

9GJ @c_'DchgXUa . '? Ua dZi a 'XUg Gdcfh[Y`ÀbXY'i bX'()!A]``]cbYb!8]`Ya a U

8Yf'9GJ'@c_'DchgXUa 'ghY\h'j cf'Y]bYf'YI]ghYbn]Y``Yb
<YfUi gZcfXYfi b['i a 'XYb'9f\U`h'gY]bYg'Gdcfh[Y`ÀbXYg'Ub
XYf'<Uj Y`"'9]b'U_hi Y``Yg'; i hUW\hYb'XYg
6i bXYgfYW\bi b[g\cZg'\Uh'XYb'GhfY]h'ØVYf'XUg'' \$"\$\$\$
Ei UXfUha YhYf'[fc»Y'; fi bXghØW_'YbhZ'Ua a hž'XYggYb'K Yfh
Ui Z'YfghUi b`]W\Y'()'A]``]cbYb'9i fc'[YgW\Ahnh'k]fX"'8]YgY
G]hi Uh]cb'\Uh'b]W\h'bi f'XYb'JYfY]bž'gcbXYfb'Ui W\'X]Y'`c_U'Y
Dc`]h]_'U`Ufa]Yfh"'8Ug'

8 Yf '9GJ '@c_'DchgXUa 'ghY\h'j cf'Y]bYf'YI]ghYbn]Y``Yb < YfUi gZcfXYfi b['i a 'XYb'9f\U`h'gY]bYg'Gdcfh[Y`ÀbXYg'Ub'XYf < Uj Y`"'9]b'U_hi Y``Yg'; i hUW\hYb'XYg'6i bXYgfYW\bi b[g\cZg'\Uh XYb'GhfY]h'ØVYf'XUg'' \$"\$\$\$ 'E i UXfUha YhYf'[fc > Y'; fi bXghØW_YbhZUa a hž'XYggYb'K Yfh'Ui Z'YfghUi b`]W\Y'() 'A]``]cbYb'9i fc [YgW\Ahnh'k]fX"'8]YgY'G]hi Uh]cb'\Uh'b]W\h'bi f'XYb'JYfY]bž gcbXYfb'Ui W\X]Y'`c_U`Y'Dc`]h]_'U`Ufa]Yfh"

8 UgʻGdcfh[Y`ÀbXYʻXYgʻ9GJʻ@c_']ghʻY]bYʻ[fØbYʻCUgYʻ]aʻ<YfnYbjcbʻDchgXUažbifkYb][YʻGWkf]hhYʻjcbʻXYfʻ\]ghcf]gWkYb; `]Yb]W_Yfʻ6fØW_YʻYbhZYfbh''<]YfʻhfU]b]YfYbʻibXʻgd]Y`YbʻnU\`fY]WkY?]W_YfʻUigʻjYfgWk]YXYbYbʻ5`hYfg[fiddYb''8cWkʻX]Yʻ<Y]aUhʻXYg7iVgʻ]ghʻb]Wkhʻ]aʻ6Yg]hnʻXYgʻJYfY]bgʻgY`VghžgcbXYfbʻk]fXʻjcbXYfʻ6ibXYgVY\ÒfXYʻ6ibXYgY]gYbVU\bjYfaÒ[YbʻjYfkU`hYh''8]YgY6Y\ÒfXYžYbhghUbXYbʻUigʻXYfʻ6U\bfYZcfaʻjcbʻ%--'ž\UhʻX]YJYfUbhkcfhib[ʻZØfʻX]Yʻb]WkhʻVYhf]YV`]WkʻbchkYbX][Yb@]Y[YbgWkUZhYbʻXYfʻ8YihgWkYbʻ6U\b"`@UihʻXYaʻJYfY]bʻk]fXʻY]bYX]fY_hYʻ?caaib]_Uh]cbʻØVYfʻXYbʻJYf_UiZʻXYgʻ;Y`ÀbXYgʻVYfY]hggY]hʻJ\fYbjYfkY][Yfh"

8 Yf GhY]b XYg 5 bghc » Yg

9]b 'Vf]gUbhYf'Di b_h']gh'XYf'9fVVUi fYWkhgj YfhfU[ž'XYf'%--UV[YgWk `cggYb 'k i fXY"'8 Uf]b ']gh'ZYgh[Y`Y[hž'XUgg'XYf'J YfY]b 'XUg
; Y`ÀbXY']bbYf\U`V'j cb '&) '\\J\fYb'_Ui ZYb'gc``hYž'Y]bY': f]ghž'X]Y
bi b 'UV[Y`Ui ZYb']gh''6Y]'Y]bYa 'i bhYf'I a ghÀbXYb'UbghY\YbXYb
J Yf_Ui Z'Ub'8f]hhY'a ØgghY'XYf'7`i V'gY]b'\\J ygh]h]cbgUb[YVch'Ui g
XYa 'J YfY]bg\Y]a ']b'<Ò\Y'j cb'' \\Z\XA]``]cbYb'8A 'a]hgUa h'XYf
Gdcfh]bZfUghfi _hi f'UVhfYhYb"'8]YgY'6YX]b[i b[Yb'ZØ\fYb'XUni \\Z\XUgg'XYf'9GJ'@c_'g]Wk']b'Y]bYf'ZfU[k ØfX][Yb'i bX'f]g_UbhYb'@U[Y
VYZ|bXYh''

8 Yf``YhnhY`5b`Ui Z`ni f`? Ui ZUbZfU[Y`k Uf`]b`&\$%, "`8]YgY 6Ya Ø\i b[Yb`\UVYb`g]W\`V]g\Yf`U`g`Zfi W\h`cg`Yfk]YgYbž'k Ug`X]Y %"`J cfg]hnYbXY`\$Øf[Yb`<Udd]W\`U`g`U`Ufa]YfYbX`VYgW\fY]Vh.` 8 Ug 69J`]gh`b]W\h`[Yk]``hž`]f[YbXYhk Ug`]a `G]bbY`XYg`Gdcfhg`ni ``ÒgYb" 9]b`JYf_Ui Z'ØVYf`Y]bYb`6]YhYfj YfZU\fYb`_ÒbbhY``Y]W\h`XUni ZØ\fYbž`XUgg`XUg`; Y`ÀbXY`b]W\h`a Y\f`ZØf`X]Y`JYfY]bgbi hni b[`ni f JYfZØ[i b[`ghY\hž'j]Y`a Y\f`ZØf`_ca a Yfn]Y``Y`Nk YW_Y Ui g[YgW\f]YVYb`k YfXYb`_ÒbbhY"

I a 'XYb'K Yfh'XYg'; fi bXghØW_g'ZYghni ghY``Ybž'[UV'Yg'X]j YfgY; i hUW\hYbž'X]Y'V]g`Ub['YXcW\'b]W\h'X]Y'8]a Ybg]cbYb'Y]bYg
()!A]``]cbYb!9i fc!K Yfhg'YffY]W\Yb'_cbbhYb"'8]YgY'GW\Ahni b[
Xi fW\'XYb'6i bXYgfYW\bi b[g\cZ_Ua 'ØVYffUgW\YbX'i bX'k ØfXY
XUg'Gdcfh[Y`AbXY'U`g'6Ui `UbX'_`Ugg]Z]n]YfYbž'k Ug'XYa
i fgdfØb[`]W\Yb'6YVUi i b[gd`Ub'k]XYfgdf]W\h"'\#b'XYb
j cf\Yf[Y\YbXYb'; i hUW\hYb'k i fXY'XYf'K Yfh'ghYhg']b'Y]bYa
6YfY]W\'ZYgh[Y`Y[hž'XYf'i bhYf'+'A]``]cbYb'9i fc'V`]YV"

$9]bV^{Y}ibX^{Z}$

8 Yf'K Y[Y'XYg'6i bXYgfYW\bi b[g\cZg'g]bX'Ub[Yg]W\hg'XYg'bYi Yb; i hUW\hYbg'ZfU[k ØfX][ž'XUg'XYa 'JYfY]b'XUg'; YZØ\`'[]Vhž i b[Y\Ofh'[YV`]YVYb'ni 'gY]b"'< Udd]W\']gh'XYf'A Y]bi b[ž'XUgg'_Y]b A]hUfVY]hYf'XYg'FYW\bi b[g\cZg'Ya U'g'XUg'; Y`\AbXY'[YgY\Yb'\Uh i bX'XUa]h'_Y]bY'ei U`]Z]n]YfhY'6Yk Yfhi b['j cf[Ybca a Yb'k YfXYb _Ubb"'8 UXi fW\'V`Y]Vh'i b_`Ufž']bk]Yk Y]h'X]Y'6Y\OfXY'a]h'GUW\! i bX'Cfhg_Ybbhb]g'X]Y'K]fhgW\UZh`]W_Y]h'XYg'; fi bXghØW_g VYi fhY]`Yb'_cbbhY"

8]Y ÒZZY bh`]WX Y `Dc`]h]_ '\ Uh'g]WX `YXcWX `YVYbZU``g`Y]b[YgWX U`hYh'' 6Øf[Yfa Y]ghYf'6i f_\ UfX `9I bYf'VYhcbhž'XUgg`Yg`i a `a Y\f'[Y\Y U`g`i a `X]Y '\bhYfYggYb `XYg`9GJ `@c_/'Ui WX `X]Y '[YgUa hY '6Yf`]bYf J cfghUXh`]gh`VYhfc ZZYbž'XU 'Yg`_Ui a `j Yf[`Y]WX VUfY 'GdcfhUb`U[Yb []Vh'' 8 Ug`@UbX'j Yfgi WXh`XUfi a `VYghÀbX][ž'XUg'; fi bXghØW_ `ni Yfk YfVYb i bX`XUa]h`XYa `J YfY]b 'Y]bY `Ni _i bZh`ni `g]WXYfb'' 8]Y GhUXh`DchgXUa `nY][h`g]WX `cZZYb `ZØf'; YgdfÀWX Yž'ghÒ» h`YXcWX `Ub X]Y ; fYbnYb `XYg`6]YhYfj YfZU\fYbgž'XUg'j ca `69J `Ub[YghfYVh`k]fX"

$$\label{thm:converse} \begin{split} &\text{Hfchn:} X] Y g Y f K \] X f] [\ _Y] h Y b `V`Y] V h `X] Y `I \ b h Y f g h Ø h n i \ b [\ `Z Ø f `X Y b `J Y f Y] b \\ &g h U f _ "`9] b Y `C b`] b Y ! D Y h] h] c b `\ U h ` Ø V Y f `%$ "$$$ `I \ b h Y f g W X f] Z h Y b \\ &[\ Y g U a \ a \ Y`h z i \ b X `d f c a \] b Y b h Y `I \ b h Y f g h Ø h n Y f `U i g `X Y f `D c`] h] _ i g Y h n Y b \\ &g] W X Z Ø f `Y] b Y `@ O g i \ b [`] a `G] b b Y `X Y g `J Y f Y] b g `Y] b "`6 f U b X Y b V i f [g A] b] g h Y f d f A g] X Y b h `8] Y h a U f `K \ c] X _ Y `\ U h `X Y b \\ &6 i \ b X Y g j Y f _ Y \ f g a] b] g h Y f `i \ a `&b h Y f j Y b h] c b `[Y V Y h Y b z i \ a `n i `_`A f Y b z k] Y `X Y f `G d c f h j Y f Y] b `] b `g Y] b Y f `H f U X] h] c b `V Y k U \ f h `k Y f X Y b `_U b b "`6] g $9 b X Y `&$ &) `k] f X `Y b h g W &] Y X Y b z `c V `X Y f `9 G J `@ _ `b U W `&) `&) `&J \ f Y b g Y] b Y `< Y] a U h 'j Y f `U g g Y b `a i g g z `k U g `Z Ø f `X] Y `A] h [``] Y X Y f `Y] b Y g W k Y f Y z `U V Y f `b c h k Y b X] [Y `< Y f U i g Z c f X Y f i b [`X U f g h Y ``Y b `_O b b h Y "$ $$$$

8 UgʻGW\]W_gU``XYgʻ9GJʻ@c_'DchgXUa ʻghY\hʻgca]hʻUi ZʻXYfʻ?]ddY" 8 YfʻXfUa Uh]gW\Yʻ5bgh]Y[ʻXYgʻ; fi bXghØW_gk Yfhgʻi bXʻXUg i b[Yk]ggYʻJYf\UbX`i b[g[YgW\]W_``UggYbʻb]W\hʻbi fʻXUg JYfY]bg`YVYbʻUi ZʻXYfʻ?]ddYʻghY\YbžʻgcbXYfbʻVf]b[YbʻUi W\`X]Y [YgUa hYʻGdcfh_i `hi fʻ]bʻXYfʻFY[]cbʻi bhYfʻ8fi W_"

8 YhU]`a

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