

K UggYfUV_cWXYb']b'?i`a U]b.'5_hi Y``Y G]hi Uh]cb'V]g'ni a '&"'GYdhYa VYf

⇒ '?i `a U]b 'V`Y]Vh'XUg'5V_cW [YVch'V]g'&"'GYdhYa VYf VYghY\Ybž'XU'X]Y' ⇒ ghU``Uh]cb'XYf'I J!5b`U[Y'g]W\'j YfnÒ[Yfh \Uh"

± XYf'_Y]bYb; Ya Y]bXY?i `a U]b i bX XYa 'VYbUW\VUfhYb N]Y[Y`\ØhhY'V`Y]Vh'X]Y '@U[Y'Ub[YgdUbbhž'XU'X]Y'6Øf[Yf'k Y]hYf\]b XUni 'Ui Z[YZcfXYfh'g]bXž']\f'Hf]b_k UggYf'UVni _cW\Yb"'8]Yg'[]`h a]bXYghYbg'V]g'ni a 'A cbhU[ž'XYa '&"'GYdhYa VYfž'i bX'\Uh'VYfY]hg ZØf'I bUbbY\a `]W_Y]hYb'[Ygcf[h"'8Yf'; fi bX'ZØf'X]Y'j cfgcf[`]W\Y A U» bU\a Y'g]bX'Wc`]Zcfa Y'6U_hYf]Ybž'X]Y'_Øfn`]W\']a <cW\VY\À`hYf'?i `a U]b'i bX'XYggYb'5V`Ui Z'Y]hi b[Yb'YbhXYW_h k i fXYb"'8]Y'DfcV`Ya Uh]_'k i fXY'VY]'fci h]bYa À»][Yb K UggYfi bhYfgi W\i b[Yb'ZYgh[YghY``hž'k Ug'6Øf[Yfa Y]ghYf'; ØbhYf?cdd'XUni 'j YfUb`UgghYž'[Ya À» 'XYf'J cfgW\f]ZhYb'ni '\UbXY`b"

8]Y'6Øf[Yf']b'?i `a U]b'i bX'N]Y[Y`\ØhhY'g]bX'bi b'gY]h'5bZUb[
5i [i gh']b'5`Ufa VYfY]hgW\UZh''8]Y'UbZÀb[`]W\Yb'HYghg'nY][hYb'Y]bY
Yf\YV`]W\Y'JYfi bfY]b][i b[ž'i bX'Yg'[UV'a Y\fYfY'FØW_a Y`Xi b[Yb
ØVYf'X]Y'Ub\U`hYbXYb'6U_hYf]Yb'''9g'a i gghYb''VYfY]hg'[Yd`UbhY
JYfUbghU`hi b[Yb'k]Y'Y]b'6Øf[YfZYgh'i bX'XYf'HU['XYf'cZZYbYb'HØf
UV[YgU[h'kYfXYbž'i a 'XUg'F]g]_c'Y]bYf'[Ygi bX\Y]h`]W\Yb
; YZÀ\fXi b['ni 'a]b]a]YfYb'''8]Yg'[YgW\U\']b'5bVYhfUW\h'XYf
k]W\h][Yb'Fc``Yž'X]Y'gUi VYfYg'Hf]b_k UggYf'ZØf'X]Y'G]W\Yf\Y]h'XYf
6Yk c\bYf'gd]Y`h''

I fgUWX Y i bX A U» bU\a Yb ni f 6Y\YVi b[

6Y]'Y]bYf'; Ya Y]bXYfUhgg]hni b['A]hhY'5i [i gh'ghY``hY'; Ya Y]bXYfUh HcV]Ug'GWXfc``'ZYghž'XUgg'X]Y'6Y`Ughi b['Xi fWX'X]Y'I a k Y`h_Y]a Y]a '<cW.VY\À`hYf'U`g'[Yf]b[Y]b[Yghi Zh'k i fXY"'9]bY'_`Y]bYž
i bX]WkhY': i [Y'k Uf'XYf', VY`hÀhYfž'Xi fWk'X]Y'i b_cbhfc``]Yfh'K UggYf
Y]bXf]b[Yb'_cbbhY"'Hfchn'X]YgYf'9f_Ybbhb]g'V`]YVYb'X]Y'6U_hYf]Yb
bUWk'k Y]hYfYb'HYghg'k Y]hYf\]b'Y]b'DfcV`Ya "'8Yf'6Øf[Yfa Y]ghYf
]bZcfa]YfhY'X]Y'6Yj Ò`_Yfi b[ž'XUgg'g]Y'i bVYX]b[h'k Y]hYf\]b
_cWkYbXYg'K UggYf'ZØf'XYb'?cbgi a 'bi hnYb'gc``hYbž'i a
[Ygi bX\Y]h`]WkY'F]g]_Yb'Ui gni gWk`]Y»Yb"

#D`XYf`<cZZbi b['Ui Z'Y]bY`fUgWXY`@Ògi b['Yb[U[]YfhY`X]Y

; Ya Y]bXY`X]Y`:]fa U`9bK UH`Ui g`GhYhhZY`XžX]Y`Y]bY`I J!5b`U[Y

]bghU``]YfYb`gc``hY"`8]YgY`]bbcj Uh]j Y`HYWXbc`c[]Y`j Yfgdf]WXh`Y]bY

g]WXYfY`8Yg]bZY_h]cb`j cb`J]fYb`i bX`6U_hYf]Yb`]a `K UggYf"`8Yf

6Øf[Yfa Y]ghYf`Ài »YfhY`g]WX`cdh]a]gh]gWX`ØVYf`X]Y`UbghY\YbXY

#bghU``Uh]cbž'X]Y`Ua `8]YbghU[ž'XYb`&+"`5i [i ghž'UV[YgWX`cggYb

gY]b`gc``hY"`8cWX`Y]bY`JYfnÒ[Yfi b[`VY]`XYf`5b`]YZYfi b[`XYf

5b`U[Y`ghY``hY`g]WX`U`g`k Y]hYfYg`<]bXYfb]g`\YfUi g"`8Yf`JYfgUbX

YfZc`[hY`Yfgh`Ua `&*"`5i [i ghi bX`X]Y`@]YZYfi b[`k i fXY`Yfgh`Ua `&-"

5i [i gh`VYghÀh][hž'k Ug`XYb`NY]hd`Ub`Yf\YV`]WX`VYY]bhfÀWXh][hY"</pre>

5_hi Y``Y`G]hi Uh]cb`i bX`5i gV`]W_

8]Y:]fa U'9bK UH']gh'a]hh'Yfk Y]'Y'U_h]j 'Ub'XYff \delta ghU``Uh]cb'XYf 8Yg]bZY_h]cbgUb`U[Yž'X]Y'Ua '&-"5i [igh']b'XYb'<cW.VY\À`hYf Y]b[YVUih'k]fX"'BUW\'XYf': Yfh][ghY``ib[']gh'Ua': fY]hU[ž'XYa'' \$"5i [ighž'Y]bY'K UggYfdfcVY'jcf[YgY\Yb"8]Y'9f[YVb]ggY'X]YgYf HYghfY]\Y'kYfXYb'Ua'AcbhU[ž'XYb'&"'GYdhYaVYfž'YfkUfhYh'ibXg]bX'YbhgW\Y]XYbX'ZØf'X]Y'5i Z\YVib['XYg'5V_cW\[YVchg"'8]Y' \qquad YaYjbXYjYfkU'hib['UddY``]Yfh'Ub'X]Y'6Øf[Yfž'JYfghÀbXb]g'ZØf X]Y'Ub\U`hYbXY'G]hiUh]cb'ni'nY][Ybž'XU'X]Y'9]b\U`hib[V\\O`fX`]W\Yf'5i ZU[Yb'bchkYbX][']ghž'ia'X]Y'EiU`]hÀh'XYg Hf]b_kUggYfg'ni'[YkÀ\f`Y]ghYb"

8]Y'_`UfY'?caaib]_Uh]cb'XUfØVYfž'XUgg'XUg'K UggYf'ZØf
j YfgWX]YXYbY'@YVYbgnk YW_Y'bif']b'[Y_cWXhYa'NighUbX'[Ybihnh
k YfXYb'XUfZž']gh'Y]b'k]WXh][Yf'GWXf]hh']b'XYf'?f]gYbVYk À`h][ib["
6Øf[YfaY]ghYf'?cdd'kY]gh'XUfUiZ'\]bž'XUgg'X]Yg'XUg'Hf]b_Ybž
?cWXYb'gck]Y'X]Y'NiVYfY]hib['jcb'GdY]gYb'ibX';YhfÀb_Yb
VYhf]ZZh"'5iWX'6Yhf]YVYžX]Y'@YVYbqa]hhY``\YfghY``Yb'cXYf'a]h

@YVYbga]hhY`b`]b`6YfØ\fi b[`_ca a Ybž'g]bX`Ub[Y\U`hYbž'X]Y YbhgdfYW\YbXYb`< m[]YbYghUbXUfXg`Y]bni \U`hYb"`5V[Y_cW\hYg K UggYf`]gh`Y]b`A i ggži a `g]W\Yfni ghY``Ybž'XUgg`_Y]bYf`Y] JYfi bfY]b][i b[Yb`X]Y'; Ygi bX\Y]h`[YZÀ\fXYb`_ÒbbYb"

A]h'6`]W_'Ui Z'XYb'5``hU[']b'?i `a U]b'i bX'N]Y[Y`\ØhhY']gh'X]Y < c \(\bar{Z}\)b i b['[fc \(\) \bar{Z}'XUgg'X]Y'J YfUbhk cfh`]W\ Yb'VU`X'dcg]h]j Y \\ BUW\\f]W\\hYb'\ØVYf'X]Y'\9f[YVb]ggY'XYf'K UggYfi bhYfgi W\ i b[j Yf_\ØbXYb'_\ObbYb\bar{Z}'i a 'XUg'5V_c\W\[YVch'Ui \and Xni \YVYb\\\^8]Y < YfUi g\(\angle \frac{1}{2} \frac{1}{

8 YhU]`g

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