

J Yfa]gghY '- \$!≯À\f][Y ']b 'GW\k Yf]b. 'Dc`]nY] V]hhYh'i a '<]bk Y]gY

8]Y 'Dc`]nY] 'GWk Yf]b 'gi Wkh'Xf]b[YbX'bUWk 'Y]bYf'j Yfa]gghYb - $$! \lambda f][Yb"' <]bk Y]gY'V]hhY'X]fY_h'Ub'X]Y'6Y\OfXYb"$

8]Y'Dc`]nY]']b'GWk Yf]b'ghY\h'j cf'Y]bYf'Yfbgh\UZhYb
<YfUi gZcfXYfi b[.'GY]h'XYa '&' "\$, "&\$&('k]fX'Y]bY'-\$!'À\f][Y': fUi
Ui g'Y]bYf'GYb]cfYbfYg]XYbn'j Yfa]ggh"'@Ui h'6Yf]Wk hYb']gh'X]Y
GYb]cf]b'gY]h'%' .' \$'I \f'UV[Ab[][ž'i bX'X]Y'V]g\Yf
i bhYfbca a YbYb'Gi WkU_h]cbYb'\UVYb'`Y]XYf'_Y]bY': cfhgWkf]hhY
Yfn]Y`h"'8]Y'G]hi Uh]cb']gh'VYgcbXYfg'VYgcf[b]gYffY[YbXž'XU'X]Y
J Yfa]gghY'Xf]b[YbX'Ui Z'a YX]n]b]gWkY'J Yfgcf[i b['Ub[Yk]YgYb]gh"

± Y]bYf'NY]hž']b'XYf'X]Y'G]WXYf\Y]h'À'hYfYf'A YbgWXYb'ni bY\a YbX]b'XYb': c_i g'fØW_hž'k]fZh'X]YgYf'J cfZU``'Ui WX': fU[Yb'ni 'XYb GWXi hna U» bU\a Yb']b'GYb]cfYbfYg]XYbnYb'Ui Z''K]Y'_Ubb'Yg'gY]bž XUgg'Y]bY'6Yk c\bYf]b'c\bY'K]ggYb'XYg'DYfgcbU'g'X]Y 9]bf]WXhi b['j Yf'Àggh3'Gc`WXY': fU[Yb'a ØggYb'g]WX'X]Y JYfUbhk cfh`]WXYb'ghY``Ybž'k À\fYbX'g]Y'['Y]WXnY]h]['i a '<]bk Y]gY Ui g'XYf'6Yj Ò'_Yfi b['V]hhYbž'i a 'X]Y'JYfa]gghY'gc'gWXbY``'k]Y a Ò[`]WX'ni 'Z]bXYb"

5_hi Y``Y`Gi WXY`bUWX`XYf`JYfa]gghYb

8]Y'9fa]hhìi b[Yb'ni f'5i ZZ]bXi b['XYf'-\$!À\f][Yb'`Ui ZYb'Ui Z < cWkhci fYb"'8 Ug'Dc`]nY]\Ui dhfYj]Yf'GWkk Yf]b'\Uh'U``Y j YfZØ[VUfYb'F Yggci fWb'a cV]`]g]Yfhži a 'X]Y'Gi WkY'ni i bhYfghØhnYb"'8 Ug'HYUa 'ghY\h'VYfY]hži a 'YXY'5fh'j cb'<]bk Y]g'ni Ybh[Y[YbbbY\a Ybž'XYf'\Y`ZYb'_ÒbbhYž'X]Y': fUi 'ni 'Z]bXYb" 6Øf[Yfž'X]Y'=bZcfa Uh]cbYb'\UVYbž'_ÒbbYb'q]Wk'i bhYf'XYf

HY`YZcbbi a a Yf`\$',)!) %, \$&&&(`cXYf`ØVYf`X]Y`Cb`]bYk UWXY i bhYf`dc`]nY]"a j bYh"XY`a Y`XYb"

9gʻ]ghʻk]W\h][žʻXUggʻk]fʻUʻgʻ; Ya Y]bgW\UZh'ni gUa a YbUfVY]hYbži a 'X]YgYʻDYfgcbʻgW\bY``gha Ò[`]W\ni 'Z]bXYb žʻVYhcbhʻ5bXfÅ: U`_Yžʻ9fghYfʻDc`]nY]\Ui dh_ca a]ggUfʻi bXʻDc`]nY]ZØ\fYfʻj ca 8]Ybgh" 8]Yʻ9]bVYn]Y\i b['XYfʻ² ZZYbh`]W_Y]hʻ\Uhʻ]bʻÀ\b`]W\Yb: À``YbʻcZh'ni 'gW\bY``Ybʻ9fZc`[Ybʻ[YZØ\fhži bXʻYXYʻ\bZcfa Uh]cb _UbbʻYbhgW\Y]XYbXʻgY]b"

$K \]WX h][\ \underline{Y}]h^{\cdot}XYf^{\cdot 2} \ ZZYbh^{\cdot}]WX \underline{Y}]hgUfVY]h$

8]Y'Dc`]nY]'\Uh'Ui W\'X]Y'gcn]U`Yb'A YX]Yb'[Ybi hnhži a 'X]Y'Gi W\Y bUW\'XYf'J Yfa]gghYb'ni 'j YfghÀf_Yb"' \(\delta\)Zcfa Uh]cbYb'\@VYf'X]Y - \$!\(\delta\)\f][Y'i bX'X]Y'I a ghÀbXY']\fYg'J YfgW\k]bXYbg'k YfXYb'cb`]bY Ui g[YghfU\`hž'i a 'Y]b'VfY]hYfYg'Di V`]_i a 'ni 'YffY]W\Yb"'\(\delta\)XYf\\Yi h][Yb'j YfbYhnhYb'K Y`h'gd]Y`h'X]Y'^2 ZZYbh`]W_Y]hgUfVY]h'Y]bY nYbhfU`Y'Fc``Y'VY]'XYf'Gi W\Y'bUW\'j Yfa]gghYb'DYfgcbYb"'\(\delta\)' a Y\f A YbgW\Yb'Ui Z'XYb': U``'Ui Za Yf_gUa 'g]bX\Z'XYghc'\\O\Yf'g]bX'X]Y 7\UbW\b'Ui Z'Y]bYb'dcg]h]j Yb'5i g[Ub["

Ni gÀhn`]W\ k]fX`XUfUi Z`\]b[Yk]YgYbž`XUgg`6]`XYf`i bX`X]Y 6YgW\fY]Vi b[`XYf`J Yfa]gghYb`Ui Z`XYf`< ca YdU[Y`XYf @UbXYgdc`]nY]`A!J`ni `Z]bXYb`g]bX"`8]Y`Dc`]nY]`gYhnh`U``Yg`XUfUbž XUg`6Yk i gghgY]b`]b`XYf`6Yj Ò`_Yfi b[`ni `gW\ÀfZYbž`i a `<]bk Y]gY ni `gUa a Y`bž`X]Y`ni f`5i ZZ]bXi b[`XYf`GYb]cf]b`ZØ\fYb`_ÒbbhYb"

 $8]Y `8 f]b[`]WX_Y]h`XYf`G]hi Uh]cb`YfZcfXYfh`Y]b`gWXbY``Yg`< UbXY`b"\\ 8]Y `VYhfcZZYbYb`5b[Y\Of][Yb`i bX': fYi bXY`XYf`JYfa]gghYb ghY\Yb`i bhYf`]a a YbgYa `Ya ch]cbU`Yb`8 fi W_"`9g`]gh`ni `\cZZYbž XUgg`X]Y`Gi WXY`VU`X`YfZc`[fY]WX`gY]b`k]fX"$

9]b 6`]W_Ui Z'X]Y < YfUi gZcfXYfi b[Yb']b GYb]cfYbfYg]XYbnYb

 $8 \ Ug^T J \ YfgWX k \]b \ XYf^T - \$! \ \mathring{A} \ f][\ Yb^T : fUi \ "k \]fZh^TUi \ WX^T Y]b^T@]WX h^TUi \ Z$ $X]Y^T < YfUi \ gZcf XYfi \ b [\ Yb \ Z^T a \]h^T XYb Yb^T GYb]cf Ybf Yg]XYb n Yb$

±0 'XYf'\Yi h][Yb'; YgY``gW\UZh'k]fX'X]Y', VYfk UW\i b['i bX 6YhfYi i b['À 'hYfYf'A YbgW\Yb']a a Yf'k]W\h][Yfž']bgVYgcbXYfY']b Y]bYf'NY]hž']b'XYf'j]Y'Y'5b[Y\Òf][Y'\Ài Z]['VYfi ZghÀh]['g]bX'cXYf b]W\h']b'XYf'BÀ\Y'k c\bYb"'8]Y': U``nU\`Yb'j cb'j Yfa]gghYb'À`hYfYb A YbgW\Yb'g]bX'U`Ufa]YfYbX'i bX'ghY``Yb'Y]bY'YfbghY < YfUi gZcfXYfi b['XUf"'@h"'GhUh]gh]_']gh'X]Y'5bnU\``gc`W\Yf': À``Y']b XYb'`YhnhYb'⇒J\fYb'ni bY\a YbX'Ub[Ygh]Y[Ybž'k Ug'X]Y Bchk YbX][_Y]h'j cb'ghÀf_YfYb'GW\i hna U» bU\a Yb'XYi h`]W\'a UW\h''

 $8]Y `Dc`]nY] `gYhnh`U``Yg`XUfUbž`X]Y `-$! $$A f][Y`gW\bY``gha \^{O}[`]WX`niZ]bXYb"`6]g`[fc»Y`9fZc`[Y`g]W\hVUf`k YfXYbž`V`Y]Vh`XUg`GW\]W_gU`XYf`: fUi `i b[Yk]gg"`9g`V`Y]Vh`ni `\c\ZZYbž`XUgg`g]Y`VU`X k c\`VY\U`hYb`[YZ\bXYb`k]fX`i bX`Y]bY`i a \ZUggYbXY`8]g_i gg]cb\QVYf`G]W\Yf\Y]h`i bX`: \Qfgcf[Y`]b`GYb]cfYbfYg]XYbnYb`Ub[Yghc»Ybk]fX"$

<]bhYf[fi bX XYf j Yfa]gghYb DYfgcb</pre>

8]Y'VYhfcZZYbY'-\$!'À\f][Y': fUi ``YVh']b'Y]bYf'GYb]cfYbfYg]XYbn']bGWk Yf]bž'X]Y'gdYn]Y```ZØf'À`hYfY'A YbgWkYb'_cbn]d]Yfh']gh'' = bgc`WkYb'9]bf]Wkhi b[Yb'`YVYb'cZh'A YbgWkYbž'X]Y'Ui Z'gdYn]U`]g]YfhYDZY[Y'Ub[Yk]YgYb'g]bXž'XU'g]Y'a Ò[`]WkYfkY]gY'Ub'Wkfcb]gWkYb9f_Ub_i b[Yb'cXYf'8Ya Ybn'`Y]XYb'''8Yf'JYf`i gh'Y]bYg'À`hYfYbAYbgWkYbž'XYf'a Ò[`]WkYfkY]gY'[Ygi bX\Y]h`]WkY'DfcV'Ya Y'\UhžghY``h'b]Wkh'bi f'Y]bY'Ya ch]cbU'Y'6Y`Ughi b['ZØf'X]Y'5b[Y\Òf][YbXUfž'gcbXYfb'Ui Wk'Y]bY'Yfbgh\UZhY'6YXfc\i b['ZØf'X]Y'; Ygi bX\Y]hXf'j Yfa]gghYb'DYfgcb'''GhUh]gh]_Yb'nY][Ybž'XUgg'[YfUXY'À`hYfYAYbgWkYb']b'BchZU``g]hi Uh]cbYb'cZh'Ui Z'I bhYfghØhni b[Ub[Yk]YgYb'g]bXž'i a 'g]WkYf'i bX'[Ygi bX'ni 'V`Y]VYb''

 $8] Y `HUhgUW `Y \check{z} `X Ugg `X] Y `Gi W Y `b UW `XY f `J Y fa] gghYb `V] g`Ub [$

c`[Yb'XYf'JYfa]gghYbaY`Xib[Yb

J Yfa]gghYba Y`Xi b[Yb'Ub'X]Y'Dc`]nY]'ghY``Yb'b]W\h'bi f'X]Y
6Y\ÒfXY'j cf'< YfUi gZcfXYfi b[Ybž'gcbXYfb'ZØ\fYb'Ui W\ni
nU\`fY]W\Yb'9a ch]cbYb'i bX'I bk À[VUf_Y]hYb'VY]'XYb
5b[Y\Òf][Yb"'C Zh'g]bX'X]YgY'G]hi Uh]cbYb'j cb'[fc» Yf'8f]b[`]W_Y]h
[YdfÀ[hž']bgVYgcbXYfY'k Ybb'[Ygi bX\Y]h`]W\Y'F]g]_Yb'VYghY\Yb"

\(\partial \text{XYf'\Yi h}[Yb'X][]\hU\Yb'\YfU']\gh'X]Y'J\YfVfY]\hi b['j cb
\(\partial \text{Zcfa Uh}\cbYb'Xi fW\'gcn]U\Y'A\YX]Yb'i bX'`c_U`Y'BUW\f]W\hYb'Y]\b
\(\)]'ZfY]W\Yg'K\Yf_nYi [ži a 'X]Y'^2\ZZYbh']W_Y]\h'Y]\bni\VYn]Y\Yb'i bX
X]Y'Gi W\Y'ni 'VYgW\`Yi b][Yb"

8]Y'Dc`]nY]'\Uh']b'XYf'JYf[Ub[Yb\Y]h'jYfgWk]YXYbY'GhfUhY[]Yb'nifGiWkY'bUWk'jYfa]gghYb'DYfgcbYb'Y]b[YgYhnhž'Y]bgWk`]Y»`]Wk'XYfBihnib['jcb'8c[ib]hg'cXYf'XYf'NigUaaYbUfVY]h'a]h:fY]k]``][Ybcf[Ub]gUh]cbYb'':U_hcfYb'k]Y'KYhhYfVYX]b[ib[YbcXYf'X]Y';Yc[fUZ]Y'XYg'GiWk[YV]Yhg'gd]Y`Yb'YVYbZU``g'Y]bYYbhgWkY]XYbXY'Fc``Y'VY]'XYf'9ZZ]n]Ybn'X]YgYf'AU»bU\aYb''8Yf9fZc`['XYf'GiWkU_h]cbYb'\Àb[h'cZh'UiWk'XUjcb'UVž'k]Y'gWkbY``ibX'dfÀn]gY'X]Y'\DZcfaUh]cbYb'jYfVfY]hYh'kYfXYb''

GhUh]gh]gW\Y'fY`Yj UbhY'8 UhYb'ni f J Yfa]gghYbZ]bXi b[

@Ui h'XYf'Dc`]nY]']b'8Yi hgWX`UbX'k YfXYb''À\f`]WX'a Y\fYfY'hUi gYbX DYfgcbYb'U`g'j Yfa]ggh'[Ya Y`XYh"'GhUh]gh]_Yb'XYg 6i bXYg_f]a]bU`Ua hYg'fb?5Ł'`Y[Yb'bU\Yž'XUgg'X]Y'a Y]ghYb J Yfa]gghYbZÀ``Y']bbYf\U`V'XYf'YfghYb'&('Ghi bXYb'bUWX'XYf A Y`Xi b['[Y`Ògh'k YfXYb"'8YbbcWX'[]Vh'Yg']a a Yf'k]YXYf': À``Yž']b XYbYb'X]Y'Gi WXY``Ub[Y'XUi Yfh'cXYf'gc[Uf'Yf[YVb]g`cg'V`Y]Vh" 6YgcbXYfg'VY]'À`hYfYb'JYfa]gghYb']gh'X]Y'K U\fgW\Y]b`]W_Y]hž XUgg'g]Y']bbYf\U`V'Y]bYg'VYgh]a a hYb'NY]hfUi a g'[YZ bXYb k YfXYbž'ghUf_'j cb']\fYa '; Ygi bX\Y]hgni ghUbX'i bX'XYf I a [YVi b['UV\Àb[]["

8]Y'6Yf]W\hYfghUhhi b['ØVYf'j Yfa]gghY'DYfgcbYb']b'`c_U`Yb A YX]Yb'_Ubb'X]Y'^2 ZZYbh`]W_Y]hgk U\fbY\a i b['i bX'XUa]h'X]Y <]`ZgVYfY]hgW\UZh'XYf'6Øf[Yf'Yf\Ò\Yb"'9g']gh'VY_Ubbhž'XUgg'Y]bY VfY]hY'A YX]YbdfÀgYbn'cZha U`g'XUni 'ZØ\fhž'XUgg'a Y\f'A YbgW\Yb \DZcfa Uh]cbYb'VYfY]hghY``Ybž'X]Y'ni f'5i ZZ]bXi b['XYf'j Yfa]gghYb DYfqcb'VY]hfU[Yb'_ÒbbYb"'

: Øf'U_hi Y``Y'8 UhYb'i bX'GhUh]gh]_Yb'Ya dZ]Y\`h'Yg'g]W\ž'X]Y <ca YdU[Y'XYg'6i bXYg_f]a]bU`Ua hYg'ni 'VYgi W\Ybž'k c fY[Y`a À»][Y'6Yf]W\hY'ØVYf'X]Y'@U[Y'XYf'JYfa]gghYba Y`Xi b[Ybi bX']\fYf'5i Z_`Àfi b['j YfÒZZYbh`]W\h'k YfXYb"

8 Y hU]`g

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