

HfU[ ]gWk Yf'J cfZU``']b'5VWf]b[ hcb.'<i bX  
h0hYh') ' !^A\ f][ Yb'A Ub b

9]b') ' !^A\ f][ Yf'A Ubb'k i fXY']b'5VWf]b[ hcb'j cb'gY]bYa`L@  
6i ``m'h0X`jWk'j Yf'Yhh"8Yf'<i bX'k i fXY'j cb'XYf'Dc`nY]  
YfgWk cggYb"

⊕'XYf'Vf]h]gWk Yb'; fUZgWk UZh'@UbWUg\ ]fY'\ Uh'g]Wk`Y]b'hfU[ ]gWk Yg  
9fY][ b]g'YfY][ bYhž'XUg'X]Y' [ YgUa hY`B Uh]cb'YfgWk 0hhYfh'9]b  
) ' !^A\ f][ Yf'A Ubb'ZUbX' ]b'gY]bYa`Y][ YbYb'Ni \Ui gY`Y]bYb  
[ Yk U`hgUa Yb'HcXž'U'g'Yf'j cb'gY]bYa`Y][ YbYb'<i bXž'Y]bYa`L@  
6i ``mž'Ub[ Y[ f]ZYb'k i fXY'"8]Y'gWk cW\_]YfYbXYb'8YhU]`g'X]YgYg  
J cfZU``g'k i fXYb'j cb'XYf'Dc`nY]'VY\_Ubbh'[ Y[ YVYbž'X]Y'bUWk`XYa  
J cfZU``i a [ Y\YbX'A U» bU\ a Yb'Yf[ f]Z'

8]Y'Dc`nY]'a Y`XYhYž'XUgg'XYf'9]bgUhn'Ua`8]YbghU[ `YfZc`[ hYž  
gcXUgg'g]Y'Ui ZX]Y'gWk k Yfk ]Y[ YbXY'G]hi Uh]cb'Ui Za Yf\_gUa  
k i fXYb"K A\ fYbX'XYf'9fa ]h'i b[ Yb'k i fXY'XYf'<i bX'U'g  
dchYbn]Y``[ YZ^A\ f`]Wk`Y]b[ Yghi Zhž'k Ug'gWk`Y]»`]Wk`ni f  
9bhgWk Y]Xi b[ `Z0\ fhYž'XUg'H]Yf'ni`YfgWk]Y»Yb"8]Y'6YUa hYb  
ghY`hYb`ZYghž'XUgg'Y]bY'i ba ]hY`VUFY'6YXfc\i b[ `Z0f'X]Y  
G]Wk Yf\Y]h'XYf'5``[ Ya Y]b\Y]h'VYghUbX'i bX'g]Y`\_Y]bY'UbXYfY'K U\`  
\UhYbž'i a`k Y]hYfYb'GWk UXYb'ni`j Yf\]bXYfb"

8 Yf' [ YZ^A\ f`]Wk Y`L @6i ``m

8Yf'J cfZU``k ]fZh'b]Wk h'bi f': fU[ Yb'ni f'G]Wk Yf\Y]hj cb  
<i bXY\U`hi b[ Yb'Ui Z'gcbXYfb'Vf]b[ h'Ui Wk`X]Y'?cbhfcj YfgYb'i a  
X]Y`F UggY'gY`Vgh'k ]YXYf']bg'@]Wk h"8Yf'L @6i ``m[ Y\0fh'ni`Y]bYf  
<i bXYfUggYž'X]Y'gY]h'\_i fnYa` ]b'; fc»Vf]hUbb]Yb'i bhYf'ghfYb[ Yb  
FY[ i`]Yfi b[ Yb'ghY\h"5i Z[ fi bX'a Y\ fYfYf'h0X`]Wk Yf'J cfZ^`Y`k ]fX  
X]Y`Ni Wk`hi bX'<U`hi b[ `X]YgYf'<i bXY'gY]hYbg'XYf'Vf]h]gWk Yb

F Y [ ] Y fi b [ ' ghUf\_`Y]b [ YgWk fÅb\_`h"Bi f'i bhYf'gdYn]Y`Yb`5i ZU[ Yb XØfZYb`< U`hYf`X]YgYf`F UggY`k Y]hYf\`b`j\ fYb`J ]YfVY]bYf`VYg]hnYb"

8]Y`Dc`nY]`VYnY]Wk bYhY`XYb`J cfZU``U`g` hfU[ ]gWk `i bX`VYhc bhYž XUgg`Yg`g]Wk `i a `Y]bYb`VYXUi Yf`]Wk Yb`J Yf`i gh`Y]bYg`@VYbg \UbXY`hY""8]Y [ YbUi Yb`l a ghÅbXYž`X]Y`ni `X]YgYa `hØX`]Wk Yb 5b[ f]Z`ZØ\ fhYbž`g]bX`bcWk `i b\_`Uf`i bX`k YfXYb`XYfnY]hj`cb gdYn]U`]g]YfhYb`9fa` ]hh`Yfb`[ fØbX`]Wk `i bhYfgi`Wk h`9g`k ]fX`Ui Wk Yfk`c[ Ybž`k ]Y`X]Y`ZJa` ]]ÅfY`G]hi`Uh]cb`XYg`A`UbbYg`]b`X]Y 9fa` ]h`i b[ Yb`Y]bZ]Y»Yb`\_ØbbhY"

## < Åi Z][ Y`Nk` ]gWk YbZÅ`Y`i`bX`[ YgY`gWk UZh`]Wk Y 6Ygcf[ b]g

Gc`Wk Y`J cfZÅ`Y`g]bX`]b` ; fc»Vf]hUbb]Yb`nk`Uf`b]Wk h`bYi`ž`g]Y`k`YfZYb`YXcWk`]a`a`Yf`k`]YXYf`Y]b`@]Wk h`Ui`ZX]Y`VYXYi`hYbXY`8YVUhhY`ØVYf`XYb`l`a`[ Ub[ `a` ]h`dchYbn]Y``[ YZÅ`f`]Wk Yb`<i`bXYb`"Hfchn`XYf [ YgYhn[ YVYf]gWk Yb`A`U»bU`a`Yb`V`Y]Vh`X]Y`Gcf[ Y`]b`XYf 6Yj`Ø`\_Yfi`b[ `ØVYf`X]Y`G]Wk Yf\`Y]h`]a`l`a`[ Ub[ `a` ]h`<i`bXYbž ]bgVYgcbXYfY`j`cb`F`UggYbž`X]Y`U`g`U[ [ fYgg]j`[ Y`hYb`"9g`]gh`\_`Ufž XUgg`fYWk h`]Wk Y`A`U»bU`a`Yb`U`Y]b`b]Wk h`Ui`gfY]Wk Ybž`i`a`X]Y DfcV`Ya`Y`ni`"ØgYb"

=a`a`Yf`k`]YXYf`g]bX`]a` `@UbX`l`bZÅ`Y`a` ]h`<i`bXYb`[ Ya`Y`XYh`k`cfXYbž`X]Y`ni`]gWk`k`YfYb`J`Yf`Yhni`b[ Yb`cXYf`gc[ Uf`ni`a`HcX`ZØ\fhYb`"8]Y`F`]hhYf`]Wk`\_Y]hj`cb`<i`bXYb`U`g`hfYi`Y`6Y[ `Y]hYf`k`]fX`c`Zi`Xi`fWk`gc`Wk`Y`hfU[ ]gWk Yb`J`cfZÅ`Y`]b` : fU[ Y`[ YghY`hž`i`bX`Yg`fi`Zh`8]g`\_i`gg]cbYb`ØVYf`X]Y`J`YfU`b`hk`cfhi`b[ `XYf`<U`hYf`\Yfj`cf`"8]Y : fU[ Yž`k`]Y`<i`bXY`f]Wk`h[ ]`hfU]b]Yfhi`bX`gcn]U`]g]Yfh`k`YfXYbž`k`]fX`]a`a`Yf`XfÅb[ YbXYf"

8 Ug`[ fØ»hY`5i`[ Yba`Yf`\_`Y]Y[ h`Yhnh`Ui`ZXYa` `GWk`]W`gU`XYf`VYhfcZYbYb` : Ua` ]]Y`"8]Y`Dc`nY]` \Uh`VYfY]hg`gdYn]U`]g]YfhY`6YUa`hY`VYUi`Zh`fU[ hž`i`a`X]Y`5b[ Y\Øf][ Yb`]b`X]YgYf`gWk`YfYb`NY]h`ni`i`bhYfghØhnYb`i`bX`ni`VYfU`hYb`"8]Y`Ya`ch]cb`U`Yb`<YfUi`gZc`fXYfi`b[ Ybž`k`Y`Wk`Y`gc`Wk`Y`J`cfZÅ`Y`a` ]h`g]Wk`Vf]b[ Ybž`g]bX`i`bj`Yf[ `Y]Wk`Wk`ž`i`bX`l`bhYfghØhni`b[ `j`cb` : UWk`Yi`hYb`\_`Ubb`ZØf`X]Y`6YhfcZYbYb`j`cb`[ fc»Yf`6YXYi`hi`b[ `gY]b"

8]Y`HfU[ ÒX]Ybž`X]Y`g]W` ]b`Ni gUa a Yb\Ub[ `a ]h`<i bXYb  
UVgd]Y`Ybž`VYXØfZYb`Y]bYf`j Yfh]YZhYb`8]g\_i gg]cb`ØVYf`H]YfgW`i hnž  
<U`hYfdZ]W`hYb`i bX`X]Y`dchYbn]Y`Yb` ; YZU\fyb`j cb`[ YZÅ\`f]W`Yb  
F UggYb``8]YgY`H\Ya Yb`k YfXYb` ]b`XYb`\_ca a YbXYb`K cW`Yb  
k U\fgW`Y]b` ]W` ]b`XYb` : cfXYfi b[ Yb`XYf`² ZZYbh`]W`\_Y]h`i bX`]b  
dc`]h]gW`Yb`8YVUhhYb`Ui ZX]Y`5[ YbXU[ YgYhnhž`i a `Å\`b`]W`Y  
J cfZÅ``Y` ]b`XYf`Ni \_i bZh`ni `j Yfa Y]XYb`"

; YgY``gW` UZh`]W` Y`J YfUbhk cfhi b[ `i bX  
H]YfgW`i hn

⇒`5bVYhfUW`h`X]YgYf`hfU[ ]gW`Yb`9fY][ b]ggY`ghY``h`g]W`X]Y  
[ fi bX`Y[ YbXY` : fU[ Yž`k ]Y`gck c`\]\fyf`J YfUbhk cfhi b[ `i Y[ YbØVYf`<Ui gh]YfYb`[ YfYW`h`k YfXYb  
\_ÒbbYb``GYbg]V`]g]Yfi b[ `i bX`5i Z\_`Åfi b[ `ØVYf`5XUdh]cbž  
9fn]Y\i b[ `i bX`DZY[ Y`j cb`<i bXYb`g]bX`]b`NY]hYb`k ]YXYf`c`hYf  
J cfZÅ``Y`i bYf`Ågg`]W` ``8Yf`GW`i hn`XYf` ; Ya Y]bgW`UZh`i bX`XUg  
K c`Yf[ Y\Yb`i bgYfYf`h]Yf]gW`Yb`6Y[ `Y]hYf`a ØggYb`<UbX`]b`<UbX  
[ Y\Ybž`i a `Y]b`g]W`YfYg`Ni gUa a Yb`VYb`a Ò[ `]W`ni `a UW`Yb`"

8]Y`DfcV`Ya Uh]\_`XYf`<i bXY\U`hi b[ `]b  
; fc» Vf]hUbb]Yb

8]Y`\Åi Z][ Yb`J cfZÅ``Y`j cb`<i bXYV]ggYb`i bX`hÒX`]W`Yb`5b[ f]ZYb  
]b` ; fc» Vf]hUbb]Yb`\UVYb`Y]bY`VfY]hYfY`8]g\_i gg]cb`ØVYf  
<i bXY\U`hi b[ `i bX`!g]W`Yf\Y]h`Ub[ Yghc» Yb`` ⇒bgVYgcbXYfY`X]Y  
F UggY`XYf`L@6i ``mk ]fX`a ]h`hYfk Y]Y`ghUf`\_`cbhfcj Yfg`X]g\_i h]Yfh`  
B UW`Y]bYf`FY]\Y`j cb`5b[ fY]ZYb`i bX`HcXYgZÅ``Yb`\Uh`X]Y`Vf]h]gW`Y  
FY[ ]Yfi b[ `A U» bU\`a Yb`Yf[ f]ZZYbž`i a `X]Y`<U`hi b[ `j cb  
VYgh]a a hYb`<i bXYfUggYb`Y]bni gW`fÅb`\_Yb``"

⇒a `š\`f`%- - %k i fXY`XYf`8Ub[ Yfci g`8c[ g`5Wh`Y]b[ YZØ\fhž`XYf`X]Y  
<U`hi b[ `VYgh]a a hYb`<i bXYfUggYb`j YfV]YhYhž`XUfi bhYf`XYf`D]h  
6i ``HYff]Yfž`XYf`šdUbYgY`HcgUž`XYf`8c[ c`5f[ Ybh]bc`i bX`XYf` : ]U  
6fUg]Y]fc``8]YgY`FY[ Y`i b[ `k Uf`Y]bY`FYU`h]cb`Ui ZghY][ YbXY  
6]ggj cfZÅ``Y`i bX`\Uh`gY]h\Yf`j ]Y`Y`8]g\_i gg]cbYb`ØVYf  
H]Yfj Yf\U`hYbž`F Ugg]ga i g]b`XYf`<i bXY\U`hi b[ `i bX`XUg`HfU]b]b[

j cb'<i bXYb'Ui g[ Y`Ogh" 8]Y`U\_hi Y`Yb'J cfZÄ`Y`nY][ Ybž'XUgg'Ui W  
a ]h'XYb'j YfgWÄfZhYb'; YgYhnYb'Y]b'6YXUfZ'Ub'k Y]hYfYb  
A U» bU\ a Yb'i bX'5i Z\_`Äfi b[ `VYghY\h"

GhUh]gh]\_Yb'ni '<i bXYV]ggYb']b  
; fc» Vf]hUbb]Yb

5\_hi Y`Y`GhUh]gh]\_Yb'nY][ Ybž'XUgg'X]Y`NU\`XYf'<i bXYV]ggj cfZÄ`Y`  
]b'; fc» Vf]hUbb]Yb'U'Ufa ]YfYbX`\cW`]gh"@Ui h'Y]bYf'l a ZFU[ Y'j cb  
8c[ '6]hY`GhUh]gh]Wg'gh]Y[ `X]Y`NU\`XYf'[ Ya Y`XYhYb'5b[ f]ZZY`]b'XYb  
`YhnhYb'`X\`fYb" "a `X\`f`&\$&&'k i fXYb'a Y\`f'U'g`&\$"\$\$\$  
<i bXYV]ggj cfZÄ`Y`VY]`XYf'Dc`nY][ Ya Y`XYhž'k cVY]j ]Y`Y`XUj cb  
? ]bXYf`VYhfUZYb" 8 ]YgY`YfgW`fYW\_YbXYb'NU\`Yb'j YfXYi h']WXYb'X]Y  
8f]b[ `]W`\_Y]h'j cb'dfÄj Ybh]j Yb'A U» bU\ a Yb'i bX  
5i Z\_`Äfi b[ gdfc[ fUa a Yb'ni f'g]WYfYb'<i bXY\U`hi b[ "

Ni XYa `nY][ Yb'Ghi X]Ybž'XUgg'Y]b[ fc» Yf'HY]`XYf'5b[ f]ZZY`Xi fW  
i bgUW[ Ya Ä» Y`9fn]Y\i b[ `i bX'gcn]U`Y`g`c`Uh]cb`XYf'H]YfY  
j Yfi fgUW`h'k ]fX" 9]b'6Yf]W`h'XYg`F GD75`fF`cmU`GcW]Yhm'Zc`f`h`Y  
DfYj Ybh]cb`cZ'7fi Y`hm'hc`5b]a U`gk`YVh`Yfj cfž'XUgg'j ]Y`Y`<i bXYž  
X]Y`U[ [ fYgg]j Yg'J Yf\U`hYb'nY][ Ybž']b']\fYf'? ]bX\Y]h'b]W`h  
Ui gfY]WXYbX'gcn]U`g]Yfh'k i fXYb" 8 ]Yg'i bhYfghfY]W`h'X]Y  
Bchk YbX][ \_Y]hž'<i bXYVYg]hnYf'ØVYf'X]Y'j YfUbhk cfhi b[ gj`c`Y  
<U`hi b[ `i bX'9fn]Y\i b[ `]\fYf'H]YfY`Ui Zni \_`ÄfYb"

8]Y`F`c`Y`XYf'5i gV]`Xi b[ `i bX'DfÄj Ybh]cb

I a `XUg`F ]g]\_c'j cb'<i bXYV]ggYb'ni 'j Yff]b[ Yfbž'gd]Y`Yb  
5i gV]`Xi b[ `i bX'gcn]U`Y`hYfU\_h]cb`Y]bY`YbhgW`Y]XYbXY`F`c`Y"  
9l dYfhYb`Ya`dZY`\Yb'<i bXYVYg]hnYfbž']\fY`H]YfY`ZfØ`nY]h][ `]b  
gcn]U`Yf'<]bg]W`h'ni `ZØfXYfb" '<i bXYgW`i`Yb'i bX'!hfU]b]b[ g`V]YhYb  
<]`ZYghY`i b[ Ybž'k ]Y`a`Ub`XUg`f]W`h][ Y`J`Yf\U`hYb`VY]`<i bXYb  
ZØfXYfhi bX'U[ [ fYgg]j Y`HYbXYbnYb`ZfØ`nY]h][ `Yf`\_Ybbh"

8]Y`i`bhYfghØhmi b[ `j cb`C`f[ Ub]gUh]cbYb'k ]Y`XYa`8c[ `Hfi`gh'i bX  
XYf`F`GD75`]gh`VYbZU`g`k ]W`h][ [ " 8]YgY`ghY`Yb`F`Yggci`fW`b'i bX  
G`W`i`i b[ gdfc[ fUa a Y`ni`f`J`YfZØ[ i b[ ž'X]Y`XUfUi`Z`UVn]Y`Ybž

<i bXYVYg]hnYf'Ui gni V]`XYb'i bX']\bYb'ni '\Y`ZYbžg]WXYf'a ]h']\fYb  
H]YfYb'i a ni [ Y\Yb" `ϕ'5bVYhfUW h'XYf'Øb[ ghYb'J cfZÀ`Y'k ]fX  
j YfghÀf\_h'XUfØVYf'bUW [ YXUW hž'cV'Y]bY'FY[ i `]Yfi b[ 'XYf  
<i bXY\U`hi b[ 'bUW 'F UggY'k ]Y'a ' : U`'XYg'L @6i `m'Ui gfY]WXYbX  
]gh'cXYf'cV'Y]b' [ Ubn\Y]h]WXYf'5bgUhn'bØh][ ' ]ghž'XYf'Ui W'X]Y  
9fn]Y\i b[ 'i bX'J YfUbhk cfhi b[ 'XYf'6Yg]hnYf'Y]bgW'Y» h''

: Øf'k Y]hYfY' ϕZcfa Uh]cbYb'ØVYf'<i bXYj Yf\U'hYb'i bX'HfU]b]b[  
\_ØbbYb'G]Y'X]Y'K YVgY]hY'XYg'FGD75 'VYgi WXYb"

8YhU]`g

6Ygi WXYb'G]Y'i bg'Ui Z.'b!U[ "XY