

: Ygh`]WXY'?`Àb[Y'ni a '> V]`Ài a . < YYfYga i g]__cfdg`VY[Y]ghYfh`]b N]Y[Yb\U]b

9]b'i bj Yf[Ygg`]WXYg'6YbYZ]n_cbnYfh'XYg'< YYfYga i g]__cfdg ?UggY`'VY[Y]ghYfhY',) \$'6Ygi WXYf'VY]a '\$V]`Ài a 'XYg GWXk U`a !9XYf!?fY]gYg"

 $G7 < K 5@A GH58H!N=9; 9B < 5=B"5a"8]YbghU[UVYbX`ZUbX`UiZ`XYa \] ghcf]gWXYb`DUfUXYd`Uhn`]b`N]Y[Yb\U]b`Y]b`i bj Yf[Ygg`]WXYg ?cbnYfh`XYg`< YYfYga i g]__cfdg`? UggY``ghUhh"=a `FU\aYb`XYf : Y]Yf`]WX_Y]hYb`ni a `) $!^\A\f][Yb`6YghY\Yb`XYg`GWXk U`a!9XYf!?fY]gYg`nc[`XUg`9j Ybh`\ØVYf`,) $`Ni gWXUiYf`Ubž`X]Y`g]WX`UiZ`XYb VYfY]h[YghY``hYb'6\Ab_Yb`i bX`]\fYb`Y][YbYb`G]hn[Y`Y[Yb\Y]hYb b]YXYf`]Y*Yb"8]Y``UiY`Gd\Ahgca aYfbUWXh`V]`XYhY`Y]bYb`]XYU`Yb FU\aYb`ZØf`Y]bYb`a i g]_U`]gWXYb`5VYbXž`XYf`]b`X]Y`; YgWX]WXhY XYf`FY[]cb`Y]b[Y\Yb`k]fX"$

K]Y Y]b ZYgh]WX Yg: Yi Yfk Yf_'Ui g'? `Àb[Yb YfÒZZbYhY XUg < YYfYga i g]__cfdg'? UggY`i bhYf'XYf'@Y]hi b['j cb'C VYfgh`Yi hbUbh HcV]Ug'HYf\UfXh'XUg'? cbnYfh'a]h'XYa '; fUZ'9VYf\UfX!A UfgWX 5`VYfh "'GcZcfh'YfZUgghY'Y]bY'5ha cgd\ÀfY'j cb'ZY]Yf`]WXYf 9f\UVYb\Y]h'XYb'D`Uhm"'8]Y'A i g]_'k Uf'b]WXh'bi f'ni '\ÒfYbž gcbXYfb'Ui WX'ZÒfa `]WX'ni 'gdØfYbž'k Ug'X]Y'Ni gWXUi Yf']b']\fYb 6Ubb'nc["'8Yf' ?U]gYfk U`nYf 'ghY``hY'X]Y'_`Ub[`]WXY'DfUWXh'i bX 5ba i h'XYg'CfWXYghYfg'i bhYf'6Yk Y]gž'k À\fYbX'g]Y'a]h' 7UdY <cfb 'X]Y'Ni \ÒfYf'Ui Z'Y]bY'YbYf[Yh]gWXY'a i g]_U`]gWXY'FY]gY a]hbU\a Ybž'X]Y'ghØfa]gWXY'A YYfY'i bX'[fc»Y'5VYbhYi Yf VYgWXk cf"

9]b 5 VYb X^i j c^{Y} f $^{'}$ <OVdi b_h Y

BUWX 'Y]bYf'_`Y]bYb'DUi gY'_Y\fhY'XUg'C fWX YghYfini fØW_'a]h'XYa GhØW_' Hchc'Zcf'Hfca VcbYg ž'XUg'X]Y'J]Y`gY]h][_Y]h'XYg Aig]__cfdg'Y]bXfi W_gj c```XYa cbghf]YfhY"'9g'k i fXY'XYi h`]WX ž'XUgg X]Y'A i g]_Yf'b]WX h'bi f'hYWX b]gWX'j Yfg]Yfh'k UfYbž'gcbXYfb'Ui WX 9a ch]cbYb'Xi fWX']\fY'8 UfV]Yhi b[Yb'hfUbgdcfh]YfhYb"'8]Y 6Y[Y]ghYfi b['XYg'Di V`]_i a g'ghY][YfhY'g]WX'a]h'YXYa 'GhØW_kY]hYfž'k Ug'gWX`]Y»`]WX']b'Y]bYa 'VY[Y]ghYfhYb'5dd`Ui g'a ØbXYhYž U`g'X]Y'`YhnhYb'BchYb'XYf'BUh]cbU`\ma bY'j Yf_`Ub[Yb"

8]Y'JYfUbghU`hi b['k i fXY'j cb'<Y`a i h'6U`Ua U[]ž'Y]bYa 'A]h[`]YX XYg'? fY]gUi ggWi ggYgž'a cXYf]Yfhž'XYf'X]Y'K ØfXY'XYg'@UbXfUhYg K]bZf]YX'6YW_Yf'i bX'XYg'9fghYb'? fY]gVY][YcfXbYhYb' \mathscr{A} f[Yb?Ui Za Ubb'j YfhfUh'' \Rightarrow fY'5bk YgYb\Y]h'j YfXYi h`]W\hY'X]Y 6YXYi hi b['XYg'5VYbXg'ZØf'X]Y'; Ya Y]bXY'i bX'XYb'GW\k U`a !9XYf!?fY]g"

$K c \ \hat{h} h] [Y'Nk YW_Y'] a : c_i g$

 $8 \ Yf'9f'\grave{o}g'XYg'? cbnYfhg'k \]fX'Y'ni f'< \grave{A}`ZhY'Ub'XYb': \grave{o}fXYf_fY]g$ 6i bXYgk Y\fghUbXcfh'GW\k UfnYbVcfb'i bX'Ub'XUg'6i bXYgk Y\f! Gcn]U`k Yf_'FY[]cbU`ghY``Y': f]hn`Uf'[YgdYbXYh''8]YgY'A]hhY`g]bX nk Y\\[YV\ [YV\ bXYb'Z\Øf'X]Y'6YhfY\ i b['j cb'Gc`XUhYb'i bX'XYfYb: Ua]`]Yb''`Gc`\W\Y'\\\\]h]Uh]j Yb'nY][Yb'XUg'9b[U[Ya Ybh'XYg < YYfYga i g]__cfdgž'\ØVYf'X]Y'A i g]_'\]bUi g'Y]bYb'dcg]h]j Yb 6Y]hfU['ni f'; YgY``gW\UZh'ni '`Y]ghYb''

8 Ug' < YYfYga i g]__cfdg'? UggY`žY]bYg'XYf'À`hYghYb']b'XYf
6i bXYgk Y\fž'k i fXY'Ua '%"'\$ b]'%-) * [Y[fØbXYh'i bX'\Uh'g]W\']b
gY]bYf'`Ub[Yb'; YgW\]W\hY'Zcfa]XUVY`'k Y]hYfYbhk]W_Y`h"'GY]h'&\$%'
hfÀ[h'Yg'gY]bYb'\Yi h][Yb'BUa Yb'i bX'Vf]``]Yfh'fY[Y`a À»]['a]h
a cXYfbYb'5ffUb[Ya Ybhgž'X]Y'Y]b'VfY]hYg'Di V`]_i a 'UbgdfYW\Yb"
8Yf'6Y[f]ZZ' A i g]__cfdg 'ghY\h'b]W\h'bi f'ZØf'a i g]_U`]gW\Y
8UfV]Yhi b[Ybž'gcbXYfb'Ui W\'ZØf'Y]bY'JYfV]bXi b['j cb'HfUX]h]cb
i bX'*bcj Uh]cbž'X]Y'X]Y'Gc`XUhYb'k À\fYbX']\fYf'9]bgÀhnY
i bhYfghØhnh"

HcV]Ug'HYf\UfXhž'XYf'XUg'CfW\YghYf'`Y]hYhž'\Uh'ni XYa i a ZUb[fY]W\Y'9fZU\fi b[']a 'a]`]hÀf]gW\Yb'A i g]_k YgYbž'i bhYf UbXYfYa 'VY]'XYf'I bhYfghØhni b['XYg'UZ[\Ub]gWXYb A]`]hÀfa i g]_X]YbghYg"'GY]bY'DfÀgYbn'i bX'X]Y'XYf'A i g]_Yf'a UWXYb XYi h`]WXž'XUgg'Yg'VY]'gc`WXYb'J YfUbghU`hi b[Yb'b]WXh'bi f'i a I bhYf\U`hi b['[Y\hž'gcbXYfb'Ui WX'i a 'X]Y'K ØfX][i b['XYf'8]YbghYž X]Y'Gc`XUhYb'ZØf'XUg'@UbX'`Y]ghYb"

 $: \varnothing f X]Y ``f \varnothing f [Yf `XYg ``GW\k U``a !9XYf!?fY]gYg ``ghY```h `XUg `?cbnYfh `b]W\h bi f `Y]bY `a i g]_U`]gW\Y `I bhYf\U``hi b [`XUf ž gcbXYfb `Ui W\Y]bY A `O[`]W_Y]h ž X]Y `J YfV]bXi b [`ini f `f i b XYgk Y\f i b X `ni `XYb a]`]h Af]gW\Y b `HfUX]h]cbYb `]b `8 Yi hgW\`UbX `ni `gh Af_Yb "`8]Y i ba]h hY`VUfY `: fYi XY`Ub `XYf `A i g]_ `i bX`XUg `_c``Y_h]j Y `9f`YVb]g Y]bYg `gc`W\Yb `9j Ybhg `ZÒf XYfb `Y]bY `; Ya Y]bgW\UZhgV]`Xi b [ž X]Y`]b XYb `: Y]Yf`]W_Y]hYb `ni a `) $! `A\f][Yb '$ V]`Ai a `]\fYb `5i gXfi W_Z]bXYh"$

9]b 6`]W_]b X]Y Ni _i bZh

9]b'k Y]hYfYg'VYXYi hYbXYg'9fY][b]g']gh'ZØf'XYb'' "'C_hcVYf'&\$&(
[Yd'Ubhz'k Ybb'Y]b'6Øf[YfZYgh'Ui Z'XYa ; Y'ÀbXY'XYg
6Y\ÒfXYbnYbhfi a g']b'<ca VYf['ghUhhZ]bXYh''8]YgYg': Ygh'k]fX
Ui WX XYb'YfghYb'9\fYbUa hghU['XYg'GWXk U'a !9XYf!?fY]gYg
VY]b\U'hYbz'k Ug'X]Y'K]WXh][_Y]h'j cb'9\fYbUa h`]WXYa
9b[U[Ya Ybh']b'XYf'FY[]cb'i bhYfghfY]WXh'''9]bY'6`Ui `]WXha Y]'Y'a]h
9]bgUhnZU\fnYi [Yb'Ui g'j YfgWX]YXYbYb'<]'Zgcf[Ub]gUh]cbYb'i bX
nU\`fY]WXY'*bZcfa Uh]cbgghÀbXY'V]YhYb'XYb'6Øf[Yf]bbYb'i bX
6Øf[Yfb'X]Y'A Ò[`]WX_Y]hz'X]Y'j YfgWX]YXYbYb': UWYhhYb'XYg
9\fYbUa hg'_YbbYbni `YfbYb'''5i WX ZØf'XUg''Y]V`]WXY'K c\`k]fX
[Ygcf[h'gY]bz'k Ug'XUg': Ygh'ni 'Y]bYa 'VYgcbXYfYb'5b`Ugg'ZØf'U``Y
a UWXh''

<]ghcf]gW\Y`Ni gUa a Yb\Ab[Y</pre>

8]Y:Y]Yf`]WX_Y]hYb'ni a ') \$!'À\f][Yb'\$V]`Ài a 'XYg'GW\k U`a !9XYf!?fY]gYg'_ObbhYb']b'[Yk]ggYf'K Y]gY'a]h'XYb'\$V]`Ài a gZY]YfbUbXYfYf'XYi hgW\Yf'@UbX_fY]gY'j Yf[`]W\Yb'k YfXYb"'9]bVYXYi hYbXYg'6Y]gd]Y`'g]bX'X]Y':Y]Yf`]W_Y]hYb'ni a ') \$!'À\f][Yb6YghY\Yb'XYg'@UbX_fY]gYg'HØV]b[Yb']a '\$U\f'&\$%) ž'X]Y'À\b`]W\Y9`YaYbhY'i a ZUgghYbž'Y]bgW\`]Y»`]W\'?cbnYfhYž'I a nØ[Y'i bX'Y]bY

6Yhcbi b['XYf'fY[]cbU`Yb' ⇒ XYbh]hÀh" 'K À\fYbX'X]Y' JYfUbghU`hi b[']b HØV]b[Yb'Y]bYb'ghÀf_YfYb': c_i g'Ui Z'X]Y'; YgWX]WXhY'i bX'?i `hi f XYf'FY[]cb'`Y[hYž'Vch'XUg' → V]`Ài a ']b'GWXk U`a ghUXh!N]Y[Yb\U]b ni gÀhn`]WX'Y]bY'X]fY_hY'I bhYfghØhni b['ZØf'Òfh`]WXY'[Ya Y]bbØhn][Y Cf[Ub]gUh]cbYb"

<]bhYf[fi bX]bZcfa Uh]cbYb ni f F c ``Y XYg < YYfYga i g]__cfdg</pre>

8]YgY'Gma V]cgY'VYk Y]gh'b]W\h'bi f'XYb'_i `hi fY``Yb'6Y]hfU['XYf 6i bXYgk Y\f'ni f'; YgY``gW\UZhž'gcbXYfb'Ui W\ž'k]Y'A i g]_'U`g'Y]b a YX]i a 'XYf'J YfghÀbX][i b['X]Ybh"'?cbnYfhYž'X]Y'k]Y'XUg']b N]Y[Yb\U]b'cf[Ub]g]Yfh'k YfXYbž'g]bX'a Y\f'U`g'bi f': YghY/'g]Y'g]bX Y]b'J Yfgi W\ž'6fØW_Yb'nk]gW\Yb'a]`]hÀf]gW\Yb'i bX'n]j]`Yb @YVYbgVYfY]W\Yb'ni 'gW\`U[Yb'i bX'V]YhYb'XYb'6Øf[Yfb'X]Y A O[`]W_Y]hž'X]Y'6i bXYgk Y\f'i bX']\fY'5b[Y\Of][Yb'bÀ\Yf_YbbYbni 'YfbYb"'

8 Ug`< YYfYga i g]__cfdg`? UggY``\Uh`XUfØVYf`\]bUi g`X]Y A Ò[`]WX_Y]hž'¹ b[Y`HU`YbhY`ni 'ZÒfXYfb`i bX'dfcZYgg]cbY``Y`A i g]_Yfni 'fY_fi h]YfYbž'X]Y`b]WXh'bi f`a]`]hÀf]gWX`[YgWXi `h'g]bXž'gcbXYfb Ui W\]b`XYf`n]j]`Yb`A i g]_k Y`h`[`ÀbnYb`_ÒbbYb"`8]Yg`\]`Zhž`Y]b dcg]h]j Yg`\all U[Y`XYf`6i bXYgk Y\f`]b`XYf`² ZZYbh`]W_Y]h`ni VYk U\fYb`i bX`[`Y]W\nY]h][`X]Y`_i `hi fY``Y`6]`Xi b[`]bbYf\U`V`XYf 6i bXYgk Y\f`ni `ghÀf_Yb"

GhUh]gh]_Yb'ni f'?i `hi f!'i bX'A i g]__i `hi f']b 8Yi hgWX`UbX

Ni XYa 'nY][h'Y]bY'5i gk Yfhi b['XYg'6i bXYga]b]ghYf]i a g'ZØf

J Yf_Y\f'i bX'X][]hU'Y' \(\frac{1}{2}\) ZfUghfi _hi fž'XUgg'fi bX'' \(\frac{1}{2}\) XYf'8 Yi hgW\Yb

Y]b'\c\Yg' \(\frac{1}{2}\) bYfYggY'Ub'J YfUbghU'hi b[Yb'\UVYbž'X]Y'Y]bYb

gcn]U'Yb'cXYf'_Uf]hUh]j Yb'Nk YW_'i bhYfghØhnYb'''8]Y'J YfV]bXi b[
j cb'\cW\k Yfh][Yf'A i g]_'i bX'gcn]U'Ya '9b[U[Ya Ybhž'k]Y'VY]a

6YbYZ]n_cbnYfh'XYg' < YYfYga i g]__cfdgž'gdf]W\h'U'gc'b]W\h'bi f'X]Y

a i g]_U']gW\Y'GY]hY'XYf'A YbgW\Yb'Ubž'gcbXYfb'ZÔfXYfh'Ui W\'XUg

gcn]U'Y'6Yk i gghgY]b'i bX'9b[U[Ya Ybh']bbYf\U'V'XYf
; YgY'`gW\UZh''

8 Y hU]`a

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z 'b!U["XY