

CVYf[fYbnVUWX.'Jcfg]WXh'VY]a Hf]b_k UggYf' '5V_cWXYb'Ya dZc\`Yb'

8]Y; Ya Y]bXY:: f]Y`YbXcfZ'Ya dZ]Y\`hž'@Y]hi b[gk UggYf']b CVYf[fYbnVUW\`UVni _cW\Ybž'XU'Yg'[YW\`cfh'i bX'Xi fW\ 6Ui UfVY]hYb'j Yfi bfY]b][h'k i fXY"

a ']Xm``]gWXYb'CVYf[fYbnVUWXžY]bYa 'CfhghY]`'j cb': f]Y`YbXcfZž gcf[hY]bY'U_hi Y``Y'K Ufbi b['XYf'; Ya Y]bXYj Yfk U`hi b['ZØf 5i ZgY\Yb"5a 'A cbhU[a]hhU['k i fXY'j]U'gcn]U'Y'A YX]Yb VY_Ubbh[Y[YVYbž'XUgg'X]Y'5bk c\bYf']\f'Hf]b_k UggYf'j cf'XYa; Ybi gg'UV_cWXYb'gc``hYb"'8Yf'; fi bX'`]Y[h']b'Y]bYf JYfgWXa i hni b['XYg'K UggYfgž'X]Y']a 'Ni [Y'j cb'6Ui UfVY]hYb'Ub XYf'K UggYf'Y]hi b['Ui Z[YhfYhYb']gh"'8]YgY'A U» bU\a Y'VYhf]ZZh'X]Y [YgUa hY'; Ya Y]bXY'i bX'gcf[h'ZØf'6Ygcf[b]g'i bhYf'XYb 9]bk c\bYfb"

8]Y'GUb]Yfi b[gUfVY]hYbž'X]Y'ni f'GhÒfi b['XYg'K UggYfZi ggYg
ZØ\fhYbž'g]bX'b]W\hi b[Yk Ò\b`]W\ž'YXcW'k Uf'X]Y'6YgW\UZī b[
j cb'Zf]gW\Ya ž'i bVYfØ\fhYa 'K UggYf'b]W\h'Ui gfY]W\YbX
g]W\Yf[YghY``h"'8]Y'ni ghÀbX][Yb'6Y\ÒfXYb'\UVYb'gW\bY```fYU[]Yfhž
i a '; Ygi bX\Y]hgf]g]_Yb'ZØf'X]Y'6Øf[Yf'ni 'a]b]a]YfYb"'8]YgY
dfcU_h]j Y'<YfUb[Y\Ybgk Y]gY']gh'Y]b'hmd]gW\Yg'6Y]gd]Y``ZØf
?f]gYba UbU[Ya Ybh'Ui Z'_ca a i bU`Yf'9VYbY"

GhUbX XYf K UggYfei U`]hÀh

8 UgʻK UggYfʻ]bʻC VYf[fYbnVUW\ k]fX'ni gÀhn`]W\ a]h'7\`cf VY\UbXY`hž'i a 'X]YʻE i U`]hÀhʻgW\bY``gha Ò[`]W\ ni ʻghUV]`]g]YfYb" 8 UVY]`\UbXY`hʻYgʻg]W\ ``Ui hʻXYfʻ; Ya Y]bXYj Yfk U`hi b[i a 'Y]bY 7\`cf_cbnYbhfUh]cbʻj cbʻa UI]a U``\$ž 'A]``][fUa a 'dfcʻ@]hYf"`8]YgY A U» bU\a Yʻ]ghʻ]bʻXYfʻHf]b_k UggYfj Yfgcf[i b[ˈØV`]W\ i bX'V`Y]Vh]bbYf\U`V`XYf'[YgYhn`]W\`ZYgh[Y`Y[hYb'; fYbnk YfhYž'k UgʻZØf'j]Y`Y 6Øf[Yf'Y]bY'[Yk]ggY'6Yfi\][ib['XUfghY``h"

8]Y'A]hhY]`i b['XYf'; Ya Y]bXY'_ca a h'U`gc'b]W\h'Ui g'\Y]hYfYa <]a a Y`ž'gcbXYfb'U`g'HY]`'Y]bYg'[i h'cfW\Yghf]YfhYb'BchZU``d`Ubg" CV['Y]W\'X]Y'G]hi Uh]cb'Ub[YgdUbbh'V`Y]Vhž'\UVYb'X]Y'5bk c\bYf X]Y'A Ò[`]W_Y]hž'g]W\'Xi fW\'5V_cW\Yb'XYg'K UggYfg'XYb dchYbn]Y``Yb'; YZU\fYb'ni 'Ybhn]Y\Yb"'8UXi fW\'k]fX'[Yk À\f`Y]ghYhž XUgg'X]Y'Hf]b_k UggYfj Yfgcf[i b['k Y]hYf\]b'g]W\Yf'V`Y]Vhž'V]g'X]Y Ghfi _hi fYb'j c``ghÀbX]['[Yg]W\Yfh'g]bX"

8]Y'U``[YaY]bY'FYU_h]cb'XYf'6Øf[Yf'UiZ'X]Y'K Ufbib[']gh
[Ya]gWkhž'Y]b][Y'g]bX'VYgcf[hž'UbXYfY'gWkAhnYb'X]Y'gWkbY``Y
?caaib]_Uh]cb'XYf'JYfk U`hib["'9]bY'XYf'<YfUigZcfXYfib[Yb']b
gc`WkYb'G]hiUh]cbYb']gh'X]Y'; Yk A\f`Y]ghib['Y]bYg'_`UfYb
&ZcfaUh]cbgZiggYgžia'; YfØWkhY'ibX'A]ggjYfghAbXb]ggY'ni
jYfaY]XYb"'8]Y'gcn]U`Yb'AYX]Yb'gd]Y`Yb'\]YfVY]'Y]bY'kYgYbh`]WkY
Fc``Yž'XU'g]Y'Yg'XYf'JYfkU`hib['YfaO[`]WkYbž']b'9WkhnY]h'a]h'XYf
6YjO`_Yfib['ni'_caaib]n]YfYb"'

; $Ygi bX Yhi bX GWYfYhXYf 6\emptysetf[Yf$

8]Y; Ygi bX\Y]h;XYf;6Yj O`_Yfi b[']b;CVYf[fYbnVUW; \Uh;\OW,ghYDf]cf]hÀh;8]Y;_`UfYb;F]W;h`]b]Yb;ni f;5V_cW;i b['XYg;K UggYfg;i bX X]Y;A U» bU\a Yb;ni f;7\`cf;XYg]bZY_h]cb;nY][Ybž;XUgg;X]Y; Ya Y]bXY;dfcU_h]j Y;GW;f]hhY;i bhYfb]a a hž;i a 'Y[`]W;Y;F]g]_Yb;ni a]b]a]YfYb;8]Y;6Øf[Yf;k YfXYb;[YVYhYbž;g]W;Ub;X]Y Ya dZc\`YbYb;F]W;h`]b]Yb;ni '\U`hYbž;i a 'g]W;Yfni ghY;`Ybž;XUgg

dchYbn]Y``Y`[Ygi bX\Y]h`]W\Y`<YfUi gZcfXYfi b[Yb`UV[Yk Y\fh
k YfXYb"</pre>

8 UgʻH\Ya UʻG]W\Yf\Y]hʻ]a ʻ6YfY]W\ʻXYfʻHf]b_k UggYfj Yfgcf[ib[ʻ]gh b]W\hini ʻi bhYfgW\ÀhnYbʻi bXʻYfZcfXYfhʻX]YʻghÀbX][Y
5 i Za Yf_gUa _Y]hʻXYfʻ6Y\ÒfXYb"ʻ8]Yʻ9]b\Uʻhi b[ʻj cbʻ; fYbnk YfhYb
ZØfʻ7\`cfʻ]ghʻY]bʻVYk À\fhYfʻDfcnYggžʻXYfʻ]bʻj]Y`Ybʻ; Ya Y]bXYb
Xi fW\[YZØ\fh`k]fXžʻi a ʻX]YʻK UggYfei U`]hÀh'ni ʻ_cbhfc``]YfYb"ʻ8]YgY
9f_Ybbhb]ggYʻgW\UZZYbʻJ YfhfUi YbžʻUi W\`k YbbʻX]YʻU_hi Y``Y
G]hi Uh]cbʻZØfʻj]Y`YʻY]bYʻI bUbbY\a `]W_Y]hʻXUfghY``h"

@Yhnh`]WX 'nY][h'XYf'I a [Ub['a]h'XYf'G]hi Uh]cb']b'CVYf[fYbnVUWXž XUgg'VY]'GWXk]Yf][_Y]hYb'Xi fWX '6Ui UfVY]hYb'Y]b'gWXbY``Yg'i bX]bZcfa Uh]j Yg'<UbXY`b'XYf'; Ya Y]bXY'YbhgWXY]XYbX']gh"'8]Y 5bk c\bYf'_ObbYb'g]WX'Ui Z'ZÀ\][Y'A]hUfVY]hYf'XYf ; Ya Y]bXYj Yfk U`hi b['j Yf`UggYbž'X]Y'g]WX'i a ']\fY'G]WXYf\Y]h _Øa a Yfb'i bX'VYgcf[h'g]bX"'8]YgY'5fh'j cb'9b[U[Ya Ybh']gh'`Y]XYf b]WXh']a a Yf'gY`Vghj YfghÀbX`]WXž'UVYf']b'CVYf[fYbnVUWX']gh'g]Y Yhnh'Ui Z'Y]bXfi W_gj c``Y'K Y]gY'XYa cbghf]Yfh'k cfXYb"

8]Y ?? cbhUa]bUh]cb j cb Hf]b_k UggYf]gh Y]b Yfbgh Yg 5b]Y [Yb ž X Ug]b j]Y Yb ; Ya Y]b X Yb 'Ui Z X Yf [Ubn Yb 'K Y h j cf_ca a Yb '_Ubb" Hmd]g W Yfk Y]g Y g]b X '6 Ui Uf V Y]h Yb 'Ub 'K UggYf Y]hi b [Yb 'Y]b \Ai Z][Yf '5 i g `OgYf 'ZØf 'gc `W Y 'J cf ZA` `Y ž X U 'G W a i hn 'c X Yf 'Ub X Yf Y J Yfi b f Y]b][i b [Yb ']b 'X Ug 'G mgh Ya '[Y `Ub [Yb '_Obb Yb " +b C V Yf [f Ybn Y V U W X 'ZØ \ f Yb 'X]Y 'U_hi Y `Yb '5 f V Y]h Yb 'X Uni ž X Ugg 'X]Y ; Ya Y]b X Yj Yfk U`hi b ['j cf g cf [`] W 'ni 'V Yg cb X Yf Yb 'A U >> b U \a Yb Ui Zfi Zh " 'Gc `W Y 'J cf ZA` `Y 'g]b X 'b] W h b i f ``c _U `'j cb '6 Y X Yi hi b [ž g cb X Yfb 'k Yf Z Yb 'Ui W ': f U [Yb 'ni 'X Y b 'U` [Ya Y]b Yb 'Gh Ub X Uf X g `X Yf K Ugg Yf ei U`]h Ah i b X `X Yf '+b Zf Ugh fi _hi f `Ui Z''

Hf]b_k UggYfj Yfgcf[ib[]b 8 Yi hgW `UbX

±b '8 Yi hgWk `Ub X 'i bhY f`]Y[h'X]Y 'Hf]b_k UggYfj Yfgcf[i b['ghfYb[Yb [YgYhn`]Wk Yb 'F Y[Y`i b[Yb"'8]Y 'E i U`]hÀh'XYg'Hf]b_k UggYfg'k]fX Xi fWk 'X]Y 'Hf]b_k UggYfj YfcfXbi b['fHf]b_k J Ł'[YfY[Y`hž'X]Y g]Wk YfghY``hž'XUgg'XUg'K UggYf'X]Y '[Ygi bX\Y]h`]Wk Yb 5b ZcfXYfi b[Yb 'YfZØ``h"'8]YgY 'J YfcfXbi b['`Y[h'gdYn]Z]gWk Y

; fYbnk YfhY ZØf'j YfgW\]YXYbY'Gi VghUbnYb'ZYghž'Y]bgW\`]Y»`]W\ 7\`cfž'i a 'X]Y'ÒZZYbh`]W\Y'; Ygi bX\Y]h'ni 'gW\ØhnYb"

8 Ug'; Ygi bX\Y]hgUa h'XYg'GWk U'a !9XYf!?fY]gYg'\Uh
a Ò[`]WXYfk Y]gY'A U» bU\a Yb'ni f'?cbhfc``Y'XYf'K UggYfei U`]hÀh
Yf[f]ZZYbž'i a 'g]WXYfni ghY``Ybž'XUgg'X]Y'K YfhY']bbYf\U`V'XYf
ni `Àgg][Yb'; fYbnYb'`]Y[Yb"'@Ui h'XYf'Hf]b_k UggYfj YfcfXbi b[
XØfZYb'a Ul]a U``\$ž' A]``][fUa a '7\`cf'dfc'@]hYf']a 'Hf]b_k UggYf
Ybh\U`hYb'gY]bž'k Ug']b'X]YgYa : U```Ubk YbXVUf']gh"

FYU_h]cbYb'XYf'6Yj O`_Yfi b['i bX =bZcfa Uh]cbgk Y]hYf[UVY

 $8]Y FYU_h]cb XYf 6Yj \ O`_Yfi b[`Ui ZX]Y K Ufbi b[žXUg K UggYf UVni _cW_Ybž_Ubb i bhYfgW_]YX`]W gY]b "K Å\fYbX Y]b][Y 6Øf[Yf VYgcf[h'g]bX'i bX'X]Y <math>\Rightarrow$ Zcfa Uh]cbg_Ua dU[bYb XYf'; Ya Y]bXY gW_AhnYbž_ObbhYb UbXYfY g_Ydh]gW [Y[YbØVYf XYb A U» bU\a Yb gY]b" 8]Y F c``Y XYf gcn]U`Yb A YX]Yb]b XYf J YfVfY]hi b['gc`W_Yf \Rightarrow Zcfa Uh]cbYb ']ghYbhgW_Y]XYbXž XU g]Y 'Yg Yfa O[`]W_Ybž gW_bY`` i bX 'YZZ]n]YbhY]bY [fc» Y 5bnU\`j cb'A YbgW_Yb'ni 'YffY]W_Yb"

8]Y'; Ya Y]bXYj Yfk U`hi b['\Uhig]W\'VYa Ø\hž'hfUbgdUfYbh'ni_ca a i b]n]YfYbž']bXYa 'g]Y'fY[Y`a À»]['I dXUhYg'ni f'G]hi Uh]cb VYfY]hghY``h''8]Yg']gh'k]W\h][ž'i a 'XUg'J YfhfUi Yb'XYf'6Yk c\bYf'ni [Yk]bbYb'i bX']\bYb'X]Y'A Ò[`]W_Y]h'ni '[YVYbž']bZcfa]YfhY 9bhgW\Y]Xi b[Yb'ØVYf']\fY'; Ygi bX\Y]h'ni 'hfYZYb''

< Ài Z][Y I fgUWX Y b ZØf K UggYf_cbhUa]bUh]cb

- 6Ui UfVY]hYb Ub K UggYf`Y]hi b[Yb
- GWAXYb'Ub'K UggYffc\fYb
- \bullet lakY`hZU_hcfYb`k]Y`, VYfgWkYaaib[Yb
- JYfU`hYhY' = 2fUghfi _hi f
- I bni fY]WXYbXY'K Ufhi b['XYf'K UggYfj Yfgcf[i b[ggmghYa Y

Ni _ØbZh][']gh'Yg'ZØf'; Ya Y]bXYb'k]Y': f]Y`YbXcfZ'YbhgW\Y]XYbXž b]W\h'bi f'U_i hY'DfcV`Ya Y'ni 'VY\YVYbž'gcbXYfb'Ui W\'dfÀj Ybh]j Y A U» bU\a Yb i bX fY[Y`a À»][Y DfØZ b[Yb ni ']a d`Ya Ybh]YfYbži a X]Y 'K UggYfj Yfgcf[i b['bUW\ 'a cXYfbghYb 'GhUbXUfXg g]W\Yfni ghY``Yb"' = 5 bVYhfUW\ h'XYf' < YfUi gZcfXYfi b[Ybž'X]Y 'Xi fW\XYb'?`]a Uk UbXY``i bX X]Y 'Ni bU\a Y 'YI hfYa Yf'K YhhYfYfY][b]ggY YbhghY\Ybž'[Yk]bbYb'X]YgY 'A U» bU\a Yb'Ub'8f]b[`]W_Y]h"

8 Y hU]`c

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z. 'X]Y!bUWX f]WX hYb "b Yh