

; fUi Yb\UZhY'HUh.'%('; fUi [ÀbgY'Ui Z': Ò\f Vfi hU`'[Y_ÒdZh°

5i Z': Ò\f'k i fXYb'%('; fUi [ÀbgY'Vfi hU`'[Y_ÒdZh"'8]Y'Dc`]nY] Yfa]hhY`hž'D9H5'V]YhYh'Y]bY'6Y`c\bi b['j cb'&\$\$\$'9i fc'ZØf <]bk Y]gY"



: Ò\fž'8 Yi hgW\`Ub X '! '5i Z'XYf'B cfXgYY! ≠ gY`: Ò\f'YfY][bYhY'g]W\
Y]b 'gW\cW_]YfYbXYf'J cfZU``ž'XYf'X]Y 'H]YffYhhi b['i bX
B Uhi fgW\i hn[fi ddYb 'ZUggi b[g`cg'a UW\h"'I bVY_UbbhY'HÀhYf\
\UVYb'%('JÒ[Y`ž'XUfi bhYf'%' '1 b[Y'; fUi [ÀbgY'i bX'Y]b'9`hYfbh]Yfž
[Y_ÒdZh"'8]Y'H]YffYhhi b['j cf'Cfh'Yf_`Àfhž'XUgg'Y]bY'; Ubg'`YVYbX
[YVcf[Yb'k YfXYb'_cbbhY"'8]Y'Dc`]nY]'Yfa]hhY`h'bi bž'k À\fYbX'X]Y
H]YffYW\hgcf[Ub]gUh]cb'D9H5'8Yi hgW\`UbX'Y]bY'6Y`c\bi b['j cb
&\$\$\$'9i fc'ZØf'<]bk Y]gY'Ui ggYhnhž'X]Y'ni f'JYfi fhY]`i b['XYg'HÀhYfg
ZØ\fYb'_ObbhYbž'k]Y'hn"XY'VYf]W\hYh"

 $8]Y'; fUi [Ubg']ghY]bY'cZh'j YfZc`[hY'5fhž'X]Y'Xi fWX']``Y[U`Y'*JJ[X'ibX'UbXYfY'6YXfc\ib[Yb'[YZÀ\fXYh'k]fX'''*±b'<Ua Vi f['ibX'UbXYfYb'GhÀXhYb'k YfXYb'; ÀbgY']b'[fc>Yb'GhØW_nU\`Yb'VY'U[hž'$

k cVY]'XYf'5VgWki gg'cZh'c\bY'Y]bXYi h][Y'Bchk YbX][_Y]h'YfZc`[h'' @c_U`Y'BUhi fgWki hnj YfVÀbXY'VYf]WkhYb'j cb'a Ugg]j Yb'9]b[f]ZZYb]b'X]Y'@YVYbgfÀi a Y'XYf'; ÀbgYž'VYX]b[h'Xi fWk'BYi VUi dfc'Y_hYi bX'`UbXk]fhgWkUZh`]WkY'5i gVfY]hi b[ž'X]Y'XYb'c\bY\]b'fYXi n]YfhY@YVYbgfUi a 'k Y]hYf'j Yf_`Y]bYfbžbYi bhcYhYf!Yj "XY'Yf`Ài hYfh"

6YXfc\ib[Yb ZØf; fUi [AbgY

; fUi [$\grave{A}bgY'kY]gYb'bUhØf`]WkY': Y]bXY'Ui Zž'XUni 'nÅ\`Yb'GYYUX`Yfi bX': ØWkgYž'XcWk'XYf'a YbgWk`]WkY'9]b[f]ZZ']gh'cZh'XYf'[YZØ\`hY < Ui dhZU_hcf'ZØf'XYb'FØW_[Ub[']\fYf'Dcdi `Uh]cbYb''K <math>\grave{A}\fYbX'XYf$ 6fi hnY]h'k YfXYb'X]Y'BYghYf'cZha U`g'j cb'K]`XgWk Y]bYbž K UgWkVÅfYb'cXYf'?f\hat{A}\Yb'[Yd`ØbXYfh''8]YgY'5b[f]ZZY'V]`XYb'bi f Y]bYb'HY]``XYf'6YXfc\i b[Ybž'XYbYb'X]Y'H]YfY'Ui g[YgYhnh'g]bX'' Ni XYa 'YbhghY\Yb'Xi fWk'_U`hYž'gWkbYYfY]WkY'K]bhYf BU\fi b[ga Ub[Y`i bX'GhfYggY]bZØggY'Xi fWk'@Afa YfY][b]ggYž'k]Y: Yi Yfk Yf_Yž'X]Y'X]Y'; $\grave{A}bgY'XUni 'Vf]b[Ybž']b'DUb]_'[Y[Yb <]bXYfb]ggY'ni 'Z]Y[Ybžh]YfgWki hn!Ui ghf]U"Uh'Yf_`\hat{A}fh''$

Ni gàhn`]W\ k]fX`X]Y`@YVYbgei U`]hàh`XYf'; fUi [àbgY`Xi fW\ `XYb ZàW\YbXYW_YbXYb`9]bgUhn'j cb`DYgh]n]XYb`]b`XYf`@UbXk]fhgW\UZh i bX`Xi fW\ `X]Y`NYfgW\bY]Xi b[`]\fYf`@YVYbgfài a Y`Xi fW\ K]bXfàXYf'i bX`, VYf`UbX`Y]hi b[Yb`ghUf_`VYY]bhfàW\h][h"\\$ b[Y\ fUi [àbgY`g]bX`VYgcbXYfg`UbZà``][ž'k Ugʻni `\ài Z][Yb`I bZà``Yb ZØ\fhž'k à\fYbX`g]Y`j Yfgi W\Ybž'6fØW_Yb`ni `ØVYfei YfYb"\8]Y`\$J[X Ui Z'; àbgY`\Uh'ni XYa `[fUj]YfYbXY`5i gk]f_i b[Yb`Ui Z']\fY Gcn]U`ghfi _hi fYbž'k UgʻY]bY`[Yn]Y`hY`Dcdi `Uh]cbgYf\U`hi b[i ba Ò[`]W\`a UW\hžbYi bhcYhYf!Yj "XY`Yf[àbnh"

$Bchk YbX][_Y]h XYg H]YfgWi hnYg$

8]Y J cfZÀ``Y 'Ui Z: Ò\f'\UVYb 'YfbYi h'X]Y '8]g_i gg]cb 'ØVYf XYb GWi hn'j cb 'K]`Xh]YfYb 'i bX'X]Y 'B chk Yb][_Y]h'j cb 'gWi ÀfZYfYb ; YgYhnYb 'ni f'6Y_Àa dZi b['j cb 'H]Yfei À`YfY] 'gck]Y ']``Y[U`Yf K]`XYfY] 'YbhZUWi h'''6Y\ÒfXYb 'i bX'Cf[Ub]gUh]cbYb 'g]bX'[YZcfXYfhž VYggYfY 'GhfUhY[]Yb 'ni a 'GWi hn'j cb '; fUi [ÀbgYb 'i bX'UbXYfYb VYXfc\hYb '5fhYb 'ni 'Ybhk]W_Y`b" J]Y`Y'A YbgWi Yb 'gYhnYb 'g]Wi 'ZØf XYb '9f\U`h'XYg'H]YfgWi hnYg'Y]bž'XcWi 'c\bY'[Ya Y]bgWi UZh`]Wi Yg

< UbXY`b'V`Y]VYb'; fUi [ÀbgY'k Y]hYf\]b
[YZÀ\fXYh"h]YfgW\i hn!Ui ghf]U"Uh'nY][h'Ui Zž'XUgg'Yg'Xf]b[YbX
]bhYfX]gn]d`]bÀfY'5bgÀhnY'VfUi W\hž'i a 'X]Y'@YVYbgfÀi a Y'j]Y`Yf
K]`Xh]YfY'YZZY_h]j 'ni 'gW\ØhnYb'i bX'ni 'fY\UV]`]h]YfYb"</pre>

8 Y hU]`g	
J cfZU``	J UbXU`]ga i g
I fgUWX Y	X]\(\mathbb{k}\) \(\nabla \)
Cfh	: Ò\fž'8Yi hgW\`UbX
J Y f`Y hn hY	%
GWX UXYb ']b '	&\$\$\$
EiY``Yb	• k k k "hn"XY
	• k k k "bYi bhcYhYf!Yj "XY
	• k k k "h]YfgWXi hn!Ui ghf]U"Uh

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