\_ `VEY`dVhY`REVdeZ]Z\_ ZELR\_U YVCVd SdeR\_eZR] ac`XcVdt YRd SW\_ ^ RUŽ AcVidTY``]VUFTREZ\_ T gNRXVZ\_4 YZVYRd cZN\_ =bWca Yg UgdYWh

 $\label{eq:starting} \begin{aligned} & 3 \forall h W_{-} "**! R_U \#!!! La & Trazer Y f d Y ] U \\ & Z T ^ & Vic d V _ d U & Vis Y & Vis d V _ d U & Z & Vis V & Vis Y & Vis V & Vis Y & Vis V & Vis Y & Vi$ 

:\_VbfR]Zej Z\_ZT^VUZdecZ5feZ\_cVRZ\_W XV\_VcR][j YZXYR\_UdeRS]V`gVceYVUVIRUV18Z\_Z T WWXZZ/e`WZX)/LhZeYZ\_VbfR]Zej VRdZ\_X`c h`cdV\_Z\_X`\_]j e`RgVcj^Z\_cUVXcWZ\_eYVUZAV @\_VgVg Z`a`ceR\_eT\_T]fcZ\_eYReTR\_SV  $UdRh_W^{\prime} UdRZWR_Rj dZ1^{0} VeYV95: UZ^{\prime}V_{1}$  $dZ_dR_UgRzRS[VdZdeYReeYVYf^R_UvgV]^a^V_e$ ac`} |Vd`WeYVUZWWCV\_ecVXZ\_dRcV\_`eR|Z\VŽ EYV}\_R]95: gR]fVac`gZU/d`\_]j Ra`Z\_eVce` R XZZV\_ cVXZ\_`dXV\_VcR] [VgV] `WReeRZ\_^ V\_eLR\_UZe \_WUde`SVofaa]V^V\_eVUSj\_dVaReVT\_dZNd ReZ `WeYVUZXWWEV e dZefReZ dViZebZXeYVEVŽ: `eYVch`ddŁeh` dVXZ\_dhZeYeYVdR^V]VgV]`W  $Yf^R U(gV)^a^V e^gV(R)^R YRgV UZWWCV e$ ac`} [VdR UUZXWWCV eTYR] [V XVde`T\_WV eŽ7ZX f cV%SRI\df a eYZIT \_T]f dZ \_ Sj dY hZ\_XLcVXZ \_ Sj cVXZ\_ŁY`h VRIY`V&YV95: RohVTedUV&V(`aVU SVehW "\*\*! R U#!!!ŽH YReZedY hdZdeyReYf} ^ R\_ Uvgy]`a^ V\_eYRd\_`eW]]`hWeYVdR^ VaReY ZRICVXZ OŽEYVUVOZX RURaa ZIRoZ `WafSZT a` ZZZAR UCVXZ\_R decRevXZAWCYf^R\_UVgY`ał ^ V\_edY`f]USVXfZUUSj R\_ RhRcV\_Vdd`WeYVdV aVIF |ZRZEZKÓŻ9 Ręz\_XdeRezteZIR Z\_UZIRe odeyReyVja  $e^{2}XV_{e$ 





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EYVZJAR`WAYReZHy4YZJAR\_%ZGRdTZA]T\_defTe eYReYRdXGUFR]jjTgdR]JZAU`gAceZVZ\_WWJ Z\_X4Ld^S`]dR\_Uh`dLdLR\_UZedRIeFRZj`c]RT `VVEUVAV\_Ud`\_Y`haVa]VZ\_eVcackeR\_UcVJReV e`eYVdZEYVacVJZ\_ZRgYja`eYVdZl`VAYVeAR` eYReT^aZJAUeYVCVA`cehRdeYReaVa]VhVcV\_` ]`\_X4cTJVAcRde`hYReT\_deZfeVUeYV4YZJAR\_ ZJV\_eZjR\_UhVcVRaac`RIYZ\_XeYZIZJV\_eZjR\_UZed ^R\_ZWAREZ\_dhZeYTcZcZRJUARIY^V\_eZ

2TT  $dZ_X_{j}HR_Va^{}_{a}$   $de g de U hRtT_UTEVU$ e UMZ ZeeV d S $der_TV WeZd$  TOZZTRJEUVERTYVU  $cV_{REZ_dYZa}$  hZY  $eVVZVR WeYZVR_Ue VeHSSJZY$  $d ^ VSR dT UZWWEV_TVd Weaac RIY R^ __XUZWWd$  $V_{ea} af JRZ_Xc$  f ad ZH YRehRdR\_Rj dVL da VIZJ $TR_{j}HVVT_gVcReZ_dR^ _XaV a JVhY YRU$  $_VgVc <math>ad VgZ f dj ^ VeRS f e hYRe hRd y4 YZVR_{m}$  $R_U hYRe Ze ^ VR_e e SV 4 YZVR_ZEYZUVRSJVU$  $eYV eVR^ e ^ Sd vgV hYRe Z RXd W4 YZV hVV$  $<math>Tf ccV_ej a cVU^ Z R_eLR_UY h aV a JV cVJReVU$ e eVV Z

 $EYV yLZIIF dZ _ Xc f a & eVIY_Zof V h Rd f dU$  I: Si DWL"\*) & Z7 c eYV dv VIZ T af ca`dvd`VeYV  $V(a)`de`g`Yja`eYvZeYZd^VeY`UYRCH_{ER_dXd}`gVc`eYVcdwTY_Zof VeY`UYRCH_{ER_dXd}`gVc`eYVcdwTYTV_eeVUeVTY_Zof VeY`_RUZIIF d
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 $\begin{array}{l} SVR1VceRZ_VLZ5ZIIf dtZ_XcfadTR_SVfdvUe \\ cvT_defTeeYV^VR_ZXRdfS[VTeTRczZdZ_afS]ZT \\ T_gvtcReZ_Z \end{array}$ 

EYVdARCTYWcf\_Zj`VUZCT fcdVZthYReXfZVd eYVT ^ a`d&Z\_`V&YVdR`a]VŽEYZtYRde`SVRd Sc`RUR\_UUZgVdVRdZt\_WUVUe`dRefdReVRUZt T fcdVR\_UZed^R[`cUZWWCV\_eZReZ\_dŽEYV^ VeY`U Ztle`deRcehZeYRSRdZfdR`a]VR\_UeYV\_fdVeYV cVcf]ed`V&YVh`c\U\_VhZeYZee`UV&C^Z\_VY`h ^ R\_j Xc`fadRcV\_WUVUe`T ^ a]V&VeYVdVRcTYL R\_UhYReeYVZcT ^ a`d&Z\_dY`f]USVŽ

7 c eYVT \_gVcReZ\_dRS`fe 4 YZVR\_ ZV\_eZejŁ eYVZ\_ZZEJ dR`a]VZ\_T]fUVUWfc Xc fad+

$$\label{eq:linear} \begin{split} & \dagger > Z W X \hat{\ } fa \ \ W \hat{\ } f_X a \hat{\ } c R f ] ed W \wedge e W \\ & ] \hat{\ } h \ d \ T Z \hat{\ } V T \hat{\ } \hat{\ } \hat{\ } Z X \hat{\ } fa \tilde{\ } \\ \end{split}$$

$$\label{eq:constraint} \begin{split} & \dagger > Z W X \hat{c} fa `W f_X R U f] ed W \wedge eY V \underline{Z} eV d \\ & \wedge V U \overline{A} e V d T Z V T_ ` \wedge Z T X \hat{c} fa \tilde{Z} \end{split}$$

† > ZIVUX°.fa`Vÿ`f\_XRUf]edW'^ eYVYZXY d`TZIVT\_`^ZTX°.faŽ

 $\label{eq:constraint} EYV eV def dWe \ dMV le eVV a Rez ZZaR_edT_dL \\ VeV eVVW] \ h \_XTYR REV ZeZd+$ 

 $\dagger$  D TZ  $\dagger$  VT \_ ` ^ ZT ]VgV]+ a Vcd \_R] Z\_T ^ VŁ h VR]eVŁ YVR]eY d deV^ Ł VUFTReZ \_Ł ` TTF a ReZ \_ ` W eYVY' f dV' ]UYVRUŁej a V' WUFTReZ \_R] VdeVS ]ZM ^ V\_e ReeV\_UVUŽ

$$\label{eq:constraint} \begin{split} &\dagger = ZWdig ~ [V4a]RIV ` WdvdLV_TVL`h_`cTYZUUV_d' \\ &a]RIV ` Wdef Uj Laf cTYRUZ_X UVIZZ_dLa]RIV ` W \\ &h`c\Z \end{split}$$

 $\uparrow$  A`]ZEZIR] eV\_UV\_Tj +`cZV\_eReZ\_ŽARcej RM/ZL ReZ\_Ž

 $\begin{array}{l} 4 \ \underline{R} \ \underline{UZ} \ \underline{Revch} Y \ \underline{W}_{1} \ \underline{Z} \ \underline{e} \ \underline{e} Y V W_{1} \ \underline{N} \ \underline{Z} \ \underline{X} \ \underline{Revc} \ \underline{A} \ \underline$ 

 $\begin{array}{l} EYVT `dZ_Re`cZ_eVCWCVURd]Zee]VRda`ddS]VZ_\\ eYVXc`fa~Uj_R^ ZTR_UT_gVcReZ_ hRd~deZ~fd\\ ]ReVUSj~eYVW]]`hZ_XbfVdeZ_d+=VedeR]\RS`fe\\ 4YZVLhYRe~ReVeYV4YZVR_d]ZVO2_UhYRe~U \end{array}$ 

j`f eYZ\_\RS`fe4YZVdXVXRaYjR\_U]R\_UHRaVO HYReU VdeYZddye jf 1dr hZ\_XeYV R4YZVR\_ ~RXOH YReZd4YZVdYZEgjZVO9`hU 4YZ VR\_deR]\OH YReRVhV4YZVR\_d]ZVT ^ aRAVUe \_VZXS`fcZ\_XTf\_c6ZdO

$$\label{eq:linear} \begin{split} & 2]] eVXc\ fad^ VeZ\ acV^ ZMdaVIZA] j\ Vbf ZaaVU\\ & Wc\ eYZlej aV^ Wh^chŽ6RIY\ dvdtZ_ hRd Uf ] j\ cVI\\ & T\ dVU\ R_U\ ecR_dTcSVLŽ3VdLVd\ eVV^ `UvRe`d.\\ & ch^ `ceYcW^ SdvgVcdhReIYVUVRIY\ dvdtZ_ W^^ \\ & SVYZ_UR^ Zc^ čZ YVecR_dTcSVU^ ReVcZI hRd cde\\ & R_Rj\ dVUdaRcReVj\ Sj\ eYcW^ V^ SVcd^ VeYVeR^ \\ & T\ ^aZZ_XeYVCVa\ ceR_UR_ `fedZVVI aVcd.R_U\\ & eY_ [`Zejj\ f_UvceYV]RevcdfaVcgZZ_Ž \end{split}$$

:\_ R] eVXcfadLT\_gVaReZ\_RS`fe4YZVR\_ ZV\_e&j daZJj e`\dravLgRJZReZ\_XeVVZ,Z&R Yja`eVVdvŽEYZIdr`hdeYReRT&ZZR]j UV&RIYVU Raac`RIY'e`eVVd'S[VTeZI\_`h R\_VdHS]ZhVUWR efd'`W&gVgUJJ T\_gVaReZ\_Ž7fceVVc^`cVLeVV T\_gVaReZ\_daZJj dRefdeVULhYZIY'dr`hdeh` eYZ\_XdZ7ZadajLeYVCVZIRV&CUXcW`VT\_dV\_dfd `\_ eVVd'S[VTeR``\_XUZWWCV\_eXcfadZDVT\_UjL eYV SRdZT dR`a]VhRd d'WIZV\_eVcVa]`dRe`g afca`dvdŽ

# ;; ł 1 Ł 'I ä

Gh Xmcb dYfWrdhcbgcZ7\]Y ]b X]ZZrfYbhUgdYWgcZ`]Zrži g]b[ ZcWig[fci dgUbX d\chc[fUd\]WWc``U[Y

EYV UZII ġVġ eYRe eYV 4 YZYR\_ZV eĞ hRd XV\_VR]j clackd/eUR1YRgZX]`de TcVUSZZġ LRd UV:TcSSVUZ\_RaaV\_UZ "Ł^ RUZe\_VTVdR; e`]``\ ^`cVI]`d/j ReeYVTYRRIEVCZEZIdR\_UgRZFeZ\_d`W eYZlclackd/\_dEZ\_RIZec/JReVUe`UZWKV\_eRtaVTed `VVZVVŽEYVRZ`hRde`cVT\_decfTeaVa]VdgZhd `VVZVVŽEYVRZ`hRde`cVT\_decfTeaVa]VdgZhd `VVZVVZ ZjEh`cVET\_d^az\_LVXVv2`VEa`[ZZTd R\_UcVZXZ\_R\_UEReeYVCR`VeZ`VEc`cVT\_decfTe eYVUXWKV\_eXcTz\_`eYVcR2`LJRtejjEhRde`R1VcHZ\_ hYRe \ZUd`VXLV\_eZZdeYVaRozZZAR\_edSVJZgVU hV2VV VXZ\_XZ\_4YZNŽ

 ^ `cVeYZ1eZ`V`\_ ^  $RZ_decVR^$  ` $aZ_Z_dZ_VRIY$  $RVReYR_{} = eVVXV_VR_U_R^{T}U_R^{T}W_gVaR_Z_Z$ EYZIZIEYVWWIFdXcfa%eWIYZbfVi>Vce\_Ł7ZthV  $R_U < V_UR$ ]L" \*& /Ž2dhVhVcVRS]Ve JVRc\_Z eVV bf RZRozevolf Uj Uváliczsvuz Raav uz "Łevyzzh `W4YZWR\_ZW\_eZej Rdd^VeYZ\_XZ'a|RfdZsjVZdgVej hZNdacVRUR\_UeYV|R\_XFRXV\_WUVUe`RceZIf |ReV ^`cVdaVIZ TVRIed`cVWZ XdZdfdTR]ji |RI\Z XŽ:e Zd\_`c^ R] Wc\_Vh `c V^ VcXZ\_XaYV\_`^ V\_Re` SV  $UZIF dW Z_{2} Z ZW c^{A} W df_{2}$ d TY 62' VRdR\_ Raac' ac2ReVL]VXE2' ReVU]R\_XFRXV  $YRdSW_Ugy^{a}WWceR_ZRS^{f}eeVV_Z afSt$ ]ZIŽ:ehRdeYfde`SVViaVTeVUeYReT\_gVcReZ\_d RS`fe4YZVR\_ZVL@252K1Ree2fUKdR\_USVRgZfcZ\_ daVTZ/TR:VRdh`f]USVT\_dedRZ\_WSj eYVaRfTZej `WR\_XFRXŽE` UVR] hZEY eYZtlac`S]V^ Łac` [VTezev eVTY\_ZofVdhVeVfdVUe`deZ`f]ReVT\_gVdReZ\_Ž HZeYeVdVeVTY\_ZofVdLWWJZ\_XdR\_U`aZ\_Z\_dReV } cdeZU/eZ;VUeVc`fXYaVa]VdTY`ZIV`WS[VTed`c Z`RXddVacVdV\_eZ\_XeVV`ŁRANchYZIYUZETfdZ\_ `VAYVZc^VR\_ZXSVXZ\_dŽ

:\_ eYZITRALEAVVaRozZZAR\_edhV&VUZZAUUZ\_e` eh`Xc`fad`VNS`fe}gVŽ6RIY`WAVV hRdXZgV\_ RWJUVc`VVT]`fcaY`e`XRaYdeR.V\_WV^ 4YZJ VR\_ ^RXRzZ\_VdR\_U\_VhdaRaVcdŽEYVj hV&VeVV\_ Rd.VUe`fdVeYVdVaY`e`XRaYde` ^R.VRT]]RXV cVacVdV\_eZ\_X hYRe e`URj`d 4 YZJV R\_U Zed aV a]V ^VR ee`eYV^Ž

@\_TV KRY d'SXc fa YRU UVAICZSVU ZedT ]]RXL T\_gVaReZ\_SVAR\_ŽE YZIh RIXF ZJUUSj RT`dZ\_R e`chY`W]`h VURdIYVLf]V`VSc`RUbf V&Z\_dL`W eYVej a V+y=VédeR]\RS`fea`]ZEZdŽH YReZda`]ZEZd  $[ZVZ_4YZ]V0\%cy=VédeR]$ \RS`feT\_d^ a $eZ_L$ Y`h U\_4YZ]VR\_dT\_d^ V0‰ EYZdeVIY\_Zbf VhRdRaa]ZUZ\_" ! Xc f ad h Y dv UZteZsf eZ\_Zdd' h\_Z\_ eVVeRS]VŽ

EYVX: fah`c\hRtIRczU`feZ acV ZkłdaW TZR]j VbfZaaVUV: eYVafca`dŽEYVX: fadhV V XfZNUSj RdaVIZRZeR\_U`SdkgVUV/^ SVZ\_UR ^ Zc`cSj eh``ceYdW`eYVcdaVIZRZedŽEYVX: fa RizzzzdhVVT\_UFTeVUZ\_5VTV^SV: #!!! R\_U ;R\_fRj #!!"HR\_UeYVT\_gkcRz\_dhVdvT dAU R\_UecR\_dIcZSVUŽ

EYVXĉfah`c\ckf]&UZ\_RVKCjj VXVViTYR\_XV `V&ZhdZ\_eYVRVRdSVZ\_XT\_dLXCVUŽEYVCVhRd RYZXY]V&J `VKXCW^V\_eR^`\_\_XeVVXĉfadŽHV hVCVf\_RSJVLY`hV&VLeR`\_\_XeVVXĉfadŽHV hVCVf\_RSJVLY`hV&VLeR`\_\_XeVVXĉfad cV&Y\_XZ\_V\_&ZZdZ\_4YZVZ2\_RjdCl`V&VVXĉfad cV&VZ\_XZV\_&ZZdZ\_4YZVZ2\_RjdCl`V&VVXĉfad cV&VALXER\_\_\_eVVYTJVeVCVhRd\_``cXR\_ZXU aVCTVáeZ\_`V&YVHJJ4YZVR\_ReEfUVdR\_USVI YRZfcYRUUV&J`aVUŽ

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$$\label{eq:started_fig} \begin{split} & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Åg \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Ag \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Ag \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Ag \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Ag \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Ag \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Ag \end{tabular} 2 & \end{tabular} 2 & \end{tabular} \\ & fi \P^2 \, gz \, Ag \end{tabular} 2 & \e$$

# =b!XYdh`]bhYfj ]YkgXYU`]b[ k]h`h`YdgmWcgcWU``XmbUa ]Wg`cZ]bX|j ]Xi U`]nUhcb

# GL 6>97 HG = BJ 9GH; 5 H98

EYVZ\_ekkgZuhddfXYee`UZT gkchYReTYR\_Xkd aV a]VYRU\_`eZIVUZ\_eYVZc`h\_]ZgkdLW/^`\_\_V XV\_kReZ\_e`eYV\_VieR\_UZ\_dTZkgj XV\_kR]jj Z\_ eYVW]`hZ\_XRxNRd=T fa]VdLeYVNR^ZjLh`c\LWW eZ\_VLh`c\Z\_X`cdefUjZ\_XeZ\_VZEYVj R]d dfXYe e`RdIVceRZ\_hYReaV a]VWjedTZkgj ViaVReVU`W eYV^R\_UYRUe``WWCeYV^Z\_eYkd/RcVRdR\_U hYRegjaVd`WMJWZ^RXVeYVj YRULZ\_cVJReZ\_ S`eY'e`eYVZcRSZZej e`RIER\_Ue`eYV deReVXZd V`a]`jVUŽ

Gfi Wi fYUbXWcbhYbhcZJXYbh]miUbX``]ZY` d`Ubb]b[

EYV cVdNRcTY WIF dVU  $\ R$  Decf Tef cV+ WWZ X  $WT YWZ TVZ ZV eq R_U ZWa]R_ZXL c W$ ^ f]eZa]ZZZj R\_UT ^ a]ViZjŽAcVdV\_TV cRSdV\_TV W  $d^{TZR}$  UV R\_U $d^{TZ}$  af edR\_U\_`c^  $dZ \sim fV_{TZ}$  XeYV def Tef cV $^ UUV_{eZ}$  R\_U ]ZWa ]R\_Z\_XŽAVcTVaeZ\_ `WANNARCAZ\_REZ\_gVcfdVieVc\_RIUVARCAZ\_REZ\_  $\underline{Z}$  cV[ReZ\_e e eV/decf Tef cV VXLV\_e2e R\_U]ZVVa]R\_1  $\underline{Z}XZS/4$   $\underline{eV}$   $^{N}$  VR\_Z\_XZ\_T]f UVUZ\_UV}\_ZZ\_d` VXUV\_eZ; R\_U]ZW a R Z XŽD TZR TRAX cZkdeYRe aV a VTf ccV eji fd/e`ZV\_eZyVeYV\_d/gvd1XV\_UVeLdTZR]T]RdeL ac`WKHZ\_Ła`]ZEZTR]`CZV\_eReZ\_ŁCV]ZXZ\_ŁVEIŽŽ D'TZR UV'  $R_Ut__c' dR_U Z_a f ed eYRe aV a V$  $V_aV_{Z_T} = V_eV_e = V_{Z_T} = V_eV_e$  $h_ZV_{eee}$  $UZIdZ_dSVdhW_aVdd_R]ViaVdZ/TVR_UVieVc_R]$ UV R\_UdRdeYV (RWW TeeYVT\_eV\_e`W LV\_eZe; R\_U ZWWa R ZXŽ

# DYfWYdh]cb<sup>-</sup>cZWUb[Yg

 $\begin{array}{c} AkčIkácZ_{} `VIYR_XkdZ_ZkV_czj R_U]ZWa]R_{} \\ \_Z_X `gkc eYVZ_UZgZLFR]d`h_ ]ZWcZ_VR_UZ_\\ T ^ aRcZd_ hZeY VRc]Zc XV_kReZ_cZ6]V^ V_cd \\ d`S[VIczgVj ZkV_cz] kURdTRfdkdR_UT_dkbfV_Tkd \\ `VeYVTYR_XkdZAkcTkácZ_ `VeVkd_R]TRaRSZZC2d \\ R_U dr`ceT ^ Z_XdZ_eVVdRcTY Wc decReWZde \\ T aVhZeY eYVTYR_XkdZ \\ \end{array}$ 

### 85H5;5H≰9F-B;

EYV d^ Zdef Tef cVU Z eVegZh eVTY\_Zof V hRd fdVU e`T]]VTe URHŽ9`h VgVLhYV\_eVVWTfd`W Z gvdžXReZ\_hRd`\_eVVTYR\_XddV a VeZ/TVU Sj Z eVegZh VdRe UZWWEV\_edHXxdZ\_eVZE`h\_]ZgvdL `c`\_Y`h eYVj dh eVZE]ZgvdSj T ^ aReZt\_hZeV eY`dv`WRc]Zic XV\_VReZ\_dd ^ VRTegvZ eVegZh eVTY\_Zof Vdh VeV fdvUZ:\_eVzTTRMLZ eVegZh Vd h VeV acvdV\_eVU Sj hRj `WeZ f]fd' hZeV deReM ^ V\_edRS`fe XV\_VER TYR\_XdT\_dZVEVU e`YRgV `TTfccVUZ\_UZWWEV\_e ReVRd`VURZj [ZWR\_U eYV\_ RthVUY`h eYVj YRU VI a VeZV\_TVU eYVdV 1ZVEYVj YRU/Z eVVZC`h\_]ZgvdZA`\_W2V d'S[VTe`\_YR\_UL Z eVegZh WdT f]U RU a eLUZUTfdd`c TYR]V\_XVR a`dEZ\_Ž

EYV <u>Z</u>ekgZh h`c\ hRd TRczUU`feSVehW\_ ?`gV SVc#!!! <u>R</u>U> RcTY #!!"Ž

# G5AD@B;

 $H ` c \ Z X Y a ` e V d d d XX d U e Y e e V d S [V] e$  $e g V R d V l e (` Y L V e g T _ d e d T e Z _ R_U ] Z W a ] R_ l$  $_ Z X h V V Z ~ f V_T U S j ` S [V l e g V W l e d f T Y R d e Y V d X V Z e e V ] Z W I j T] V e Y e Z U g Z L F R d Y R U c V R I Y U$  $R_U e Y V g a V W R a R S Z e X d a c g Z N U S j e V Z d T Z l$  $V T _ ` ^ Z T X c f a L X / U C R_U V a ] ` j ^ V e a ` d E Z _ Ž$ E Y V d V T Z E X G R h V V f d U e ` d e f T e c V e Y V R ` a ] V $h Y Z Y h R e ` T _ e Z % Z e X g Z h V d U Z t e Z f e U Z$  $R T d R_T V h Z Y e V W] ` h Z X T Y R R E X Z t A$ 

GHU[Y]b`]ZYWMWY

1eYVZC^ RZ\_ TYRERIEWSZECT ZIEYREEYY YRGV\_`ej VE ^`gVUe`h RdUdZ\_UVAV\_UV\_TVZ\_ R\_j RVR/

 $\label{eq:linear} \begin{array}{c} \uparrow AV a]VhY RVSWZ_ZXe^{SVT} VZUVI \\ aV_UV_e^{V} \uparrow e^{V}ZVP^{*}ZZdZ^{-}V^c^{*}dVRVRd \\ 1dReZXRVP^{*}ZjLaRdV_e^{*}ULSWZ_ZXh^cd^{*} \end{array}$ 

† AV a]VhY`RtVReeYVT\_d`]ZRtZ\_dtRtVZ eYV dkejVU RtaVTed`VeYVZ:]Zgvd1h`c\LaRce\_VtL ac`SRS]j hZtY RU`]VtTV\_eTYZUV\_/

† AV a]VReeYVa`dHT\_d`]Z.RZ\_dHXVhY`YRgV T^a]V&UeYVy^R[`c]ZWARd\chaaRcV\_cZ\_XLh`c\L VEIŽLXV\_VAR]j``WA&ZV^V\_eRXV

# C ₩₩ dUh]c b

† Def UV\_edıZ\_T]f UZ\_Xj`f\_XaV a]VhY`YRgV Uc`aaUU`fe`WdIY``}∕

†9`fdMhZgVd

 $\label{eq:constraint} $$ Ac`WddZ_R]dR_U daVIZR]ZkW h`c\Vd1dV]W V`a]`jW`c`eVdhZb/$ 

 $F_dZWh^cVd$ 

2d dXRUd eVV`eVvc TYRRTeVZteZd1DR\_eAX gVcfd dVXZ\_dLD68 R\_U dM/LeVV dR^a]VhRd UZteZsfeVURdW]]`hd+

 $\label{eq:product} $$ FY[]cbg "! 1#^ WZ^ IYZY R_UYZY d TZ I $$ VT_`^ ZT]VgVL%ZeVC^ WZEVR_U^ WZ ^ I]`h d TZ IVT_`^ ZT]VgVL%]`h R_U WacZgVU d TZ I $$ VT_`^ ZT]VgV/Z:_eVcZgXhdh VCVYUUZ_eVVTZZd `Wbf Zbf VL4`bf Z`S`LGZRUV] > RLIR_eR4cf kL 4`_TVaTZ_L4`c`_V] R_UGZ]RccZR$ 

; 'A Yb.'"\*

; Kca Yb. #"

# 85H5 5B5@MG=G

EYV} adeatevá Z\_R\_Rj dZ\_XUReRh Rde` dVT\_deaf Te eYV]`XZTf\_UVdjZXeYVZeVcgZhWd\_RccRoZcVRd RhY`]VŽEYZlac`gZUURcWWCV\_TVa`Z\_ee`V\_dfcV eYRe df Sdybf V\_e R\_Rjj dyd R\_U eYV XV\_VdR] ^ `UVjd UVCZęVU W/^ eYV^ UZU\_`e UZde`ce eYV`cZXZ\_R ^ WR\_Z\_X`WWRIY\_RccRezgVŽEYVZ\_eVcgZ/hdhVćV eYV\_TUVUŽEYZdhRdU\_VSjWRXXVeZXeYV \_RcRezevelt\_TvafRzzXeYV\_R\_UeYV\_cVRez\_X eYVT\_TVacfR] ^ ReVZR] `SeRZ\_VLŽEYV cV[ReZ\_d R^ `\_XT\_TVaedR\_UR^ `\_XTReVX cZdXV\_VReVU eYc`f XY eYVT UZ\_Xac`TVdddvgyURdh`c\Z\_XYj } a`eYVdVdZEYVdVhVcVfdVURdTcZeVcZRVVcTRcgZX `feac`XcVddgVdR`a]VdvJVTeZ\_ŁZ`ac`gZ\_XeYV ZelogZh XfZMZVdRUWkeYVćVRS`deZXeYV  $\mathbb{Z}$ ZZZR] dIYV^ ReR `WR\_Rj dZZE YZClac` TVUf dV hRd Va] jUf\_eZeYVcVeZRdefdReZ `VeYVT\_ł TVaf RI TREVX cZid XV\_VCREVU Sj eYV R\_RIj dZI YRU SW\_RIYZgVUŁŻŻEſ\_eŹełVa`ZehYVċVowoł/UReR  $VZEYVCRUVU_Vh Z_WC^ ReZ__` cZ_gRJZ_REVUeYV$ h`c\ZXYja`eYVdVdŽ

 $\begin{array}{l} & {\rm EYZ}(R,R) \in {\rm ZR} \ {\rm ac} \ {\rm TVUF} \, {\rm eV} \, {\rm YU} \ {\rm eh} \ {\rm de} {\rm XV} \ {\rm de} \ {\rm UV} \ {\rm d} {\rm ICZ} \ {\rm deg} \ {\rm VR},R) \ {\rm d} {\rm d} {\rm ICZ} \ {\rm deg} \ {\rm VR},R) \ {\rm d} {\rm d} {\rm d} {\rm R} \ {\rm Z}_R \ {\rm R},R) \ {\rm d} {\rm d} {\rm Z} \ {\rm Z} \ {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d} {\rm d} {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d} {\rm d} {\rm d} {\rm d} {\rm Z} \ {\rm d} {\rm d$ 

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`c T \_\_\_VI&Z\_d R``\_X eYV UXW&V\_e T \_eV\_ed j ZJUVU Sj eYVUVIICZa&ZVVEY UXW&V\_e T \_eV\_ed j ZJUVU Sj eYVUVIICZa&ZVVE EYZIR\_Rj dZIZ\_TJf UVdh` d TTVdtZVdEXA: RZ/  $TUZ_XR_U dJVI &ZVTUZ_XI = X eYVVVC^ V&UZWA$  $V_e T ^ acVY_dZV^ `UJdh VXX_VE&UVC^YV$  $RaVIedZV_eZ_VURICZ_eZ_aV a]Vda VCIVaeZ_d$  $`VeYVZc d cc f_UZ_X&Z_ eYVRVRd`VeYVV? ZjL$  $T fa]V&h`c\ R_UV&VeZ_VLR_UZ_ZV_eZj R_U$  $JZWa]R_Z_XZ6RIY RVRCVacVdV_edR_RZIRc`f_U$  $hYZTY eYV V/V V_ed`W VR_ZXT_d&E eZ XZ$  $RVRcR_XVZ:_ eYV]ReV&LR Wh_1eYCW_XV_VR$  $T ^ acVY_dZV^ `UJdh VCVT_def TeVLVRTY`W$  $eYV^ JZ_ZXe X&YC eYVVdV_eX] RaVIed`VeYV$  $<math>^VR_Z_XIR_UU_J_R^2Zd cacVdV_eVURc`f_U eYV$  $RZJ UZ_VeZ_Z$ 

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%"8YgW[dh]cbcZYjYfmXUm`]ZY ?RccReZzVaRce

E` SVZ\_ hZAL: h`f]U]ZVJ`f e` eVJ] ^ VhYReR \_`c^R] hVXUB ZJZVVCj`fLVC/ eVvZ Vj`f Xie fa e` eVVZ Vj`f X e` SVŽ

> R.Vdf dVeYReh YReW][`hdZl/Vaedr` œŽ:\_ł bf ZtVZ\_e` eYVeYdWR:VRd+T fa]VR\_UVR^ Zj 1d/aR dR/j/Lh`c\R\_UV&Vv2 VŽ4]RZjVSRdTRd=VRd`W eYVd/R:VRdRdeYVj T ^ Vfa Z\_ eYV\_RcdRzgvŽi6ŽXŽ hY ^ U j`f]ZgVhZeYR\_UdZ\_TVhYV\_LhYReU Vd j`fch`c\V\_dRZLY`h]`\_XU Vdj`fcURj]RdHhYRe U j`f adWkce`U Z\_j`fcV&Vv2 VLVETŽ

:WAYY U`\_`eT^Vfa\_RefoR]jjZ\_eYV\_RocReZgVL Rol, WcUXIICZeZ\_d`WKRIY RAKUZAVIEjŽ2d,Y`h eYY\_CVT\_TZVh`c\R\_UWR^ZjŁX/UVcCVREZ\_CŽ

 $HYRe Zdj`fch`c\]ZV07ZU`feY`h^R_j$ Y`fcdReVh`c\UUR\_UhYReeZ`VeVVh`c\ZXURj SVZ\_dR\_UV\_UČZ

HYReUj f U Z j f c VAVVeZ VO

9 `h h`f]Uj`fUdEZV`cTREREXEXVeVVeVVeV &\_dZaj`fYRgVhZeYj`fcaRce\_Ve02\_UhZeYj`fc We^ZjL`ceVVaVa]Vj`f]ZgVhZeVO

5`j`f WWJT)`dVe``cZU\_eZ; WUhZeYd^VdTZe? X`fa`ceV\_UV\_Tj05`j`f aRceZTZaReVZ\_R\_jX`fa `c`cXR\_ZAReZ\_0 &" 7 \Ub[ Yg]b Yj YfmXUm`]Z/ A]R\_ 2+@aV\_ Z\_gV6ZREZ\_

2dTvoetZ\_hYveYvCaVa]VYRgV\_`e2TvUTYR\_XveL R\_UZ\_hYReRXRdŽ4`\_}\_Vj`focM/We'eYVTYR\_Xvel eYVjSoZ\_Xfaob`\_eR\_VfdjEVgV\_ZWeYvOvOv/ReVe` [foeRodZ\_X]VRAVRLR\_URoN\_RS`fe+

† 9`h eVVj gZvh eVV TYR\_XVdLZ\_aReeZff]Rc hYVeYVceVVj dWeVV^RdeYVdVdf]e`VeYVZc`h\_ Z\_ZZFRegVL`WVieVc\_RJUV^R\_Ud`cZ'a`dEZ\_dL`c `WT\_eZ\_XV\_TZXd

†EYVZcdfS[VTægVVIaVZZ\_TV`WYYR\_XVR\_UhYRe YRde`SVU\_Ve`RURaee`ZeidedZ\_dLT\_ecRUZ1 eZ\_dLVIa]R\_REZ\_deYVJYRgVe`XgV`eYVcdLT aZ\_X deReVXZdLVEIŽ

†9`heYy VgRfReveYdVTYR\_Xv&ZŽZLa`d&zgVj `c\_VXRzZgVj

=BjeYVdeVdd\_`ed ^fTY`\_eYVUVdTcZaeZ\_`W eYVTYR\_Xd1Rd`\_WWJZ\_Xd+ya]VRcfcVd%R\_UyZcZER eZ\_d%Sc`fXYeSjeYVTYR\_XdŽ

Egie``SeRZ\_RTJVRcUVETCZaeZ\_``WeYVTYR\_XV SVehW\_eYVacVeLe^`^V\_eR\_UeYVeZ`VhZeY hYZIY eYVT ^ aReZt]\_ZtJSVZ\_X^RUVZ2ch Z\_eVet gZhWete daVTZfVeYVaVcZU`gVchYZIY eYVJ ReV ^ R.Z\_XeYVT ^ aReZt]\_ 1S`eY Z\_eYVZc`h\_]ZgVet R\_UZ\_cVJReZ\_e`VRcJZcXV\_VReZ\_dŽ

? `h : \\_ `h RSZe^ `cVRS`fej`fL:  $hR_ee$  Rd, j`f e`eVJ] ^ VZV/f eVZ \ j`fc]ZVVRdIVR\_XUT^1 aRcVUe` hYReZehRdSWCVieVZIbf VdZ\_ZI^ `cVRaac`acZeVVkc^ ZUJVIRXU`c`]UvcaV a]VŽ

:  $h`f]UR_{d} [ZVe` \ 'h Zy'f eY_ AZXHYgV TYR_XUh YV_j`f T^aReVj`fc]ZWhZYeV/Zyd`W VR_ZCXV VRZ_dtj`fcaReV_ed_VCZ_dR_TVZ$ 

9 `h YRGVJ` f VaVZV\_TVU1UZUJ` f VaVZV\_TVRV j` f VaVZV\_TZ\_X eYVTYR\_XdRdeYY YRGVR\V\_1Rd eYY e``\`ZR\V a]RTVO9 `h YRGVJ` f TaVUhZY eYV O 5 `j` f WWJ eYY YRGVRWWWEVUJ` f aRceZff [Rc]j` cRcV eYY TYR\_XdeYRe YRGVRWWWEVU` eYvcaVa]VRchV][O

 $HYReUj f eYZ \setminus eYAVTYR_XdRcVUFVeO$ 

Z\_eWeYZ\_XIeYReReVZ\_a`ceR\_ee`j`fOHYReReV eV/SV&R\_Uh`cobeYZ\_XIRS`feeYZITYR\_XIO(ScZ\_X Z\_WWJZ\_XX

H YReX`UR\_USRUT\_dbfV\_TXANgveYAVTYR\_XAd YRUVk:j`fc]ZWZ\_aRceZff]RcO

HYV\_aVa]VU\_`eefTY`\_R] eYoWRANd `WWgNgUBj [ZWITfa]VINR^ZjLh`c\LWWWeZVV `WeNVZc`h\_RTTdLeYVZ\_eNgZhNocdr'f]USoZ\_X faeYV`\_V`c`\_Vd`^ZeNUR\_URd\eYV`e`ac`l gZUNRUMEZaeZ\_R\_UeYV\_R\_RHANdh`V\_e`WeYV TYR\_XAZ

A]R\_3+8fZJUZ\_gVdzXReZ\_

 $: W^{T}_{X} TR_X dRV^ V_{eZ}_W da^{eR}_V f dj W I$ If dZ\_ekgZh Wd^\_ `\_V^ WeYVeYCW da VIZ, TRARd R\_ULZ\_ eYVyRIZZVZ\_ekgZh % dej ]VLURh eYVZ; Rel eV\_eZ\_ e^TYR\_X dR\_U eYV\_ }\_U`f eh YVEYVceYVj Raa]j Z\_eVZ; ]ZzVLSWKVX Z\_X`\_e`e^VZ; TRf dR] V\_a]R\_REZ\_dR\_U RdVdf' V\_eRdZ\_A]R\_ 2Ž

:\_ `eYkćZekógZhoLd^ VaVa/VYRgVe`/UfdeYRe eYkVYRgVSW\_SZXTYR\_XkdiZ\_eYVhB, WY Zj /ZW Zl`cXR\_Z&VL`ceYVhB, Tfa]VdcVJReVL`ceYVhB aVa]Vh`c\R\_UeYVZ:VaVZZ\_TV`Vh`c\L`ceYV hBj aVa]VViaVZZ\_TVeYVZ:V&WeZ\_VZ9RdR\_jł eYZ\_X/Z/VeYZHRaaV\_VUe`j`fO

:WeYY U dTTWUZ ZN\_eZYZ\_XTYR\_X/LeYV ZevlgZhVcdrf]UT\_eZfVRdhZeYAJR\_2Ž

# ' "`=XYbh]hm

7Z\_U`feYh eYY ZV\_eZyVhZY eYVc]VdeYY YRgVZ\_eYZheYVdV RcNRd/R\_UYh eYY }eZe XcfadZ\_bfZVhR/e hYReVieV\_eeYy cVRUeVdV c]VdRIVddV\_eZR]Z\_UV}\_ZX eYV\ZU`VaVd\_ eYY RcViS/YhZ a`ceR\_eeYVZcc]VZde`eYV, iT/Yh UVa]j\_V\_XXXU eYy WWJ hZeY eYVXcfa `cXcfadT\_TVc\_VUeYZIU`Vd\_`eYRgVe`^VR\_ UJZSVCReV^V`SVcdYZa`VXcfadLZbfZVRdhVJ] Ze`dTZAJTReVX cZdR\_U]ZWdaj]VdhZeYhYZY eYV cVda`\_UV\_eZU/eZVdZ

7Z\_U`fehYRetZ\_eYVZcgZhteYVZcUZWWCV\_ec`]Vd Z\_eYVUZWWCV\_eRCVRdRUUfae`1WWJZ\_Xd`WTYVd V\_TVLT\_ecRUZEZ\_/Ž

# A]R\_ 2

@VR] eYVeY\_XahVgVer]\VURS`feLhYReZZeeARe ^`deUV\_Vdj`fRdRaVcd\_0 :  $UV_ZXeVhRjj$  f RXLYRgVj f SW\_Z ddZVU Sj d^V\_V`cd^VeYZXO

A]R\_ 3

 $J`f YRgVUZWWEV_ec`]V&=RdR d_ERdR h`cVZX$  $aVcd_ERdR WEVVEVEZ`d`aa]j RdRaac`acZeVV&V^$  $hYReZd_`h \_`h_ RS`feeYVaVcd_/ZHYZTYU$  $j`f^`deZV_eZyVhZeVO@dhYZTYU j`f WWJZH``de$  $j`fOTY``dV`_]j`_V`WEVVdVeh` bfVdeZ_de`$  $afee`eYV^Z$ 

HYZYU j`f]Z\VSV&OHYZY`W&V^ h`f]Uj`f ]Z\Ve`de`aUZ\_XO

: \_ UVJ\_ZXeYVhRj j`f RXLYRgVj`f SW\_ZddZVU Sj d^V\_V`cd^VeYZXO

:\_ cV]ReZ\_ e` eYZddy]WUVJ\_ZEZ\_ŁW.a]`cVhYRe aV a]VWWJ yd TZAġ %W aVTed`WeYV`ŁR\_UZWAYCV ReVdecRZ\_d`cT\_ecRUZTeZ\_dSVehW\_hYReePYJ WWJ ZdVI aVTeVU`WeYV`R\_UY`h eYY\_V aVcZV\_TVeYZĔ 7Z\_U`feRS`feT\_~ZTedhZeY eYVdVUV`R\_UdR\_U T aZ\_XdecReWXZdŽ

5`j`f WWJ eVRed TZAġ VraVRedj`f e`SVR aRd eZf JRch Rj0

5 'j 'f WWJelRed TZlej ]RjdUh\_d']VdWcelVhRj j 'f dr'f]UelZ \ R\_URTeZ j 'f c c']VRdh^V\_eZ\_ eW^` 'deZ' a' cdR\_e/O

9 `h U j`f cka`\_Ue` eXkVUV R\_UD9 `h U j`f ^R\_RXVe` TaVhZeY eYZIT\_ecRUZEZ\_O1HYRe U j`f U hYV\_j`f WWJ eAReeY`d/Rc`f\_Uj`f VaVe j`f e` SVR aRceZIF]Rc hRJOHYRe U j`f WWJ JZ/V eVJZ\_XeYV Ø

5`j`f aRceZZaReVZ <u>R</u> j X`fa`c`cXR\_ZAReZ\_O 5`j`f WWJ TJ`dVe``c ZAV\_eZ VU hZeY <u>R</u> j d'ZRJ X`fa`ceV\_UV\_TJO. WeYVR\_dh VcZL\_`+YRgVj`f VgVc SVJ\_XU e` RX`faO@d:UZUj`f ZAV\_eZJVhZeY <u>R</u> j eV\_UV\_TJ Z\_eVVaRdeO6i a]`dVScZV-jŽ

9 'h Z' a'  $ceR_eZdeYZdX$ 'f a e' j'f O@dhYReUVdeVVX'f a cháck $dV_e$ 'c ^ VR\_e' j'f  $OHY_0$ 

HYReX`fah`f]Uj`f]ZVe`SV[\_Xe`0

5` j`f WWJ eYRej`f RCVR d^ VhYRe UZWWEV\_e aVcd\_Z j`fc UZWWEV\_e RIBGZEZCO`c Z UZWWEV\_e RCVRd`Vy?fc]ZWO

:WeYVR\_dh\cZdj\d+*HYReZdZeJZ\VVkcj`fLeYZd* 

 $SVZ_XUZWWEV_eZ_UZWWEV_eRcVRdDV(a)^cVWWJZXd$ Rdd TZReVU hZEY ^ f]GZa]ZZZj/

:\_bfZVRS`feW\_UR`V\_eRJZV\_eEjTYR\_Xd`gVc eYVT fcdV`WZWnRg`ZJScZ\_XZ\_XfaTYR\_XdeYRe ^ZXYeSVViaVReU`gVceYV[ZWIjT]VŽ

 $HY\underline{V} = AVa[VRcVRcVRcVVRS`feeVVLC]Z_{V}dR\underline{V} = UeYy T^{aRcVLZ_{W}RV}eaVZ_{L}dZ_eVVLC`h_]Z_{V}VLd^{V} W eVV dV dV dV_{L}:^{n} _`eeVVdR^VVaVd_ R_j^{-n}`cVZ_{L} H`f]Uj`f dV eVReRS`fej`fcdVVV$ 

( "'@]2Y'd`Ubg

2d. aV aJVY h eYY dWeYV dMgvd Z\_Wef dV 1eg e` }\_U`fe ZWeYY YRgVR JZWaJR\_R\_UZWeYY dW eYZ H RI d ^ VeYZ\_X eYY YRgVT \_def TeVU V/c eYV dMgvd`c Rd d ^ VeYZ\_XZ' a`dvU fa`\_ eYV Sj eYVZ V\_gZ`\_^ V\_eZH YRe U eYY eYZ \ hZJ UVeVc^ Z\_V hYVeYvc eYVZ: Wef dVX Vd`\_V hJJ `c eVV`eYvc0

: h`f]U]ZVj`f e`eV]] ^ VZWhYV\_j`f hVeV j`f\_XVeJ`f VgVca]R\_VU`feY`hj`f hR\_eVUj`fc ]ZWe`SVV0'^eVV\_`\_1TgVceYVUZWVeVeRVRdŽ

7Z\_U`feRS`feeYV\_RefcV`WeYVZcZ:RXV`W eYVWAefdV1ZZZLeYVVieV\_ee`hYZIYZcZlecVReVU RdRfe`aZEL`chYVeYVcRTeZ\_ZlSVZ\_XeR\V\_e` eVRTZAVZeZ

 $5 \text{VdeVhR} j fc ZWZdXZX_h 1Z eVVRVR$ 

 $c \operatorname{ReVRd} V_eZ_WV eR_j j hZeY hYRe j f TV a_R_VU0$ 

HYReTRE dUZee`X eYVhRjZeYRd

HYReh`f]Uj`f]ZVj`fc]ZWiReh`c\ŁZ\_eW WYZjŁZ\_j`fc\WWEVV`e`SV]ZVZ\_VHECO

2cVj`f UZXR\_jeVZXe`^R\VeVZXlh`c\`fe eVRehRj0

 $HYReZdzZVUj f e a]R_VceYReO$ 

5`j`f WWJ eVRehYVeYVc`c\_`ej`f cVRJZkVj`fc a]R\_UVaV\_U'\_j`f`c`\_`eVVceYZ\_XODhYReO

5`j`f WWJj`f RcVViaVIeWUd TZIġ ViaVIedj`f/e` a]<u>R\_j</u>`fc]ZWZ\_RTVceRZ\_hRJO

:Wd+9`h U j`f WWJ RS`feeYZO15` j`f WWJ a]VRCULO5` j`f WWJ eYKCVRCVdeRZ\_d`cT\_eRUZH eZ\_dV

5`j`f WWJdTZAġZłYVjaZXj`f SVhYRej`f hR\_ee`SVO:\_hYRehRjdZdZeUZXeYZO:\_hYRe hRjdZd\_eZO

5 `Vde`UB'dd'ZdjZ 4 YZVXgyj `f c``^ e` VacVdd  $R_UU$ gy[`aj`fc`h\_hBj` VXXZXFS`feeVZXdR\_U j`fc`h\_ JZWa]R\_O

E`V\_UeYZtaRceL: h`f]U]Z.Ve`Rcl,j`f hYRej`f ]Z.VSVdeRS`feetVhRj eYZ\_XRcVVk:j`f\_`hŽ

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 $H Y W c b g f i W j c b c Z Z V \g f c f Y g$ 

 $EYV^{S}[VFezeV^{VeYz(def U} hRde^{RIVeRZ} Y^{h}]ZWYZZe^{ZdhVeVT}_def^{TeVUZ} 4 YZVLY^{h}e^{Yzd}ac^{TVdh^{Z}Ye}YRgVTYR_XULR_UhYRe_VhdedRZ_d^{h}e^{Yz}d^{h}VeVZg^{h}gVUZ_UV_ZX^{Ve}VRgVTYR_XULR_UhYRe_XIZZ_X]ZWa]R_dZe^{YVeVWeV_TVa^{Z}edR_UbfVdeZ_dXe^{Z}Z_X^{e}VVR_RJdZ_HVeVA$ 

H,Y`ghfU]b`VYlk YYb`]XYbh]lmiZ;f`cbYgY`Z# ]XYbh]lmiZ;f`h,Y`ch,Yf

R/H YReR:VeYV cZXZ\_d`WeYVeh` ej aVd`WLV\_ł eZZAD9`h U` eYVateRZ\_d`WeYZtlac`TVdtUVgVJ`a `gVceZ`VO S/9 RgVeYVEVSW\_TYR\_Xd&\Y\_VgV\_ed`gVceYV T f cdV`VeYVaVcd\_d]ZWYZde`g`eYReYRgVSc`\V\_ eYZdUV/ZIReVSRIR\_TVSVchW\_ZUV\_eegi Wc`\_VeN/W R\_UZUV\_eegi Wc`eYV`eYVc09`h YRdeYZdRWWTeVU WWkcede`T\_decfTeR]ZWa]R\_0

=XYbh]hmid`Ubb]b[ #fYU`]nUh]cb

 $S = \frac{1}{2} h R_U Z_h YRe Reverver a R_d c R_Z WU`c$ 

X&V\_d SdR\_TVe UB 02 cVeYy T \_def TeVU`\_ eV SRZEI` VA YReaV a]VdWRdUVZERS]VVCeYV` dAgvd `c`\_]j` VA YRe Zda` dZS]VR\_UaVc^ ZdZS]VZ\_ eV daRIV]VASj eVd TZEJ Z RXZ\_Rcj R\_Uded Tef cV` W `aa` cef \_ZZXdD

 $\label{eq:constraint} T'H YReZ a WAR_U WRIZERe Ade YVC RZREZ_`W$  $\label{eq:constraint} ZMa]R_d DAVCT A acZ_d ZRE AC CZd`WR_R i dE d TZRL$  $TF ]ef cRL VR'Zj Lad TY`]`XZRL V``eZ_RL YZE CZ$  $TRL Z_dEE f eZ_RL VETŽZ$ 

H\Y`Webghfi Whjeb`eZ`jZY`\jghef]Ygžef``jZY` ]ngY`Z

 $\begin{array}{l} R &= Rel j \mbox{ LU } \underline{Z} \mbox{ LZ } I \mbox{ R} d \mbox{ W} \mbox{ eV } L \mbox{ Z} \mbox{ R} d \mbox{ W} \mbox{ eV } L \mbox{ Z} \mbox{ Z} \underline{Z} \mbox{ X} \\ \mbox{ h } Y \mbox{ eV } O \mbox{ H } \mbox{ Re } R \mbox{ eV } V \mbox{ W} \mbox{ ed } \mbox{ d} \mbox{ A} \mbox{ d} \mbox{ eV } \mbox{ R} \mbox{ eV } \mbox{ d} \mbox{ eV } \mbox{ d} \mbox{ d} \mbox{ eV } \mbox{ d} \$ 

 $\begin{array}{l} $S': deYV&R_j \in \mathbb{N}^{\infty} \ Wc \land R_{k} \ Wc & R_{k} \ Wc & R_{k} \ SVZ \ eYVZ \ PVZ$ 

T' H YRe\_Vh `aa`cef\_ZZARVV` VXZ\_XWc eYVT\_decfTeZ\_`V/ZWYZE`cZATh YReREVEYV\_Vh decRZ\_dR\_UWfdecReZ\_dD(@aa`cef\_Zej+VgXejeYZ\_X eYReV\_RS]VdaVa]Ve`WWjeYVjREVac`dEX\_ZdedR\_U XggVdTSdeR\_TVe`eYVZca]R\_dZTH YReZtaRceZTf]Rctj T\_eV`a`dRcjRS`feeYV&VdecRZ\_dD

EYVR\_RJjÓZdevådeYV^ RezZ dr`hZ\_XeYVderRZ d Z\_ZV\_eZej T\_decfTeZ\_ac`TvdtvdZ\_JZWYZde`cZd R\_U JZW a]R\_d1VkefcvácvRJZkReZ\_/ŽE`XfZV eYV cvRuZ\_X`WeYV ^ RecZLLJZW YZde`cZdh VcV`cXR \_ZkVUZ\_e`eh`c`fXY ej aVd+R/JZvdcVRJZkU, S/ JZvda`dea`\_VLŽ

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Eh V]gV ]ZW YZte`cZtcfi h VcV R\_R]j dVLŽE YVdV h VcVcV]RevUSj a``caV a]VVdV^ S`eYfcSR\_ R\_U cf dc] RcVRdR\_USj aV a]VVdV^ eYVfcSR\_ ^ZUJV T]RdER\_Uh VcVT ^ aZVUSVehW\_ "\*\*(R\_U#!!!Ž 2\_RjjdZl`V&YVdčdZdV\_RSJWeYVW]`hZXdSJV e`SVT\_decT&UZ\_RTCdR\_TVhZeYeYVdh` ejaVd ZV\_eZ\_VUŽ

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# HYW\b]WU`bchYgcbh\YIB8D&\$\$%diV`]Wcd]b]cbgifjYm

$$\begin{split} & EYVF\_Z\!AU? R\!e\!Z\_d5 VgM^a^V eAc^X\!R^^V \\ & 1F? 5 A'T^^Z\!t\!LZ_VUE:> 6 C6D62C49 \\ & 4YZVLR^RC^VeCVARCTYT^aR_jLe^VVdZ_R \\ & dR^a]VR\_UTRcj^feeVV}VJLh^cVKR_R\!e\!Z\_hZV \\ & afS]ZT^aZ_Z_dcgVJZEYVZ_def^V_eRaa]ZUhRd \\ & UVgM^aVUSjF? 5 AhZeYdfaa^ceVd^eVVdR^V \\ & T^aR_jZ \\ \end{split}$$

$$\begin{split} & EYV \} VJLh`c\ hRdT\_UFTeVU W'^{-1} 2acd e`\\ & S! > RJ \#!!"ZE`T^a] VeV eV bf VdeZ_RZVL\\ & VRIVe \} VRIVZ_eVcgZhdh VeV YVJUZ_cVch`UV_ed'\\ & Y^VZZ_`eVcT^aR_jLDE2E4@>LTRccZU\\ & feVeVcT_d aVcgZZ_`VeVV \} VJLh`c\ S`eY`_eVVXc`f\_UR_UZ_eVV`VVTZ \end{split}$$

7 \UfUWhYf]gh]WgcZh\YgUadYXYg][b.

F\_Zevlad/`WevVdefUj+Z\_YRSZeR\_ed`WevYZvRXvU ") R\_U`gvlŽ 
$$\label{eq:response} \begin{split} & R^a]Z_XWR^{h^*}(h^* c^+ V_R_Uh^* V_R_Uh^* V_R_UU^*)\\ & R_U^*gVLSV_{Z_Xe^*}(e^*Vd^*T_2^*) \\ & R_U^*gVLSV_{Z_Xe^*}(e^*Vd^*T_2^*) \\ & R_U^*(h^*) \\ &$$

$$\label{eq:response} \begin{split} & \mathsf{DR}^a a ] \mathsf{Vd} \mathsf{K} \mathsf{Ve}^c \ \mathsf{V}_c \mathsf{f}^c \mathsf{VRX}^{UUV\!\mathcal{K}} \mathsf{W} \mathsf{Vd} \mathsf{XZ}_R \\ & \mathsf{C} \mathsf{d} \mathsf{c} \mathsf{Vd}_c \mathsf{d} \mathsf{e} \mathsf{z} \mathsf{g} \mathsf{V}_c \mathsf{Vd} \mathsf{L} \mathsf{e} \mathsf{V} \mathsf{V} \mathsf{R}^a a ] \mathsf{Vd} \mathsf{K} \mathsf{d} \mathsf{W} \mathsf{c}^c \mathsf{RIY} \mathsf{c} \mathsf{VZ}_R \\ & \mathsf{h} \mathsf{Ve} \mathsf{V} \mathsf{R}]^* \mathsf{TRe} \mathsf{W}^a - \mathsf{R}_c \mathsf{a}^c \mathsf{a}^c \mathsf{e} \mathsf{Z}_R \mathsf{I} \mathsf{S} \mathsf{R} \mathsf{d} \mathsf{Z} \mathsf{L} \mathsf{R}_c \mathsf{U} \\ & \mathsf{h} \mathsf{Z} \mathsf{e} \mathsf{Y} \mathsf{Z}_c \mathsf{VRIY} \mathsf{c} \mathsf{VZ}_c \mathsf{e} \mathsf{e} \mathsf{V} \mathsf{R}]^* \mathsf{TRe} \mathsf{Z}_c \mathsf{a}^c \mathsf{a}^c \mathsf{a}^c \mathsf{Z}_c \mathsf{e}^c \mathsf{e} \mathsf{R} \mathsf{U} \\ & \mathsf{Z} \mathsf{e}^c \mathsf{f}^c \mathsf{c} \mathsf{S} \mathsf{R}_c \mathsf{R}_c \mathsf{U} \mathsf{c} \mathsf{c} \mathsf{R} \mathsf{d} \mathsf{R}^c \mathsf{a} \mathsf{I} \mathsf{V} \mathsf{d} \mathsf{Z}_c \mathsf{a}^c \mathsf{a}^c \mathsf{a}^c \mathsf{Z}_c \mathsf{e}^c \mathsf{e} \mathsf{R} \mathsf{R} \\ & \mathsf{c} \mathsf{VZ}_c \mathsf{d} \mathsf{a}^c \mathsf{a}^c \mathsf{I} \mathsf{Re} \mathsf{Z}_c \mathsf{g} \mathsf{R} \mathsf{f} \mathsf{V} \mathsf{U} \mathsf{d} \mathsf{W} \mathsf{e} \mathsf{S} \mathsf{S} \mathsf{V} \mathsf{Z} \end{split}$$

 $\label{eq:linear} DR^{a}]\underline{Z}XgiaV_{+}^{f}]\underline{\partial \mathcal{L}}RXVLdcRzMUUSjeVV\\ cVXZ_R_UfcSR_{zcf}cR]RVRgRzMS]VEZ:_eVV}cde\\ dRXVLR_f^SVc^VAAcVdV_dRzWT^{f}_UdhRd$ 

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2UNE = ZR U > M ZNE Zi \*\*)/3RXdeVUL> ŽR U7RcPRdL:Ž1#!!!/ <u>=RTf]efcRa`]3eZIRTYZV Rj]`daRceZU`dUVTV ec`Ž</u>  $F_RVia]ZIRIZ_Rec`a`]^2XZIR$  $DR_{e}RX \pm 4YZVL7 U W4f = dR6T_{2^{A}}ZR$ 2]VIR UV£:Ži#!!!/  $D^{TZ}$  XR Tf | ef dR $> VIZT 4Zit2_eYc a d7=24D@$ 2]^ RdkRL> ŽR U8 RccZUL> Ž1"\*\*(/ yARceZIZaRIZE\_a`]3eZIR V\_[2gV\_Vda`S]RU`cVdŽ 6gR/fRIZE\_TFR/ZEREZERUV/Q`Veb`j\_ZRY3%46V\_ 8 fk^ ï\_Ł=Ži VUZê c/Ł<u>6i a]` dRIZ\_VdV\_adZî |`X</u>RA a`|36277R: DR\_678X Ł4 YZWLF\_Z5Vcd/LRU5 ZWX A`ceRVd 2^ V U RL8Ži#!!!/ =RTZ URUa`de^ `U\c\_R > RUZULA VIVAEV6UZE CZR2`f\_ŁDŽi#!!"/ <u>2 ac`TfcRU aRcRidi `f\_ZqVcd`U efcZd^`</u> 4 R^ aZ RdL3dRkZLARaZf d6UZé dR  $2aaRUf dR L2ZR_UDeV_{L<ZI} #!!!/$ yDf dfrZ\_FS [Va]f drZth R\_UeYWWaf dv VSV \_XZ\_XM ZF?6D4@ŁH`clUTflefcVcVa`ce 2d 7743Ž <u>AfS]ZT daRIV R\_U VXR]ZERCZR\_T]RZ\_dLf\_UREVU</u> ^ R f dTcZaeŁ 5 VaRce^ V e `W8 `gVc ^ V eŁ F\_Zevazej`V6dM PPP1"\*\*'/ 2 RCTYZAVIRX `WafS|ZT da RTVdL^R f dTcZaeL 5 VaRce^ V\_e`V&`gVc\_^ V\_eLF\_ZeVcdZej `V6cdM PPP1#!!!/ 6] clyled UV RUZNEV TZR 4 RARIRAL 6 LEE OZR]? f Vor D TZURU 2gcZkWL=Ži"\*\*\*/ y5 ZI X j cWW ZZLRUŽ 2 TVĆIR UV |R cV|RIZ\_ V\_eeVVdWRa1/\$JZRj ^ VLZdUVT ^ f\_ZRIZ\_%  $\underline{Z} > \underline{VaRa} ]362IRL? \pm *$ > VíZľ 4 ZejŁ4 V\_ec`UV 6 def UZ dUV A`] 3 ezTR  $4^{\circ}$  aRRR 4YZV 3R}VUL6Ži"\*&)/ EYV^`dR] SROZEL`VSRI\hReUd TZA ? Vh J`c\ŁEYV7cWAcVdd

4 \_ VXXf cRIZ\_Vd d TZRVd UV VdaRIZ d UV f d  $\underline{a^{1}}$   $\underline{S}$   $\underline{Z}$  +  $\underline{R}$   $\underline{d}$   $\underline{U}$  =  $\underline{R7}$   $\underline{C}$   $\underline{R}$   $\underline{L}^{A}$   $\underline{R}$   $\underline{f}$   $\underline{d}$   $\underline{C}$   $\underline{z}$   $\underline{R}$ DR\_07RX Ł4 YZV 3Rc > VVLAŽi"\*\*)/y4`hS`jdR\_UT\_defTeZ\_d?ReZ\_RZecvacval\_ePeZ\_ `WaRde`dR]]ZWZ\_a`dela`deR[ZR\_4YZ[V%LZ\_;`fc\_R]`W  $= \operatorname{ReZ} 2^{\circ} \operatorname{VeZIR} \operatorname{Def} \operatorname{UZVeL}? \pm \$!$ ? Vh J`c\Ł4 R^ ScZLX/F\_Zękczej Acked 3Rf^R\_ŁKŽi"\*\*) R⁄ 8] SRZARZ\_ŽEYVYF ^ R\_T\_dNofV\_TVAL ? Vh J`c\Ł4` |f^ SZRF\_Zevkozej Acktd PPP1"\*\*) S/ <u> $H^c_{T} df^VZ_{R} = UeV_{ha^c}$ </u> > RZV\_YVRUL@aV\_F\_ZgVcdZj AcVdd PPP1"\*\*\*R∕ 4f lef cVRdacRiZd =`\_UCVALDRXV PPP1"\*\*\*S/ : dMRcTY`Wa`]ZeZTd 4 R^ SozzXIA Z AcVdd 3VT\ŁF Ži#!!!/  $y=Z_{e}Z_{i}X_{j}fc_{h} ]ZWZ_{R}cf_{h}R_{j}h_{c}]U_{+}$ :\_UZeZUFRJZKREZ\_ŁXJ`SRJZKREZ\_ R\_U a` ]ZEZICH6 V 8ZUV dL2ŽR U9fee LHŽ1VUdŽL8) SR TRaZRIZA ? Vh J`c\ŁEYV? Vh AcVdd 3VT\ŁFŽR U3VT\ł8 \cdr\Z Ł6Ži#!!"/ : UZEZLFRIZKREZ +: dezefez RIZKUZUZEZLFRIZM R UZedd TZR R Ua` ZZZIR T dybf V Tyd =`\_U\_ŁDRXV 3V X ℝL:Ži"\*) &⁄ <u>9 Zeè cZRUVj af VSj` ^ Raf TYV+DZXj` dI : I j I I</u> DR ØRX Ł4 YZVŁ6UZZ VODF C PPP1"\*\*'/ =RT ^ f ZRU aVd ZRŽ6 da ` dd ScVZV eZRU j Tf ]ef cR+ ]`d UVdRV14d UV ]R ^ `UVc ZkRIZE V DR\_ORX Ł4 YZVŁ6UZZ\_VODF C

PPP1"\*\*\*/ y5 V S`URdLgZR[Vdj e`ceRd162 <u>CVgZteR UV]R</u> 27RV ZRL? ±% DR\_eZRX Ł 4 YZWŁ F\_ZęVcdZURU 2 TRUV^ZR UV  $9f^{R}Zf^{ } 4cZdzR^{ }$ 3V\_YRSZ5ŁDŽ1"\*\*"/ y> `UM|VUVd´WWVelZTYV\_CRf^d%LoZ\_D`kZRV H MeŁ%#ž# > f\_ZIYŁ:\_deZefe W.c D`kZ]`XZkŁF\_ZevCodZece > í \_TYV 3V [R^ ZŁHŽi"\*\*)/ y8 VcR^ ^ VjeVDIYcZAAV\_ 3R\_UCZ#Z465\_RdaRdrRXV ł hVċ∖ 7dR\_\\KkdeLDf Yc\R^ a 3Vc^ R Ł> Ži"\*\*)/ 2]] eYRe Zdd ZU^ VjedZe` RZ+EYVVi aVcZ/TV`W ^`U\cZij ? Vh J`c\ŁAV XfZ F D2 3ZSV\_jŁ? Ži"\*\*\*/ 5 V `TARIZRARAR RUZZVALRU 3RcTV[`\_RL2cZV] 3`fd**Z**{f}{AŽi"\*)%  $5 \text{ ZbeZ TeZ} + 2 \text{ d TZR} \text{ TeZeZbf V ` WeYV [f UXV^ V e}$ `WaRdeV 4 R^ ScZLXVL > RdRIYf dveed 9 RogRdU F\_Zevedzi AcVdd 3d\_\_V&;ŽŽi"\*)(/ : Uf decZR j ^ VcTRU Tf ]ef cR]Vd V 4 YZ]V+ <u>UVdTcZaTZZ j TFR eZ TRIZ VdLh cZ X aRaVc</u> ?±\$&\* DR\_ORX Ł4YZVŁ7=24D@ PPP1"\*))/ F\_VdaV(`ecZkRU` DR or 24 March 12 DR of 24 De PPP1#!!!/ <u>6UFTRIZE\_Ž6dIV\_RcZdUV\_Wefc`Ž?fVgRd</u> <u>eVT`]`X3Rdj d`TZURUUV]RZWć^RTZ\_</u>Łh`c\ZX aRaVc DR\_ORX Ł4 YZVLAC62=  $3fT_{i} > cdtDZ_{i} ** /$ EYVUZRIVIEZICI` WAWZ X 4 R^ SozLXVL> RdRTYf dveed.> : E Advdd 3f c\**\ŁAŽ**ı"\*\*(∕ GRoZWZAA`WIF]efcR]YZE`cj ? Vh J`c\Ł4`c\_V||F\_**Z**z\ka**Z**ej Ac\kad DR eZRX Ł4YZWŁ4V ec`UV 6def UZ da RcR Vj

4 RUV2\_L7ŽL9`aV\_YRJ\_L> ŽR\_U@ee`\_VL6Ž 1"\*\*% v9 RIZR f Rava ViezeR TeizeZIRUV R^ `Uvc Z.RU+ |Rd UZ' V\_dZ\_Vd Tf |ef dR|Vd UV |R edR\_dVc^ RIZ\_ ac`UfTegerT\_VofZRU%LZ\_4`^ZUZ\_^f\_UZR UVTFjefcRj UVdRcc`]]`L^ R\_fdTcZae DR\_ORX Ł4YZV PPP1"\*\*'/ 6 dR Vabf ZgR^ `UVc ZLRUŽ5 VaRcc`]]` LTZE URUR 374 j Tf]efcRV\_2^1/cZIR=ReZRjV]4RcZSV 4 RORIROL? I VORD TZURU 4 RUV2\_L7ŽLR\_UDR\_Z 1/2L;Ž1"\*\*\*/ 6 XRe bf V RUR =RARAL3` ZZZLA f dR 6UZE dvd 4 RdeVIŁCŽi#!!\$/ 7c`^ ^ R f R] h`c\Vcd e` h RXV |RS`cVcd+ EdR dWc^ ReZ \_ `WeYVd TZR] bf VdeZ AZTIRER RIL? Vh; Vady LEar artez Af S ZYVad  $4 \operatorname{Rel}[d > \tilde{Z}_1 **) /$ y8 |`SR[ZkRIZE\_ŁeVT\_`]`X3RLecRSR[`ŁV`a]V j V acVARAZ CVZER 7RTé CAR 3RcTV R 4 Rde` cZRLZ2L4Ž1"\*) (/ <u>EYVZ'RXZ Rozz dezef ez `Wat Tzkięł g`]Ž:</u> 4 R° Sozitvila Zi Advid PPP1"\*\*'/  $=R^{*} eV/2U$  ]"Z dZX Z R TV+=Vd TRacWWf cd Uf  $R_i cZ eW:G$ ARZŁDYZ 4 ReRii ŁĄŽR UDf\_\VŁ8Ži"\*\*!/  $4 \quad df^{*} \quad Tf = dR V \quad 4 YZVZ = RVZEVL^{*} \quad RdZg^{*}$  $\hat{c}ZXaRaVc? \pm$ DR ORX Ł4 YZVŁ7=24 D@ 4 ReRii Ł4Ži#!!!/ 6] f d U M e Z A a j V T d A U A V Z d L7@? 564JE ac j VTe? ±"\*)!) &( DR\_ORX Ł4YZV PPP1#!!"/ y > R]dLT ^ f\_ZIRIZ\_ j TZf URUR\_3R466Z 6] > VcTf cZ L ##; f ]iDR\_@RX Ł4 YZV 465 1"\*\*)/  $= d^{VZ} dVT^{f} ZRZ V 4YZV$  $DR_eZRX \pm 4 YZ/V \pm 4 V_ec$  UV 6 def UZ d a R d V 5 VcRcc` ||` PPP1#!!!/ <u>'9 RjaRezRbfVUWVUKO=RZVezLRU\_RIZ\_R</u> WW eVR RX SRZKRIZ

5 VcRcc` ||`

46A1#!!"/ 4 YRceZdLCŽi"\*)\*/ > RaRUV | RcMZXZ dLRUV 4 YZVDR eRX Ł4YZVŁ4V ec`UV6def UZ dA1/S/ZT d 46Ał:DDA1#!!"/ PPP1"\*\*&∕ > RaRUV | RcV ZXZ dLRUV \$# aRead DR eZRX Ł4 YZVŁ4 V ec`UV6def UZ dA1/S ZT dR U : eVc RIZ\_RID TZRIDf cgV/Ac XCR^ ^ V dZX[`") 3RTY RL8 VIZR 4? EG 1"\*\*(/ : WC^ V VarUBARZT UV |R eV/VeZZZZ UV |ZScV <u>cVIVa</u>TZ\_\_\_\_\_\*\*\*' 4f lef cVZ eYValf cR  $DR_e aRX 14 YZV14 ~dV1 ~ RIZ_R UVEVVaRZ_$ PPP1"\*\*)/ DR øZRX UV4YZV :\_Wc^ V VaeRUBaleZT\_UV ]R eV/VgZtZ\_UV ]ZScV cVIVaTZ "\*\*(  $DR_{e}RX L4 YZVL4 \ dV \ RIZ_R UVE VVeZZ_$ 56DF41#!!"/ PPP 1#!!! ℝ⁄ EVétVerl" (@Tè SVé Acz TzaRIVdever Jeru duvirv Tr ver RIZ\_RIUV eWv272 "\*\*\*  $DR_{ex} + 4Y_{A} + 2M_{a}^{2} = M_{a}^{2} PPP1#!!!S/ : Wc^ V VdeRU3deZT UV eV/VgZdZ UV ]ZScV cVTVaTZ #!!!  $DR_{\theta}ZX \pm 4YZV \pm 4^{-}dV^{-} RIZ_R UVEV \pm 2ZE_{-}$ EYVh`dU`VXX`Ud PPP1#!!"/ ? Vh J`c\ŁC`fe|VLXV =R`WoeRac`XcR^ïeZIRUV|ReVIVeZCZ a`cTRS|V V 4YZV#!!! 64=24 1"\*\*%  $DR_{eff} \times \frac{1}{2} M^{2} = M^{2} \times \frac{1}{2} M^{2} = M^{2} \times \frac{1}{2} M^{2} = M^{2} \times \frac{1}{2} M^{2} \times \frac{1}{2} M^{2} = M^{2} \times \frac{1}{2} M^{2} \times \frac$ 4`]`^ **RŁ7Ž**R UC` [**RŁAŽ**1#!!!/ =ReZRj Vj4RcZSV y6g` |f TZ\_\_UN| ^ VETRU |RS` cR1%4Z =RccR3/4L7ŽR U GVEXROLCŽIVUDŽL<u>=RecR\_dVC^\_RIZ\_\_VT\_2^ZR</u> UV4YZV PPP1#!!"/ DR\_e277X Ł4 Y27VL4 V\_ec`UV6def UZ dA!/\$]27 d DR\_62RX Ł4 YZV 4@? 2D521#!!!/ <u>6defUZ\_RIZ\_RIUVT^a`ceR^ZVe`dMfR\_V</u> 6LhRdH:Ži"\*\*\*/ 4YZV DR eZRX Ł4 YZWŁ4 `^ ZWZ\_? RIZ\_R UN D.52 4` cc\RLDŽL;`TVjj\_{9`]eL2ŽL7Z& Vc`RL4ŽLC` ||\L 4Ž.R. UGZIf ĐRL> Ži#!!"/ 6YeV SVeXL2Ži"\*\*)/ 9 Zee c RUM d ZAI I I TYZV ` =RVREZXTVU yeeVdZ DR ØRX Ł4 YZVŁDF UR^ VOZIR R 4`fd2D`Ł4ŽR\_UGRV\_kfVRL6Ži#!!!/ 6] **Z**cl? Ži<sup>"\*\*</sup>)/ yD TZRSZZURU j Rd TZROZGZURU% Z 6def UZ d EYV8Vc^Rd  $A^{1/s}Z d? \pm (($ DR Ø RX Ł4 YZV PPP₁"\*\*)∕ 4`iŁ4Žı#!!"/ v6] Tf cc37f |f ^ Ven |RcUM VNef c 36Z AVena VTEZEREL > VIZT 4ZejŁ8 cfa` 6UZe cZR]? `c^ R g`]f^V%L?"# PPP1#!!"/ DR ø 2RX Ł4 YZV EYVA TZAG VZ UZEZLFRA

ĭ=V^`\_UVT^^VcVack@V\_eReZ\_ĭŁZ\_<u>2\_RVd</u>Ž 6T <u>`^ZKŽD TZKKZ KZ</u> ?`gV SVd5 VTV SVd? ±' ŁaaŽ'' & & #! 6 da RIZ a 1/5 ZT Ł TC36ZIR j UVCRICRZKRIZ V V 5 V4 VeWRf L> Ži"\*\*(/ > Z\_VRa`]ZELF\_ZgVdzEj`W&Z\_Vd1eRAdVdd 5 VCR^ 2\_Ł2Ži#!!!/ DR ØRX ŁA YZVŁDFUR^ VOZIR R 6dfUZ d'ScVIRR' ZHRULd' cgV af SIZHVUZ =R DR\_eZRX Ł4YZVŽ:\_deZefeV`WD`TZ]`X1ŁA`\_eZ;TZR F\_ZevcolLRU4Re<sup>2</sup> ZIRUV4YZV  $5 \times 10^{-1} \text{ W4f} \, \text{lef} \, \text{R}^{+}$ 4 Ree XCRVIII TF Jef CR UV 4 YZV 2 eRd DR eZRX Ł4YZWL> ZZEWZ UV6UFTRIZE 5 f XRd > ŽR U: dV ch U 3ŽI" \*\*'/ = RZ Uf decZRTf |ef dR| V |RUZ i ^ ZRUM UVdRcc` |]` j ]R^ `U\c Z.RU+? f VeRd |VTef dRd aRdR 2^ 1/6ZIR DR eZRX Ł4 YZVŁD TZR UVgV a^ V e5 ZeZZ D'TZR aR ` CR^ R ` V&ReZ 2^ VeZIR y4YZVLA`]`\_ZRL\_ZXf\_RaRceV%LZ\_@cV/[R\_RL4Ž 1VLZE C/Ł<u>AYZVV |R^ZR</u> DR\_ORX Ł4 YZVŁA R\_VR ARC31L6UZZ\_d@UZV;RTS ? Vh J`c\Ł4`]f^ SZRF\_ZgVcdZgi AcVdd =RTZZZZKRIZ \_ UV]`daRUEVdj`ec`dV dRj`d

?VhJ`c\Ł4`\_eZff^

6hVŁDŽi"\*))/ 2]] T  $d^{T}ZXZ' RX(d+EYVa) ZZ' d' V(de |VZ)$ <u>T\_eV`a`dRqi Tf]ef dV</u> ? Vh J`c\Ł3R2T3``\d 7RT<sup>2</sup> ŁCŽi#!!!/ vCZefR[VeL} Volkedj a`UVe%Le6defUZdD`TZR[VeL? ± ")  $DR_{R} = R7VL2cX_{e_{1}} = RF_{2}VcdR_{e_{1}} = RT_{e_{1}} ReYVcde \_\_VL> Ži" \*\*!/ 4` df^ VcTf ]ef cVR Ua`de^`Uvc Zf =`UŁDRXV 7\c i U\kLAŽi"\*\*\*/ =RRWIEZRUT |VIEZR > VíZT 4Zeji ERFofd 7\kcj1; ŽH`]e`\_15 ŽR\_U`eY\kclı"\*)\*/  $^{E}$  EYV\_Vh af S]ZTRCV\_R Z <u>9 Vc^ ød</u>? ±% ARZL4? CD6UZZ\_d 7 eRZ VŁCŽi#!!"/ 4 YZ]V #! " ! Ł \_f Vg`d VdIV\_RcZ d UV ]R T^f\_ZIRIZ<sup>e</sup>\_<sup>\*</sup>LUTf^V\_eWceYVDWXf\_U 4`\_XXXI UVAFS|ZIZIRU DR\_eZRX Ł4YZWŁ2d TZRIZE\_UV2XV\_TZRdUV Af S|ZZRU12492A/ 7cR kŁ4Ži#!!"/  $= R^{f} dR R R V eV dR R$ DR OZRX ŁA YZWŁAJR VOR 7f V kRZRŁCŽi#!!!/ =Revivezze a1/S ZRV 2^ 1/2ZR=Rez RZCWC^ R acZeReZkRIZ  $DR_{e}RX \pm 4YZVL7 U W4f = cR6T_{2}^{2} ZR$ 7f Xf V£2Ži#!!!/ AcZ VcRaRceV DR ØRX Ł4 YZVŁ2 XF ZRC 8 RcT3RL;Ži"\*\*\*/  $y6daRIZ a^{1}sZTLdVeZUT^{1}_{4} j T_WZTe^{1}$ a`]362T V\_4Y2W160 CV22HR UV]R2TRUV 2RL? ± % DR\_eZRX Ł 4 YZ VŁ F\_ZgVcdZURU 2 TRUV ZR UV  $9 f^{R} R Z h^{3} 4 c Z h R^{3}$ 8 RcT3R4 R TZZ?Ži"\*) (/ A`]36ZIRdTf]efcR]VdV\_2^16ZIR=ReZR > VíZT 4ZejŁ8 cZRS PPP1"\*\*&∕ 9 j ScZUTF Jef cVd  $> Z_VRa^{3}$ ZLF\_ZgVcdZg  $^{VV}Z_Vd$ eRAcVdd PPP1"\*\*'/ =RTZFURUUV]`dgZR[Vc`dŽEdRgVdBRdVZ'RXZRcZd  $f cSR \ d \rightarrow \frac{1}{2} ZT \ Z'' \ast H + !!!$ > VíZT 4ZejŁ8 cZRS

PPP1"\*\*(/ v6]aReeZ`ZTF]efcRUV> ½ZTj]RT\_defTTZ Z`RXZ\_RCZRUV]`\_RIZ\_R]%LZ\_7]`cVdIR\_`Ł6Ž  $1 \text{VLR} \text{ (}216 \text{)} \text{ a Rec } \text{Z} \text{ Z} \text{ RIZ } \text{ R} \text{ UV} > \frac{1}{2} \text{ Z}$ > \IZ 4ZjL7\_U UV4f]efcR6T\_2^ ZR PPP1"\*\*)/ =RdZ Uf decZRdTIf )ef dR[Vdj V] UVdRcc` ]]` VT\_2^ ZT\_ i d'TZR DR\_eZRX Ł4YZVŁ^ R\_f dTcZae acVdV\_eVU Re eYV  $4 f [ef cR j 5 V dR cc^{2}]$  DV Z ReL:  $eV d2^{4} V dZ R_{2}$  $5 V_{gV}^{a^{V}e3R}$ PPP1"\*\*\*/ =RX|`SR|ZkRIZE\_Z`RXZ RUR 3fV`d2ZV&LARZPd PPP1#!!"/ 4` df^ VodR UTZEZKV d > Z\_VRa`]ZELF\_ZĘVcoZej `W& Z\_VeleRAcVel 8 RCT3R4 R TIZ ZL? ŽR U> `VERL4 ŽLVUČI"\*\*\*/ = Rd Z Uf decZRd Tf ]ef cR]Vd V ]R Z eVXcRTZ <u>Rez R Vézir r</u> >  $V_1Z_1 4Z_1 L 8 cZRS$ 8 RcT3RUV R9 f VceRL> Ži" \*\*\*/ CV-VIZ\_VdR^VzZR RdZ6 dR dUVZ edri Yzze dzR DR eRX Ł4 YZVŁ=@> 8 Rocke<sup>2</sup> Ł> Ž2h#!!#/ > RcTY DR\_677X Ł4YZV  $8 \operatorname{Rec}^{2}_{L} \geq \mathbb{Z}\mathbb{Z}\mathbb{R} \cup 4 \mathrm{f}^{\circ} \mathrm{d}\mathbb{Z} \cup \mathbb{L} \otimes \mathbb{Z}_{1} \# ! ! "/$ AVETVATZ\_VATF | of aRVAUV | RUXAZAF RURU  $DR_{e}ZRX \pm 4 YZVE > Z_ZEVCZ UVA]R_Z TRIZ_j$ 4``aVARIZE 8 Rf TYVeL> Ži"\*\*)/  $= \underline{RcM}\underline{Z}\underline{X}\underline{L}\underline{R}\underline{d}\underline{R}\underline{U}\underline{h}\underline{2} \quad \underline{TcR}\underline{d}\underline{Z}\underline{V}$ ARZL8RZ RU 8 Rk^ f c2L4 Ži#!!"/ 6] 4 YZVUJ 4 V eV RZŁ OV dr ZerdUV RTCZZ DR\_eZRXŁA`\_eZZZZRF\_ZgVcdZURU4Re²]ZIRUV 4 YZV8\&XV\_L<Ži#!!!/ EYV dref drew dryw ? Vh J`c\Ł3RdZT3``\d 8ZUV d.2Ži"\*\*"/ <u>>`UVCZEjRUdMWZUVeZEj</u> 4 R° SczlXVLA Zi AcVdd PPP1"\*\*#∕ EYVecR dWc^ ReZ `VZ eZ' RIj 4 R^ SczlXVLA Zi AcVdd

8 ZdV Ł3Ži"\*\*\*/ <`]]V.eZeVZ.V eZece 7dR \WideLDf Yc\R' a 8 d kZ d ZDŽi"\*) ' / =RT ] ZReZ UV] "Z RXZ RZV ARZL8RIZ RU PPP1"\*\*\*/  $= \operatorname{RaV} d M \wedge \frac{1}{2} d M$ ARZŁ7R RU 8f VcdRL7H Ži"\*\*#/ y=VdRgReRcdUV|RcVaclorv\_eReZ\_RfI:IVdZUV%kZ 8Ž4`fVWX\_RL<u>C1ZZgVeVc]RU1/2`TcReZ</u>/ ARCZŁACYCHYURY\_UREZ\_?REZ\_RJUYCHOTZY\_TYC A`]ZeZbfVd 8fk^ï\_Ł=Ži"\*\*(/ V> VZ dUVT ^ f ZRIZ Ł^ VUZREKRIZ UV R a`]362TRj\_fVgRdeVT\_`]`X38c966Z\_8fk^ï\_Ł=ŽL 6ia  $\dot{RIZ}$  VdV adZT  $\dot{XR}a$  36ZIR: DR\_678X Ł4 YZWLF\_ZEWCHIRU 5 ZWA A` ceRWd 9 Rc TYVŁ4Ž1#!!"/ y5 Vd Wc^ Vd Ve UVd ^ R\_ZacVd V\_ U1/2 ` TareZ%66  $CRZ1 \_ A` ]ZZDf VL? \pm #$ ARZEL7 \_ UREZ \_ UVODIZY\_TVOLA ` ZEZOF VO  $9 \operatorname{RocZi}_{\underline{l}} = \operatorname{ZR}_{\underline{l}} U9 f \operatorname{eZ}_{\underline{\lambda}} = \operatorname{LDZi}_{\underline{l}} # ! ! ! /$  $4 f ef cV^{ReeVcd+9} h gR f Vd dYRaV Yf^R$ <u>ac`Xdd</u> ? Vh J`c\Ł3RdZT3``\d 9 Z \VR ^ Vet 7Ži" \*\* &/ 4 f ] ef cR UV ] R V da V cR kR j d TZ/URU dZ <u>MTIF dZE Ł</u> DR; d425VZ9`aV\_YR\_L>Ži#!!"/ CVaV\_dRcVj edRSR(`  $2cW \in \mathbb{R}^{2} \cap \mathbb{R}$ 9`aV\_YRj\_Ł> R\_U@e`\_\_VŁ6Ži#!!!/ 6 XR VdR<sup>2</sup>  $3fV_d2ZVdL7_UUV4f]efcR6T_2^ZR$ :Sï ÐV&L;Žı"\*) &⁄ <u>> ïdR]]ïUV]RdTZ]`XRLV]Xfa`UVUZ11fdZ`,</u> el/E ZIRj TceZIR 3RcTV/`\_RLDZX/`II: :URCHF Zever RUUV4YZV1#!!!/ 6 TF ValeRa' SolvZ e` [Var TZRj UZCTToZ' Z RTZE DR 6277X Ł4 YZVŁ7f URIZE : UVRd

:621#!!!/ 4 Zezt WITRez RTc dd T f eezdd+ Eh V ei ł Wf c REZ\_RTRAVATUZIAW/^ eYV:62 TZZTVUT TRZ\_ ac` Me 2^ deVol.R^ HE YV:\_eVc\_ReZ\_R] 2 dd TZReZ\_ WceYV 6gRjfReZ\_`V6UfTReZ\_Rj2TYZgV^V\_e PPP1#!!"/ <u>4 ZeZkV dYZa R U VUFTReZ Z eh V ej ł VZXY</u>e <u>Tf</u>  $ecZdZZT \ h]VLXVR UV XRXV V e Re$ RXVWfceW 1Yeea-ŧžħhhŽhR^Žt^UŽUfžoZRž⁄ EYV:\_eVc\_ReZ\_R|2dd1ZReZ\_WceYV6gRlfReZ\_ `W6UfTReZ\_R]2TYZkgV^V\_e : ||R\_VE>Žı"\*) '/ y6iecRl^fc`dŽF\_RViacVdZ\_UVTf]efdRRfe`cZRCZRV  $4 YZVa der = ZRM_{64} ecZsfTZ VdL? \pm S^*$  $DR_{e}RX L4 YZVL7=24 D@$ :=@ 1"\*\*\*/ 7]VIZSZZKRIZZ V V ^ RCXV + ]R CWVC^ R UV T edRe`UVedRSR[`  $DR_eZRX \downarrow 4YZ[VL : eVc_ReZ_R] = RS`fc$ @cXR ZkReZ :? 61#!!!/  $yF_RU$  WRRURUVRR TVTF of R Max Z <u>6 Wbf Vd</u>  $6 de RUB de ZT d? \pm ($ DR\_eZRX Ł4 YZNŁ:\_deZfe`? RIZ\_R UV6deRURdeZRd :?:1#!!!/ 6\_TfVdR[2gVVd DR\_@27X124Y2/VL:\_d626fe`?R1Z\_R]UV]R;fgV\_efU :EG 6UZe cVd1#!!"/ <u>5 ZVTe cZ\_RIZ\_R UVV acVaRdj V[VIf ezg d</u> DR OZRX Ł4 YZVŁ: EG 6UZO CVA :R^ Vd Ł7Ži"\*\*)/ 4flefdRlefc =`\_U\_ŁGVcd ;ReRYi AVdReV e`ŁDŽi#!!!/ y2 T cURR]^ RŽ2^ SZERJÝ\_TZROVR^ SZA ZLRUNOUR  $ZV \in ZRV RIZ R \ll 6 \det UZ dD TZR V \pm ")$  $DR_{R} = R7VL2cXV_{eZ}RF_ZVcdRUUV_{eZ}RF$ ; `TMj\_ł9`]eŁ2Ži"\*\*) R⁄ 6] a.Vd UV ]R\_`TYV+\_f ValeaR War XZ WareR VkR YZe<sup>2</sup>cZR DR\_677X Ł4 YZVŁA]R\_VAR PPP1"\*\*) S/ 6] 4 YZV a Vca V Ž5 V RgR kRc dZ ecR dRc R ecR\_dRcdZ\_aRdRc DR\_ORX Ł4 YZWŁAJR\_VOR 2021 <]VZŁ?Žı#!!#/ ? = X + ? daRIVL TY ZIVL Sd=`\_U\_ŁAZIRU c

<`dM]\VI\{LCŽi"\*\*(/ > R k2L;Ži"\*\*(/ y6] ^ f\_U a` ]362T UV\_2D`dj [2gV VdV\_4Y2V4 = Via 1/6ZV TVUV] YZE cZV 7R° ZZRZLRUŁRWIE dj RIEZE UVOVOW EVRCVINEV EVO ARZL8 RIZ RU a`]362T d%12 8 f k^ ï Ł=ŽuVU2ê c/Ł6ia]`dRIZ Vd < cRf dML> Ž1"\*\*% V adZT ]`X3Ra`]36ZTR: y=RZ\_gVdeXRIZ\_TFRZRezeRef\_TR^a`UVa`dSZZLRUVd DR\_678X Ł4 YZWLF\_ZEWCOZURU 5 ZAX A` ceRWd jUXRAMANGCVZZEREV ROUVOUTRIZ ? ±# =RDVCV\_RLF\_ZgVcckLRUUV=RDVCV\_R > Rce3/413RcSVc L;Ži"\*\*\$/ <u>4`^^f\_ZTReZ\_LTf]efcVRUYVXV``jŽ7c`^</u> =RS`dNL>Ži#!!"/ eYV^VURe`^VUReZ\_d vDZeV[VTIZ VdUV] 4V eV RZ%LZ 6] > VcIf cZL=`\_U\_ŁDRXV \* Dvael SVc DR ØRX Ł4 YZV PPP1"\*\*)/ y6iaV2V\_T2RRfUZg2fRjjUVddV\_TfjefdRj% =Ra  $\mathcal{R}$ KŽ<sub>1</sub>#!!!/  $\underline{Z} > \operatorname{Res}_{4}^{2}(3\operatorname{RcSVc} L; \underline{Z}R_{U} = {}^{2}aVkUV]RC`TYVL7\underline{Z}$ =VdRIcVUf acl/dV\_e 1 V dŽL<u>4f]ef cRL^ V Z dj d TZURU</u> AR:7212.7]R^ ^ R:7\_\_ 3`X`eïŁ4V\_ec`dUV6defUZdD`TZR]VdUV]R  $F_Z (M, RU? RIZ_R UV4)^{^{1}} SR$ y=R dRUZIR]ZkRIZ \_ UV `Ta`eZIR W Z\_ZHR46Z\_ PPP1#!!!/ 2 d ZEZZ J V ZE (24.6) dvg v d UV R UZW CV TZR y6] Whet c`bf V YRSZER |R ^ V `cZEV&Z\_D`\_TYVkL 4 RORIROL? I VORD TOURU  $8 ZR UHZ VL > Z VUZL > f dV L^ V CZR j$ RIZ PPP1#!!"/ 3 X  $\ddot{e} L > Z Z$  V 4 f e RA`]362TRj cVac`UFTT22 >  $V_1Z_1 + Z_1 + A_1 = R_1 + A_1 + A_2 +$ PPP1#!!"/ CVT\_}XfcRIZ\_VdT^f\_ZREZeRdUV]`a1/S]ZTŁ =R UZL@Ži"\*\*#/ ^ R\_fdTcZae 5 Vg<sup>2</sup> dR<sup>^</sup> V<sup>^</sup> edRgVk 3fV`d2ZV&LA|RV&R  $> \operatorname{Ref} Z Z T D Z_1 " **' /$  $y=RaR[RSdRV_f_UZ]^X RdZ^1/ecZT + ^RcTd$  $= RccR^{2}/4t$ ;  $Z_{1}^{**}$  (/ Zdezer TZ\_RVdj\_VX TZRIZ\_UVjdV\_ezU %LCVezzer y=RecR VIe c2R Rez R^ V2IR\_RR R^ UVC\_ZRUM <u>GVcdZ\_Ž6defUZdUVT^f\_ZIRIZ\_ja`]3ezIR</u> 6df UZ dA1/\$Z d2? ±'' 4ZejŁ F\_ZeyVcdZURU 2fe<sup>2</sup>\_`^R  $> MZ\Gamma$ DR\_&77X L4 YZVL4 V\_ec`UV6def UZ dA1/\$jZr d > Vec`a` ZER R PPP1#!!"/ > Ref dR RŁ9 Ži#!!#/ : UV eZLRUTYZV R y=RTZEURUR \$PaVdSZ]`X\$PaafdP&LZeVcgZAhhZY DR\_ORX Ł4 YZVŁ=@>  $GZXZ_RCZ dVT LARecZ \ge Z 4 f ef dR ? ± #%$ =RdIYŁ4Ži"\*\*\*/ DR eRX Ł4 YZVŁ5:32> 4f]efcV`WRcTZdZch > \Vf TTZL2Ži"\*\*\*/ ? Vh J`c\LHZHZ? `ce`\_ 4 ` ^  $aR_j$  $y_{6}dW_{CR} a^{1}s$ ]ZIR j UV `TCRIZR V\_ |R VCR UV |R =RdMLDŽ1"\*\*\$/ Z W6^ RIZ\_% > VeRa` ]3621RL? ±\* 6T\_`^Zd`WZZ\_dR\_UdaRIV >  $V_1ZT_4Ze_1L4V_ec_V6defUZdUVA^3$ 4`^ aRRR =`UŁDRXV PPP1"\*\*%/ > Vce LCZL7ZAVL> ZR U < VUR]LAZI" \* & /<u>EYV WIF dW Z every  $h+2 \wedge R f R$  Wac SIV d</u> CV-VIZZZE R\_UZEdUfS]Vd+DecfTefcVLRVdeYVeZIL  $T \wedge f_Z_j \sim Z_3V_I + F Z_8 Z_U_d_2 R_U = R_M DZ_1$ R Uac TUf dd  $\underline{CV-VIZeV^{^{\prime}}}$   $\underline{VecZeReZ_{+A^{\prime}}}$   $\underline{ZeZeCeRUZeZ_{R}U}$ ? Vh J`c\ŁEYV7cWAcVdd RVARY AZIGZ eVV^ `UVC\_d TZR] `d.VC >:56A=2? 1#!!"/ 4 R° SCILINILA ZI ACVOU <u>4`\_df^` Tf]efaR| UV]`dY`XRavdUV| 8 aR</u>  $=^{2}aV_{kL}=\tilde{Z}_{1}^{***}/$ 4 V ec dT ^ Vélik Vál DR OFFX Ł4YZWŁF ZLRUW6def UZ dAc da VTOZE d > VIZT 4Z412; f Vdec` EZV^ a` > :56A=2?łA?F51#!!!/ 5 VdRcc = 1 of R V = RdT f RdUV4YZVLEV RdUV5 VARce ]] Df deV\_eRS [VdVZVdL? ±% DR ø RX Ł4 YZV

> :? 65 F 4 1> ZZecj `W6Uf TReZ\_/1:62 ARc\V&4Ži"\*\*)/ 1#!!"/ vCV/ZXZ j TF ) of dP262Z E` ]` kRL4ŽL=RYVCRL6Ž 4ZURUR RAJ VETRIZ V 4YZVŽCVEJERU dUM 1VUŽŁ<u>4YZVV]`d\_`gVe</u>R 6 def UZ : eVc RIZ R UV 6 UF TRIZE 4 3 gZR V DR OZRX Ł 4 YZVŁ ACYZIU TZR UV |R CVa<sup>1</sup>/S |ZIR j Valt UZR eVal UV " % RD al V\_ #) a Redukt Ž 1 Yeen + žž 5`]^V hhhŽhR^Žt^UŽUTzoZRž?R=Z\_Rjz4YZVRŽYe^/ A` |R j ZL<Ži" \*&(∕ > ZZEWZ UV 6UFTRIZE\_ŽEYV:\_eVc ReZ\_R EYVXCVReedR dV/c^ ReZ 2 dd TZReZ\_WceYV6gR f ReZ\_`W6Uf TReZ\_R 3° de`\_L> RdRIYf dvædL3VRT \_ Acval 2TYZkgV^V\_e Af SIZ 6EC@ 1#! ! "/ >` dL2Ž"\*\*(/ `6 TFVdR> Raf TYVdłZ AfSZZ Vec'Ľ' 2fXfde =R ^ 1/eRaY`cV d`TZR]V+:^ RXVL eVccZe`ZcVL DR\_oZRX Ł4YZWLG`i A`af]Z  $T^{\uparrow} f_ZReZ_$ ARCZŁACYCHYCH ZEWCZERZYCUW 7cR TV Af XR: Ži \*\* (/ =RReV f RIZE UM TROEMIR UV4 YZV4f V Wbf V > `cRU1/2AŽi"\*\*!/ adRX^ RZ Xi 3062T = R cVIf a VcRIZ UV | R ZIV eZIRU TF | ef cR  $3RcTV_{a}^{T}REZR_e^{3} 3R_TY=Zc^{2}d$ REZ R VEIR R Z 7VC I UNAL 4 Z 2 df Zevier dR j ^ `U\c Z.RU.Rac` aZRLR Af e^ R ŁCŽi"\*\*% DR\_ORX Ł4 YZWŁER |VC 2^ 1/02TR > R\Z XUV^ `TaRIj h`c\ Acz\_TVé\_ŁAcz\_TVé\_F\_zęvcozej Acvod  $> d\bar{z}_{1} d\bar$ 227VdUVWR 22RŽ4fjefcRjdT2VURUV\_2^1/62TR BfVgVUŁ7Ži#!!!/  $= \operatorname{Re} Z R$ <u>=Reczelykruj tyzv</u>łg`lf^VZ' 3ReTV RL2 RXR R  $DR_{eZRX} L > df Ze 4^{f} JRIZ_Vd$ > 1 \_TY^ Vj V£8Ž1#! ! #/ CZ f i Ł; ŽĄŽR UDZCZ V]]ZŁ; ł 7Ži "\*\*' / :\_eVcgZth hZeyERzZAV\_\_RLZ\_DZteVfl(?±\$ A`fcf VYZte`ZtVTflefcMIV DR\_ORX Ł4 YZV ARZŁDY Z > f **Z**kRXRL; Ž4Ž1#!!"/ CZIYRUŁ? Ži"\*\*)/  $y=RV_e^{-}RIZ_ZTZKeRV_V$  VI YRS]R $dR_{OZX}TZRK_{OZ}$ CVALF`dj ^ Va Ward16 dr `dUVTc & TRTF | ef dr  $\underline{ARecZ \geq Z 4f} = \frac{f}{cR}? \pm \#$ d ScVV 4 YZVUV RecR dZZ / DR ORX Ł4 YZVŁ5:32> DR\_@27XL4Y27VL4fRce Ac aZ @ ReRcc #L; Ži #! ! "/ C TRMZ ] LCZ' \*\*\*/'9 ` ^ ScVdR | RUVZZROA` UVZLeeRSR ` j dM ` y=Rd Z Uf decZRd Tf ]ef cR]Vd V\_ ]R gZJV dWcR DR ORX Ł4 YZVŁ7=24 D@ ]ReZ ` R^ VCZIR\_R46Z\_ 8 RCT3R 4 R\_T]Z\_ZL? ŽR\_U @cZ]]4`deRLAŽLA½Vk;Ž>ŽR\_UEc`aVRL7Ž ZeVXCRIZE |ReZ`R^ VCZIR R 1"\*\*'/  $> VIZT 4Zi \pm 8 cZRS$ EcZsfdfcSR Rd 3RCTV\_RLARZPd:S16ZTR  $C^{R}_{R}^{1} = tAZ_{1}^{**}/$ y=Vdfe`aZkdc1/2kCVd2gVdUV]RU1/2`TdReZ1/16Z @co2kLCŽi"\*\*\*/ 5Ž4`YV\_ R\_U`eYVcdL<u>7cR TV+ |Vd c½`|f eZ\_d</u>  $\sqrt{5}$  Zevol RUTF lef cR j T d' `a` ZZd' `% Z > Rce<sup>3</sup>/4 <u>Z g**ZfS**]V</u>d 3RSVc  $\pm; \tilde{Z} = 2aVk UV | RC^TYV \pm 7ZR U; RR^2 Z| \pm$  $ARcZL4R^{n}R_{l}=1/g$ ;Ž<u>Af]efcRjX</u>`SRZRIZE\_ 3`X`eïŁ4V\_ec`UV 6def UZ d D`TZR]Vd UV ]R PPP1#!!!/  $F_Z V (R R U? R Z_R UV4^)^{\ } S R$ =RU1/2 `TcReZ/Z RIYVg1/2/ ARZŁSR]Z RU @dd15Ži"\*\*\*/ y=`d^Ze`dUV]4YZ/VT\_S`eRC%4Z\_@cV]]R\_RL4Ž DIVALDŽR U2]gR RLCŽI#!!!/ 1VLZE C/Ł4YZVV |R^ZR = R^ R|RWC^ RUV|RUV `TCRIZR  $DR_{\Theta}RX L4 YZ VLA R_VR$ DR eRX Ł4 YZVŁ=@> @ddt4Ži"\*\*\*/ =RaR eR]RUMZR eVZ=`d\_f Vg`dVdIV RcZ dUV]R  $T \wedge f$  ZIRIZE V 4 YZV DR\_OFFX L4 YZVL=@> 1F\_ZVCORRU2C4:D

DYZ RURUŽI#!!!/ 5 Z/V&UF X[RaR d 7 cR\_\Wodt.4 R^ af d

 $\mathbf{DR}_{\mathbf{A}} = \mathbf{A} \mathbf{X} \mathbf{L} \mathbf{A} \mathbf{Y} \mathbf{Z} \mathbf{V} \mathbf{L} \mathbf{5} : \mathbf{32} \mathbf{S}$ 

DVa¼gVUR.7Ži#!!"/ y5Z]`XdV\_]R4fVgRUV]:^Sf\_TVV%LZ\_eVcgZh hZEY > RETV]` > V\_U kRL<u>ARecZ` Z4f]efcR</u>? ± ##

DV\_VetCŽI"\*\*)/ <u>EYVT cc`dZ\_`WYRRRIeVc</u> ?Vh J`c\ŁHŽIŽ?`ce`\_\_4`^ aR\_j

DV\_Ł2Ž"\*\*)/ `2dZ\_ gR]fVdR\_UVT\_`^ZTXc`heY~%\_Z F?6D4@Ł<u>H`dUTf]efcVd&`œ</u> AR:ZLF?6D4@AfS]ZHZ\_X

DIY^ fT]V&9ŽR\_U> ReR>Ž4Ž1"\*\*#/ <u>A`]&ZRj T`^f\_ZRIZ</u> 3fV\_`2ZV&L4Rij`X d

PPP1"\*\*\*/

y=ReV/\_`gV/RTYZ/\_RŽ5Z11fcc1dTZA]jWATZZ\_ UR^ïeZ117444<u>CVgZbRUV:gV/bZXRIZZ\_j4c36211R</u> ?±# DR\_627XL4YZ/VLF\_Z2Vc2U.RU2C4:D

DR\_eR4d1kL6Ž"\*\*'/ @cZXV\_j\_Wefc\_UVf\_RaRd22\_Ž7½eS`]LTf]efdR j\_^\_UVc\_ZRU DR\_eATX`L4YZWL=@>12C4:D

 $\begin{array}{l} & \label{eq:rescaled_re$ 

 $\begin{array}{l} DR_{R}R_{R}L > \tilde{Z}R_{U}GR_{U}CR_{C}^{A}R_{L} > \tilde{Z}_{1}\#!!!/\\ \underline{5Z}R_{U}Ve_{C}^{A}dV_{C}R_{C}dZ_{L}^{A}\\ DR_{C}R_{C}X_{L}L_{4}YZN_{L}=@> \end{array}$ 

 $\begin{array}{l} DR_{R}R_{T} \& ZR_{U} & DAZ_{e} \& L; Z & T & T \\ \underline{O} Z \& ZR_{T} & \underline{O} & \underline{O} & U \\ DR_{e}ZX_{t} & A & YZ \\ \underline{O} & \underline{C} & X & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} & \underline{O} & \underline{O} \\ \underline{O} \\ \underline{O} & \underline{O} \\ \underline{$ 

DRZ\_eAf]XV\_dt>ŽUV1"\*\*\*/ =VXfgVc\_V\_VeUV]RTf]dfcV AR22L8R][Z]RU}=V5½Re

> PPP1#!!"/ y? f Vg ValV\_Rz Tf ] of dR  $M_{LC}$   $V_{C}$  dR V dR V?  $\pm$ %\*( DR eZRX Ł4 YZW EVZEMS`Z'ŁGŽi"\*(\$/ <u>6]`}TZ TZFURUR`</u> DR\_eZRX Ł? RdIZ V\_e EZ: Z6Ž1"\*\*% y=R\_f VgRRJZR\_kRŽ=RTf ]ef cRTYZJV\_RV\_edR\_dZIZE\_Ł "\*\*! }" \*\*%&<u>C\\$ZHR4f]efo</u>RLokVIZR] VL76Z\_  $DR_{e}ZK \pm 4 YZV \pm DVTCV = 0 + f_ZRTZ_j$ 4f lef dR PPP 1"\*\*\*/ <u>=RZcfaTZ\*\_UV]Rd^RcRdjVj^RlVdeRcUV]Rd</u> <u>MZeVd</u> DR\_ORX Ł4 YZVŁ8 CZRS` PPP1#!!"/ y6]T\_d^` R]RTYZ[V\_R%LZ\_eVcgZ/hhZeY4]RfUZR  $\hat{O}|R^{\wedge} \geq \underline{C} = \underline$ DR e277X Ł4 Y2/V E`^<u>|Z</u>d\_Ł2Ži"\*\*!/ v4` d^ VcTf lef cVR UeVVRf dR` VeYVT ^ ^ ` UZi %60 <u>dej [V</u> =`\_U\_ŁC`feWW

7cR\_\VKceLDf Yc\R' a Df SVETRARf i L3Ži" \*\*% yA`]3eZTRd Tf ]ef cR]V& 3R]R\_TV UV ]R ecR\_dZIZ\_% Ac`a`dZIZ\_V&? ±#&

yA`]36ZTRdTf]efcR]VdUV]R4`\_TVceRIZ\_+=`Xc`dj

UVERWALLZ\_D\_d\_`hd\ZLDŽR\_U\_AREED`ŁCŽL<u>F\_R</u> TF]ef\_dRaRR]RUV\_`TERIZRV\_2^½ZTR=REZ\_R

> VíZT 4ZqŁ7\_U UV4f]efdR6T\_2^ ZIR

DR ØRX Ł4 YZVŁDF C 6UZIZ VO

4 YZWL'f aRed  $^ Uc ^0$ 

4 YZV f R TRYZE dR

 $DR_{\Theta}RX L4 YZVL=@>$ 

DR ORX 14 YZVL6UZZ Vd3

PPP1"\*\*'/

PPP1"\*\*\*R∕

PPP1"\*\*\*S/

DecRf SL;  $\check{Z}$ " \*\*)/ yAVcd\_R]Vf\_U\`]]V.egV:UV\_e&e%LZ\_2dd R\_ R\_U7cZdV1VU $\check{Z}$ L:<u>UV\_e&e%L</u>? ±\$ 7R\_\M64 Df Vc\R' a

 $\begin{array}{l} Def{Z}_{A} E_{A}^{*} E_{A}^{*} & = 0 \\ E_{A}^{*} RcUd R & V_{A} aRcRUZX^{*} & V_{C} U/gM/a^{*} V_{C} \\ \hline DecReVXZ/dLa^{*} & ZZ/d R & U ac^{*} TV/dM/dLacV/M_eU \\ \hline Re F_ZeVU ? ReZ_d 4^{*} & WCV_TV^{*} & EcRUV R & U \\ \hline 5 VgM/a^{*} V_{C} 1F? 4E25/^{*} & @Te^{*} SVc^{*} *L \\ \hline 8 V_VgV \end{array}$ 

F 32 1#!!!/ <u>D TZURU</u>Ł? ±"' 3fV d2ZV R R e RF 3D1#!!!/ "=`\_UEVET\_\_`^ ZEL#" 5 VTV^ SVC F?5A1"\*\*!/ <u>9f^R\_Ukgy`a^VecVa`ce</u> @iWeURU? Vh J`c\L@iWeUF\_ZeverZej Acver PPP 1"\*\*"/ 9f^R\_Ugy`a^VecVa`ce @iWdUR\_U? Vh J`c\L@iWdUF\_ZqVdZj Advdd PPP1"\*\*#/ <u>9f^R\_Ukgy`a^Vecka`œ</u> @iWeURU? Vh J`c\L@iWeUF\_ZeverZej Acver PPP 1" \*\* \$/ <u>9f^R\_Ugy`a^VecVa`ce</u> @iWdUR\_U? Vh J`c\L@iWdUF\_ZqVdZj AcVdd PPP1"\*\*% 9f^R\_Ugy`a^VecVa`ce @iWdURU?VhJ`c\L@iWdUF\_ZqVdZqiAcVdd PPP1"\*\*&∕ <u>9f^R\_Ugy`a^VecVa`ce</u> @iWdUR\_U? Vh J`c\L@iWdUF\_ZzvkdZi AcVdd PPP1"\*\*'/ <u>9f^R\_Ugy`a^VecVa`ce</u> @iWdUR\_U? Vh J`c\L@iWdUF\_ZqVdZj AcVdd PPP1"\*\*(/ 9f^R Ukgy`a^V ecka`œ @iWeURU? Vh J`c\L@iWeUF\_ZeverZej Acver PPP 1"\*\*) ℝ⁄ <u>9f^R\_UkgVia^VecVaice</u> @iWdUR\_U? Vh J`c\L@iWdUF\_ZzVdZj Advdd PPP 1" \*\*) S/ : \_ Wc^ Vcl ScV5 VcRcc` ]]` 9 f ^ R `Ž=RdaRcRU [Rd UV]R^`UVc ZkRIZE DR eZRXŁ4YZW PPP1"\*\*\*R∕ <u>9f^R\_UkgVia^VecVaice</u> @iWURU? Vh J`c\L@iWUF Zevade Acvad  $PPP_1 "***S/$  $\underline{o} \underline{V} \underline{V} \underline{V} \underline{V} \underline{V} \underline{R} \underline{c} ]]^{\circ} 9 f^{\wedge} \underline{R} \cdot \underline{V} 4 \underline{Y} \underline{Z} \underline{V} "**!$ \*\*\*) ŁEV^ Rd UV UVCRcc` ]]` Df deV eRS [V dVcZVcŁ ?±\$ DR ØRX Ł4 YZV

PPP 1#!!! ℝ⁄ : Wc^ V d ScV 5 VdRcc` ]]` 9 f ^ R ` #! ! Ž> Rd d TZURUaRCRX SVC Rc DR ø 2RX Ł4 YZV PPP1#!!!S/ ERIVed Sever RIZE j UV R URdUV) daf VSI d ZU3XAV RoHSRIR TVj aVcobVT6Z6RoL^ZV DR\_OFAX Ł4 YZV PPP1#!!"/ 9f^R UVgVi`a^V ecVa`œ @iWdURU? Vh J`c\L@iWdUF Zevade Acvad F?5Ał46A1"\*\*(/ 6 TFV&R RIZ RId ScVdVAfcZLRUYf^R R DR ø 2RX Ł4 YZV F? 6D4@1"\*\*& @fcTcVReZeVUZeVccZejŽCVa`ce`WeYVh`c]U  $4^{\circ} \wedge ZtZ$  4f eARCZŁF? 6D4@ AfS]ZYZX PPP1"\*\*)/ H`clUTf lef cVcVa`ce ARCZŁF? 6D4@AfSZYZX PPP1#!!!/ H`dUTf ]ef dVdva`œ ARZELF? 6D4@ AFSZEYZX GZIYV&ReL5Ži#!!!/ <u>EYVdaReZR</u> <u>cV~VTeZ</u> <u>`WeYVafS</u>]ZL^ R\_f dTcZae 4`gV\_eqiLF\_ZgVcdZgi`WHRchZT\  $GZIf DR > Ž_1 #!! "/$ =RSV||V1/a`bfVTYZVR DR\_6777X Ł4 YZVŁDFUR^ VOZIR\_R HRX V&AŽı"\*\*)/ y7ValDeVIIf\_XV\_%LZ\_2 adr R\_ R\_U 702XaV1VUdZL : <u>UV eZeoeV Ł?</u> ±\$ 7dR\_\\KkdLDfYc\R^a H GD1#!!"/ H`clUGRIf VdDf cgVi DR OZRX Ł4 YZWŁ> @C: 4 YZW





# United Nations Development Programme

#### OTHER HUMAN DEVELOPMENT PUBLICATIONS FROM THE UNDP OFFICE IN CHILE

- INFORME SOBRE DESARROLLO HUMANO EN CHILE 1996
- INFORME SOBRE DESARROLLO HUMANO EN CHILE 1998, LAS PARADOJAS DE LA MODERNIZACIÓN
- INFORME SOBRE DESARROLLO HUMANO EN CHILE 2000, MÁS SOCIEDAD PARA GOBERNAR EL FUTURO

#### Temas de Desarrollo Humano Sustentable series

- N°1 Globalización, Identidad y Estado en América Latina, Manuel Castells
- N°2 Desarrollo Humano y Globalización, speeches by: Mr. Eduardo Frei Ruiz-Tagle, President of Chile; Ms. Elena Martínez, Director, UNDP / Regional Bureau for Latin America and the Caribbean; Mr. José Antonio Ocampo, Executive Secretary of the Economic Commission for Latin America and Caribbean
- N°3 Indice de Desarrollo Humano Chile 1990-1998
- N°4 Globalización Económica y Nuevo Contrato Social, Pierre Rosanvallon
- N°5 Desarrollo Humano en las comunas de Chile
- N°6 Chile: Informe sobre capacidad tecnológica, José Joaquín Brunner
- N°7 Internet en Chile: Oportunidad para la participación ciudadana, Claudio Orrego y Rodrigo Araya



As Chileans prepare to mark two hundred years of Independence, they are having to come to terms with themselves. Who are we, the Chileans? And what kind of country do we want? The Human Development Report in Chile 2002 is an invitation to debate these questions in society, from the perspective of a human development approach that seeks to make people both the agents and the actual beneficiaries of development in Chile.

The country is currently faced with a cultural challenge, since what needs to be debated are the ways people live together in practice and the collective imaginaries that surround this common life.

The Report presents the findings of a number of empirical studies, including a map of cultural activities in Chile. The research reveals that people's idea of what is "Chilean" has become indistinct. The image of "We, the Chileans" is weak and confused. This is connected to the apparent difficulty that Chileans have in experiencing society as a collective actor, able to mould its future. The studies point to a dissociated diversity. Reconciling the different experiences and representations of national life, then, is the cultural challenge that has to be taken up if nationbuilding is to succeed.