

9fa]hh`i b[Yb'bUW\'hÒX`]W\Ya 'JcfZU``']b <YfbY!9]W_Y`. 'BYi Y'K YbXi b[']a ': U``

A cfX_ca a]gg]cb Yfa]hhY`h'bUW\``YVYbg[YZÀ\f`]W\Yf $JYf`Yhnib[Y]bYg'**! *A\f][Yb']b'< YfbY'': YghbU\a Y'Y]bYg: Ua]`]YbUb[Y\Of][Yb"$

± '< YfbY!9]W_Y`']gh'Y]b'hfU[]gW\Yf': U``'j cb'; Yk U`h'i bX

YhnhYbX`]W\Yb'JYf`i ghYb'ni 'j YfnY]W\bYb"' ± XYf'BUW\h'j ca '&*"

Ui Z'XYb'&+"': YVfi Uf'&\$&('Z]Y`'Y]b'**!'À\f][Yf'A Ubb'a]h

YVYbgVYXfc\`]W\Yb'JYf`Yhni b[Yb']a 'I bhYf`Y]V']b'gY]bYa

Y][YbYb'Ni \Ui gY'Ui Z"'8]Y'I a ghÀbXY'fi bX'i a 'X]YgYb'JcfZU```g]bX

U``Yg'UbXYfY'U`g'_`Ufž'i bX'X]Y'9fa]hhìi b[gVY\ÒfXYb'ghY\Yb'j cf

Y]bYf'gW\k]Yf][Yb'5i Z[UVYž'i a 'X]Y'k U\fYb'<]bhYf[fØbXY'Ubg

@]W\h'ni 'Vf]b[Yb"

8]Y`]bhYbg]j Y`9fa]hh`i b[gUfVY]h`XYf`A cfX_ca a]gg]cb`6cW\i a i bX`XYf`GhUUhgUbk U`hgW\UZh`6cW\i a `ZØ\fhY`gW\`]Y»`]W\`Ua `&) "

\$ b]`&\$&(`ni f`: YghbU\a Y`Y]bYg`' &! ^A\f][Yb`A UbbYg`Ui g

8 cfha i bX"'9f`[Yf]Yh`]b`XYb`: c_i g`XYf`9fa]hh`Yfž`XU`Yf`U`g`Yb[Yf
: Ua]`]YbUb[Y\Of][Yf`XYg`JYf`YhnhYb`[]`h"8Yf`: Ygh[Ybca a YbY

VYZ]bXYh`g]W\`gY]h\Yf`]b`I bhYfgi W\i b[g\UZhž`k A\fYbX`X]Y

GhUUhgUbk U`hgW\UZh`i bX`X]Y`Dc`]nY]`k Y]hYf\]b`U``Y`&Dcfa Uh]cbYb

ni qUa a YbhfU[Yb"

GWkcW_]YfYbXY'K YbXib[

8]Y'G]hi Uh]cb'bU\a 'Y]bY'gW\cW_]YfYbXY'K YbXi b['Ua '%- "'5i [i gh &\$&(ž'U`g'X]Y'Dc`]nY]'YfbYi h'ni 'XYf'5XfYggY'XYg'**!À\f][Yb [Yfi ZYb'k i fXY"'8]YgYg'A U`'k Uf'XYf'A Ubb'hch']b'gY]bYa '<Ui g Ui Z[YZ bXYb'k cfXYb"'9]b'YfbYi hYf'6Ygi W\'XYf'A cfX_ca a]gg]cb k Uf'i bj Yfa Y]X`]W\'zi a 'X]Y'l a gh\'abXY'gY]bYg'HcXYg'ni '_`AfYb"

8]Y '5 i Z_`Àfi b['gc`W\Yf': À``Y']gh'Ybhg\\Y]XYbXž'b]\\\h'bi f'Z\Øf'X]Y : Ua]`]Yž'gcbXYfb'Ui \\\'Z\Øf'XUg'; YZ\Ø\``XYf'G]\\\Yf\Y]h']b'XYf BU\\\VUfg\\\UZh''

8]Y'UbgW\`]Y\YbXY'CVXi_h]cbž'X]Y'Ua '&\$"'5i[igh'&\$&(XifW\[YZØ\fh'kifXYž'YfVfUW\hY'_Y]bY'<]bkY]gY'UiZ'Y]b
: fYa Xj YfgW\i`XYb"'8]Yg'_ObbhY'VYXYihYbž'XUgg'X]Y'IfgUW\Yb'ZØf
XYb'HcX'XYg'AUbbYg'aÒ[`]W\YfkY]gY'kYb][Yf'_`Uf'g]bXž'U`g'Yg
nibÀW\gh'XYb'5bgW\Y]b'\UhhY"'8YbbcW\'V`Y]VYb'X]Y'9fa]hh`ib[Yb
XYf'AcfX_caa]gg]cb'ibX'GhUUhgUbkU`hgW\UZh'kY]hYf'Ua'@UiZYbž
ia'iaZUggYbXY'?`Uf\Y]h`ni'gW\UZYb"

$K \]WX h][\ \underline{Y}]h^{\cdot}XYf^{\cdot}9fa \]hh^{\cdot}i \ b[\ Yb]$

 $6YfY]hg`Yhnh`]gh`_`Ufž`XUgg`X]Y`9fa]hh`i b[Yb`_ca d`Yl`g]bX`i bXY]bY`J]Y`nU\``Ub`: UWYhhYb`Ui Zk Y]gYb"`8Yf`: c_i g``]Y[h`gck c\``Ui ZXYa 'j YfXÀWkh][Yb': Ua]`]YbUb[Y\Of][Yb`U`g`Ui Wk`Ui Z`XYb la ghAbXYbž`X]Y`ni a 'YfghYb`JcfZU```ZØ\fhYb"`8]Y`Gi WkY`bUWk`XYf K U\f\Y]h`]gh`cZh`a]h`j]Y`Yb`<YfUi gZcfXYfi b[Yb`j YfVi bXYbž`i bXX]Y`5i Z_`Afi b[`gc`WkYf`gWkcW_]YfYbXYb`JcfZA``Y`]gh`YbhgWkY]XYbXZØf`X]Y`; YgY``gWkUZh"$

 $dfY]g[YVYb'_ObbYb\check{z}'g]bX'g]Y'VYghfYVh\check{z}'X]Y'K U\f\Y]h'ni 'Yfa]hhY`bibX'XYb'CdZYfb'; YfYW\h][_Y]h'k]XYfZU\fYb'ni '`UggYb'''9g'V`Y]Vh'ni \cZZYb\check{z}'XUgg'VU`X'_`UfY'5bhk cfhYb'Ui Z'X]Y': fU[Yb'[YZibXYbkYfXYb\check{z}'X]Y'X]YgYf'hfU[]gW\Y': U```Ui Zk]fZh''$

9]b 'V `Y]V Y b X Y f '9]b X fi W

8]YgYf:: U``nY][hY]ba U`a Y\fž'k]Y'_ca d`Yl'a YbgW\`]W\Y
6Yn]Y\i b[Yb'i bX'?cbZ]_hY'gY]b'_ObbYbž'i bX'`Aggh'X]Y': fU[Y']a
FUi a 'ghY\Ybž'k]Y'j]Y``9]bZi gg'dYfgOb`]W\Y'6Yn]Y\i b[Yb'Ui Z
gc`W\Y'XfUa Uh]gW\Yb'JcfZA``Y'\UVYb'_ObbYb"'8]Y'ghAbX][Y
l bg]W\Yf\Y]h'ØVYf'X]Y'k U\fYb'; YgW\Y\b]ggY'\]bhYf`Aggh'b]W\h'bi f
VY]'XYb'X]fY_h'6YhfcZZYbYbž'gcbXYfb'Ui W\']b'XYf'l a [YVi b['XYg
CdZYfq'Y]bYb'V`Y]VYbXYb'9]bXfi W_"

8]Y 'Zcfh`Ui ZYbXYb'9fa]hh`i b[Yb'k YfXYb'g]W\Yf`]W\'bcW\'j]Y`Y
8YhU]`g'Ubg'@]W\h'Vf]b[Ybž'X]Y'gck c\``X]Y'5i Z_`Àfi b['XYg': U``g'U`g
Ui W\'X]Y'K U\fbY\a i b['XYf'; Ya Y]bgW\UZh'VYY]bZ`i ggYb'_ObbhYb"
K À\fYbX'X]Y'A cfX_ca a]gg]cb'i bX'X]Y'GhUUhgUbk U`hgW\UZh']\fY
5fVY]h'ZcfhgYhnYbž'V`Y]Vh'X]Y'<cZZbi b[ž'XUgg'X]Y'K U\f\Y]h'YbX`]W\
Ubg'@]W\h'_ca a Yb'k]fX'i bX'XYf'; YfYW\h][_Y]h'[YbØ[Y'[YhUbk]]K]fX"

9fa]hh`i b[Yb'i bX'fYW\h`]W\Y FU\a YbVYX]b[i b[Yb

8]Y``Ui ZYbXYb`9fa]hh`i b[Yb`XYf`A cfX_ca a]gg]cb`]b`6cWi a ghØhnYb`g]W\`Ui Zi a ZUb[fY]W\Y'_f]a]bU`hYW\b]gW\Y'5bU`mgYb`i bX 6YZfU[i b[Yb"'=a `XYi hgW\Yb`FYW\hggmghYa `]gh`Yg`5i Z[UVY`XYf Dc`]nY]ž`VY`UghVUfY`6Yk Y]gY`ni `gUa a Y`bži a `X]Y`I a ghÀbXY`Y]bYg JYfVfYW\Ybg`Ui Zni _`ÀfYb"`8Yf`DfcnYgg`VY[]bbh`a]h`Y]bYf`YfghYb HUhcfhi bhYfgi W\i b[ž`[YZc`[h'j cb`XYf`G]W\Yfi b[j cb 6Yk Y]ga]hhY`bž'JYfbY\a i b[Yb'j cb`NYi [Yb'i bX`JYfXÀW\h][Yb gck]Y`ZcfYbg]gW\Yb`I bhYfgi W\i b[Yb"`8Ug`N]Y``XYf`9fa]hh`i b[Yb]gh`Ygž'X]Y`[YbUi Yb`<]bhYf[fØbXY`XYg`JcfZU``g`ni `_`ÀfYb`i bX`X]Y YbhgdfYW\YbXYb`fYW\h`]W\Yb`GW\f]hhY`Y]bni `Y]hYb"

a :: U```XYg`**!'À\f][Yb`<Yffb`Ui g`<YfbY`]gh`X]Y`<YfUi gZcfXYfi b[ZØf`X]Y`9fa]hh`Yf`VYgcbXYfg`\YfUi gZcfXYfbXž`XU`XYfhUhj YfXÀW\h][Y`5b[Y\Of][Y`Y]bY`Yb[Y`ZUa]`]ÀfY`6Yn]Y\i b[`ni a CdZYf`Ui ZkY]gh"8]Yg`_Ubb`X]Y`9fa]hh`i b[Yb`ni gÀhn`]W_ca d`]n]YfYbž`XU`Ya ch]cbU`Y`: U_hcfYb`i bX`a O[`]W\Y A ch]j Uh]cbYb`gW\kYfYf`ni `VYgh]a a Yb`g]bX"`8]YGhUUhgUbk U`hgW\UZh`6cW\i a `k]fX`g]W\a]h`XYf`Ni [Ub[gYf\YVi b[i bX`XYf`5i gkYfhi b[`[YgUa a Y`hYf`6YkY]gY`VYZUggYbž`i a [Y[YVYbYbZU``g`5b_`U[Y`ni `Yf\YVYb"

2 ZZY b h`]WX Y F Y U_h]c b i b X G]WX Y f \ Y]hg V Y X Y b _ Y b

8]Y'ÒZZYbh`]W\Y'FYU_h]cb'Ui Z'XYb'JcfZU``]gh'j YfghÀbX`]W\Yfk Y]gY j cb'6Ygcf[b]g'[YdfÀ[h"+\XYf'; Ya Y]bXY'<YfbY'\Uh'g]W\'Y]bY 8]g_i gg]cb'ØVYf'X]Y'U``[Ya Y]bY'G]W\Yf\Y]h'Ybhk]W_Y`hž]bgVYgcbXYfY']b'6Yni ['Ui Z'ZUa]`]ÀfY'; Yk U`h'i bX'XYfYb DfÀj Ybh]cb"'@Ui h'Y]bYf'Ghi X]Y'XYg'6i bXYga]b]ghYf]i a g'ZØf: Ua]`]Yž'GYb]cfYbž': fUi Yb'i bX'\$ [YbX'g]bX'ZUa]`]ÀfY'; Yk U`hhUhYb Y]b'k Y]h'j YfVfY]hYhYg'DfcV`Ya ']b'8Yi hgW\`UbX"'Gc'k i fXYb'&\$&\$ a Y\f'U`g'%) \$"\$\$\$: À``Y'j cb'\Ài g`]W\Yf'; Yk U`h'[Ya Y`XYhž'k cVY] Y]b'Yf\YV']W\Yf'HY]`'XYf'HÀhYf'Ui g'XYa 'Yb[ghYb': Ua]`]Yb_fY]g ghUa a h"

9]b'k Y]hYfYf'Yfk À\bYbgk YfhYf'5gdY_h'g]bX'X]Y'F Yggci fW'bž'X]Y XYf'Dc`]nY]'i bX'XYb'gcn]U`Yb'8]Ybgh`Y]ghYfb'ni f'J YfZØ[i b[ghY\Ybž'i a 'Ui Z'X]YgY'5fh'j cb'J YfVfYWXYb'fYU[]YfYb'ni '_ObbYb" DfÀj Ybh]j Y'A U» bU\a Yb'i bX'+bZcfa Uh]cbg_Ua dU[bYb'ØVYf j YfZØ[VUfYb'GWXi hn'i bX'I bhYfghØhni b['g]bX'ZØf'X]Y'VYhfcZZYbYb 6Yj O`_Yfi b[ghY]`Y'j cb'[fc» Yf'6YXYi hi b["'

$Y \setminus b^* = Y \cdot b^* = h \cdot Zf \emptyset \setminus Yf Yb \cdot ?f = b \cup ZA^* Yb$

± XYf XYi hgWX Yb ?? f]a]bU`[YgWX]WX hY '[]Vh'Yg'a Y\fYfY': À``Yž'X]Y Ub 'X]YgYb 'J cfZU`` 'Yf]bbYfb " '9]b '6Y]gd]Y` ']gh'XYf 'A cfXZU`` ']b 'XYf : Ua]`]Y '< " ']b '6fYa Ybž'XYf '&\$%, 'ZØf'[fc» Yg'5i ZgY\Yb 'gcf[hY"' ± X]YgYa ': U`` 'k i fXY 'Y]b ': Ua]`]Yba]h[`]YX 'YVYbZU``g'U`g

8]YgY'ZfØ\YfYb': À``Y'j YfXYi h`]W\Yb'b]W\h'bi f'X]Y'?ca d`Yl]hÀh'j cb ZUa]`]ÀfYb'; Yk U`hXmbUa]_Ybž'gcbXYfb'Ui W\'X]Y'\Ài Z][bchk YbX][Yb'\deltahYfj Ybh]cbYb'j cb'Ui » YbghY\YbXYb'GhY``Ybž'k]Y Dc`]nY]'i bX'gcn]U`Y'8]YbghYž'i a '`Ub[Zf]gh][Y'@Ògi b[Yb'ni 'Z]bXYb'' 8]Y'5i Z_`Àfi b['gc`W\Yf'HUhYb']gh'j cb'YbhgW\Y]XYbXYf'6YXYi hi b[žia'ni_ØbZh][Y'JcfZÀ``Y'ni 'jYf\]bXYfb'i bX'XUg'G]W\Yf\Y]hg[YZØ\`]b'XYf'; YgY``gW\UZh'ni 'ghÀf_Yb''

8 Y hU]`q

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z. 'X]Y!bUWX f]WX hYb "b Yh