

K]Y '_ca a h'a Ub ni a '9a a U[Yb '7fYY_ Gk]a a]b['<c`Y ' 7UdY Hf]Vi `Uh]cb3

9]b j c``ghÀbX][Yf @Y]hZUXYb ZØf XYb 6Ygi W\ XYg 9a a U[Yb 7fYY_!GWk]a a `cWkg]b 7UdY Hf]Vi `Uh]cbžEi YYbg`UbXž 5i ghfu`]Yb"'9bh\à`h'8YhU]`g'ni f'5bfY]gYž'k Ug'G]Y'Yfk UfhYh $ibX^{\circ}: chcg^{\circ}jcb^{\circ}X]YgYa^{\circ}ibVYf\emptyset \ fhYb^{\circ}FY[Ybk^{\circ}U^{\circ}X!6UXY^{\circ}cW^{\circ}]$ 8 Ug '9a a U[Yb '7fYY_'GW\k]a a `cW\']gh'Y]bYg'a Y]bYf $dYfgOb^{M}Yb^{Q}YV^{b}[ggWk]aa^{OW}Yf^{B}b^{T}UdY^{H}f]Vi^{Uh}cb^{T}$ $8]YgYfYfZf]gWXYbX'_`UfY'GØ$ k UggYfVUWX'`]Y[h']a'8U]bhfYY!BUh]cbU`dUf_]ba]hhYb Y]bYf CUgY a]h Ødd][Ya FY[Ybk U`X" $K Y b b G Y b U W Y b Y f _ c g h Y b c g Y b i b X g] W Y f Y b A O [`] W _ Y] h$ $gi W Yb \check{z}'g W ']b '7 Ud Y 'Hf]Vi `Uh]c b 'UVni _Ø\ `Yb \check{z}' X Ub b ']gh$ 9a a U[Yb'7fYY_'Y]bY' \Rightarrow fYf'VYghYb'K YhhYb°'G]Y'a ØggYb'bif Y]bYb'_i fnYb'FY[Ybk U`XgdUn]Yf[Ub['a UW\Ybž'i a ']\b'ni YffY]WXYbžibXij]Y``Y]WXh'YbhXYW_Yb'G]Y'ibhYfkY[g'gc[Uf Y[b][Y'Y]bY[a]gWY'K]Xh]YfY°U`h1 / Ua d/, &&\$/G GGK 5GG9FG7 < K \Rightarrow A 9B89G'@C7 < $^{+}$ \Rightarrow 75D9 HF =61 @5H € B/ Ua d/, &&\$// [h/ $U^1 / Ua d/_ , && /9A A 5; 9B / Ua d/_ Y^1 d/_$

9]b'j c``ghÀbX][Yf'@Y]hZUXYb'ZØf'XYb'6Ygi WX'XYg'9a a U[Yb'7fYY_!GWk]a a `cWxg']b'7UdY'Hf]Vi `Uh]cbž'EiYYbg`UbXž'5i ghfU`]Yb" 9bh\À`h'8YhU]`g'ni f'5bfY]gYž'k Ug'G]Y'Yfk UfhYh'i bX': chcg'j cb X]YgYa 'i bVYfØ\fhYb'FY[Ybk U`X!6UXY`cWx"'

8 Ugʻ9a a U[Ybʻ7fYY_'GW\k]a a `cW\']gh'Y]bYgʻa Y]bYf dYfgÒb`]W\Yb'@]YV`]b[ggW\k]a a `ÒW\Yf']b'7 UdY'Hf]Vi `Uh]cb"'8]YgYf YfZf]gW\YbX'_`UfY'GØ» k UggYfVUW\'`]Y[h']a '8 U]bhfYY!BUh]cbU`dUf_]ba]hhYb'Y]bYf'C UgY'a]h'Ødd][Ya'FY[YbkU`X"

K Ybb'G]Y'bUW\'Y]bYf'_cghYb`cgYb'i bX'g]W\YfYb'A O[`]W_Y]h gi W\Ybž'g]W\']b'7UdY'Hf]Vi `Uh]cb'UVni _O\`Ybž'XUbb']gh'9a a U[Yb 7fYY_'Y]bY'\[Array\]fYf'VYghYb'K YhhYb''G]Y'a OggYb'bi f'Y]bYb'_i fnYb

FY[Ybk U`XgdUn]Yf[Ub['a UW\Ybž'i a ']\b'ni 'YffY]W\Ybž'i bX j]Y``Y]W\h'YbhXYW_Yb'G]Y'i bhYfk Y[g'gc[Uf'Y]b][Y'Y]b\Y]a]gW\Y K]`Xh]YfY°

- 'U`h1 G, GGK 5GG9FG7<K → A 9B89G'@C7<'-B'75D9 HF→61@5H→CB 2
- 'U`h1 9A A 5; 9B '7F 99? 'GK → A → B; '@C 7 < '→B '75 D9 HF → 61 @5 H → C B 2
- 'U`h1 85=BHF99!B5H=CB5@D5F?!K5GG9F@C7< 2

JYfdUggYb'G]Y'b]W\h'a Y]bYb'i a ZUggYbXYb'7UdY'Hf]Vi `Uh]cb; i]XY'a]h'&\\$'XYf'VYghYb'5_h]j]h\hYb']b'XYf'FY[]cb'i bX'a Y]bYb I bhYf_i bZhgZØ\fYf'ZØf', VYfbUW\hi b[ga Ò[`]W_Y]hYb"

Gc [Y `Ub [Yb 'G]Y 'ni a '9a a U[Yb '7fYY_ Gk]a a]b['< c `Y

7fYY_``]Y[h'Yhk U') '?]`ca YhYf'bÒfX`]W\'j cb'7UdY'Hf]Vi `Uh]cb"'9g a Uf_]Yfh'hUhgÀW\`]W\ 'XUg' 9bXY'XYf'GhfU» Y 'ZØf'Nk Y]fUXZU\fYfž'XUG]Y'XYb'6UW\'ØVYfei YfYb'a ØggYbž'k Ybb'G]Y'k Y]hYf'bUW\'BcfXYbbUW\'6`cca Z]Y`X'cXYf'7cc_hck b'ZU\fYb'a ÒW\hYb"

I a `\]Yf\Yf`ni `[Y`Ub[Ybž`Zc`[Yb`G]Y`XYf`7UdY`Hf]Vi`Uh]cb`FcUXbUW\BcfXYbžij cfVY]`Ub`A mU```6YUW\ž'A Ugcbg`K UhYf\c`Yž'XYaAcibh`Gcffck `F]X[Y`HfU]``ibX`XYb`aY]ghYb`UbXYfYb`<][\`][\hg`]b7UdY`Hf]V"`6U`X`YffY]W\Yb`G]Y`Y]bYb`ibVYZYgh][hYbGhfU»YbUVgW\b]hh"`?Y]bY`Gcf[Yž`X]YgY`fY`Uh]j`_ifnY`GhfYW_Y`jcb'ž)`?]`caYhYfb`]gh`n]Ya`]W\`[ih`UV[YghiZh`ibX`a]h`XYb`aY]ghYb&K8!:U\fnYi[Yb``Y]W\h`ni`VYkÀ`h][Ybž`nia]bXYgh`V]g`G]Y

8]Y'Ghfu» Y'ghY][h']b'Y]b][Yb'5VgW\b]hhYb'ghYh]['Ubž'U`gc'bY\a YbG]Y'g]W\'NY]h'i bX'UW\hYb'G]Y'Ui Z'UbXYfY': U\fnYi [Y"'G]Y'k YfXYbk]ggYbž'k Ubb'G]Y'g]W\'9a a U[Yb'7fYY_'bÀ\Yfbž'k Ybb'G]Y'g]W\XYa 'f]Yg][Yb'K Øf[YZY][YbVUi a 'Ui Z'XYf'fYW\hYb'GhfU» YbgY]hYbÀ\Yfb"Bi f'Y]b'dUUf'\i bXYfh'A YhYf'XU\]bhYf'gY\Yb'G]Y'X]Y'[fc» Y[YfÀi a hY': `ÀW\Yž'Ui Z'XYf'cZh'5i hcg'[YdUf_h'k YfXYbž'i a 'ni a GW\k]a a `cW\'ni '[Y`Ub[Yb"

U`h1 9A A 5; 9B 7F 99? : @ GG 69F E I 9F I B; ž'(K 8 2 9a a U[Yb 7fYY_'7fcgg]b[' 'XUj cf'dUf_Yb

9a a U[Yb 7fYY_'K U`_'fl_i fnŁ'

BUWX XYa 'G]Y' \Rightarrow f': U\fnYi ['[YdUf_h'\UVYbž'[Y\Yb'G]Y'Y]b'GhØW_k Y]hYf'\]bi bhYf'ni f'GhfU» Yb_fYi ni b['9a a U[Yb'7fYY_"'G]Y k YfXYb'\]Yf'X]Y'GWX]`XYf'a]h'GWXk]a a j YfVch'ZØf'?fc_cX]`Y VYa Yf_Yb'''GhfYggYb'G]Y'g]WX'YXcWX'b]WXh'''9hk Ug'k Y]hYf Zi ggUi Zk Àfhg'j cb'XYf'GhfU» Y'_ÒbbYb'G]Y'Ua '9a a U[Yb'7fYY_g]WXYf'gWXk]a a Yb''

; `Y]W\ ``]b_g'j cf'XYa '6UW\ 'VY[]bbh'Y]b'_i fnYf'K UbXYfk Y["'8]YgY GhfYW_Y']gh'j Ò``]['YVYb'i bX'bi f'k Yb][Y'\i bXYfh'A YhYf'`Ub[" : c`[Yb'G]Y']\a 'i bX'G]Y'[Y`Ub[Yb'ni 'X]YgYa 'i b[`Ui V`]W\Yb GØ» k UggYf!GW\k]a a `cW\" U`h1 85 \pm BHF99!B5H \pm B5@D5F?!: @ GG 2

J9FK5B8H9FDCGH."+"VYghY"7UdY"Hf]Vi `Uh]cb"HcifYb

K Ug'G]Y']a '9a a U[Yb'7fYY_'Gk]a a]b['<C`Y Yfk UfhYh'</pre>

9a a U[Yb'7fYY_']gh'a Y]b'dYfgÒb`]WXYg'@]YV`]b[g!GØ* k UggYf! 6UXY`cWX']b'7UdY'Hf]Vi`Uh]cb"'8Yf'6UXYd`Uhn']gh'Y]b'h]YZYf 5VgWXb]hh'XYg'6UWXYg'a]h'YfcX]YfhYb'I ZYfbž'X]Y'j cb'X]W_Yb FY[Ybk U'Xk i fnY`b'[YhfU[Yb'k YfXYb" U'h1 9A A 5; 9B'7F99? \dot{z} '85\$\BHF99!B5H\DECEDSF? 2 5b'XYa '6Ui a ']gh'gc[Uf'Y]bY'GY]`gWXUi _Y`VYZYgh][hz'a]h'XYf'G]Y]b'XUg'_f]ghU``_`UfY'K UggYf'gdf]b[Yb'_ObbYb"'8]Y'H]YZY'_Ubb'Y bUWX'\J\fYgnY]h'j Uf]]YfYbz'UVYf'VY]'i bgYfYa '6Ygi WX'i bhYf'fY`Uh]j hfcW_YbYb'6YX]b[i b[Yb'k Uf'g]Y'a]bXYghYbg'*: i *'h]YZ'' U'h1 9A A 5; 9B'7F99?'GK \A A \B; '< C@9\z'75D9'HF\LEOI @5H\DECODS B 5I GHF5@\DECODS B 2

G]Y'k YfXYb'Ui W.'j]Y`Y'[fc» Y'8 gWki b[Y`VUfgWk Z]gWkY'VYa Yf_Ybž X]Y'Ub'XYb'I ZYfb'XYg'6UWkYg'gWkk]a a Yb"'→W'j Yfa i hYž'X]YgY ⅓ b[g'g]bX'n]Ya `]Wk'Ub'A YbgWkYb'[Yk Ò\bhž'XU'g]Y'g]Wk'ØVYf\Ui dh b]Wkh'Ub'i bg'ni 'ghÒfYb'gWk]YbYb"

K Ybb 'G]Y'; `ØW_'\UVYbž'_ÒbbYb 'G]Y'Ua '9a a U[Yb'7fYY_'Ui W\Y]bYb'? Ugi Uf'YbhXYW_Yb"'@Y]XYf'_cbbhYb'k]f'VY]'i bgYfYa '6Ygi W_Y]bYb 'YbhXYW_Yb"'I bgYf': fYi bX'a UW\hY'YXcW\'bi f'Y]bY'Ghi bXY bUW\'i bg'Y]bYb'5i gZi ['ni a '@c W\'i bX'YbhXYW_hY'Y]bYb a Àbb`]W\Yb'? Ugi Uf'i bX'XfY]'? \emptyset _Yb° U`h1 \Rightarrow B; @9'65FG7< \check{z} 75D9'HF \Rightarrow I @5H \Rightarrow E 2

? Ubb a Ub Ua '9a a U[Yb '7fYY_gWk]a a Yb3'

Jca 'GWkk]a a Yb'Zi ggUVk Àfhg']b'XYf'BÀ\Y'XYf'GhfU»Y'k]fX XYZ]b]h]j 'UV[YfUhYbž'XU'\]Yf'Y]b'?fc_cX]`nY]WkYb'ghY\h"'9g']gh YXcWk']a '5``[Ya Y]bYb'g]WkYfž'Ua '9a a U[Yb'7fYY_! GWkk]a a `cWk'kY]hYf'ghfca Ui Zk Àfhg'ni 'gWkk]a a Ybž'XU'[fc»Y:Y`gVfcW_Yb'XYb'?fc_cX]`Yb'XYb'K Y['bUWk'cVYb'j YfgdYffYb"

5i » YfXYa ']gh'Yg'Y]b'gY\f'VY_UbbhYg'GWk]a a `cWk']b'7UdY Hf]Vi `Uh]cbž'XUg'YXYb'HU['a Y\fYfY'6Ygi WkYf'Ubn]Y\h" U`h1 F9; 9BK 5@8!G9=@G7<5l ? 9@ž'85-BHF99 2

;]Vh'Yg'?fc_cX]`Y'Ua '9a a U[Yb'7fYY_3'

BUWN Y]b'k Yb]['FYWNYfWNY']gh'_`Ufž'XUgg'Ua '9a a U[Yb'7fYY_?fc_cX]`Y'[Yg]WNhYh'k i fXYb"'G]Y'k i fXYb''YXcWN']a a Yf'bi f ghfca UVk Àfhg'[Yg]WNhYh''8Ug'K UggYf'Ua '9a a U[Yb'7fYY_ GWNk]a a `cWN']gh'gY\f'Zf]gWNž'UVYf'X]Y'GU`nk UggYf_fc_cX]`Y VYj cfni [Yb'XUg'6fUW_k UggYf'ghfca UVk Àfhg'ni a 'CnYUb"

 $69GH9^{\circ}85 + BHF99^{\circ}7FC7^{\circ}HC1F^{\circ}fFYnYbg]cbt^{\circ}Gc^{\circ}Uf^{\circ}K^{\circ}gdYf^{\circ}fcWcX]^{\circ}Y^{\circ}7fi^{\circ}gY$

, VYfbUW\ hi b[ga $O[\]W_Y]hYb'Ua'7UdY$ Hf]Vi $\Uh]cb$

BUWX Zc`[YbX`\UVY`]WX`Y]b][Y`H]ddg`ZØf`X]Y`VYghYb , VYfbUWX hi b[ga $O[`]WX_Y]hYb`Ui Z'=\fYf`FY]gY`bUWX`7UdY$ Hf]Vi `Uh]cb`ni gUa a Yb[YghY``h"`K Ybb`G]Y`k Y]hYfY`JcfgWX`À[Y`a]h : chcg`k ØbgWXYbž``YgYb`G]Y`a Y]bYb`i a ZUggYbXYb I bhYf_i bZhgZØ\fYf`ZØf`7UdY`Hf]Vi `Uh]cb"

I b[`Ui V`]WXYf'FY[Ybk U`X!5i ZYbh\U`h.'K]`Xk ccX'FU]bZcfYgh 7chhU[YgK]`Xk ccX'V]YhYha]h'5VghUbX'XUg'i b[`Ui V`]WXghY FY[Ybk U`X!5i ZYbh\U`hgYf`YVb]gž'XUg']b'8U]bhfYY'Ub[YVchYb'k]fX" 8Ug'K]`Xk ccX'`]Y[h']a '<YfnYb'j cb'7UdY'Hf]Vi `Uh]cb'Ui Z'Y]bYa gY`hYbYb'YI ch]gWXYb'CVgh[UfhYb"8]Y'; ÀghY'\UVYb'YI_`i g]j Yb Ni [Ub['ni a 'CVgh[UfhYb'i bX'_ObbYb'X]Y'ØVYf', \$\$'6Ài a Y'Ui Z XYa '; fi bXghØW_'ZfY]'Yf_i bXYb'i bX'X]Y': fØWXhY'XYf'GU]gcb dZØW_Yb'i bX'dfcV]YfYb"'5``Y'N]a a Yf'V]YhYb'Ni [Ub['ni 'Y]bYa Ub[Y`Y[hYb'; UfhYb'i bX': Yi YfghY``Ybž'Ub'XYbYb'G]Y'i bhYf'XYb GhYfbYb'[f]``Yb'_ObbYb"

6YghY'< YfVYf[Y']b'7UdY'Hf]V.'8U]bhfYY'7fcWcXmig'< cghY`: Øf
Fi W_gUW_hci f]ghYb'i bX'X]Y'Yb][Yb'a]h'_Y]bYa '6i X[YhžX]Y'Y]b
Yhk Ug'fc\YfYg'8U]bhfYY!9f'YVb]g'VYj cfni [Ybž'k ØfXY']WX'X]Y
<YfVYf[Y'7fcWcXmig'Ya dZY\Yb"'=b'7ck '6Umž'bÀ\Yf'Ub'XYf
: À\fYž'UVYf'bi f'Y]bYb'? UhnYbgdfi b['j cb'7UdY'Hf]Vi `Uh]cb'i bX
A mU``6YUWX'YbhZYfbhž'V]YhYh'X]YgYg'< cghY``N]a a Yf']a 'GUZUf]!NY`h!
Gh]`ž'X]Y'Ui g'< c`n'i bX'GY[Y`hi WX'[YVUi h'g]bXž'a]h'\c\Yb'8Y\W_Ybž
J Ybh]`UhcfYb'i bX'A cg_]hcbYhnYb"'5``Y'N]a a Yf'\UVYb'6`]W_'Ui Z
XYb'FY[Ybk U`X'i bX'VY]b\U`hYb'XYb'Ni [Ub['ni ']\fYa
Gk]a a]b[dcc`*

9d]gWXYg': Yf]Yb\Ui g'ZØf'; fi ddYb.'7UdY'Hf]Vi `Uh]cb'<c`]XUm <ci gY'A]h'Y]bYf'; fi ddY'cXYf'XcW\']YVYf'Y]b'[fc*Yg'<Ui g']a $FY[Ybk\ U`X'[Ubn'ZØf'g]WX'U``Y]bY3'8]YgY'I bhYf_i bZh']gh'XUg'Ua \\VYghYb'VYk YfhYhY': Yf]Yb\Ui g']b'7UdY'Hf]Vi `Uh]cb'''9g'`]Y[h'Ui Z') <Y_hUf'FY[Ybk\U`X'i bX'j YfZØ[h'ØVYf'Y]bYb'f]Yg][Yb'6U`_cbž'&GWX`UZn]a a Yf'i bX'Y]bY'j c```Ui g[YghUhhYhY'?ØWXY'' U`h1 75D9'HF<math>6$ I @5H6B'BCF8EI 99BG05B8 2

K Y]hYfY '5_h]j]hÀhYb ']b '7 UdY 'Hf]Vi `Uh]cb 'i bX : Uf 'B cfh\ 'E i YYbg`UbX

#W `\cZZYž'XUgg' =\ bYb`X]YgY'?i fnUb`Y]hi b['ni a '6Ygi W\ 'XYg
9a a U[Yb'7fYY_'Gk]a a]b['<c`Y']b'7UdY'Hf]Vi `Uh]cb'[YZU``Yb
\Uh"'K Ybb'G]Y']a '\c\Yb'BcfXYb'j cb'Ei YYbg`UbX'i bhYfk Y[g'g]bX
i bX'bUW\'5_h]j]hÀhYb'gi W\Ybž'gW\Ui Yb'G]Y'g]W\'i bVYX]b[h'Y]b][Y
a Y]bYf'UbXYfYb'FY]gYZØ\fYf'i bhYb'Ub"</pre>

A 9-B 9 ? 5 A 9 F 5 T B 8 : C H C 5 I G F , G H I B ;

- Gd]Y[Y``cgY'?Ua YfU.'7Ubcb'F)
- 8 fc \ b Y . '8 > A Uj] W D fc '&
- ' *\$!; fUX!5Wh]cb!?Ua YfU. =bghU' *\$ CbY L&
- @UbXgWXUZhgcVY_h]j . 7 Ubcb F: %)!') a a Z#&", @
- 5``fci bX!CVY_h]j . '7Ubcb'F: '&(%\$) 'a a 'Z#(@
- HY`YcVY_h]| . '7 Ubcb'F: '%\$\$) \$\$ a a 'Z#Z#(ž) + ž%'@
- @Ub[Y'5_h]cbgghUb[Y.'\phighU' *\$'\phi]g]V'Y'Dc'Y'fbi '`YhH]a YŁ
- @UbXgWXUZhg`]bgYbZ]`hYf.'< cmU'7]fW'`Uf'Dc`Uf]nYf
- ? Ua YfUfi W_gUW_. :: !Ghcd H]`cdU
- @ $YV^{b}[gZchcniVY\Of.DYU_8Yg][b.7UdhifY.7^{d}]$

9]bY'@]ghY'a Y]bYf'Ya dZc\`YbYb': chcUi gfØghi b['fM]bgW\`]Y»`]W\k Ug']W\'VYbi hnY'i bX'k Ufi a Ł'Z]bXYgh'Xi ']b'a Y]bYa '@Y]hZUXYb'ZØf?Ua YfUUi gfØghi b['ZØf'X]Y'FY]gY"

K Ybb 'G]Y : chcg 'Ui Z'X]YgYf 'K YVg]hY 'j Yfk YbXYb 'a ÒW hYbž VYgi W\Yb 'G]Y 'V]hhY 'a Y]bY '@]nYbn]Yfi b[ggY]hYž'i a \YfUi gni Z]bXYbž'k]Y" : Øf '\cW\Ui Z'ÒgYbXY / '_ca a Yfn]Y ``Y Bi hni b['_cbhU_h]YfYb 'G]Y 'a]W\ 'V]hhY 'X]fY_h" U`h1 9A A 5; 9B '7F 99? 'G7 < K \Rightarrow A @C 7 < 2