

I bZU``Zi W h]b @Ø\ bXY. 'NYi [Yb '[Ygi W h
bUW '6A K !? c``]g]cb

ϕ'@Ø\ bXY`_Ua `Yg'ni `Y]bYf`J Yf_Y\fgi bZU``Zi W h"Dc`nY]
GUfghYXh'gi W h'NYi [Yb'ni a `J cfZU``Ua `<Ui Yfk Y["'<]bk Y]gY
YfVYhYb°

<]XYg\Y]a ` ϕ'XYf'fi \][Yb ; Ya Y]bXY`@Ø\ bXYž'X]Y`HY]`XYf`GhUXh
<]XYg\Y]a `]ghž'[UV`Yg'nk]gW Yb`XYa `&%"5i [i gh&\$\$(ž'%, .\$\$'i \f
i bX`XYa `&&"5i [i gh&\$\$(ž'\$+.() 'i \f`Y]bYb`J cfZU``ž'XYf`VY]`XYb
9]bk c\bYfb`6Ygcf[b]g`Ui g`Ògh"9]b`i bVY`UbbhYf': U\fnYi [ZØ\YfY
j Yfi fgUW`hY`Y]bYb`J Yf_Y\fgi bZU``ž]bXYa `Yf`a]h`Y]bYa `[YdUf`hYb
6A K `'_c``X]YfhYž'i bX`YbhZYfbhY`g]W `UbgW`Y» YbXž`c\bY`g]W`i a
XYb`YbhghUbXYbYb`GW`UXYb`ni `'_Øa`a`Yfb"

8Yf`J cfZU``YfY][bYhY`g]W`]a `<Ui Yfk Y[ž'U`g`XUg': U\fnYi [`]b
F]W`hi b[`7Uf`g\U`k Y[`Z` \f"9g]gh'bcW`i b`_Ufž`k`Y`W`Y`5fh]`cb
: U\fnYi [`]b]`c`j`Yfh`k`Ufž`i`bX`YVY`b`gc`i`bVY`Ubbh]`gh`X]Y`⇒Ybh]h`h`h
XYg': U\fyfgž`XYf`bUW`X`Ya`'i`bZU``X]Y': `i`W`h`Yf[`f]Z`'8]Yg`k`]fZh
: fU[Yb`Ui`Z]bgVYgcbXYfY`]b`6Yni [`Ui`Z`X]Y`G]W`Yf\Y]h`Ui`Z`XYb
GhfU» Yb`X]YgYf': Ya`Y]bXY`"J`Yf`_Y\fgi`bZU``Zi`W`h]`gh`_Y]b`9]bnY`ZU``ž
i`bX`gc`W`Y`J`cfZ`A``Y`_ØbbYb`XUg`J`YfhfUi`Yb`XYf`6Øf[`Yf`]b`X]Y
J`Yf`_Y\fgg]W`Yf\Y]h`ØVYfgW`UhYb"

8]Y`9fa`]hh`i`b[`X`i`f`W`X`X]Y`Dc`nY]

8]Y`Dc`nY]`GUfghYXh`\Uh`X]Y`9fa`]hh`i`b[Yb`ni`X]YgYa`J`cfZU``
Ui`Z[Ybca`a`Yb`i`bX`V]hhYh`X]Y`²`ZYbh]W`_Y]h`i`a`A`h\`ZY`"NYi [Yb
cXYf`DYfgcbYbž`X]Y`ϕ`Zcfa`Uh]cbYb`ØVYf`XUg[Yg]W`hYhY': U\fnYi [
cXYf`XYb': U\fyf`\UVYbž`k`YfXYb`Ui`Z[YZcfXYfhž`g]W`i`bhYf`XYf
HY`YZcbbi`a`a`Yf`\$) \$*`*`#` ,) \$`ni`a`Y`XYb"²`ZYbh]W`Yg`ϕ`hYfYggY
k`]fX`ni`bY`a`YbX``Ui`hž`k`cVY]`5bk`c\bYf`i`bX`J`Yf`_Y\fgH]`bY`a`Yf

Y]b`j YfghÀf_hYg`6Yk i gghgY]b`ZØf`X]Y`J YfUbhk cfhi b[`]a
GhfU» Ybj Yf_Y`f`Zc fXYfb"

I bZU`Zi W`hYb`g]bX`b]W`h`bi f`fYW`h]W`d`fcV`Ya Uh]gW`ž`gcbXYfb
Ui W`a`cfU`]gW`ZFU[k ØfX]["8]Y`C`dZYf`Y]bYg`gc`W`Yb`i bZU`g
V`Y]VYb`cZiUi ZXYb`?cghYb`i bX`Y`f[Yfb]ggYb`g]hnYbž`k À`fYbX`X]Y
J Yfi fgUW`Yf`i b[YghfUZh`XUj cb_ca`a`Yb`8]Yg`i bhYfghfY]W`h`X]Y
B`chk`YbX][_Y]h`Y]bYf`[Ya`Y]bgUa`Yb`J YfUbhk cfhi b[`i bhYf`XYb
J Yf_Y`fghY]`bY`a`Yfbž`i a`gc`W`Y`J`cfZ`À`Y`ni`j`Yf`]bXYfb"

8]Y`F`Y`Yj`Ubn`j`cb`J`Yf_Y`f`gg]W`Yf`Y]h

8Yf`J`cfZU`Yf]bbYfhi`bg`XUfUž`k`jY`k`]W`h][`Yg`]ghž
j`YfUbhk`cfhi`b[`gVYk`i`ggh`ni`ZU`fYb`i`bX`Ui`ZX]Y`i`a`[`YVi`b[`ni
UW`hYb`"i`bgVYgcbXYfY`]b`K`c`b[`YV]YhYbž`k`c`j`]Y`Y`:`U`fnYi`[`Y
dUf_Ybž`a`ØggYb`:`U`fYf`VYgcbXYfg`j`cf]g]W`h][`gY]bž`i`a`GW`ÀXYb
ni`j`Yfa`Y]XYb`"9]b`_i`fnYf`A`ca`Ybh`XYf`i`bUi`Za`Yf_gUa`_Y]h`_Ubb
gW`k`Yfk`]Y[`YbXY`:`c`[`Yb`bUW`g]W`n]Y`Ybž`b]W`h`bi`f`ZØf`XUg
9][`Ybhi`a`ž`gcbXYfb`Ui`W`ZØf`XUg`J`YfhfUi`Yb`]bbYf`U`V`XYf
;`Ya`Y]bgW`UZh"

J`Yf_Y`f`gj`Yf`Yhni`b[`Ybž`k`]Y`X]YgY`i`bZU`Zi`W`hž`nY][`Yb`b]W`h`bi`f
]bX]j`]Xi`Y`Y`B`UW`Àgg][`_Y]hž`gcbXYfb`Ui`W`XUg`Xf]b[`YbXY
6YXØfZb]g`bUW`Yf`Ò`hYf`J`Yf_Y`f`gYfn]Y`i`b[`i`bX`GYbg]V`]g]Yfi`b[
ZØf`j`YfUbhk`cfhi`b[`gVYk`i`gghYg`:`U`fj`Yf`U`hYb`"i`bgYfYb`GhfU»`Yb
Z`À`fh`Y`XYf`ZØf`g]W`gY`Vghž`Xc`W`k`]f`gc`hYb`Ui`W`]a`a`Yf`X]Y
UbXYfYb`]a`5i`[`Y`VY`U`hYb`"8Yf`GhfU»`Ybj`Yf_Y`f`]gh`Y]b`6YfY]W`ž
]b`XYa`k`]f`U`Y`J`YfUbhk`cfhi`b[`hfU[`Yb``Yg`[`Y`h`b]W`h`bi`f`i`a`i`bg
gY`Vghž`gcbXYfb`Ui`W`i`a`X]Y`A`YbgW`Yb`i`a`i`bg`Yfi`a`"

8]Y`6Y`À`fXYb`g]bX`VYghfYVhž`X]Y`J`Yf_Y`f`gg]W`Yf`Y]h`ni
j`YfVYggYfb`i`bX`X]Y`6Yj`Ò`_Yfi`b[`]b`X]Y`8]g`_i`gg]cb
Y]bni`VYn]Y`Yb`"6Y]`XYf`5i`Z`Àfi`b[`ØVYf`X]Y`:`c`[`Yb`j`cb
J`Yf_Y`f`gi`bZ`À`Yb`i`bX`XYf`Ni`bU`a`Y`j`cb`J`Yf_Y`f`ghY]`bY`a`Yfbž
X]Y`]`fYb`DZ]W`hYb`b]W`h`bUW`_ca`a`Ybž`]gh`X]Y`Ni`gUa`a`YbUfVY]h
XYf`6Øf[`Yf`i`bYf`Àgg]W`"Gc`W`Y`J`cfZ`À`Y`ZØ`fYb`cZi`ni`Y]bYa
5i`Zfi`Z`Ub`X]Y`:`Ya`Y]bgW`UZhž`U`_h]j`Y`A`U»`bU`a`Yb`ni`Yf`fY]ZYb`i`bX
g]W`[`Y[`YbgY]h][`ni`i`bhYfghØ`hnYbž`i`a`X]Y`GhfU»`Yb`g]W`YfYf`ni

[YghU`hYb"

9]b`5i Zfi Z`ni f`J YfUbhk cfhi b[

8]YgYf`J cfZU``]gh`Y]b`k Y]hYfYg`6Y]gd]Y``XUZØfž`XUgg`k]f`U``Y`Y]bYb
HY]`XUni `VY]hfU[Yb`_ØbbYbž`X]Y`G]WXYf\Y]h]a`GhfU»Ybj Yf_Y\`f`ni
k U\`fYb``9g`VY[]bbh`VY]`XYf`]bX]j]Xi Y``Yb`J YfUbhk cfhi b[`Y]bYg
`YXYb` : U\`fYfgž`X]Y`J Yf_Y\`fgg]WXYf\Y]h`ni`fYgdY_h]YfYb`i bX`ni
gW`ØhnYb``8]Y`Dc`]nY]`VYbØh][h`X]Y`<]ZY`XYf`7ca`a`i`b]hmž`i`a
gc`WXY`J cfZÄ``Y`gW`bY``Ui Z`ÄfYb`ni`_ØbbYb``9g`[]hž`Ui Za`Yf_gUa
ni`gY]b`i bX`VY]`J YfXUW`h`Ui Z`_f]a`]bY``Y`<UbX`i`b[Yb
Y]bni`gW`fY]hYb"

< Äi Z][_Y]h`j`c`b`J Yf_Y\`f`gi bZÄ``Yb`i bX`XYfYb
: c`[Yb

⇒8Yi`hgW`U`bX`]gh`X]Y`J Yf_Y\`fgg]WXYf\Y]h`Y]b`nYbhfU`Yg`5b`]Y[Yb"
GhU]gh]_Yb`nY][Ybž`XUgg`]a``>U\`f`&\$&&`ØVYf`&ž)`A`]]cbYb
J Yf_Y\`f`gi bZÄ``Y`fY[]ghf]Yfh`k`i`fXYbž`XUj`cb`Yhk`U`&-`("\$\$\$`a`]h
DYfgcbYbgW`UXYb``8]YgY`NU\`Yb`j`YfXYi`h]WXYb`b]W`h`bi`f`X]Y
; YZÄ\`f`]W`_Y]h`XYg`GhfU»Ybj Yf_Y\`fgž`gc`bXYfb`Ui`W`X]Y
<YfUi`gZc`fXYfi`b[Ybž`a`]h`XYbYb`X]Y`Dc`]nY]`i`bX`X]Y`ž`gh]n
_cbZfc`bh]Yfh]g]bXž`k`Ybb`Yg`i`a``J Yf_Y\`f`gi bZU``Zi`W`hYb`[Y\`h"

9]b`VYgcbXYfYf`5gdY_hj`c`b`J Yf_Y\`f`gi bZU``Zi`W`hYb`]ghž`XUgg`X]Y
HÄhYf`c`Zhi`bYb`hXYW_h`V`Y]VYb``NU\`Yb`XYg`XYi`hgW`Yb
GhU]gh]gW`Yb`6i`bXYgUa`hYg`nY][Ybž`XUgg`X]Y`5i`Z`Äfi`b[gei`chY
VY]`gc`WXYb`J cfZÄ``Yb`j`Yf[`Y]W`gk`Y]gY`b]YXf][`]gh``8]Yg`ZØ\`fh`XUni`ž
XUgg`j`]Y`Y`; YgW`ÄX][hY`Ui`Z]\`fYb`?`cghYb`g]hnYb`V`Y]VYb`a`ØggYb"
8]Y`Xi`fW`gW`b]h]W`Yb`?`cghYb`j`cb`J Yf_Y\`f`gi bZÄ``Yb`k`YfXYb`Ui`Z
a`Y\`fYfY`hUi`gYbX`9i`fc`[YgW`Änhž`k`cVY]`X]Y`[YbUi`Yb`6YhfÄ[Y
ghUf`_j`cb`XYb`i`a`ghÄbXYb`XYg`Yk`Y]][Yb`J cfZU``g`UV\`Äb[Yb"

F YW`h`]W`Y` ; fi`bX`U[Yb`VY]

J Yf_Y\`f`gi bZU``Zi`W`h

J Yf_Y\`f`gi bZU``Zi`W`hž`Ui`W`U`g`i`bZU``Zi`W`h`VY`_Ub`bž`]gh]b

8 Yi hgWk`UbX`Y]bY`GhfUZhUh[Ya Å» `z`%(&`XYg`GhfUZ[YgYhmVi WkYg
fGh 6Ł" B UWk`X]YgYa`DUfU[fUZYb`]gh`Yg`DZ]Wk hž`bUWk`Y]bYa`i bZU`
X]Y`Dc`nY]`ni`]bZcfa`YfYb`i bXž`gcZYfb`a Ò[`]Wk ž`gY]bY`≠Ybh]hÅh
cZybni`Y[Yb`"8 Ug`J YfgÅi`a b]gž`X]Yg`ni`hi bž`_Ubb`a`]h
Ya`dZ]bX`]Wk Yb`GhfUZyb`[YU`bXYh`k YfXYbž`Y]bgWk`]Y»`]Wk
; Y`XghfUZyb`cXYf`[Uf`: fY]`Y]hgghfUZyb`]cb`V]g`ni`XfY]`≠U`fYb"

8]Y`5i`gk`]f`_i`b[Yb`Y]bYg`g]Wk`ZØ`fYbXYb`F`YWk`hgj`Yfghc»`Yg`g]bX
b]Wk`h`bi`f`fYWk`h]Wk`Yfž`gcbXYfb`Ui`Wk`[YgY`gWk`UZh]Wk`Yf`BUhi`f"
J]Y`Y`J`Yf`_Y`f`g`X`Y`]`_h`Y`g`Wk`UXYb`X`Ya`J`Y`fhf`Ui`Yb`nk`]g`Wk`Yb
J`Yf`_Y`f`ghY`]`b`Y`a`Yfb`i`b`X`X`Yf`5`"[Ya`Y]b`Y]h`"GhYi`Yfn`U`Y`f
a`ØggYb`c`Zi`X]Y`?`c`ghYb`ZØf`XYb`Yf`Ø`h`Yb`Dc`]nY]Y]bgUhn`i`b`X`X]Y
≠`gh]n`c`ghYb`hfU[Ybž`X]Y`gc`Wk`Y`J`cfZÅ`Y`b`UWk`g]Wk`n]Y`Y`b"

J`Yf`U`h`Yb`X`Yf`²`ZZYb`h`]Wk`_Y]h`i`b`X Df`Åj`Yb`h]c`b`g`a`U»`b`U`a`Y`b

8]Y`GYbg]V`]g]Yfi`b[`]XYf`²`ZZYb`h`]Wk`_Y]h`ZØf`X`Ug`H`Y`a`U
J`Yf`_Y`f`gi`b`ZU`Zi`Wk`h`U`h]b`X`Yb`Y`hnhYb`≠U`fYb`ni`[Yb`c`a`a`Yb"
Dc`]nY]`_Ua`dU[`b`Yb`i`b`X`≠Zcfa`Uh]c`bgj`Yf`Ub`gh`U`hi`b[Yb`gc`Yb
A`c`hc`ff`UX`ZU`fYfbž`5i`hc`ZU`fYfb`i`b`X`:`i`»`[`Åb[Yfb`[`]Y]Wk`Y
5i`Za`Yf`_g`Ua`_Y]h`VY]a`: U`fYb`i`b`X`DUf`_Yb`b`Å`Y`f`Vf]b[Yb`"J]Y`Y
Gh`Å`X`h`Y`U`V`Yb`ni`g`Å`h`]Wk`A`U»`b`U`a`Yb`ni`f`J`Y`f`V`Y`gg`Y`fi`b[`]XYf
,`VYfk`UWk`i`b[`]i`b`X`8`c`_i`a`Yb`h`Uh]c`b`]cb`i`b`ZÅ`Yb`Yf[`f]ZZYbž`Y`hk`U
Xi`f`Wk`X`Yb`9]bgUhn`]cb`,`VYfk`UWk`i`b[`g`_Ua`Yf`Ug`]b`VY`g`cb`XY`fg
_f]h]g`Wk`Yb`6`Y`f`Y]Wk`Yb"

Ni`X`Ya`[`]V`h`Y`g`6`Y`gh`f`Y`Vi`b[Ybž`X]Y`6`Øf[Yf`Ui`Zni`Zc`f`X`Y`fbž`VY]
J`Y`f`X`U`Wk`h`Ui`Z`Y]b`Yb`i`b`ZU`c`X`Y`f`Y]b`Y`f`n`Yi`[Yb`g`Wk`U`Zi]Wk`Yb
G]hi`Uh]c`b`U`_h]j`ni`k`Y`f`X`Y`bž`]b`X`Y`a`g]Y`V`Y]gd]Y`g`k`Y]g`Y`6`Y`k`Y]g`Y`]b
:`c`f`a`j`cb`:`c`hc`g`g`Ua`a`Y`b`c`X`Y`f`?`Y`b`b`n`Y]Wk`Yb`b`c`h]Y`f`Y`b`"Gc`Wk`Y
A`U»`b`U`a`Yb`_`Ø`b`Yb`ni`f`gd`Å`h`Y`f`Yb`≠Y`b`h]Z]n]Y`fi`b[`]Z`Ø`Wk`h][`Y`f
: U`f`Y`f`V`Y]h`f`U[Yb`i`b`X`gc`X]Y`U`[Ya`Y]b`Y`J`Y`f`_Y`f`gg]Wk`Y`f`Y]h
ghY][`Y`fb"

Ni`f`k`Y]h`Y`f`Yb`: Òf`X`Y`fi`b[`]X`Y`f`J`Y`f`_Y`f`gg]Wk`Y`f`Y]h`k`Y`f`X`Y`b`Ui`Wk
8]g`_i`gg]c`b`Yb`Ø`V`Y`f`a`c`X`Y`fb`Y`f`Y`H`Y`Wk`b`c`c[`]Y`b`k`]Y`8`U`g`W`U`a`g`i`b`X
a`c`V]Y`5`d`d`g[`]Y`Z`Ø`f`h`ž`X]Y`U`g`<`]Z`ga`]h`h`Y`Z`Ø`f`X]Y`8`c`_i`a`Y`b`h`Uh]c`b

j cb' l bZÄ`Yb'X]YbYb'_ÖbbhYb" Gc`WXY`æbcj Uh]cbYb'_ÖbbhYb
`Y`ZYbž'X]Y'5i Z_`Äfi b[gei chY'VY]'J Yf_Y`fgi bZU`Zi W`hYb
g][b]Z]_Ubh'ni `Yf\Ö\Yb'i bX'X]Y'G]W`Yf\Y]h'U`Yf
J Yf_Y`fghY]`bY\`a Yf'ni `ghÄf_Yb"

8 YhU]`g

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