

# 9]b`a i g]\_U`]gW\Yg`> V]`Ài a .`(\$`>U\ fY GhcXhVYf[ gU]h`b`]b`9gW\YbVUW\

: Y]Yfb`G]Y`a`]h`XYf` GhcXhVYf[ gU]h`b`Ua` : fY]hU[ ž`&` "  
5i [ i ghž`i a`%` `l` \f`Y]b`XYb\_k ØfX][ Yg`> V]`Ài a`g\_cbnYfh`Ua`  
F i » k Y]\Yf"

5a` : fY]hU[ ž`XYb`&` "5i [ i ghž`XØfZYb`g]W\`A i g]\_`YV\UVYf`Ui`Z`Y]b`  
VYgcbXYfYg`9fY][ b]g`ZfYi`Yb.`8Ug`> V]`Ài a`g\_cbnYfh`XYf`  
GhcXhVYf[ gU]h`b`Z]bXYhi`a`%` `l` \f`j`cf` GYYV`]W\_`&%`Ua`  
F i » k Y]\Yf`ghUhh`8]YgY`<cVVma`i`g]\_`[ fi`ddY`\Uh`gY]h`]\fYf`  
; fØbXi`b[ `]a` `A`Àfn`%-` , )` `Y]bY`Ui`ZfY[ YbXY`FY]gY`\]bhYf`g]W\`i`bX`  
`ÀXh`]\fY` : Ubg`ni` `Y]bYa` `bcghU`[ `]gW\Yb`5VYbX`Y]b`8]Y`  
J`YfUbghU`hi`b[ `]`Yfgdf]W\hž`Y]b`YVYbX][ Yg`9f`YVb]g`ni`k`YfXYbž`VY]`  
XYa` `X]Y`A`i`g]\_`[ YgW\]W\hY`XYf`%-` &\$Yf`V]g`%-` +\$Yf`>U\ fY`k`]YXYf`  
Ui`Z`fghY`h`A`]h`]\fYf`A`]gW\i`b[ `Ui`g`J`c`\_ga`i`g]\_`ž`GU`cba`i`g]\_`ž`  
9j`Yf[ fYYbg`i`bX`K`]YbYf`@]YXYfb`VY[ Y]ghYfh`X]Y` ; fi`ddY`gY]h]`]Yf`  
>U\fnY`b`hYb`]\fY`Ni` \ØfYf"

8]Y` GhcXhVYf[ gU]h`b` `Uh`g]W\`ØVYf`X]Y`>U\ fY`Ybcfa`  
k`Y]hYfYbhk`]W\_Y`h`i`fgdfØb[ `]W\`U`g` `9gW\YbVUW\Yf` ; Y][ Yba`i`g]\_`  
[ Y[ fØbXYhž`Z`g]cb]YfhY`g]Y`VU`X`ni` `Y]bYf`VY`]YVhYb`A`i`g]\_`[ fi`ddY`  
]b`XYf`FY[ `]cb"; Ycf[ `6UmYf`ž`Y]bYf`XYf` ; fØbXYfž`Yf]bbYfh`g]W\`Ub`  
X]Y`5bZ`Ab[ Y.`6Y[ cbbYb`\UVYb`k`]f`a`]h`fY]bYf`c`VYfdZ`nYfž`  
Y[ Yf`ÀbX]gW\Yf`i`bX`Zf`Àb\_]gW\Yf`J`c`\_ghUbna`i`g]\_"`8]YgY`ZfØ`Yb`  
5i`Zhf]hhY`k`i`fXYb`gh]a`a`[ Yk`U`h][ `]`cb`XYb`YfghYb`Ni` \ØfYfb`  
fYn]d]Yfh`i`bX`Y[ hYb`XYb` ; fi`bXghY]b`ZØf`Y]bY`Yb[ U[ ]YfhY`?Uff]YfY`"  
=a`@Ui`Z`Y`XYf`NY]h`k`i`fXYb`b]W\h`bi`f`X]Y`GhØW`Yž`gcbXYfb`Ui`W`X]Y`  
=bghfi`a`Yb`hY`i`bX`X]Y`6YgYhni`b[ `]`Y`Z`h][ Yfž`gcXUgg`X]Y`\Yi`hY`  
gd]Y`YbXYb`bYi`b`A`i`g]\_`Yf`Y]b`\_i`bhYfVi`bhYg`a`i`g]\_`U`]gW\Yg`  
9f`YVb]g`V]YhYb`\_ØbbYb"

## 9]bY`Ub[ Y`9fZc`[ g[ YgWx ]Wx hY

⇒ a`ϕ\`f`%- , ) ž`U`g`X]Y` GhcXhVYf[ gU]hb`XUg`@]Wx`h`XYf`K`Y`h`  
YfV`]W`hY`ž`[ UV`Yg`b]Wx`h`bi`f`X]Y` ; fØbXi`b[ `Y]bYf`bYi`Yb`  
A`i`g]\_[ fi`ddY`ž`gcbXYfb`Ui`Wx`X]Y`J`YfV]bXi`b[ `j`cb`A`YbgWxYb`Xi`fWx`  
X]Y`@Y]XYbgWxUZh`ini`f`A`i`g]\_`"6UmYf`nc[ `Ui`g`6Y]YfgXcfZ`bUWx`  
9gWxYbVUWx`i`bX`]b]h]]YfhY`XYb`5i`ghUi`gWx`a`]h`c`\_U`Yb`A`i`g]\_Yfbž`  
X]Y`XUg`9bgYa`V`Y`Yfk`Y]hYfhYb`"8]YgY`J`YfV]bXi`b[ `j`cb`HU`YbhYb`  
ZØ\fhY`XUni`ž`XUgg`X]Y` GhcXhVYf[ gU]hb`VU`X`b]Wx`h`bi`f`fY[ `]cbU`ž`  
gcbXYfb`ØVYf`X]Y` ; fYbnYb`j`cb`9gWxYbVUWx` \]bUi`g`VY`\_Ubbh`  
k`i`fXY`"

⇒ a`@Ui`ZY`XYf`ϕ\`fY`k`UbXY`hY`g]Wx`XUg`F`YdYfhc]fY`XYf`6UbX`"BUWx`  
XYb`YfghYb`J`c`\_ga`i`g]\_Ui`Zh]hYb`ghUbX`Y]bY`I`a`cf]Ybh]Yfi`b[ `Ub`.  
6UmYf`i`bX`gY]bY`A`]hghfY]hYf`k`c`hYb`Zf]gWxYb`K`]bX`]b`]\`f`  
a`i`g]\_U`]gWxYg`GWxUZZYb`Vf]b[ `Yb`"8]Yg`ZØ\fhY`ni`Y]bYa`VfY]h`  
[ YZÅWxYfhYb`5i`Zh]hggdY`hfi`a`ž`XUg`GhØW`Y`Ui`g`XYf`GU`cba`i`g]\_ž`  
hUb[ `cVY`UZhYhY`?`Àb[ `Y`i`bX`X]Y`@YVYbgZfYi`XY`XYf`À`hYfYb`  
A`i`g]\_hfUX]h]cbYb`i`a`ZUggh`"8]Y`A`]h[ `]YXYf`XYf` ; fi`ddY`\_ØbbYb`bi`b`  
Ui`g`Y]bYa`[ `fc»`Yb`i`bXi`g`Ub`B`chYb`gWx`ØdZYbž`XYf`j`cf`&\$`ϕ\`fYb`  
a`]hY]bYa`6Ygi`Wx`]b`Y]bYa`6Yf`]bYf`A`i`g]\_Ub]ei`Uf]Uh`Yfk`Y]hYfh`  
k`i`fXY`"

8]Y`A`i`g]\_[ Ya`Y]bgWxUZh`YVh]`cb`XYf`Vi`bhYb`A`]gWx`i`b[ `]\`fYf`  
A`]h[ `]YXYf`"8Yf`9]bgUhn]`cb`j`YfgWx]YXYbYb`ϕghfi`a`YbhYbž`]`cb`  
J]c`]bY`ØVYf`5`\_\_cfXYcb`V]g`\]b`ni`?`Uf]bYhY`i`bX`GUI`c`Zcbž`gcf[ `h`  
ZØf`XYb`Y]bn]]`Ufh]]`Yb`?`Ub[ `XYf` GhcXhVYf[ gU]hb`"Ni`XYb`  
?ØbghYfbž`X]Y`Ub`X]YgYa`5VYbX`Ui`ZhYhYb`k`YfXYbž`[ `Y`ØfYb`Ui`Wx`  
VY`\_UbbhY` ; Yg]Wx`hYf`k`]Y`?`Ya`Ybg`8`ØhgWx`ž`6UfVUfU`8`ØhgWx`i`bX`  
G]]`fi`b`9]Wxa`Ubbž`XYfYb`@Y]XYbgWxUZh`i`bX`9b[ `U[ `Ya`Ybh`ZØf`X]Y`  
A`i`g]\_`i`a`gc`a`Y`f`VY[ `Y]ghYfb`"

## 9]b`F`ØW`V`]W`\_`Ui`Z`X]Y`a`i`g]\_U`]gWx`Yb` 5bZÅb[ `Y`

8]Y` ; fØbXi`b[ `g[ YgWx]Wx`hY`XYf` GhcXhVYf[ gU]hb`]gh]`cb`  
6Y[ `Y[ `bi`b[ `Yb`i`bX`Y]bYa`]YVYj`c`Yb`I`a`[ `Ub[ `a`]h`A`i`g]\_[ `YdfÅ[ `h`"

8]Y`YfghYb`A cbUH`k UfYb`j cb`9l dYf]a Ybh]YfZfYi XY  
[ Y`YbbnY]W`bYh`i bX`gc`a UW`h`Y]bY`5bY`\_XchY`XYi h]W`ž`k ]Y`j ]Y`  
K Yfh`Ui ZX]Y`a i g]\_U`]gW`Y`9bhk ]W`\_i b[ `Y`Y[ h`k i fXY`"9]b` ; Ugh  
Y]bYg`XYf`YfghYb`5i Zh]hhY`VYa Yf`\_hY.` GW`cb`[ Ubn`[ i h`ž`UVYf`U  
V]ggYf`gUi VYfYf`a Øggh`g`gW`c`bcW`gd]Y`Yb`" `8]YgY`5fh] cb  
F ØW`\_a Y`Xi b[ Yb`a ch]j ]YfhY`X]Y`A i g]\_Yfž`]\fY`8UfV]Yhi b[ Yb`ni  
j YfZY]bYfb`i bX`Y]bYb`BUa Yb`]b`XYf`A i g]\_gnYbY`ni `YhUV`]YfYb`"

8 Ug`ž`V]`Ài a`k ]fX`Ui W`Y]b`NY]W`Yb`ZØf`XYb`Ni gUa`a Yb`U`hi bX  
X]Y`6Ygh`ÀbX][`\_Y]h`XYf` ; fi ddY`gY]bž`X]Y`hfcm`XYf  
<YfUi gZcfXYfi b[ Yb`XYf`NY]hi bX`DYfgcbU`k YW`gY`X]Y` ; fYi XY`Ub  
A i g]\_i bX` ; Ya Y]bgW`UZh`VYk U`fh`U`h`"8]Y` GhcXhVYf[ gU]hb` `U`h  
g]W`ghYhg`XYb` ; Y[ YVYb`Y]hYb`Ub[ YdUgghi bX`i bhYf`6Yk Y]g  
[ YghY`h`ž`k ]Y`k ]W`h][`fY[ ]cbU`j YfUb`\_YfhY`A i g]\_[ fi ddYb`g]bXž`i a  
X]Y`\_i`hi fY`Y`j ]Y`ZU`h`ni`VYk U`fYb`i bX`YVYbX][`ni`U`hYb`"5a  
: fY]hU[ `k ]fX`XUg`Di V`\_]i a`]b`X]YgYf`HfUX]h]cb`VYk ]fhY`h`k YfXYbž  
k Ybb`X]Y`bghfi a YbhY`Yf`\_]b[ Yb`i bX`X]Y`A i g]\_Yf`Ui g  
@Y]XYbgW`UZh`ZØf`]\fY`?i bgh[ Ya Y]bgUa`a i g]n]YfYb`"

## B c ghU`[ ]Y`i bX`5i gV`]W`\_

8]YgYg`ž`V]`Ài a`g`cbnYfh]gh`b]W`h`bi f`Y]b`F ØW`V`]W`\_Ui Zj ]Yf  
X]fnY`bhYž`gcbXYfb`Ui W`Y]b`5i gV`]W`\_Ui ZX]Y`Ni`\_i bZi`XYf  
GhcXhVYf[ gU]hb`"8]Y`6Y[ Y]ghYfi b[ `ZØf`XUg`A i g]n]YfYb`i bX`X]Y  
: fYi XY`Ub`XYf`6Y[ Y[ bi b[ `a ]h`XYa`Di V`\_]i a`ghY`Yb`bUW`k ]Y  
j cf]a`A ]hhY`di b`\_h`K Ybb`G]Y`Ua` : fY]hU[ UVYbX`X]Y`ZUfVYbZfc`Yb  
?`Àb[ Y`XYf` GhcXhVYf[ gU]hb`Yf`YVYbž`k YfXYb`G]Y`HY`]Y]bYf  
`YVYbX][`Yb`HfUX]h]cbž`X]Y`Yg`j YfX]Ybh`U`h`ž`k Y]hYf[ YhfU[ Yb`ni  
k YfXYb`"8]Y`A i g]\_]ghY]b`k i bXYfVUfYf`K Y[ ž`9]bbYfi b[ Yb`ni  
k YW`Yb`i bX`X]Y` ; Ya Y]bgW`UZh`ni`VYfY]W`Yfb`i`i bX`[ YbUi`XUg  
k YfXYb`X]Y`A i g]\_Yf`Ub`X]YgYa`VYgcbXYfYb`5VYbX`hi b`"

## 8]Y`9bhk ]W`\_i b[ `XYf`J c`\_ga i g]\_`]a XYi hgW`gd fUW`X][`Yb`F Ui a

8]Y` GhcXhVYf[ gU]hb`\_]gh`b]W`h`bi f`HY`]XYf`A i g]\_[ YgW`]W`hY`]b  
9gW`YbVUW`ž`gcbXYfb`Ui W`Y]b`ZUgn]b]YfYbXYg`6Y]gd]Y`ZØf`X]Y

9bhk ]W\_i b[ 'XYf'J c`\_ga i g]\_ja 'XYi hgW\gdFUW ][ Yb'F Ui a "  
J c`\_ga i g]\_ \Uh'Y]bY''Ub[ Y'HfUX]h]cb`]b'8Yi hgW`UbXž² ghYffY]W  
i bX'XYf'GWk Y]n'i bX'Ybhk ]W\_Y'hY'g]W`ØVYf'À\ f\i bXYfhY'\]bk Y[  
Xi fW'fY[ ]cbU'Y'Gh]Y'i bX'9]bZØggY""8]Y'5bZÅb[ Y'XYf'J c`\_ga i g]\_  
g]bX'Yb[ 'a ]h'ÅbX']WYb'; Ya Y]bgW\UZhYb'j YfVi bXYbž'k c'g]W  
Xi fW'a ØbX']WY', VYf']YZYfi b[ '@]YXYf'i bX'A Y'cX]Yb'V]'XYhYb"

æa ' &\$" 'À\ f\i bXYfh\_Ua 'Yg'ni 'Y]bYa 'FYj ]j U'XYg' ðhYfYggYg'Ub  
hfUX]h]cbY''Yf'J c`\_ga i g]\_ž'XUg'Xi fW'j YfgW]YXYbY'6Yk Y[ i b[ Yb  
i bX'5\_hYi fY'j cfUb[ Yhf]YVYb'k i fXY"" ðgh]hi h]cbYb'k ]Y'XYf'  
**6UmYf]gW Y'F i bXZi b\_**'gd]Y'hYb'Y]bY'k ]W h][ Y'Fc''Y'VY]'XYf'  
: ØfXYfi b[ 'XYf'J c`\_ga i g]\_ž]bXYa 'g]Y'Dfc[ fUa a Y'gYbXYhYb'i bX  
5i ZbU\ a Yb'dfcXi n]YfhYbž'X]Y'XUg'9fVY'VYk U\ fhYb""8]Y  
J YfV]bXi b[ 'nk ]gWYb'HfUX]h]cb'i bX'nY]h[ YbØgg]gWYa '9]bZi gg  
\Uh; fi ddYb'k ]Y'X]Y' GhcXhVYf[ gU]h b 'Yfa Ø[ 'W hž'Z]gWY  
DYfgdY\_h]j Yb'Ui ZVYk À\ fhY'A Y'cX]Yb'ni 'Ybhk ]W\_Y'b'i bX'X]YgY'j b  
]\fY'5i ZØ\fi b[ Yb'Y]bZ]Y» Yb'ni ''UggYb"

## 7fcggcj Yf!A i g]\_ 'i bX'nY]h[ YbØgg]gW Y 9]bZ'ØggY

8 Ug'FYdYfhc]fY'XYf' GhcXhVYf[ gU]h b 'nY][ h'b]W'h'bi f'X]Y'K i fnY'b  
]b'XYf'J c`\_ga i g]\_ž'gcbXYfb'Ui W'Y]bY'5bdUggi b[ gZÅ\][ \_Y]h'Ub  
nY]h[ YbØgg]gW Y'A i g]\_gh]'Y""8]Y'6UbX'\Uh'Yg'j YfghUbXYbž  
j YfgW]YXYbY'A i g]\_f]W'h' b[ Yb'a ]hY]bUbXYf'ni 'ca V]b]YfYb'i bX  
gc'Y]b'VfY]hYfYg'Di V`\_i a 'Ubni gdfYWYb"" ð'XYb''YhnhYb'À\ fYb']gh  
Y]b'HfYbX'ni 'VYcVUW'hYbž'VY]'XYa 'hfUX]h]cbY''Y'J c`\_ga i g]\_ 'a ]h  
9'Ya YbhYb'Ui g'Dcdž'FcW\_i bX'UbXYfYb'a cXYfbYb'; YbFYg  
Zi g]cb]Yfh'k ]fX""8]Yg'ZØfXYfh'b]W'h'bi f'X]Y'5hfhU\_h]j ]hÅh'ZØf'Øb[ YfY  
; YbYfUh]cbYbž'gcbXYfb'gW UZh'Ui W'Y]bY'D'UhhZcfa 'ZØf'\_fYUh]j Y  
5i gXfi W\_gZcfa Yb"

8 UVY]'\_Ubb'X]Y' GhcXhVYf[ gU]h b 'U'g'HY]'Y]bYg'[ fØ» YfYb  
D\Åbca Ybg'[ YgY\Yb'k YfXYbž'VY]'XYa 'j ]Y'Y'J c`\_ga i g]\_[ fi ddYb  
g]W' bYi 'YfZ]bXYbž]bXYa 'g]Y'\fY'K ]YXYf[ UVYb']b'a cXYfbY  
?cbhYi hY'XYf'\Yi h][ Yb' < ØfYfgW UZh'Y]bVYhYb""Gc'WY'7fcggcj Yf!  
Dfc'Y\_hY'g]bX'b]W'h'bi f'a i g]\_U'g]W'gdUbbYbXž'gcbXYfb'nY][ Yb  
Ui W'ž'k ]Y''VYbX][ 'i bX'UbdUggi b[ gZÅ\][ 'J c`\_ga i g]\_gY]b'\_Ubb"

8 Yf'9]bZ'i gg'j cb'gcn]U`Yb`A YX]Yb`Ui Z`c\_U`Y  
A i g]\_[ fi ddYb

ϕ`XYf`\Yi h][ Yb`NY]h'gd]Y`h'XUg`ϕhYfbYh'Y]bY`nYbhfU`Y`F c``Y`ZØf`  
`c\_U`Y`A i g]\_[ fi ddYb`i bX`XYfYb`FY]Wk Y]hY"8]Y  
GhcXhVYf[ gU]hb` \Uhž'k ]Y'j ]Y`Y ]\fYf"?c``Y[ Ybž'X]Y`J cfhY]`Y  
gcn]U`Yf`A YX]Yb`[ Ybi hnhž'i a` ]\fY`A i g]\_`i bX`J YfUbgH`hi b[ Yb  
Y]bYa`VfY]hYfYb`Di V`\_i a`j cfni ghY`Yb"D`UhhZcfa Yb`k ]Y  
: UWVcc`\_i bX`ϕghU[ fUa`V]YhYb`X]Y`A Ò[ `]W\_Y]hž?cbnYfhY`ni  
VYk YfVYbž'a ]h: Ubg`ni` ]bhYfU[ ]YfYb`i bX`Y]b`7ca a i b]hml; YZØ`  
ni`ZØfXYfb"8]YgYg`A YX]i a` ]gh`VYgcbXYfg`k Yfhj c``ZØf`; fi ddYbž  
X]Y`g]Wk`b]Wk`h`Ui Z`\_ca a Yfn]Y`Y`5i Zhf]hhY`\_cbnYbhf]YfYbž`gcbXYfb  
Ui Z`\_i`hi fY`Y`i bX`[ Ya`Y]bgWk`UZh]Wk`Y`9fZU`fi b[ Yb`gYhnYb"

Gcn]U`Y`A YX]Yb`Yfa Ò[ `]W\_Yb`Yg`XYf` GhcXhVYf[ gU]hb` ž]\fYb  
GhUhi`g`U`g`c\_U`Y`ϕgh]hi h]cb`ni`ZYgh][ Yb`i bX`[ `Y]Wk`nY]h][ `bYi Y  
Ni \ØfYf`ni` [ Yk ]bbYb"8i fWk`XYb`5i ghUi gWk`j cb`J ]XYcg`i bX  
: chc`g`j cb`5i Zhf]hhYb`\_ØbbYb`g]Y`Ui Wk`Y]bYb`9]bV`]W`\_b]\fY  
a i g]\_U`]gWk`Y`FY]gY`[ YVYb`i bX`]\fY`J YfV]bXi b[ `ni f`FY[ ]cb  
j Yfh]YZYb"

8 YhU]`g

6 Ygi Wk`Yb`G]Y`i bg`Ui Z.`b!U[ "XY