

5i gY]bUbXYfgYhni b[ 'Ub`HUb\_ghY`Y.  
; `UgZ`UgW\Y`j`Yf`Yhnh`&&!>À\ f][ Yb

5i gY]bUbXYfgYhni b[ `]b`J G!J ]``b[ Yb.`Nk Y]`A`ÀbbYf`ghfY]hYbž  
Y]bYf`k`]fX`a`]h`Y]bYf`6]YfZUgW\Y`j`Yf`Yhnh``Dc`nY]`gi`W\h  
NYi [ Yb"

⊕`XYf`B`UW\h`ni`a`:`fY]hU[ `Yf`YVhY`Y]bY`HUb\_ghY`Y`]b`XYf  
; Yfk`][`ghfU»Y`]b`J G!J ]``b[ Yb`Y]b`i`bYfZfYi``]W\Yg`GW\Ui`gd]Y`ž`U`g  
Yg`ni`Y]bYa``\_ÖfdYf`]W\Yb`Nk`]gW\YbZU``nk`]gW\Yb`nk`Y]`A`ÀbbYfb  
\_Ua`"K`Ug`U`g`j`YfVU`Y`5i`gY]bUbXYfgYhni`b[ `VY[`Ubbž`Yg\_U`]YfhY  
gW\YbY``ni`Y]bYa``5b[ f]ZZ`VY]`XYa`Y]bY`; `UgZ`UgW\Y`Y]b[ YgYhnh  
k`i`fXY``8Yf`J`cfZU`ž`XYf`g]W\`Ua``%\*`"5i`[ i`gh`&\$&( `YfY][`bYhYž`\Uh  
b]W\h`bi`f`J`Yf`Yhni`b[ Ybž`gcbXYfb`Ui`W\`Y]bY`Ui`ZYbXY`dc`nY]`]W\Y  
l`bhYfgi`W\i`b[ `ni`f`:`c`[ Y"

9]b`&&!>À\ f][ Yf`A`Ubb`k`i`fXY`VY]`XYf`5i`gY]bUbXYfgYhni`b[  
Yf\YV`]W\`j`Yf`Yhnh``8Yf`9fa`]hh`i`b[ gVYf]W\h`VYgW\fY]Vhž`XUgg`XYf  
↑`b[ Y`A`Ubb`j`cb`gY]bYa``?`cbhfU\YbhYb`Y]bY`j`c``Y`6]YfZUgW\Y`]bg  
; Yg]W\h[ YgW\`U[ Yb`VY\_Ua`"8]Yg`ZØ\fhY`ni`DfY``i`b[ Yb`]a`:`Yg]W\h  
i`bX`k`]fZh`:`fU[ Yb`Ui`Z`ØVYf`X]Y`<`]bhYf[ fØbXY`i`bX`XYb`J`Yf`Ui`Z`XYg  
[ Yghf][ Yb`?`cbZ]\_hg" `Gc`W\Y`J`cfZÄ``Y`g]bX`b]W\h`bi`f`VYXUi`Yf`]W\ž  
g]Y`k`YfZYb`Ui`W\`Y]b`@]W\h`Ui`ZX]Y`dchYbn]Y``Y`; YZU\fž`X]Y`]b  
gW\Y]bVUf`\Ufa``cgYb`G]hi`Uh]cbYb`j`YfVcf[ Yb``]Y[ Yb`\_Ubb"

< ]bhYf[ fØbXY`i`bX`9fa`]hh`i`b[ Yb

8]Y`[ YbUi`YfYb`< ]bhYf[ fØbXY`XYf`5i`gY]bUbXYfgYhni`b[ `g]bX  
XYfnY]h`bcW\`i`b`\_Ufž`XU`X]Y`Dc`nY]`⊕Zcfa`Uh]cbYb`ØVYf`X]Y  
⇒Yb]h]h`h`XYg`GW\`Ä[ Yfg`gi`W\h`NYi [ Ybž`X]Y`XYb`J`cfZU``  
VYcVUW\hYh`\UVYb`cXYf`X]Y`Dc`nY]`a`]h`k`Y]hYfYb`⊕Zcfa`Uh]cbYb  
i`bhYfghØhnYb`\_ÖbbYbž`k`YfXYb`Ui`Z[ YZcfXYfhž`g]W\`X]fY`\_h`a`]h`XYa

Dc`nY]fYj ]Yf`J ]`b[ Yb`b`J YfV]bXi b[ `ni `gYhmYb"8]Y`Bi a a Yf  
`Ui hYh`\$++&%#\* \$%\$""8]YgY`5i Zfi ZY`g]bX`cZhYggYbn]Y``žXU`g]Y  
YbhgWXY]XYbX`ni f`5i Z\_`Àfi b[ `gc`WXYf`J cfZÀ`Y`VY]hfU[ Yb`\_`ÒbbYb"

8Yf`9]bgUhm`j cb` ; Yk U`h]b`gc`WXYb`G]hi Uh]cbYb`]gh`b]W`h`bi f  
[ YZÀ`f`]W`ž`gcbXYfb`Ui W`YfgW`fY`W`YbX""5`g`HY]`XYf`9fa ]h`i b[ Yb  
a i gg`Ui W`X]Y` : fU[ Y`[ Y`\_`Àfh`k YfXYbž`k Ug`XYb`GhfY]h`Ui g[ Y`Ògh  
`Uh" : ð j ]Y`Yb`À`b`]W`Yb` : À`Yb`g]bX`Yg`cZh`\_`Y]bYfY  
A Y]bi b[ gj YfgW]YXYb`Y]hYbž`X]Y`Ui » Yf`? cbhfc`Y`[ YfUhYb""9g]gh  
k ]W`h][ ž`XUfØVYf`bUW`ni XYb`\_`Ybž`k ]Y`?cbZ]\_`hY`j Yf`À`hb]ga `À» ][  
i bX`Zf]YX`]W`[ Y`Ògh`k YfXYb`\_`ÒbbYbž`c`bY`XUgg`Yg`ni  
\_`ÒfdYf`]W`Yf` ; Yk U`h`\_`ca a h"

## 8]Y`6YXYi hi b[ `XYf`NYi [ Yb

8]Y`Fc`Y`XYf`NYi [ Yb`b`gc`WXYb` : À`Yb`]ghj cb`Yf`YV`]W`Yf  
6YXYi hi b[ ""G]Y`\_`ÒbbYb`cZhYbhgWXY]XYbXY` ð Zcfa Uh]cbYb`]YZYfbž  
X]Y`XUg`6]X`XYg` ; YgW`Y`Yb`g`j Yfj c`gh`ÀbX][ Yb"" ð fY`5i ggU[ Yb  
\_`ÒbbYb`b]W`h`bi f`Y`ZYbžXYb`H`hYf`ni` ]XYbh]Z]n]YfYbž`gcbXYfb  
Ui W`X]Y`[ YgUa hY`8mbUa ]\_`XYg`J cfZU`g`VYggYf`ni` j YfghY`Yb"  
2 fh]W`Y` ; Ya Y]bgW`UZhYb`g]bX`cZh`X]Y`VYghYb`5i [ YbnYi [ Yb`i bX  
gd]Y`Yb`Y]bY`nYbhfU`Y`Fc`Y`VY]XYf`J Yf`]bXYfi b[ `j cb` ; Yk U`hi bX  
XYf`5i ZFYW`hYf`U`hi b[ `XYf`G]W`Yf`Y]h"

8]Y`Dc`nY]`k ]fX`U`Yf`K U`fgWXY]b`]W`\_`Y]h`bUW`X]YgVYnØ[ `]W`U`Y  
[ YgUa a Y`hYb` ð Zcfa Uh]cbYb`Ui Za Yf`\_`gUa`Ui gk YfhYb""5i W`k Ybb  
X]YgY`5i gY]bUbXYfgYhni b[ `ni a` ; `ØW`\_`b]W`h`a ]higW`]a a YfYb  
J Yf`Yhni b[ Yb`YbXYhYž`ghY`h`g]Y`XYb`bcW`Y]bYb  
VYgcf[ b]gYffY[ YbXYb`HfYbX`XUfž`XYf`6Yj Ò`\_`Yfi b[ `i bX`6Y`ÒfXYb  
ni a`B`UW`XYb`\_`Yb`Ub`fY[ h"9g]gh`Y]b`< ]bk Y]g`XUfUi Zž`XUgg]b  
i bgYfYf` ; YgY`gW`UZh`ni bY`a YbX`F`Ui a`ZØf`?cbZ]\_`hY`YbhghY`hž  
X]Y`[ YZÀ`f`]W`YbXYb`\_`ÒbbYb"

8Yb`bcW`[ ]Vh`Yg`<cZ`bi b[ ž`XUgg`Xi fW`gc`WXY`J cfZÀ`Y`Y]b  
6Yk i ggghY]b`]bbYf`U`V`XYf` ; Ya Y]bgW`UZh`YbhghY`hž`gck c`l`ZØf  
X]Y`F]g]\_`Yb`XYg`?cbZ]\_`hg`U`g`Ui W`ZØf`X]Y`B`chk YbX][ \_`Y]h]j cb  
8]U`c[ `i bX`8YYg`\_`U`Uh]cb""8Yf`gh`ÀbX][ Y`5i ghUi gW`nk ]gW`Yb  
Dc`nY]i bX`6Øf[ Yfb`gd]Y`h`Y]bY`k YgYbh`]W`Y`Fc`Y`ž`i a`ni`\_`ØbZh][ Y

5i gY]bUbXYfgYhni b[ Yb`ni`j Yf\]bXYfb"

F YZ`YI ]cb`ØVYf`XYfUfh][ Y`J cfZÀ`Y`Y

9g`V`Y]Vh`ni` \cZZYbž`XUgg`XYfUfh][ Y`J cfZÀ`Y`Y]b`Ni`\_i`bZh`k`Yb][ Yf`  
\`Ai`Z][`Ui`Zh`fY`hY`b" `X`XYf`U`h`X]Y`J`Yf`Ub`hk`cf`hi`b[`ž`g]W`X`b]W`X`h`b`i`f`Z`Øf`  
X]Y`Y][`Yb`Y`G]W`X`Y`f`Y]hž`g`c`b`X`Y`f`b`Ui`W`X`Z`Øf`X]Y`G]W`X`Y`f`Y]h`g`Y]b`Y`f`  
A`]h`a`Y`b`g`W`X`Y`b`Y]b`ni`g`Y`h`n`Y`b";`Y`k`U`h`]g`h`b]Y`a`U`g`X]Y`@`Øgi`b[`ž`i`b`X`Y`g`  
]g`h`k`]W`X`h][`ž`J`Y`f`U`h`Y`b`g`k`Y]g`Y`b`ni`Z`Øf`X`Y`f`b`ž`X]Y`Y]b`Y`[`Y`k`U`h`Z`f`Y]Y`  
?`c`b`Z]\_`h`Øgi`b[`i`b`h`Y`f`g`h`Ø`h`n`Y`b" `8]Y`g`\_`Ø`b`b`h`Y`X`i`f`W`  
6]`X`i`b[`g]b]h]U]j`Y`b`c`X`Y`f`D`f`c[`f`U`a`a`Y`ni`f`;`Y`k`U`h`d`f`À`j`Y`b`h]c`b`  
[`Y`g`W`X`Y`Y`b`ž`X]Y`]b`G`W`X`i`Y`b`c`X`Y`f`;`Y`a`Y]b`g`W`X`U`Z`h`g`n`Y`b`h`f`Y`b`  
U`b[`Y`V`c`h`Y`b`k`Y`f`X`Y`b"

K ]Y`c`Zh`[ ]V`h`Y`g`ni`a`6`Y]g`d]Y`G`h`f`Y]h][`\_`Y]h`Y`b`U`b`C`f`h`Y`b`ž`X]Y`a`U`b`Z`Øf`  
g]W`X`Y`f`U`h`ž`k`]Y`H`U`b`\_`g`h`Y`Y`b`3`G`c`W`X`Y`5`i`g`Y]b`U`b`X`Y`f`g`Y`h`ni`b[`Y`b`g]b`X`  
c`Z`h`Y]b`K`Y`W`f`i`Z`i`b]W`X`h`b`i`f`Z`Øf`X]Y`D`c`n`Y]ž`g`c`b`X`Y`f`b`Ui`W`X`Z`Øf`X]Y`  
[`Y`g`U`a`h`Y`;`Y`g`Y`g`W`X`U`Z`h`Y`b`Y]b`Y`f`N`Y]hž`b`X`Y`f`?`À`fi`b[`i`b`X`  
?`c`a`a`i`b]\_`U`h]c`b`a`Y`f`X`Y`b`b`Y`[`Y`Z`f`U[`h`g]b`X`ž`g`c`h`Y`b`k`]f`U`Y`X`U`ni`  
U`i`Z[`Y`f`i`Z`Y`b`g`Y]b`ž`b`U`W`X`K`Y[`Y`b`ni`g`i`W`X`Y`b`ž`X]Y`i`b`g`Y`f`  
N`i`g`U`a`a`Y`b`Y`V`Y`b`g]W`X`Y`f`Y`f`i`b`X`f`Y`g`d`Y`\_`h`j`c`Y`f`[`Y`g`h`U`h`Y`b"

; YgY`g`W`X`U`Z`h`]W`X`Y`5`i`g`k`]f`\_`i`b[`Y`b`j`c`b`

; Yk`U`h`U`\_`h`Y`

; Yk`U`h`]b`Ø`Z`Y`b`h`]W`X`Y`b`F`À`i`a`Y`b`ž`k`]Y`]a`c`V`Y`b`V`Y`g`W`X`f]Y`V`Y`b`Y`b`  
J`c`f`Z`U`ž`U`h`i`k`Y]h`f`Y]W`X`Y`b`X`Y`[`Y`g`Y`g`W`X`U`Z`h`]W`X`Y`5`i`g`k`]f`\_`i`b[`Y`b`  
G`c`W`X`Y`9`f`Y][`b]g`g`Y`Y`f`k`Y`W`Y`b`c`Z`h`5`b[`g`h`i`b`X`i`b`g]W`X`Y`f`Y]h]b`b`Y`f`U`V`  
X`Y`f`;`Y`a`Y]b`g`W`X`U`Z`h`G]Y`\_`Ø`b`b`Y`b`X`U`g`G]W`X`Y`f`Y]h`g[`Y`Z`Ø`X`Y`f`  
5`b`k`c`b`Y`f`V`Y`Y]b`h`f`À`W`X`h][`Y`b`i`b`X`X`U`g`J`Y`f`h`f`U`i`Y`b`]b`X]Y`Ø`Z`Y`b`h`]W`X`Y`  
C`f`X`b`i`b[`i`b`X`X`Y`b`F`Y`W`X`h`g`g`h`U`U`h`i`b`h`Y`f[`f`U`V`Y`b" `g`V`Y`g`c`b`X`Y`f`Y`]b`  
G`h`À`X`h`Y`b`i`b`X`6`U`i`b[`g`f`À`i`a`Y`b`ž`k`c`X`U`g`F`]g]\_`c`Ø`Z`Y`b`h`]W`X`Y`f`  
5`i`g`Y]b`U`b`X`Y`f`g`Y`h`ni`b[`Y`b`U`Y`f`]g`hž`b`Y][`Y`b`A`Y`b`g`W`X`Y`b`X`U`ni`ž`  
j`c`f`g]W`X`h][`Y`f`ni`g`Y]b`i`b`X`Ø`Z`Y`b`h`]W`X`Y`D`À`h`n`Y`ni`a`Y]X`Y`b"

I`a`i`[`Y[`Y`b`X]Y`g`Y`9`b`h`k`]W`\_`i`b[`Y`b`j`c`f`ni`[`Y`Y`b`ž`U`V`Y`b`j`]Y`Y`G`h`À`X`h`Y`  
D`f`c[`f`U`a`a`Y]b`g`@`Y`V`Y`b`[`Y`f`i`Z`Y`b`ž`X]Y`g]W`X`a`]h`;`Y`k`U`h`d`f`À`j`Y`b`h]c`b`

VYgWÀZh][ Yb"8]YgY'Dfc[ fUa a Y'n]Y`Yb`XUfUi Z'UVž?cbZ]\_hY  
[ Yk U`hZfY]ni `ÒgYb`i bX`X]Y`ϕhY[ fUh]cb`i bX`XYb`8]U`c[ `nk ]gWYb  
j YfgW]YXYbYb` ; fi ddYb`ni `ZØfXYfb"Y`b`]WY`ϕ]h]Uh]j Yb`[ ]Vh`Yg  
Ui W`b`J`]]b[ Yb!GWk Ybb]b[ Yb`i bX`l a [ YVi b[ "8]Y`Dc`nY]i bX  
`c\_U`Y`C f[ Ub]gUh]cbYb`gYhnYb`g]W` [ Ya Y]bgUa `XUZØf`Y]bž`XUg  
6Yk i gghgY]b`ZØf`a Ò[ `]WY`?cbZ]\_hY`ni `gW`ÀfZYb`i bX`]b`XYf  
; Ya Y]bgW`UZh`Y]b` ; YZØ`j cb`G]WYf`Y]h`ni `gW`UZZYb"

## GhUh]gh]gW`Y`8 UhYb`ni ` ; Yk U`hj YfVfYW`Yb`]b 8 Yi hgW`UbX

8]Y`U`\_hi Y`Yb`GhUh]gh]\_Yb`nY][ Ybž`XUgg ; Yk U`hXY`\_hY`]b  
8Yi hgW`UbX`]b`XYb`YhnYb`ϕ\`fYb`GWk Ub`\_i b[ Yb`i bhYf`]Y[ Yb`  
@Ui h`XYa`i bXYg`\_f]a ]bU`Ua h`f6?5Ě`gUb`\_X]Y`5bnU`XYf  
fY[ ]ghf]YfhYb` ; Yk U`hXY`\_hY`]a`ϕ\`f`&\$&&]a`J Yf[ `Y]W`ni `XYb  
J cf`U`fYb`Y]W`h`8YbbcW`V`Y]Vh`X]Y`NU`XYf` ; Yk U`hXY`\_hY`Ui Z  
Y]bYa`U`Ufa ]YfYbX`c`Yb`B]j YUi "ϕ`XYf`Dc`nY]`]WYb  
?f]a ]bU`ghUh]gh]\_fD?GĚ`k ]fX`YXYg`ϕ\`f`Y]bY`J]Y`nU`j cb`J cfZ`Yb  
Xc`\_i a Ybh]Yfh`X]Y`j cb`?ÒfdYfj Yf`Yhni b[ `ØVYf`F Ui V`V]g`\]b`ni  
gW`k YfYf`k Y]hYfYf` ; Yk U`h`fY]WYb"

⇒a`ϕ\`f`&\$&&`k i fXYb`Yhk U`% , \*"\$\$\$ : À`Y`j cb`[ YZ`f`]WYf  
?ÒfdYfj Yf`Yhni b[ `]b`8Yi hgW`UbX`fY[ ]ghf]Yfh"8]YgY`NU`Yb  
j YfXYi h]WYb`X]Y`B`chk YbX][ \_Y]hj Yfgh`Àf`\_hYf`5i Z`Àfi b[ `i bX  
Df`Aj Ybh]cbga U»bU`a Ybž`]bgVYgcbXYfY`]b`gh`Xh]gWYb` ; YV]YhYbž  
k c`A YbgWYb`Ui g`i bhYfgW]YX`]WYb`gcn]U`Yb`i bX`\_i `hi fY`Yb  
<]bhYf[ fØbXYb`Ui ZY]bUbXYfhfYZZYb"

## F YU`\_h]cb`XYf` ; Ya Y]bgW`UZh

B UW`[ Yk U`h`h`h] [ Yb`5i gY]bUbXYfgYhni b[ Yb`[ ]Vh`Yg`\`Ai Z][ `Y]bY  
gdØfVUfY`F YU`\_h]cb`]b`XYf`VYhfc ZYbYb` ; Ya Y]bgW`UZh"5bk c`bYf  
i bX`c`\_U`Y`5`\_h]cbg[ fi ddYb`cf[ Ub]g]YfYb`c`Zi`HfY ZYbž`i a`ØVYf  
G]WYf`Y]hgZfU[ Yb`ni `X]g`\_i h]YfYb`i bX`@Øgi b[ Yb`ni `Z]bXYb`"Gc`WY  
J YfUbghU`hi b[ Yb`ZØfXYfb`b]W`h`bi f`XYb`5i ghUi gW`nk ]gWYb  
6Øf[ Yfb`i bX`GhfUz] YfZc`[ i b[ gVY`ØfXYbž`gcbXYfb`hfU[ Yb`Ui W`ni f  
6]Xi b[ `Y]bYg`gc`]XUf]gWYb`BYhmk Yf`\_Yg`VY]ž`XUg`g]W`[ Y[ Yb

; Yk U`h'k YbXYh"

Ni gÀh`]W\`i bhYfghØhnYb`nU\`fY]W\Y`b]h]Uh]j Yb`X]Y`CdZYf`j cb  
; Yk U`hž`]bXYa`g]Y`<]`ZgUb[ YVchY`i bX`6YfUhi b[ `VYfY]hghY``Yb"  
8]YgY`Dfc[ fUa`a`Y`g]bX`YbhgW\Y]XYbXž`i a`b]W\h`bi f`XYb`CdZYfb  
ni`Y`ZYbž`gcbXYfb`Ui W`X]Y`[ UbnY`; Ya`Y]bgW\UZh`ni`ghÀf`\_Yb`i bX  
X]Y`DfÀj Ybh]cbgUfVY]h]j cfUbni hfY]VYb"

8YhU]`g

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