

H\Øf]b[Yb'd`Ubh'A]``]cbYb'bYiYf GWXihnfÀiaY''=gh'XUg'[Ybi[3

H\Øf]b[Ybg'±bbYba]b]ghYf'ZcfXYfh'XYb'5igVUi'jcbGW\ihnfÀiaYb"'9]b'?cbnYdh'ZØf'a]``]cbYbZUW\YGW\ihnaÒ[`]W_Y]hYb']b'8YihgW\`UbX']gh']b'5fVY]h"

6]Y`YZY`Xž'8Yi hgWX`UbX'!'5a '%%"'\$ b]'&\$&) 'f]WX hYb'g]WX'X]Y
6`]W_Y'Ui Z'X]Y'9bhk]W_`i b[Yb']a '6YfY]WX'XYg
6Yj O`_Yfi b[ggWXi hnYg']b'8Yi hgWX`UbX"'H\Øf]b[Ybg'\DYba]b]ghYf
; Ycf['A U]Yf'\Uh'_Øfn`]WX'VYhcbhž'XUgg'Yg'dchYbn]Y``'[YY][bYhY
? UdUn]hÀhYb'ZØf'bYi Y'GWXi hnfAi a Y'[]Vh"'8]YgY'5i ggU[Y
i bhYfghfY]WXh'X]Y'Bchk YbX][_Y]h'Y]bYg'BYi VY[]bbgž'XU'U`hY
GWXi hnfAi a Y'[fO) hYbhY]`g'b]WXh'a Y\f'j cf\UbXYb'cXYf
i a [Ybi hnh'k i fXYb"' 6YggYf'a Ub'\Uh'U`g'a Ub'\AhhY ž'gc'A U]Yfž
k À\fYbX'Yf'X]Y'8f]b[`]WX_Y]h'XYf'G]hi Uh]cb'\Yfj cf\YVh"

H]a a : i Wkgž·F Y ZY f Uhg`Y]hY f 'ZØf' 6 Y j Ò`_Y f i b [gg Wk i hn 'V Y]a 8 Y i hg Wk Y b 'GhÀ X hY! 'i b X'; Ya Y]b X Y V i b X ž i b hY f ghØhnh 'X]Y g Y G] Wkhk Y]g Y i b X 'Zcf XY f h Y]b i a ZUgg Y b X Y g '? c b n Y d h 'ZØf 'X Y b '5 i g V U i j c b 'G Wk i hn f À i a Y b " '9 f 'a U \ b hž 'X Ugg 'X] Y '? c a a i b Y b 'c \ b Y Z]b U b n] Y ``Y 'I b hY f g hØhn i b ['X i f Wk 'X Y b '6 i b X 'X] Y 'Y f Zcf XY f `] Wk Y \

\[
\Delta Z f Ugh f i _h i f 'b] Wkh 'U i g 'Y] [Y b Y f '? f U Z h 'Z] b U b n] Y f Y b '_ Ob b Y b " : i Wk g j Y f [`Y] Wkh X] Y g Y b 'D f c n Y g g 'a] h 'Y] b Y a 'A U f Uh\ c b `U i Z ž XY f \

`Ub [Z f] g h] [Y 'I b h Y f g hØhn i b ['V Y b Oh] [Y ž i a 'Y f Z c `[f Y] Wk 'n i 'g Y] b "

$8f]b[`]WX_Y]hXYg5igVUig$

8]Y'U_hi Y``Y'G]W\Yf\Y]hg`U[Y']b'9i fcdU'\Uh'X]Y'5b_ØbX][i b['XYg 6i bXYgUa hYg'ZØf'6Yj Ò`_Yfi b[ggW\i hn'i bX'?UhUghfcd\Yb\]`ZY fb6?\E'VYY]bZi gghž'k cbUW\']b'8Yi hgW\`UbX'Y]bY'A]``]cb'bYi Y GW\i hnfÀi a Y'[YgW\UZZYb'k YfXYb'gc``Yb"'FU`d\'H]Yg`Yfž'DfÀg]XYbh

XYq.66? ži bhYfghfY]WXh.X]Y.k UWXqYbXY.Gcf[Y.ØVYf.a Ò[`]WXY $?f]Y[ggnYbUf]YbiibXiX]Yi8f]b[i]WX_Y]hiXYgi5igVUig"i5biX]YgYa$ Dib_hk]fX XYi h`]W\ ž XUgg XYf 6YXUfZ Ub GW\ i hnf\ i a Yb b]W\ h b i f h\YcfYh]qW\VYghY\hzqcbXYfb'Ub[Yq]W\hq'XYf'[Ycdc`]h]qW\Yb 9bhk | W `i b [Yb '] a a Yf 'Xf | b [`] W Yf 'k | f X "

=b '8 Y i hgWX `Ub X '[]Vh'Yg'XYfnY]h'fi b X ') +- 'hYWX b]gWX Y GWX i hnfài a Yž'X]Y'ni fnY]h'D`Uhn'ZØf'Yhk U'(++")-' 'DYfqcbYb V]YhYb"'8]YgY'9]bf]WXhib[Yb'ghUa a Yb'\Ui dhgÀWX`]WX'Ui g'XYf'NY]h $XYg^{n}kY^{h}b^{n}KY^{h}_{g^{n}}Y^{g^{n}}bX^{n}_{g^{n}}bX^{n}_{g^{n}}bX^{n}_{g^{n}}U^{n}$ $GY]h^* \& \$ + [UV^*Yg^*_Y]bY^* = bghUbX \setminus U^*hi b[ga U^*bU \setminus a Yb^*a Y \setminus fž^*k Ug]$ $X[Y^G]hiUh]cb^kY]hYf^iYfgWAAfZh"8]Y^FØW_UVk]W_ib[^icb]$ GWXi hnUb`U[Yb'kifXY']a '\\f'&\\$+'VYgWX`cggYb\Z'UVYf'XYf'?f]Y[$b \times Y f = fU b Y \cdot Uh \times Y \cdot 9 b g h Y \cdot i b [\times X Y g Y f \cdot F Ø W UV k] W i b [$ [Yghcddh"

5 hi Y``Y'GW\i hnfÀi a Y']b 5bnU\`

8 Yi hgWX`UbX

² ZZYbh`]WXY`GWXihnfÀiaY) +-
GWXi hnd`ÀhnY	(+ + ") - '

8Yf'5i gVUi 'gc``'b]W\h'bi f'Ui g'VYghY\YbXYb'5b`U[Yb'k]Y'Hi bbY`b cXYf'H]YZ[UfU[Yb'YfZc`[Ybž'qcbXYfb'UiWX'bYiY'?cbnYdhY'ZØf a Y\fhÀ[][Y'5i ZYbh\U`hY'i a ZUggYb"'8UVY]'g]bX'[Ughfcbca]gW\Y 9]bf]WXhi b[Ybž'Hc]`YhhYb'i bX': Y`XVYhhYb'j cf[YgY\Yb"'H]Yg`Yf gW\Ahnhz\Ugg\]b\XYb\b\W\ghYb\nY\b\\\J\fYb\a\]bXYghYbg'\\$ A]``]UfXYb '9i fc 'VYbOh][h'k YfXYb"'8]Y '9i fcdA]gWXY 'I b]cb '\Uh YVYbZU``g'Y]bY'bYiY'GhfUhY[]Y'nif'?f]gYbjcfgcf[Y'jYfUVgWX]YXYhž $X | Y \cup Z \cap Ab \times Y f \emptyset \vee Y f [fY] Z Y b X Y \cap B c h Z U \cap d f c h c _ c \cap Y \cap b X \cap [Y [Y b g Y] h] [Y h g Y h g$ I bhYfghØhni b['gYhnh"

:]bUbn]Y``Y'< YfUi gZcfXYfi b[Yb

8 | Y 'Z|bUbn | Y ``Y '@U | Y 'XYf'? ca a i bYb 'ghY ``h'Y | b ' | fc » Yg' < | b XYfb | g $XUf'': i W g' \setminus Uh'Ui Z'X Y g Y'GW k Y f f [_Y] h Y b' \setminus] b [Y k] Y g Y b' i b X$ ZcfXYfh'Y]b'?cbnYdhž'XUg'ØVYf'X]Y'fY]bY'6YfY]hghY``ib['jcb GWN i hnfài a Yb'\|bUi g[Y\h"'< |YfVY|'k |fX'X|Y'J YfUbhk cfhi b['ZØf XYb'NighUbX'XYf'GWXihnfÀiaY'\UidhgÀWX`]WX'XYb'GhÀXhYb'ibX

?ca a i bYb 'ØVYf`UggYbž'k À\fYbX 'XYf`6i bX'_Y]b '9][Ybhi a 'Ub XYb 'a Y]ghYb 'ÒZZYbh`]W\Yb 'GW\i hnfÀi a Yb '\Uh" 'GhUhhXYggYb Yl]gh]Yfh'`YX][`]W\Y]b 'j YfhfU[`]W\Yg'Bi hni b[gfYW\h"

8]Y'k Uf'V]g'ni f'9f\Ò\i b['XYf'a]']hÀf]gWXYb': À\][_Y]hYb'XYf'B5HC k Yb]['6YUW\hi b['[YgW\Yb_h'k i fXYž'UVYf'XUg'U_hi Y``Y [Ycdc`]h]gWXY'?`]a U'YfZcfXYfh'Y]bYb'I a XYb_Yb']b'XYf'XYi hgWXYb; YgY``gWXUZhii bX'XYf'[YgUa hYb'Yi fcdÀ]gWXYb G]WXYf\Y]hgUfWX]hY_hi f"'9]b'9I dYfhYbhYUa '\Uh'VYfY]hg'a]h'XYf 5i gk Yfhi b['XYf'6YghUbXgUi ZbU\a Y'XYf'GWXi hnfÀi a Y'VY[cbbYb i bX'k]fX'j cfUi gg]WXh']WX']a 'Gca a Yf'&\$&) 'Y]b'i a ZUggYbXYg?cbnYdh'j cf`Y[Yb"

8 Y hU]`g	
J c f ZU``	B c hZU``
Cfh	6]Y`YZY`Xž'8Yi hgWX`UbX
EiY``Yb	• k k k "a Xf"XY
	• k k k "VV_"Vi bX"XY
	 XY"Yi fcbYk g"Wca

6Ygi WXYb G]Y i bg Ui Z. b!U["bYh