

² ghYffY]WX]a '9G7!:]YVYf. 'GhÀXhY k YhhY]ZYfb i a 'XYb [fc » Yb '5 i Zhf]hh°

9fZU\fYb'G]Y'U``Yg'ØVYf'K]Ybg'6YkYfVib['ZØf'XYb'9G7 &\$&*ž'bYiY'Hcif]gaigghfUhY[]Yb'ibX'X]Y'dc`]h]gW\Yb 8]g_igg]cbYb'XUni"



K]Ybž²² ghYffY]WX '! → XYb 'YhnhYb' HU[Yb'XfY\hY'g]WX'U'Yg'i a XYb'9i fcj]g]cb'Gcb['7cbhYgh'f9G7Ł'&\$&*ž'i bX'Ua '&"'⇒']'&\$&)

ZUbX'Y]b'YbhgWXY]XYbXYg'HfYZZYb'XYf'5fVY]hg[Ya Y]bgWX UZh

GhÀXhYhci f]ga i g']b'→bgVfi W_'ghUhh''8UVY]'k UfYb'b]WXh'bi f

J YfhfYhYf'Ui g'XYf'6i bXYg\Ui dhghUXhž'gcbXYfb'Ui WX'8Y'Y[]YfhY

UbXYfYf'@UbXYg\Ui dhghÀXhYž'X]Y'g]WX'ØVYf'ni _ØbZh][Y

Hci f]ga i gghfUhY[]Yb'Ui ghUi gWXhYb'i bX']\fY'→bhYfYggYb'Ub'XYf

5i ghfU[i b['XYg'9G7'Zcfa i ']YfhYb'''6UfVUfU'D'UhhbYf'Ui g

→bgVfi W_'i bX'BcfVYfh'?YhhbYf'Ui g'K]Yb'ZØ\fhYb'X]Y'8]g_i gg]cbž

X]Y'XYi h`]WX'a UWXhYž'XUgg'X]Y'I bhYfgWXY]Xi b['nk]gWXYb

I f'Ui Vg[ÀghYb'i bX'9]b\Y]a]gWXYb'U'g'ØVYf\c'h'Ub[YgY\Yb'k]fX''

→[YgUa h'\UVYb'g]WX'bYi b'ÒghYffY]WX]gWXY'@UbXYg\Ui dhghÀXhY

VYnØ[']WX'bYi Yf'i fVUbYf'GhfUhY[]Yb'[YY]b][h'i bX'gY\Yb'X]Y

 $8 \ Yf'?i \ hi \ f! \ i \ b X \ A \ YX]Yba \]b]ghYf'5bXfYUg'6UV \ Yf'gdfUW \ j \ cb \ Y]bYa \ [fc > Yb \ A \ ca \ Yb h'ZØf'X]Y \ OghYffY]W \]gWX Y \ A \ i \ g]_gnYbYž'U \ g'Yf \ X]Y \ FØW__Y \ f'XYg'9G7 \ bUW \ ^2 \ ghYffY]W \ VY[fØ > hY'" \ b bgVfi W_ž \ C VYfk Ufh'i b X 'K Y \ g' \ UVYb 'VYfY]hg'] \ f' \ b hYfYggY 'Ub 'XYf \ 5i ghfU[i b['VY_i b XYhž'k À\ fYb X'; fUn'YVYb ZU \ g'XUfØVYf \ bUW XYb_hž'Y]bY '6Yk YfVi b[']b'] \ fYa 'GhUXhgYbUh'ni 'X]g_i h]YfYb'' 6Øf[Yfa Y]ghYf' \ \ & \ UbbYg'5bnYb[fi VYf'j cb' \ b bgVfi W_ \ \ c V X]Y \ C \ ma d]U\U \ 'Y' U \ g'] XYU \ Yb' J YfUbghU \ hi b[gcfh'\Yfj cfž'k \ A\ fYb X']b \ K Y \ g'Y]bY \ bYi Y 'A YggY\U \ Y' ZØf' \ & \ & \ *' [Yd`Ubh']gh'' 5i W ']b \ B]YXYfOghYffY]W \ []Vh'Yg' 6 YghfYVi b[Ybž'XYb' 9G7']a '6i bXYg`UbX Ui gni f]W \ hYb'' \$

K]Yb]a FYbbYb i a XYb 9G7

K]Ybg'6Øf[Yfa Y]ghYf'A]W\UY``@ Xk]['g]Y\h'XYb'a Ò[`]W\Yb'9G7! G]Y['U`g'[fc > Yb'5i [YbV`]W_'i bX'VYhcbh'X]Y': À\][_Y]h'XYf'GhUXhž]bhYfbUh]cbU`Y'; fc > j YfUbghU`hi b[Yb'dfcZYgg]cbY``ni cf[Ub]g]YfYb"'I bhYfghØhni b['_ca a h'Ui W\'j cb'?i `hi fghUXhfÀh]b JYfcb]WU'?Ui d! < Ug`Yfž'X]Y'X]Y'J]Y`ZU`h'K]Ybg'`cVh'i bX'Ui Z'X]Y 7\UbW'\]bk Y]ghž'A YbgW\Yb'ZØf'CdYf'i bX'A i g]_'ni 'VY[Y]ghYfb"?`U[YbZi fh'i bX'GU`nVi f['\UVYb'g]W\'XU[Y[Yb'Ui Z[fi bX Z]bUbn]Y``Yf'i bX']bZfUghfi _hi fY``Yf'9]bgW\fÀb_i b[Yb'Ui g'XYa FYbbYb'[Ybca a Yb"

Hci f]ga i g!GhUUhggY_fYhÀf]b '9`]gUVYh\ 'NY\YhbYf'g]Y\h']a '9G7
b]W\h'bi f'Y]b '?i `hi fYfY][b]gž'gcbXYfb 'Ui W\ 'Y]bY '[Yk U`h][Y
7\UbW 'ZØf'XYb '\Y]a]gW\Yb 'Hci f]ga i g'i bX 'XUg']bhYfbUh]cbU`Y

a U[Y'² ghYffY]W\g"'8Yf'9G7 '&\$%) ']b 'K]Yb 'Yhk U'[YbYf]YfhY 'Y]bYb
I a gUhn'j cb '_bUdd'' \$'A]``]cbYb'9i fc'i bX 'VfUW\hY'ØVYf'%\$\$"\$\$\$
; ÀghY']b 'X]Y 'GhUXh'' =qh'XUg'b]W\h'VYY]bXfi W_YbX3

K]fhgWX UZh`]WX Y DYfgdY_h]j Yb

 $8]Y'k]fhgWk UZh`]Wk Yb'7 \ UbWkb'Y]bYg'k Y]hYfYb'9i fcj]g]cb'Gcb[7cbhYghg']b'^2 ghYffY]Wk'g]bX'Ybcfa "'8Yf'9G7'_ÒbbhYž'k]Y'Y]bYZfØ\YfY'Ghi X]Y'nY][hYž'nU\`fY]WkY'5fVY]hgd`ÀhnY'gWk UZZYb'i bX$

#bj Ygh]h]cbYb']b'X]Y'#bZfUghfi _hi f'Ubghc» Yb"'8Yf'CF:!
; YbYfU'X]fY_hcf'Fc`UbX'K Y]» a Ubb'VYhcbhYž'XUgg'hfchn'XYf
Z]bUbn]Y``Yb'< YfUi gZcfXYfi b[Yb'Ui Z'Y]bY'ei U`]hUh]j '\cW\k Yfh][Y
G\ck' [YgYhnh'k]fX"'A Y\fYfY'GhÀXhY'\cZZYbž'j cb'XYb'a]h'XYf
JYfUbghU'hi b['j YfVi bXYbYb'JcfhY]`Yb'dfcZ]h]YfYb'ni '_ObbYb"'8]Y
Ni gW\Ui YfnU\`Yb'VY]a 'Z]bU`Yb'5i Zhf]hh'j cb'>\(\frac{\pi}{2}\)XYf'XYb'9G7'\&\\$\&\)
[Yk cbbYb'\Uh\(\frac{\pi}{2}\)k UfYb'UhYa VYfUi VYbX'''V]g'ni '\(\frac{\pi}{2}\) 'A]``]cbYb
j YfZc`[hYb'gY]b'5i Zhf]hh''

 $\label{thm:strain} 5b[Yg]Wkhg`XYf`dcg]h]j Yb`5i gg]WkhYbž`XYf`JcfZfYi XY`i bX`XYa VYfY]hg`VY[cbbYbYb`8]U`c[`ia`X]Y`:]bUbn]Yfi b[`XYg`9j Ybhgž gWkY]bh`_`Uf.`8Yf`9G7`&$&*`k]fX`U``Yg`XUfUb`gYhnYbž`Y]b i bj Yf[Ygg`]WkYg`9fY][b]g`ni `kYfXYb`i bX`V]YhYh`XYf`\Y]a]gWkYb K]fhgWkUZh`[`Y]WknY]h][`X]Y`A <math>\grave{O}[`]Wk_Y]h\check{z}g]Wk`]bhYfbUh]cbU``ni dfÅgYbh]YfYb"^2 ghYffY]Wk`\Uh`XUg`DchYbn]U`ž`b]Wkh'bi f`U`g ; Ugh[YVYfž`gcbXYfb`Ui Wk`U`g`_fYUh]j Yg`i bX`_i `hi fY``Yg`NYbhfi a Ui Z`XYf`Yi fcdÅ]gWkYb`6Ø\bY`Ui Zni hfYhYb"$

: Øf'a Y\f' \pm 0Zcfa Uh]cbYb'ni 'X]YgYb'gdUbbYbXYb'9bhk]W_`i b[YbghY\h' \pm bYb'X]Y'6Yf]W\hYfghUhhi b['j cb' \overline{Z} j k ž'?cga c'i bX' @YUXYfgbYh'ni f'JYfZØ[i b["

8YhU]`g	
Cfh	K]Ybž ^{·2} ghYffY]WX
EiY``Yb	• k k k "Zj k "XY
	• k k k "_cga c"Uh
	k k k "`YUXYfgbYh"Uh

6Ygi WXYb G]Y i bg Ui Z a Y]b!k]Yb bYh