

BYi Y: U\ffUXghfU» Y']b'XYf'I b[UfbghfU» Y YfÒZZbYh' '>Yhnh'fUXY`b'

5a '%("'⅓`]'&\$&) '`ÀXh'6Yf`]b'ni f'9fÒZZbi b['Y]bYf'bYi Yb : U\ffUXghfU» Y']b'XYf'I b[UfbghfU» Y'Y]b"'9fZU\fYb'G]Y'a Y\f°



I b[UfbghfU» Yž%\$(') '6Yf`]bž8Yi hgWX`UbX`!'5a ', "'*\`]'&\$&)
[UV'XUg'6Yn]f_gUa h'A]hhY'VY_UbbhžXUgg'X]Y'6Ui UfVY]hYb'ZØf'X]Y
bYi Y': U\ffUXghfU» Y']b'XYfTI b[UfbghfU» Y'bi b'UV[YgWX`cggYb
g]bX"'8]YgY'bYi Y'GhfU» Y'YfghfYW_h'g]WX'nk]gWXYb'XYf'A Ø``YfghfU» Y
i bX'XYf'\deltaX]gWXYb'GhfU» Y'i bX']gh'Y]b'k YgYbh`]WXYf'6YghUbXhY]`
XYg'FUXj Yf_Y\fgj cffUb[bYhnYg'XYf'GhUXh"'8Yf'6Yn]f_gghUXhfUh'ZØf
CfXbi b[ž'I a k Y`hž'BUhi fž'GhfU» Yb'i bX'; fØbZÀWXYbž'7\f]ghcd\Yf
GWXf]bYfž'VYhcbhYž'XUgg'X]Y': U\ffUXghfU» Y'Y]bY'UhhfU_h]j Y'FUX!
Fci hY'UVgY]hg'XYf'ghUf_'ZfYei Ybh]YfhYb'JYf_Y\fgUXYfb'V]YhYh''A]h
XYa 'N]Y'ž'X]Y'G]WXYf\Y]h'i bX'G]WXhj Yf\A`hb]ggY'Ub'XYb
?fYi ni b[Yb'ni 'j YfVYggYfbž'k i fXYb'i a ZUggYbXY'A U» bU\a Yb
i a [YgYhhhž'X]Y'Ui WX'ni gÀhn`]WXY'5VghY``a Ò[`]WX_Y]hYb'ZØf
: U\ffÀXYf'Y]bVYn]Y\Yb"

8]Y '6Ui UfVY]hYb 'k i fXYb ']a 'Bcj Ya VYf'&\$&('VY[cbbYb'i bX _cbbhYb']a 'A U]'&\$&) 'YfZc`[fY]W\ 'UV[YgW\`cggYb'k YfXYb"'8]Y I a VUi _cghYb'VY`]YZYb'g]W\ 'Ui Z'Yhk U'%&\$"\$\$\$ '9i fcž'Yf[Àbnh Xi fW\ 'ni gÀhn`]W\ Y'* \$"\$\$\$ '9i fc 'ZØf'X]Y'GUb]Yfi b['XYg'5gd\U`hg" 8]Y'bYi Y': U\ffUXghfU\() Y']gh'bi b'a]h'_`UfYf'6YgW\]`XYfi b['i bX A Uf_]Yfi b[Yb'Ui Z'XYf': U\fVU\b'j YfgY\Ybž'gcXUgg'F UXZU\fYbXY i bX': i \() [Ab[Yfl]bbYb'_`Uf'j cbY]bUbXYf'UV[Y[fYbnh'g]bX"'\XXcW\XØfZYb': Yi Yfk Y\f!9]bgUhnZU\fnYi [Y'X]Y'GhfU\() Y'YYZU\fYbž'k Ug

9]b`UXi b['ni a '5bfUXY`b

I a $[X]Y: Yfh][ghY]i b[XYf: U\ffUXghfU] Yini <math>[ZY]Yfbz]i \lambda hXUg 6Yn]f_gUa hini [Y]bYf:5bfUXY]j YfUbghU]hi b[Y]b":8]YgY:Z]bXYhIUa A cbhU[zXYb:%(":\delta]]*&\delta)zij cb:%).' \delta V]g:%*.\delta I\fIUb:XYf I\b[UfbghfU] YIUb:XYf:9W_YIni f:\delta X]gWXYb:GhfU] YIghUhh" \delta hYfYgg]YfhY:g]bX:\Yfn`]WX:Y]b[Y`UXYbz]Y:bYi Y'GhfYW_YIni Yf_i bXYb:i bX:g]WX:\ØVYf'k Y]hYfY:D`\delta Y']a '\delta YfY]WX:XYf FUX]bZfUghfi _hi fini []bZcfa]YfYb"$

8]YFY[Y`i b[Yb']b'XYf'bYi Yb: U\ffUXghfU» Y'g]bX'_`Uf'XYZ]b]Yfh"
FUXZU\fYbXY'XØfZYb'X]Y'[YgUa hY: U\fVU\bVfY]hY'bi hnYb'i bX
bYVYbY]bUbXYf'ZU\fYbž'k À\fYbX'? Zn!J Yf_Y\f'bi f'a]h
VYfYW\h][hYa '5b`]Y[Yb'fKUfi bhYf'ZÀ``h'XUg'Ni gUhngW\]`X' 5b`]Y[Yf
ZfY] Ł'Xcfh'ZU\fYb'XUfZ''8 Ug'FYW\hgZU\f[YVch'V`Y]Vh'VYghY\Ybž'i bX
X]Y'; YgW\k]bX][_Y]h'XUfZ'a UI]a U`'' \$'_a #\'VYhfU[Yb'''8]YgY
A U» bU\a Yb'YbhgdfYW\Yb'XYb'U``[Ya Y]bYb'Jcf[UVYb'ZØf
: U\ffUXghfU» Yb']b'8Yi hgW\`UbXž'X]Y'\Ài Z]['a]h'Y]bYf'\c\Yb
8]W\hY'Ub'FUXj Yf_Y\f'i bX'Y]bYf'i bhYf[YcfXbYhYb'6YXYi hi b['ZØf
XYb'a chcf]g]YfhYb'JYf_Y\f'Y]b\Yf[Y\Yb"

JcfhY]`Y`i bX`; YghU`hi b['jcb
: U\ffUXghfU» Yb

 $: U \setminus ffUXghfU \Rightarrow Yb `V]YhYb `j]Y `Y `J cfhY]`Y `ZØf `F UXZU \setminus fYbXY "`G]Y `g]bX gdYn]Y```XUfUi Z'Ui g[Y`Y[hž XYb `F UXj Yf_Y \f`ni `df]cf]g]YfYb `i bX Yfa Ò[`]W\Yb `Y]b `g]W\YfYg `i bX `Ub[YbY \a Yg `: U \fYb" @Ui h`XYa$

: U\ffUX!A cb]hcf'&\$&' 'Ya dZ]bXYb', 'i 'XYf'FUXZU\fYbXYb : U\ffUXghfU» Yb'U`g'g]W\Yfž'i bX'(, 'i 'VYj cfni [Yb'g]Y'[Y[YbØVYf UbXYfYb'FUXk Y[Yb": U\ffUXghfU» Yb'gcf[Yb'a]h'Y]bYf FY[Y'VfY]hY'j cb'a]bXYghYbg'j]Yf'A YhYfb'ZØf'VfY]hYfY : U\fVU\bYbž'k Ug'ni gÀhn`]W\'XUni 'VY]hfÀ[hž'XYb'FUXj Yf_Y\f'ni ZÒfXYfb'i bX'G]W\Yf\Y]h'ni '[Yk À\f'Y]ghYb"

 $8]Y T a gYhni b[gc`WXYf`Dfc Y_hY`]gh`YbhgWXY]XYbX`ZØf`X]Y JYf_Y\fgk YbXY`]b`8Yi hgWX`UbX"`JYfUbghU`hi b[Yb`k]Y`XUg 5bfUXY`b`]b`XYf`I b[UfbghfU» Y`i bhYfghØhnYb`X]Y`5_nYdhUbn`i bX 6Y_Ubbh\Y]h`XYf`bYi Yb`JYf_Y\fgk Y[Yž`k À\fYbX`[`Y]WXnY]h][nU\`fY]WXY`\dangle]h]Uh]j Yb`ni f`: ÒfXYfi b['j cb`: U\ffUXghfU» Yb VYghY\Yb"'6Yf`]b"XY`i bX`A cV]`]hÀhgZcfi a `V]YhYb k Y]hYfZØ\fYbXY`\dangle Zcfa Uh]cbYb`ni `XYb`U_hi Y``Yb`9bhk]\W_`i b[Yb]a `6YfY]WX`FUXj Yf_Y\f`i bX`XYb`gdYn]Z]gWXYb`Jcf[UVYb`ZØf : U\ffUXghfU» Yb`]b`8Yi hgWX`UbX"$

8 YhU]`g	
Cfh	lb[UfbghfU»Yž"%\$(')~6Yf`]bž"8YihgWX`UbX
EiY``Yb	• k k k "VYf`]b"XY
	• k k k "a cV]`]hUYhgZcfi a "Vi bX"XY

6Ygi WXYb G]Y i bg Ui Z. a Y]b!VYf`]b "bYh