

K UbXYfb ni a 'K UggYfZU``'A UY 'MYbž'DU]' H\U]`UbX

8 Yf A UY MY b!K UggYfZU```]gh'Y]b Yd]gWXYf
8 gWX i b[Y`k UggYfZU```]b XYf B À\Y XYf Zf]YX`]WXYb 6Yf[ghUXh
DU]']b H\U]`UbX" K Ybb G]Y 'Ui Z'XYf Gi WXY bUWX 'Yd]gWXYb
HU[YgUi gZi [gUVYbhYi Yfb cXYf _i fnYb ii bUV\Àb[][Yb
K UbXYfi b[Yb']b DU] g]bXž XUbb]gh'XYf K UggYfZU```A UY MYb
j]Y``Y]WX h [YbUi XUg F]WX h][Y ZØf G]Y * 8 Yf K Y[ini a
K UggYfZU```]ghY]b 5 VYb hYi Yf ZØf g]WX "C Vk c\``X]Y
K UbXYfi b[in]Ya `]WX Y]bZUWX]ghž XUi Yfh g]Y a]bXYghYbg
nk Y] Ghi bXYb ZØf Y]bY GhfY W_Y " 5 i Z'XYa K Y['d Ugg]YfYb G]Y
6 UbUbYbd`UbhU[Ybž 8 gWX i b[Y`Zi gggmghYa Y ii bX
i b[`Ui V`]WXY @UbXgWX UZhYb]a 'B cfXYb 'H\U]`UbXg" K]Y
_ca a ha Ub ini a 'A UY MYb 'K UggYfZU``3'8 Yf VYghY 'K Y[ži a
ni a 'K UggYfZU``A UY MYb 'ni '[Y`Ub[Ybž']ghž Y]b 'A chcffUX]b
/ Ua d\Y``]d/

8 Yf'A UY'MYb!K UggYfZU``']gh'Y]b'Yd]gWXYf'8 gWXi b[Y`k UggYfZU``']b XYf'BÀ\Y'XYf'Zf]YX`]WXYb'6Yf[ghUXh'DU]']b'H\U]`UbX"'K Ybb'G]Y'Ui Z XYf'Gi WXY'bUWX'Yd]gWXYb'HU[YgUi gZi [gUVYbhYi Yfb'cXYf'_i fnYb i bUV\Àb[][Yb'K UbXYfi b[Yb']b'DU]'g]bXž'XUbb']gh'XYf'K UggYfZU`` A UY'MYb'j]Y``Y]WXh'[YbUi 'XUg'F]WXh][Y'ZØf'G]Y°

8 Y f 'K Y ['ni a 'K UggY f ZU```]gh 'Y]b '5 V Y b h Y i Y f 'ZØf 'g] W "'C V k c \ ``X] Y K Ub X Y f i b ['n] Y a `] W 'Y]b ZU W '] gh z X U i Y f h 'g] Y 'a]b X Y gh Y b g 'n k Y] Gh i b X Y b 'ZØf 'Y]b Y 'Gh f Y W Y "'5 i Z 'X Y a 'K Y ['d Ugg] Y f Y b 'G] Y 6 Ub Ub Y b d `Ub h U [Y b z '8 g W i b [Y `Z i ggg mg h Y a Y 'i b X 'i b [`Ui V `] W Y @ Ub X g W UZ h Y b '] a 'B c f X Y b 'H \ U] `Ub X g "

K]Y _ca a ha Ub ni a A UY MYb K UggYfZU``3

 $8\,Y\,f^{\,\prime}V\,Y\,g\,h\,Y^{\,\prime}K\,\,Y\,[\,\,\check{z}^{\,\prime}\,i\,\,a\,\,\,\dot{}\,n\,i\,\,a\,\,\,K\,\,U\,g\,g\,Y\,f\,Z\,U\,\hat{}\,\,\,^{\,\prime}A\,\,U\,Y^{\,\prime}M\,Y\,b^{\,\prime}\,n\,i\,\,\,^{\,\prime}\,[\,\,Y\,\hat{b}\,\check{z}^{\,\prime}\,]\,g\,h\,\check{z}^{\,\prime}\,Y\,]\,b$

A chcffUX']b'DU]'ni 'a]YhYb'i bX'ni a '6Y[]bb'XYg'K UbXYfk Y[g'ni ZU\fYb"'Gck Y]h'a]f'VY_Ubbh']ghž'[]Vh'Yg'_Y]bY'[YZØ\fhYb K UbXYfi b[Yb'bUWX'A UY'MYbž'U`gc'a i ggh'Xi 'X]YgY'U``Y]bY Ub[Y\Yb"

U`h1 A 59'M9B'K 5GG9F: 5@K 5B89FIB; 2 6YbÒh][Yb'G]Y'Y]bYb'df]j UhYb'HfUbgZYf'j ca': `i [\UZYb'7\]Ub[A U]3' '6i WXYb'G]Y']a 'J cfUi g'ZØf'i bhYf'%)'' °

5 i g[Ub[gdi b_h XYg K UggYfZU ``g A UY MYb

8 Yf'5i g[Ub[gdi b_h'XYg'K UggYfZU``g'A UY'MYb'VYZ]bXYh'g]W\bYVYb'Y]bYa '7 Ua d]b[d`Uhn'bUa Ybg' K i bXYf`UbX'7 Ua d]b[ž Yhk U'%\$'A]bi hYb'j cb'DU]'YbhZYfbh'''G]Y'Z]bXYb']\b'Ui Z'XYf'? UfhY i bhYb'a Uf_]Yfhž'cXYf'G]Y'_ÒbbYb'U`hYfbUh]j 'bUW\' A UY'MYb K UhYfZU``'<]_]b['HfU]` 'gi W\Yb"

GcVU`X'G]Y'Ui Z'XYa '7Ua d]b[d`Uhn'Ub[Y_ca a Yb'g]bXž'_ÒbbYbG]Y'\(\Rightarrow\) f'A chcffUX'UVghY``Yb'i bX'XYb'YfghYb': `i gg'bYVYb'XYa 7Ua d]b[d`Uhn'ØVYfei YfYb"'8]Y'YfghY', VYfei Yfi b['[]Vh'Y]bYb_`Y]bYb'Jcf[YgWXa UW_'XUfUi Zž'k Ug'G]Y'Ybh`Ub['XYg'K Y[YgYfk UfhYh'

U`h1 A 59'M9B'K 5GG9F: 5@@K 5B89FIB; $^{\circ}$ B'D5=28]Y'YfghY: `i ggØVYfei Yfi b["

A UY!MYb!K UggYfZU``!K UbXYfk Y[

 $B \ UWXXYa \ "G]Y \ "XYb "YfghYb": `i gg "ØVYfei Yfh" \ UVYbž "Zc`[Yb "G]Y "XYf VfY]hYfYb "GhfU" Y "k Y]hYfž "Xi fW "Y]bY "6 Ub Ub Yb d`Ub hU[Y "i b X "Y]b _ `Y]bYg "8 c f Zž "V]g "G]Y "gWX `]Y " `]WX "]b "X Ug "X]WX hYfY
<math display="block"> 8gWXi b[Y`[YghfØdd"[Y`Ub[Yb" U`h1 K 5B89FB" \ B "D5=H < 5 = 65B8 2 \\ J c b "\]Yf "Ui g "Zc`[Yb "G]Y "k Å\fYb X "XYf"[YgUa hYb "&!ghØb X][Yb K Ub XYfi b["XYa :: `i ggž "XYf "Y][Ybh`]WX "X]Y "E i Y``Y "XYg "K UggYf "ZU``g]gh" "9bh`Ub["XYf "GhfY \ W_Y "ØVYfei YfYb "G]Y "XYbgY `VYb :: `i gg" * "A U`fk]f `\ UVYb "[Yn Å\`hŁž "VYj cf "G]Y "gWX `]Y "> `]WX "Y]bYb "n]Ya `]WX "ghY]`Yb `YhnhYb "5 Vg WX b]hh "Yf _`]a a Yb "i b X "g WX `]Y "> `]WX "XYb "K UggYf "ZU```A UY MYb "YffY] WX Yb"$

?cghYb`cg $^{\circ}$ =a :; Y[YbgUhn'ni 'Y]b][Yb'UbXYfYb'K UggYfZÀ``Yb']b'DU] _cghYh'G]Y'X]YgYf'_Y]bYb'Y]bn][Yb'6U\h $^{\circ}$

K UbXYf`Àb[Y.'8]Y'K UbXYfi b['ni a 'A UY'MYb!K UggYfZU```XUi Yfh i b[YZÀ\f'&'Ghi bXYb'dfc'GhfYW_Y"

9bhZYfbib[."Ib[YZÀ\f***_a "dfc "GhfYW_Y"

 $GWK k \]Yf][\ _Y]hg[\ fUX \ XYf \ K \ Ub XYf \ b[\ . \ 8 \ Yf \ K \ Y[\]gh \ ZØf \ XYb \ [\ fO) \ hYb \ HY] \ XYf \ K \ Ub XYf \ b[\ Z \ UWK \ i \ bX \ fY \ Uh]j \ Y]b ZUWK z \ UV[\ YgY \ Yb \ j \ cb \ Y]b Ya \ ghY] \ Yb \ YhnhYb \ 5 VgWK b]hh \ Ua \ 9b XY'' \ U`h1 \ A 59 \ M9B \ K 5 GG9F : 5 @K 5 B 8 9F \ I B; \ D5 = H < 5 &5 B 8 2 \ H \ DD. \ 9g \]gh \ b \ cfa \ U`Yfk Y]gY \ a \ O[`]WK z \ 6 Ub Ub Yb \]b \ XYa \ _`Y]b Yb \ 8 \ cfZ \]b \ XYf \ B A \ Y \ XYg \ 6 Y[]bbg \ XYg \ K \ Ub XYfk Y[g \ ni \ _Ui \ ZYb''$

A UY MYb K UggYfZU``; DL!8UhY]

K Yf'Ui Z'Bi a a Yf'g]W\Yf'[Y\Yb'a ÒW\hYž'_Ubb'g]W\'X]YgY'; DL! 8 UhY]'ZØf'gY]b'<UbXm'cXYf'gY]bY'; DG!I\f'\Yfi bhYf`UXYb"

; DL!8UhY]. < Yfi bhYf`UXYb

AY]b'GhfUj U.'6Ygi W

"BUW\ '7\]Ub['FU]'fY]gYb3'J YfdUggYb'G]Y'b]W\h'a Y]bYb@]YV`]b[gk UggYfZU``. 'A UY'GU]'K UhYfZU``

A UY!MYb!K UggYfZU``

CVk c\`'Yf'k Yb][Yf'VY`]YVh']gh'U`g'UbXYfY'K UggYfZÀ``Y']b'XYf
; Y[YbXž']gh'X]YgYf'a Y]bYf'A Y]bi b['bUW\'XYf'VYghY'K UggYfZU``']b
DU]°'GcVU`X'G]Y'Ub_ca a Ybž'VYhfYhYb'G]Y'Y]bY'k i bXYfgW\`ÒbY
8 gW\\i b[Y`cUgYž'X]Y'j cb'ghY]`Ybž'a ccgVYXYW_hYb': Y`gk \\angle bXYb
i a [YVYb']gh"

8 Y f'A UY 'M' b!K UggY f ZU```VY ghY\h'Y][Ybh`]W\'Ui g'X fY] 'ghY]`Yb 9 VYbYbž'X]Y ']b'_`Y]bY '6 Y W_Yb'a ØbXYb" '8 Y f'i bhY fY '6 c c ``]gh n]Ya `]W\'ZUW\'i bX'Yf`Ui Vh'XY Z]b]h]j '_Y]b'?`]ddYbgdf]b[Yb'c XY f

HUI WXYb"'K U\fgWXY]b`]WX'a ÒWXhYb'G]Y'YXcWX'XUg'6YghY'XUfUI g a UWXYbž']bXYa 'G]Y'g]WX']b'XYb'Zf]gWXYb'Z]YybXYb'; Yk ÀggYfb UV_ \emptyset \`Yb"

K Ybb 'G]Y 'j cfg]Wk h]['g]bXž']gh'Yg'a Ò[`]Wk ž'X]Y 'fYWk hY 'GY]hY 'XYg K UggYfZU``g'\]bUi Zni _`YhhYfbž'i a ']b'Y]bYa '_`Y]bYbž'\ØZh\c\Yb 6YW_Yb'Ua '; fi bX'XYg'nk Y]hYb': `i ggYg'ni 'g]hnYb"'G]Y 'a ØggYb j cfg]Wk h]['gY]bž'XU'Yg'gY\f'fi hgWk][']ghž'i bX'XYb_Yb'G]Y 'XUfUbž]a a Yf'bUWk 'ŸbXYfi b[Yb'XYf'6YX]b[i b[Yb'5i ggWk Ui 'ni '\U`hYb"

- 'U`h1 2
- 'U`h1 K 5B89FB'NI A 'A 59'M9B'K 5GG9F: 5@@'D5= H<5=@5B8 2

6YghY'l bhYf_i bZh']b'DU]'

A m'DU]'5VWca a cXUh]cb.'K U_Y'I d']b'DU]8]YgYf'Cfh'k Uf'Y]bY'XYf V]``][ghYb'Cdh]cbYb'ZØf'Y]bYb'gUi VYfYb'GW\`UZgUU``a]h _cghYb`cgYa': fØ\ghØW_']b'DU]"'8Ug'<chY```]Y[h']a'NYbhfi a']b'XYf BÀ\Y'j cb'A chcffUXj Yf`Y]\ž'7UZÅg'i bX'XYa'K U`_]b['GhfYYh A Uf_Yh"

6YghVYk YfhYhYg'; ÀghY\Ui g. 'DU]'MUfX'6UW_dUW_YfgGi dYf'[Øbgh][Y I bhYf_i bZh'a]h'i b[`Ui V`]WXYb'6Yk Yfhi b[Yb"'GUi VYfY'N]a a Yfž [i hY'@U[Yž'[i hYf'DfY]g'i bX'[i hYg'9ggYb"

 $6Yf\emptyset \ a \ hYg'DU]' < cghY`. 7]fW' g' < cghY`DU]8]YgYf'Cfh']gh'Y]b': Uj cf]h \\]b'DU]'Z\emptysetf'X]Y'Yb][Ybž'X]Y'bUWX'Y]bYf'[fc> Ufh][Yb'5ha cgd\AfY gi WXYb''9g'[]Vh'YXYb'5VYbX'Y]bYb'[fc> Yb'Dcc`a]h'gUbZhYb \\ 6Yf[_i`]ggYb'i bX'@U[YfZYiYfb''KYbb'G]Y'UbXYfY \\ Fi W_gUW_hcif]ghYb'hfYZZYb'a ÒWXhYbž'i a 'a]h']\bYb'XYb'A UY'MYb! K UggYfZU``ni'VYgi WXYbž'XUbb']gh'X]Yg'k U\fgWXY]b`]WX'XYf f]WXh][Y'Cfh''$

JYf[`Y]WXYb'G]Y'X]Y'VYghYb'I bhYf_i bZhga Ò[`]WX_Y]hYb']b'DU]'a]h 6cc_]b["Wca 'cXYf'5[cXU"'

- 'U`h1 2
- 'U`h1 K 5GG9F: 5@@!K 5B89FK 9; 'A 59'M9B'D5= H<5=@5B8 2
- 'U`h1 A 59'M9B'K 5GG9F: 5@@': @ GGK 5B89FIB; 'D5=2
- 'U`h1 65B5B9BD@5BH5; 9'-B'D5='H<5-@5B8 2

"U`h1 K UbXYfb'ni a "K UggYfZU```A UY'MYbž'DU]' 'H\U]`UbX 2 "

8 YhU]`g

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z. 'Y]bY!fY]gY "XY