

: U\ ffÅXYf`g]W\ Yfb. `7cX]YfU\_h]cb`XYf  
Dc`nY]`]b`<U[ YbVi f[ `Ua`%"`GYdhYa VYf

5a`%"\$- "&\$&( `V]YhYh`X]Y`Dc`nY]`<UU[ YbXcfZ] cb`%`!%+`I` \f  
: U\ ffUXWcX]Yfi b[ `Ub""5ba Y`Xi b[ `YfZcfXYf`]W\`

&+"\$, "&\$&( ` `%&.\$%

⇒<U[ YbVi f[ žY]bYa`CfhghY]`j cb`GhUXh\U[ YbžghY\h`Y]b  
k ]W\h][ Yf`HYfa ]b`ZØf` : U\ ffUXVYg]hnYf`]bg`<Ui g""5a`%"`  
GYdhYa VYf`&\$&( žj cb`%` `V]g`%+`I` \fž`cf[ Ub]g]Yfh`XUg  
Dc`nY]\_ca a ]ggUf]Uh`GhUXh\U[ Yb`Y]bYb` : U\ ffUXWcX]YfhYfa ]b  
X]fY\_h`VY]`XYf`Dc`nY]ghUh]cb`Ub`XYf`GhY]b\i`XYf!A`YYf!GhfU»`Y`%"`  
8]YgY`J`YfUbgH`hi b[ `f]W\hYh`g]W\`Ub`U`Y`F`UXZU\`fYfž`X]Y`]\f  
: U\ ffUX`j`cf`8]YVghU\`gW\ØhnYb`k`c`Yb`i`bX`k`Yfhj`c`Y`8`UhYb`ni`f  
K ]YXYfVYgW\UZZi b[ `]a` : U`Y`Y]bYg`J`Yf`i`ghYg`Yf\U`hYb`a`ØW\hYb`"

8Ug`7cX]YfYb`XYf` : U\ ffÅXYf`VYXYi`hYhž`XUgg`g]Y`a` ]h`Y]bYf  
gdYn]Z]gW\Yb`Bi`a`a`Yf`j`YfgY\Yb`k`YfXYb""6Y]`X]YgYa`J`cf[ Ub[  
k`YfXYb`b]W\h`bi`f`⇒Zcfa`Uh]cbYb`ØVYf`XUg` : U\ ffUX`gY`Vghž  
gcbXYfb`Ui`W\`ØVYf`XYb`6Yg]hnYf`[ YgUa`a`Y`h`"8]YgY`8`UhYb  
k`YfXYb`XUbb`]b`Y]bYa`gdYn]Y`Yb`GmghYa`ni`f  
J`cf[ Ub[`gVYUfVY]hi b[ `XYf`Dc`nY]`[ YgdY]W\Yfh""8]YgY`nYbhfU`Y  
GUa`a`i`b[ `Yfa`Ø[ `]W\h`Y]bY`Y]bZUW\YfY`⇒Ybh]Z]n]Yfi b[ `i`bX  
F`ØW`ZØ\fi b[ `j`cb`[ Yghc`YbYb` : U\ ffÅXYfb`i`bX`ghY`h`gca` ]h`Y]bYb  
k ]W\h][ Yb`GWf]h]b`XYf`6Y`\_Aa`dZi b[ `j`cb` : U\ ffUX`\_f]a` ]bU`]hAh  
XUf"

## 5ba Y`Xi b[ Yb`YfZcfXYf`]W\

⇒hYfYgg]YfhY`6Yg]hnYf`a`ØggYb`g]W\`ZØf`XYb`7cX]YfhYfa ]b  
Uba Y`XYbž`k`Ug`j`cb`A`cbhU[ `V]g` : fY]hU[ `nk ]gW\Yb`-`i`bX`%( `I` \f

hY`YZc]gW`i bhYf`XYf`Bi a a Yf`\$) +&%!- , &&!&&( `a Ò[ `]W`]gh" `9g  
k ]fX`Ya dZc`Ybž`g]W`ZfØ`nY]h][ `Y]bYb`D`Uhn`ni `g]W`Yfbž`XU`X]Y  
B UW`ZfU[ `Y]b`XYf`F`Y[ `Y`cW`]gh"

: Øf`X]Y`HY]`bU`a Y`Ua `7cX]YfhYfa ]b`g]bX`Y]b][ `Y`k ]W`h][ `Y  
8c`\_i a YbhY`bch`k YbX][ " `>XYf`HY]`bY`a Yf`gc`hY`Y]bYb`U`\_hi Y`Yb  
DYfgcb`U`\_i`gk`Y]g`gck ]Y`Y]bYb`9][ `Ybhi`a`gbUW`k`Y]gž`ni`a`6Y]gd]Y`  
Y]bY`F`YW`bi`b[ `XYg: U`ffUX`Ygž`a ]hVf]b[ `Yb`8`Ua ]h`k ]fX`XYf  
B UW`k`Y]g`YfVfUW`hž`XUgg`XUg: U`ffUX`k ]f`\_]W`XYa`Y`k`Y][ `Yb  
6Yg]hYf`[ `Y`Øfhž`k`Ug`X]Y`G]W`Yf`Y]h`i`bX`XYb  
B UW`j`YfZc`[ `VUf`\_Y]hgd`fc`nYgg`Yf`Ø`h"

Ni`g`À`hn`]W`a`Øgg`Yb`X]Y`YfZc`fXYf`]W`Yb: cfa`i`UfYž`X]Y`Ui`Z`XYf  
K`YVgY]hY`XYf`Dc`]nY]`GhUX`h`U[ `Yb`Xck`b`cUXVUf`g]bXž]a`J`cfUi`g  
Ui`g[ `YZØ`h`i`bX`ni`a`HYfa`]b`a`h[ `YVfUW`h`k`YfXYb`8]Yg`Yf`Y]W`hYfh  
XYb`5V`Ui`Z`i`bX`gc`f[ `h`XUZØfž`XUgg`XYf`7cX]Yfi`b[ `gdfcnYgg  
fY]Vi`b[ `g`cg`i`bX`YZ]n]Ybhj`Yf`Ài`Zh"

## 9fk`Y]hYfhY`A`Ò[ `]W`\_Y]hYb`ni`f`7cX]Yfi`b[

: U`g`G]Y`Ua`%"`GYdhYa`VYf`b]W`h`hY]`bY`a`Yb`\_ØbbYbž`[ ]Vh`Yg  
k`Y]hYfY`7cX]YfhYfa`]bY`]b`XYf`i`a`[ `YVi`b[ `j`cb`GW`Ui`a`Vi`f[ " `8]YgY  
≠Zcfa`Uh]cbYb`g]bX`YVYbZU`g`Ui`Z`XYf`K`YVgY]hY`XYf`Dc`]nY]  
GhUX`h`U[ `Yb`j`YfZØ[ `VUf`i`bX`nY][ `Ybž`XUgg`X]Y`Dc`]nY]j`Yfgh`À`f`\_h`Ui`Z  
df`Àj`Ybhj`Y`A`U»`bU`a`Yb`gYhnhž`i`a`: U`ffUXX]YVghU`ni  
fYXi`n]YfYb"

8]Y`7cX]Yfi`b[ `]gh`b]W`h`bi`f`Y]b`Y]bZUW`Yf`GYfj`]W`ž`gc`bXYfb`Ui`W`  
Y]b`NY]W`Yb`XYg`[ `Ya`Y]bgUa`Yb`9b[ `U[ `Ya`Ybhg`j`cb`Dc`]nY]i`bX  
6Yj`Ø`\_Yfi`b[ `ZØf`a`Y`f`G]W`Yf`Y]h": U`ffUXX]YVgh`À`Y`g]bX`Y]b  
k`Y]h]YfVfY]hYhYg`DfcV`Ya`ž`i`bX`X]Y`7cX]Yfi`b[ `]gh`Y]b`YZZ`\_h]j`Yg  
A`]hY`ž`i`a`X]YgYa`Ybh[ `Y[ `Ybni`k`]f`\_Yb`i`bX`X]Y: U`ff`À`XYf`XYg  
9]bnY`bYb`ni`gW`ØhnYb" `≠`j`]Y`Yb`Gh`À`X`hYb`U`h`g]W`[ `YnY][ `hž`XUgg  
7cX]Yfi`b[ `gU`\_h]cbYb`ni`Y]bYa`F`ØW`[ `Ub[ `j`cb`8]YVgh`À`Yb`ZØ`fYb"

8]YgY`J`YfUbg`h`U`hi`b[ `]b`<`U[ `YbVi`f[ `]gh`U`gc`Y]bY`Y`Yfj`c`ffU[ `YbXY  
; `Y`Y[ `Yb`Y]h`ZØf`U`Y: U`ffUX`]YV`UVYf`]b`XYf`F`Y[ `]cbž`]fY  
Nk`Y]f`À`XYf`ni`g]W`Yfb`i`bX`g]W`a`]h`XYf`Dc`]nY]`ØVYf`k`Y]hYfY

DfAj Ybh]cbga U» bU\ a Yb`Ui gni hUi gWYb"8]Y [ Ya Y]bgUa Y  
J YfUbhk cfhi b[ `j cb`6Øf[ Yfb`i bX`Dc`nY]`hfÀ[ h`k YgYbh]W\`ni f  
G]WYf\Y]h`b`XYf`; Ya Y]bXY`VY]"

: U\ ffUXWcX]Yfi b[ .`9]b`k ]W\ h][ Yf`GW\ f]hh`ni f  
G]WYf\Y]h

8]Y` : U\ ffUXWcX]Yfi b[ `]gh`Y]b`k ]W\ h][ Yf`6Y]hfU[ `ni f`G]WYf\Y]h`j cb  
: U\ ffÀXYfb`]b`XYf`F Y[ ]cb"8i fW\`X]YgY`A U» bU\ a Y`k ]fX`Y]b  
k Yfh] c`Yg`BYhk Yf`\_`ni f`J Yf\]bXYfi b[ `j cb`?f]a ]bU`]hÀh  
[ YgW\ UZZYb"8]X Ya `X]Y`Dc`nY]`gc`WY`\_cghYb`cgYb`8]YbghY  
UbV]YhYhž`nY][ h`g]Y`]\f`9b[ U[ Ya Ybh`ZØf`X]Y`G]WYf\Y]h`XYf`6Øf[ Yf  
i bX`i bhYfghØhnh`X]YgY`U\_h]j `VY]`XYf`DfAj Ybh]cb`j cb  
: U\ ffUXX]YVghÀ`Yb"8]Y`A Ò[ `]W\`\_Y]hž`Ub`Y]bYa`gc`WYb  
7cX]YfhYfa ]b`hY]`ni bY`a Ybž`gc`hY`XU\Yf`Yfbgh\UZh]b`6YhfUW\h  
[ Ync[ Yb`k YfXYb` `XYbb`Y]b[ i h[ Yg]WYfYg` : U\ ffUX`]gh`b]W\h`bi f  
XYf`Ghc`n`XYg`6Yg]hnYfgž`gcbXYfb`Ui W\`Y]b`gW\k YfYf`J Yf`i gh`ZØf  
X]Y` ; Ya Y]bgW\UZhž`k Ybb`Yg[ Yghc`\`Yb`k ]fX"8Yf`bÀW\ghY  
7cX]YfhYfa ]b`\_ÒbbhY`XYf`YfghY`GW\ f]hh`ni `a Y\ f`G]WYf\Y]h`ZØf`À f  
: U\ ffUX`gY]b"

? cX]Yfi b[ `j cb` : U\ ffÀXYfb. `GW\ i hn`j cf  
8]YVghU\`

8]Y`7cX]Yfi b[ `j cb` : U\ ffÀXYfb`]gh`Y]bY`YZY`\_h]j Y`A Yh\cXY`ni a  
GW\ i hn`j cf`8]YVghU\`i bX`ni f`F ØW`ZØ\fi b[ `[ Yghc`\`YbYf` : U\ ffÀXYf  
ni `]\fYb`9][ YbhØa Yfb"8]Y`Dc`nY]`j Yfk YbXYh`\]YfVY]`Y]b  
Y]bn][ Ufh][ Yg`9f`\_Ybbi b[ ggmgHYa ž`XUg`Yg`Yfa Ò[ `]W\hž` : U\ ffÀXYf  
a ]h\`ZY`]\fYf`gdYn]Y`Yb`X`Ybh]Z]\_Uh]cbgbi a a Yf`ni `]XYbh]Z]n]YfYbž  
X]Y`Ui Z]j YfgW\]YXYbY`HY]Y`XYg` : U\ fnYi [ g`Ui Z[ YVfUW\h`k ]fX"  
8]YgY`A U» bU\ a Y`ghY][ Yfh`b]W\h`bi f`X]Y`G]WYf\Y]h`XYf`F UXZU\fyfž  
gcbXYfb`k ]f`\_h`Ui W\`UVgW\fyW`YbX`Ui Z`dchYbn]Y`Y`8]YVY" `@Ui h  
Y]bYf`GhUh]gh]\_`XYg`6i bXYg`\_f]a ]bU`Ua hg`k i fXYb`]a `X\ f`&\$&&]b  
8Yi hgW\`UbX`ØVYf` "\$\$\$\$` : U\ ffÀXYf[ Yghc`\`Yb"8]Y`7cX]Yfi b[  
k ]fX`U`g`Y]bY`XYf`VYghYb`j cfVYi [ YbXYb`A U» bU\ a Yb`Ub[ YgY\Ybž  
i a `XYb`8]YVghU\`j cb` : U\ ffÀXYfb`ni `j Yf\]bXYfb"

I bhYf`XYa `; Yg]W\hgdi b\_h`XYf`ghY][ YbXYb` : U\ffUXbi hni b[ ž  
]bgVYgcbXYfY`]b`gh`Xh]gW\Yb` ; YV]YhYbž`U`h`X]Y`B UW\ZFU[ Y`bUW\  
gc`W\Yb`G]W\Yf\Y]hga U» bU\`a Yb`ni [ Ybca`a Yb`" `a `?cbhYI hij cb  
B UW\`U`h][ \_Y]h`i bX`YfbYi YfVUfYf`A`cV]`h`h`[ Yk`]bbh`XUg` : U\ffUX  
U`g`HfUbgdcfha`]hY``]a`a Yf`a Y`f`Ub`'6YXYi hi b[ "8Yf`HfYbX`ni  
a Y`f` : U\ff`AXYfb`Ui ZXYb`GhfU» Yb`VYXYi hYhž`XUgg`Ui W`X]Y  
Dc`]nY]`j Yfgh`A`f`\_h`Ui Z`Df`A`j Ybh]cbga U» bU\`a Yb`gYhnhž`i a`X]Y  
G]W\Yf\Y]h`XYf`F`UXZU`fYf`ni` [ Yk`A`f`Y]ghYb`"

## H]ddg`ni f`J`cfVYfY]hi b[ `Ui Z`X]Y`7cX]Yfi b[

hYfYgg]YfhY` : U\ffUXVYg]hYf`gc`hYb`[ i`h`j`cfVYfY]hYh`ni`XYb  
7cX]YfhYfa`]bYb`YfgW\Y]bYb`"9g]gh`b`chk`YbX][ ž`U`Y`YfZcfXYf`]W\Yb  
I bhYf`U[ Yb`a`]hni Vf]b[ Ybž`i a`X]Yb`J`cf[ Ub[ `ni`VYgW\`Yi b][ Yb`"Ni  
XYb`b`chk`YbX][ Yb`8c`\_i`a`YbhYb`[ Y\`ÖfYb`XYf`DYfgcbU`Ui`gk`Y]g  
gk`]Y`Y]b`9][ Ybhi`a`gbUW\k`Y]g`ZØf`XUg` : U\ffUXž`ni`a`6Y]gd]Y`Y]bY  
F`YW\bi b[ `cXYf`Y]b`?Ui`ZY`Y[ "8]YgY`8c`\_i`a`YbhY`V]YhYb`XYf  
Dc`]nY]`X]Y`b`chk`YbX][ Y`6Ygh`h`[ i`b[ ž`XUgg`XYf`9][ Ybh`Øa`Yf  
hUhg`W\`]W\`XUg`F`YW\h`VYg]hnhž`XUg` : U\ffUX`ni`W`cX]YfYb`"

8UfØVYf`\]bUi`g`Ya`dZY`\`Yb`9I`dYfhYbž`g]W\`ØVYf`X]Y  
j`YfgW\]YXYbYb`A`Ö[ `]W\`\_Y]hYb`XYf` : U\ffUXg]W\Yfi`b[ `ni  
]bZcfa`]YfYb`"BYVYb`XYf`7cX]Yfi`b[ `\_ÖbbYb`Ui`W\`cW\k`Yfh][ Y  
GW\`ÖggYf`i`bX`UbXYfY`G]W\Yf\Y]hgj`cff]W\hi`b[ Yb`j`Yfk`YbXYh  
k`YfXYbž`i`a`X]Y`K`U`fgW\Y]b`]W\`\_Y]h`Y]bYg`8]YVghU`\`g`k`Y]hYf`ni  
a`]b]a`]YfYb`"

## 8]Y`F`c`Y`c`\_U`Yf`6Y\`ÖfXYb`i`bX`XYf ; Ya`Y]bgW\UZh

8]Y`h]Uh]j`Yb`ni`f` : U\ffUXW`cX]Yfi`b[ `k`YfXYb`cZ]j`cb`c`\_U`Yb  
6Y\`ÖfXYb`i`bhYfgh`hnh`i`bX`g]bX`HY]`i`a`ZUggYbXYfYf`Dfc[`fUa`a`Y  
ni`f`?f]a`]bU`]h`hgVY`\_`A`a`dZi`b[ "8UfØVYf`\]bUi`g`gd]Y`h`X]Y  
6YhY]][ i`b[ `XYf` ; Ya`Y]bgW\UZh]Y]bY`YbhgW\Y]XYbXY`F`c`Y`"8]Y  
GYbg]V]`g]Yfi`b[ `ZØf`8]YVghU`\`df`A`j`Ybh]cb`i`bX`X]Y` : ÖfXYfi`b[ `XYf  
 : U\ffUXbi`hni`b[ `hfU[ Yb`XUni`VY]ž`X]Y`ÖZZYbh]W\Y`G]W\Yf\Y]h`ni  
Yf\`Ö\`Yb`i`bX`Y]b`gh`A`f`\_YfYg` ; Ya`Y]bgW\UZhg[ YZØ`\`ni`Ybhk`]W`\_Y`b`"

J YfUbgH`hi b[ Yb`k ]Y`X]Y`]b`< U[ YbVi f[ `Ub[ Y[ YVYbY`7cX]Yfi b[  
gYbg]V`]g]YfYb`b]W`h`bi f`X]Y`6Øf[ Yf`ZØf`G]W`Yf\Y]hgZfU[ Ybž  
gcbXYfb`V]YhYb`Ui W`Y]bY`D`UhhZcfa ži a`H]ddg`ni f`g]W`YfYb  
5i ZVYk U\fi b[ `j cb` : U\ffÅXYfb`Ui gni hUi gW`Yb`"Gc`W`Y  
=bZcfa Uh]cbYb`g]bX`ZØf`F UXZU\ fYf`j cb` [ fc» Ya`K Yfhž  
]bgVYgcbXYfY`ZØf`X]Y`Yb][ Ybž`X]Y`]b`gh`Xh]gW`Yb` ; YV]YhYb  
k c\ bYbž`k c`X]Y`8]YVghU\`gfUhy`\`Ò\Yf`]gh"

8YhU]`g

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