

## BYi Yg'DUfhY]YbgdY\_hfi a ']a 'CghYb.'6GK i bX'5Z8']a '5i Zk ]bX

8]Y'dc`]h]gWXYb'K U\`Yb']b'XYb'cghXYi hgWXYb'6i bXYg`ÀbXYfb GUWXgYb'i bX'H\Øf]b[Yb'k YfZYb']\fY'GWXUhhYb'j cfUi g"'6Y] I a ZfU[Yb'nY]WXbYh'g]WX'Y]b'ØVYffUgWXYbXYg'9f[YVb]g'UV. 8]Y'bYi '[Y[fØbXYhY'DUfhY]'6ØbXb]g'GU\fU'K U[Yb\_bYWXh fbGK Ł'\_ÒbbhY'Ui Z'nk Y]ghY``][Y'K YfhY'\_ca a Yb"'8]Y'YfghYb Dfc[bcgYb'nY][Ybž'XUgg'X]Y'6GK ']b'GUWXgYb'a ]h'%' 'DfcnYbh i bX']b'H\Øf]b[Yb'a]h'gc[Uf'%, 'DfcnYbh'XUg'

8]Y'dc`]h]gWXYb'K U\`Yb']b'XYb'cghXYi hgWXYb'6i bXYg`ÀbXYfbGUWXgYb'i bX'H\Øf]b[Yb'k YfZYb']\fY'GWXUhhYb'j cfUi g"'6Y]
I a ZfU[Yb'nY]WXbYh'g]WX'Y]b'ØVYffUgWXYbXYg'9f[YVb]g'UV.'8]YbYi '[Y[fØbXYhY'DUfhY]'6ØbXb]g'GU\fU'K U[Yb\_bYWXh'fbGK Ł\_\ObbhY'Ui Z'nk Y]ghY``][Y'K YfhY'\_ca a Yb"'8]Y'YfghYb'Dfc[bcgYbnY][Ybz'XUgg'X]Y'6GK ']b'GUWXgYb'a ]h'%' 'DfcnYbh'i bX']bH\Øf]b[Yb'a]h'gc[Uf'%, 'DfcnYbh'XUg'FYbbYb'a UWXYb'\_\ObbhY''

8 Yf'Dc`]hc`c[Y'?`Ui g'GWX fcYXYf'j cb'XYf': fY]Yb'l b]j Yfg]hÀh'6Yf`]b Vf]b[h']b'Y]bYa '\delta hYfj]Yk 'a]h'6i nn: YYX'BYk g'8 Yi hgWX`UbX'Y]bYb Ui ZgY\YbYffY[YbXYb'JYf[`Y]WX.'9f'g]Y\h'DUfU``Y`Yb'ni 'XYb dc`]h]gWXYb'l a k À`ni b[Yb']b'\dc`]h]gWXY GhfÒa i b[Yb'YbhghUbXYb DUfhY]Yb'[U`hYb'i bX'bi b'bYi Y'dc`]h]gWXY'GhfÒa i b[Yb'YbhghUbXYb g]bX''' K ]f'ghY\Yb'Ub'Y]bYa 'K YbXYdi b\_hž'Ub'XYa 'g]WX'XUg DUfhY]YbgdY\_hfi a ']b'8 Yi hgWX`UbXž'VY[]bbYbX']a 'C ghYbž'ghUf\_ j YfÀbXYfb'k]fX ž'Ài » Yfh'Yf'g]WX'cdh]a ]gh]gWX'ØVYf'X]Y

8 Ug '9b XY 'XYg'\_`Ugg]gWX Yb DUfhY]YbgdY\_hfi a g 9]bY'\_`UfY'HfYbbi b[ 'nk ]gW\Yb' `]b\_g 'i bX' fYW\hg 'k ]fX'`Ui h
GW\fcYXYf']a a Yf'gW\k ]Yf][ Yf"'\do XYb'\_ca a YbXYb'K U\`Yb']b
GUW\gYb'i bX'H\Øf]b[ Yb'`UggYb'g]W\'X]Y'Dfc[ fUa a Y'XYf'578'i bX
XYf'6GK '\_Ui a 'j cbY]bUbXYf'i bhYfgW\Y]XYb"'6Y]XY'DUfhY]Yb
Zcfa ]YfYb'g]W\'U`g'Y]b'; Y[ Yb[ Yk ]W\h'ni 'XYb'YhUV`]YfhYb'?f\\ZhYb''
8 Ug'\_`Ugg]gW\Y'DUfhY]YbgdY\_hfi a '[ ]Vh'Yg'b]W\h'a Y\f ž'VYhcbh
XYf'Dc`]h]\_k ]ggYbgW\UZh`Yf'i bX'ZØ\fh'k Y]hYf'Ui gž'XUgg'X]Y
XYfnY]h][ Y'5a dY`!?cU`]h]cb'X]Y'9fk Ufhi b[ Yb'j ]Y`Yf'K \A\`Yf'b]W\h

8]Y'<YfUi gZcfXYfi b[Yb'ZØf'X]Y'fY[]YfYbXY'?cU`]h]cb'i bhYf'GD8ž; fØbYb'i bX': 8D'g]bX'cZZYbg]W\h`]W\"'9]b'6Y]gd]Y```]YZYfh'X]Y'GD8žX]Y']a 'K U\`\_Ua dZ']b'6fUbXYbVi f['VYk i ggh'5VghUbX'j cb6i bXYg\_Ubn`Yf'C`UZ'GW\c`n'bY\a Yb'a ÒW\hY"'8]YgY'9bhk]W\_`i b[nY][h'XYi h`]W\ž'XUgg'X]Y'hfUX]h]cbY``Yb'DUfhY]Yb'GW\k]Yf][\_Y]hYb\UVYbž'X]Y'K À\`YfVUg]g'ni '\U`hYb"

#### 8]Y 'U\_hi Y``Yb 'I a ZfU[ Yb 'i bX ']\ fY ': c`[ Yb

8]Y'GnYbUf]Ybž'X]Y'Ui g'XYb'I a ZfU[Yb'\Yfj cf[Y\Ybž'g]bX
VYi bfi \][YbX'ZØf'X]Y'78I "'5\_hi Y``Yb'Dfc[bcgYb'ni Zc`[Y'k ØfXY
g]Y']b'GUW\gYb'a ]h''' 'DfcnYbh'nk Uf'ghÀf\_ghY'? fUZhž'UVYf'XU\]bhYf
Xfc\h'Y]b'Yb[Yg'FYbbYb'a ]h'XYf'5Z8ž'X]Y'Ui Z'' \$'DfcnYbh'\_ca a Yb
\_\ObbhY'''\dagger H\\Øf]b[Yb'k \ØfXY'X]Y'5Z8'gc[Uf'VY]'' \$'DfcnYbh`\UbXYbž
[YZc`[h'j cb'6GK 'a ]h'&\"DfcnYbhž'k Ug'Ui Z'Y]bYb'Y]bXfi W\_gj c``Yb
5i Zgh]Y['XYf'K U[Yb\_bYW\h!DUfhY]'\]bk Y]gh"

GWX fc Y X Y f 'V Y g WX f Y ] V h 'X ] Y 'G ] hi Uh] c b 'ZØf 'X ] Y '78 I 'U `g 'd f Y \_ À f "

A Ò[ `] WX k Y ] g Y 'k ] f X 'g ] WX 'X ] Y '78 I 'X Uni '[ Y nk i b [ Y b 'g Y \ Y b ž'a ] h 'X Y f

6GK 'ni '\_ccd Y f] Y f Y b ž'i a 'Y ] b Y 'g h U V ] `Y 'A Y \ f \ Y ] h 'ni 'V ] `X Y b 'Y ] b

a UWX h d c `] h ] g WX Y f 'G WX f] h h ž' X Y f 'b c WX 'j c f '\_i f n Y a 'i b X Y b \_ V U f 'g WX ] Y b "

9 f 'g U [ h '9 g 'k ] f X 'X Y f '78 I 'b ] WX h g 'Ø V f ] [ V `Y ] V Y b ž' U `g 'Ø V Y f '] \ f Y b

G WX Uhh Y b 'ni 'g d f ] b [ Y b 'i b X 'a ] h X Y a '6 Ø b X b ] g 'G U \ f U 'K U [ Y b \_ b Y WX h

ni '\_c U `] Y f Y b " '8 ] Y 'g c n ] U `X Y a c\_f Uh] g WX Y '5 a d Y `f Y [ ] Y f i b [

Y f g WX Y ] b Y 'g WX c b 'Y h n h 'U `g 'U i g f U b [ ] Y f h ž' k Ug 'X ] Y '78 I 'ni g À h n`] WX

i b h Y f '8 f i W\_ 'g Y h n Y "

 $8 ] Y `dc`] h] g W Y b `l a k \`A`ni b [Yb`] b `Cgh X Y i hg W `Ub X `g] b X `a Y \ f`U`g$ 

Y]b fY[]cbU`Yf HfYbX"'G]Y \_ObbhYb k Y]hfY]W YbXY J YfÀbXYfi b[YbUi Z'6i bXYgYVYbY bUW g]W n]Y\Ybž'X]Y XUg XYi hgW Y
DUfhY]YbgmghYa [fi bX`Y[YbX fYZcfa]YfYb" 9g ]gh'Y]b DfcnYggž
XYf b]W h bi f Ui Z'X]Y fY[]cbU`Yb K U\`Yb VYgW fÀb\_h'V`Y]Vh ž
Yf\_`Àfh GW fcYXYfž gcbXYfb Y]bYb 8 ca]bcYZZY\_h'Ui g`OgYb
\_ObbhYž'XYf g]W ØVYf XYb [YqUa hYb 6i bXYgqhUUh'YfqhfYW\_h"

 $8 ]Y `K U `dfc[bcgYb'_ObbhYb'`Yhnh`]WX `b]WX h'bi f'X]Y 'dc`]h]gWX Y @UbXgWX UZh']a `CghYb'j YfÀbXYfbžgcbXYfb'X]Y [YgUa hY'bUh]cbU`Y Dc`]h]_'\]bhYfZfU[Yb'i bX'bYi [YghU`hYb'' <math>\Rightarrow$  Y]bYf'NY]hž']b'XYf'j ]Y`Y 6Øf[Yf'XUg'J YfhfUi Yb']b'X]Y'YhUV`]YfhYb'DUfhY]Yb'j Yf`]YfYbž\_ObbhY'X]Yg'X]Y'7 \UbWY'ZØf'bYi Y'dc`]h]gWXY'5`hYfbUh]j YbXUfghY``Yb''

### $Dc^{h}gWXY'9bhk]W_{i}b[_{b}CghXYihgWX^{b}X$

 $8 ]Y'dc`]h]gWXYb'JYf\A`hb]ggY']b'CghXYihgWX`UbX'nY][Yb'gY]h'XYb YhnhYb'\(\frac{1}{2}\) UbhY'JYf\AbXYfib[Yb'''<]ghcf]gWX'VYhfUWXhYh \\Uh'XYf'CghYb'8YihgWX`UbXg'bUWX'XYf'K]YXYfjYfY]b][ib['%--\$Y]bY'J]Y`nU\`'dc`]h]gWXYf'Iak\A`nib[Yb'Yf`YVh\(\frac{1}{2}\)Y'nia'HY]`'V]g \\YihY'bUWXk]f_Yb'''K\A\fYbX']b'XYb'5b\ZUb[g'\U\fYb'X]Y'D8G \\fDUfhY]'XYg'8Yac_fUh]gWXYb'Gcn]U`]gaig\{\frac{1}{2}\}BUWX\{\frac{1}{2}\}C`[Yf]b'XYf'G98\(\frac{1}{2}\}U\fY\fY\]bY'VYXYihYbXY'Fc``Y'Y]bbU\\aYb\(\frac{1}{2}\}Uh'g]WX\XUg'dc`]h]gWXY'GdY_hfia'nibY\\aYbX'YfkY]hYfh'''$ 

6YgcbXYfg'VYa Yf\_Ybgk Yfh']gh'XYf'5i Zgh]Y['XYf'5Z8ž'X]Y'g]W\'UV &\$%' ']b'XYb'cghXYi hgW\Yb'6i bXYg'ÀbXYfb'U'g'ghUf\_Y'?fUZh
YhUV`]YfhY'''\*Xhnh'gW\Y]bYb'bYi Y'5\_hYi fY'k]Y'XUg'6GK 'i a 'GU\fU
K U[Yb\_bYW\hž'Y]bY'Y\Ya U`][Y'Gd]hnYbdc`]h]\_Yf]b'XYf'@|b\_Ybž'Ub
6YXYi hi b['ni '[Yk]bbYb'''8]Y'\*gc`]Yfi b['XYf'YhUV`]YfhYb'DUfhY]Ybž
k]Y'XYf'78I 'i bX'GD8ž'k]fX'Xi fW\'Y]bY'j YfVfY]hYhY
I bni Zf]YXYb\Y]h'a ]h'XYf'U\_hi Y``Yb'dc`]h]gW\Yb
5i gY]bUbXYfgYhni b['i bX'XYb'[YgY``gW\UZh`]W\Yb'J YfÀbXYfi b[Yb
VYZYi Yfh'''8]Y'k]fhgW\UZh`]W\Y'I bg]W\Yf\Y]h']b'j]Y`Yb'FY[]cbYb'i bX
XYf'XYa c[fUd\]gW\Y'K UbXY``g]bX'XUVY]'YbhgW\Y]XYbXY': U\_hcfYbž
X]Y'XUg'K À\`Yfj Yf\U`hYb'VYY]bZi qgYb"

## $K \ A \ Yfj \ Yf \ U \ hYb \ i \ b \ X \ I \ a \ ZfU[\ Yb]$

5\_hi Y``Y`I a ZfU[Yb`XYi hYb`XUfUi Z`\]bžXUgg`g]W\`X]Y`K À\`YfgW\UZh]b`C ghXYi hgW\`UbX`ni bY\a YbX`fUX]\_U`]g]Yfh'i bX`U`hYfbUh]j Y dc`]h]gW\Y`5b[YVchY`gi W\h"`Gc`nY][h`X]Y`: cfgU!I a ZfU[Yž`XUgg`X]Y Ub[YghfYVhYb`nk Y]ghY``][Yb`K YfhY`ZØf`XUg`6GK`i bX`X]Y`ghUf\_Y Dcg]h]cb]Yfi b[`XYf`5Z8`XUfUi Z`\]bXYi hYbž`XUgg`Y]bY`VfY]hY A UgW\]bYf]Y`XYf`I bni Zf]YXYb\Y]h`]a `; Ub[Y`]gh"`9]b`: U\_hcfž`XYf]a a Yf`k]YXYf`VYhcbh`k]fXž`]gh`X]Y`i bni fY]W\YbXY`9fZØ``i b[`j cb 9fk Ufhi b[Yb`Xi fW\X]Y`6i bXYgfY[]Yfi b[ž`]bgVYgcbXYfY`Xi fW\X]Y`5a dY`!?cU`]h]cb"`

 $6YXYi\ hYbXY'I\ a\ ZfU[Yb'\UVYb'Yf[YVYbž'XUgg'j]Y`Y'K \ A\`Yf'g]WX\\ j\ cb'XYb'hfUX]h]cbY``Yb'DUfhY]Yb'UVk YbXYb'i bX'bYi Y'dc`]h]gWXY\\ 6Yk Y[ib[Yb'ibhYfghØhnYbž'X]Y']\fY'\ bhYfYggYb'j Yfa Y]bh`]WX\\ VYggYf'j YfhfYhYb'''5i ZZA```][']gh'XUVY]ž'XUgg'X]Y'dc`]h]gWXY'\ <math>\Rightarrow$ XYc`c[]Yb]WXh'a Y\f'gc'\_\_`Uf'nk]gWXYb'``]b\_g'i bX'fYWXhg'i bhYfgWXY]XVUf']ghžk Ug'X]Y'U\_hi Y``Yb'9bhk]W\_`ib[Yb']b'GUWXgYb'i bX'H\Øf]b[YbibYfghfY]WXh''

GhUh]gh]gW\ 'nY][ h'g]W\ . '6Y]'XYf'`YhnhYb'K U\``]b'GUW\gYb'Yf\]Y`h'X]Y 5Z8 'fi bX'' \$'DfcnYbh'XYf'Gh]a a Ybž'k À\fYbX'XUg'6GK g][ b]Z]\_UbhY'Ni gdfØW\Y'[ YbYf]YfYb'\_cbbhYž'X]Y'X]Y 5i Za Yf\_gUa \_Y]h'XYf'YhUV`]YfhYb'DUfhY]Yb'Ui Z'g]W\ 'nc[ Yb"'8]Yg']gh Y]b'<]bk Y]g'Ui Z'X]Y'J YfgW\]YVi b[ ']b'XYf'dc`]h]gW\Yb'@UbXgW\UZh"

# Ni gUa a YbUfVY]h'i bX ?cU`]h]cbga Ò[`]WX\_Y]hYb

8]Y'a Ò[`]WXY'Ni gUa a YbUfVY]h'nk ]gWXYb'XYf'78I ii bX'XYa '6GK k ]fZh: fU[Yb'Ui Zž'X]Y'ØVYf'V`c» Y'GhfUhY[]YYbhgWXY]Xi b[\]bUi g[Y\Yb"K À\fYbX'X]Y'78I 'U`g'[fÒ» hY'?fUZh']b'GUWXgYb'a ]h Yhk U'' ' 'DfcnYbh'Yfa ]hhY`h'k ]fXž'XYi hYh'X]Y'FYU`]hÀh'Ubž'XUgg'g]Y']bYa 'dchYbn]Y``Yb'6ØbXb]g'a ]h'GU\fU'K U[Yb\_bYWXh'Y]bY'bYi Y GhfUhY[]Y'XYf'?cffY\_hi f'UbghfYVYb'\_ÒbbhY"'

 $C\ Vk\ c\ ``Y]bY`gc`WkY`?cU`]h]cb`Ub[Yg]Wk\ hg`]XYc`c[]gWkYf \\ 8\ ]ZZYfYbnYb`Ui\ Z`XYb`YfghYb`6`]W_`i\ bk\ U\ fgWkY]b`]Wk`YfgWkY]bYb \\ a\ U[\ \check{z}'\_\grave{O}bbhY`X]Y`78I `[Ynk i b[Yb`gY]b\check{z}'dfU[a\ Uh]gWkY`GWkf]hhY`ni \\$ 

i bhYfbY\a Ybži a 'Y]b'FY[]Yfi b[gVØbXb]g'ØVYf\Ui dh'ni
fYU`]g]YfYb"'8Yf'V]g\Yf][Y'?i fg'XYf'5a dY`!?cU`]h]cbž'XYf
5`hdUfhY]Yb']b'CghXYi hgW\`UbX'b]W\h'U`g'K U\`\_Ua dZa UggY'ni
bi hnYbž'\_ÒbbhY'g]W\'U`g'ghfUhY[]gW\Yf': Y\`Yf'Yfk Y]gYb'
]bgVYgcbXYfY']a '?cbhYl h'XYf'VYj cfghY\YbXYb'K U\`Yb']a '<YfVgh
&\$&("</pre>

8]Y'9bhk]W\_`i b['\_ObbhY'b]W\h'bi f'ZØf'XUg'DUfhY]YbgmghYa ']b CghXYi hgW\`UbXž'gcbXYfb'Ui W\'ZØf'X]Y'[YgUa hY'6i bXYgfYdi V`]\_Yf\YV`]W\Y'5i gk]f\_i b[Yb'\UVYb"'9g'V`Y]Vh'UVni k UfhYbž'k]Y'g]W\X]Y'dc`]h]gW\Yb'?f\A`hb]ggY'k Y]hYfYbhk]W\_Y`b'k YfXYb'i bX k Y`W\Y'8 mbUa]\_Yb'g]W\'Ui g'XYf'Yhn][Yb'G]hi Uh]cb'Yf[YVYb"' B5;

8 YhU]`q

6Ygi WXYb 'G]Y 'i bg 'Ui Z. 'a Y]b!VYf`]b "bYh