

GWk YfYf'l bZU``'Ui Z'5+'VY]'A Ya a]b[Yb. JYf_Y\fgghUi 'V]g'ni f'5-*

Nk Y] 5i hcg _c ``]X]YfhYb 'Ui Z'XYf'5+ 'VY] 'A Ya a]b[Ybž'k Ug'ni Yf\YV`]W\Ya 'F \emptyset W_ghUi 'Z \emptyset \fhY" | bZU``gW\UXYb. '&) "\$\$\$ '9i fc"

9]b'5i ZZU\fi bZU```Ui Z'XYf'5+'\Uh'Ua '8cbbYfghU['a Ugg]j Y
J Yf_Y\fgVY\]bXYfi b[Yb'Ui g[Y`Ògh"'\daggarange XYf'BÀ\Y'j cb'A Ya a]b[Yb
_Ua 'Yg'ni 'Y]bYa 'Ni gUa a Ybghc» ž'XYf'gck c\`'XYb'6Yfi Zgj Yf_Y\f
U`g'Ui WX'X]Y'i a `]Y[YbXYb'JYf_Y\fgghfU»Yb'Yf\YV`]WX
VYY]bhfÀWXh][hY"

8 Yf J cfZU``YfY][bYhY g]W\ ni f' < Ui dhj Yf_Y\fgnY]hž U`g`X]Y GhfU» Yb ghUf_'ZfYei Ybh]Yfh'k UfYb"'9]bY') %! A\f][Y: fUi 'k Uf'Ui Z'XYa `]b_Yb: U\fghfY]ZYb XYf 5i hc VU\b ii bhYfk Y[g'i bX'a i gghY YbhgdfYW\YbX'XYf J Yf_Y\fg`U[Y'UVfi dh'UVVfYa gYb"'8]Y'\]bhYf']\f ZU\fYbXY *!A\f][Y'5i hc ZU\fYf]b \UhhY'YXc W GW k]Yf][_Y]hYbž X]Y'G]hi Uh]cb 'fYW\hnY]h]['ni 'YfZUggYb"'8 UXi fW\ '_Ua 'Yg'ni 'Y]bYa \YZh][Yb'5i ZdfU``nk]gW\Yb'VY]XYb': U\fnYi [Yb"'8]Y'Dc`]nY]'ghY``hY ZYghž XUgg'X]Y': U\fYf]b 'XYg'j cfXYfYb'5i hcg'Ui Z[fi bX'XYg 5i ZdfU``g`Y]W\h'j Yf`Yhhh'k i fXY'i bX'ni f'a YX]n]b]gW\Yb I bhYfgi W\i b[']b'Y]b'?fUb_Yb\Ui g'[YVfUW\h'k YfXYb'a i gghY"

$JYf_Y\fgWUcgUiZXYf5+ibX5-*$

 $8]Y : c`[Yb`X]YgYg`5i ZZU\fi bZU``g`nY]W\&bYb`Y]b`XYi h`]W\&Yg`6]`X`XYf ; YZU\fYb`]a `GhfU» Ybj Yf_Y\f''8 Yf`I bZU```ZØ\fhY`XUni ž`XUgg`XYf `]b_Y : U\fghfY]ZYb`ZØf`X]Y`I bZU``Ui ZbU\a Y`[YgdYffh`k YfXYb a i gghYž`k Ug`Y]bYb`[Yk U`h][Yb`F ØW_ghUi `]b`VY]XY : U\fhf]W&hi b[Yb`ni f`: c`[Y`\UhhY''`GY`Vgh`X]Y`VYbUW&VUfhY`5-* <math display="block">V`]YV'j cb`XYb`GhUi g`b]W\&h'j YfgW\&cbh''`8 Ug`?fYi n`A Ya a]b[Yb`k UfdfU_h]gW&``U\a [Y`Y[hž`i bX`X]Y`Dc`]nY]`VYf]W&hYhY`j cb`Yf\YV`]W&Yb$

8]Y'G]hi Uh]cb'ghY``hY'ZØf'j]Y`Y'DYbX`Yf'i bX'FY]gYbXY'Y]bY'[fc»Y < YfUi gZcfXYfi b['XUfž'XU'X]Y'K UfhYnY]hYb'i bX'XYf'Gh]``ghUbX'XYg JYf_Y\fg'Zfi ghf]YfYbX'k UfYb"'8]Y'I a `Y]hi b[Yb'ZØ\fhYb'XUni ž XUgg'U`hYfbUh]j Y'Fci hYb'Ub[Ybca a Yb'k YfXYb'a i gghYbž'X]Y ni gÀhn`]W\Y'NY]h']b'5bgdfi W\'bU\a Yb"'5i W\'X]Y'6Yf[i b['XYf VY]XYb'b]W\ha Y\f'ZU\fVYfY]hYb'5i hcg'hfi ['XUni 'VY]ž'XUgg'XYf JYf_Y\f'ZØf'a Y\fYfY'Ghi bXYb'VYY]bhfÀW\h][h'V`]YV"

8]YG]WXYf\Y]hUiZibgYfYbGhfU»Yb

8 Yf J cfZU```k]fZh Zi b X Ua YbhU``X]Y : fU[Y b UW `XYf

J Yf_Y\fgg]WX Yf\Y]h `Ui Z' `Gck c\``: U\fYf]bbYb `U`g `Ui WX :: U\fYf `g]bX

c Zh Y]bYf `J]Y `n U\` `j cb `5 V `Yb_i b[Yb `Ui g[YgYhnhž k Ug `ni

[YZÀ\f`]WX Yb `G]hi Uh]cbYb `ZØ\fYb `_Ubb" `\delta `X]YgYa `gdYn]Y``Yb :: U``

nY][h `g]WX ž k]Y `k]WX h][`Yg `]ghž ghYhg `Ui Za Yf_gUa `ni `V`Y]VYb ž

]bgVYgcbXYfY `]b `YfY][b]gfY]WX Yb `NY]hYb `XYg `HU[Ygž k Ybb `XYf

J Yf_Y\f`\Ài Z][`ØVYf`UghYh `]gh" `J Yf_Y\fgi bZÀ``Y`_ObbYb `]b `Y]bYa

6fi WX hY]``Y]bYf `GY_i bXY `[YgWXY\Ybž i bX `YXY i bbOh][Y

5 V`Yb_i b[`_Ubb `[fUj]YfYbXY :: c`[Yb `\ UVYb"

 $9g`]gh`YbhgWXY]XYbXž`XUgg`JYf_Y\fghY]`bY\aYf`X]Y\\JYf_Y\fgnY]WXYbYgck]Y`XUg`JYf\U`hYb`XYf`UbXYfYb`: U\fYf`[YbUiVYcVUWXhYb'':8Yf`GWXkYfdib_h`UiZ`XYZYbg]jY`: U\fkY]gY`_Ubbb]WXh`bif`XUg`dYfgÒb`]WXY`F]g]_c`a]b]a]YfYbž`gcbXYfb`hfÀ[h`UiWXnif`G]WXYf\Y]h`U``Yf`UiZ`XYf`GhfU»Y`VY]''`9]b`F<math>\emptyset$ W_V`]W_`UiZXYf`GhfU»Y`VY]''`9]b`F \emptyset W_V`]W_`UiZXYfUfh][Y`G]hiUh]cbYb`aU\bh`ibgž`XUgg`5iZaYf_gUa_Y]h`ibXF \emptyset W_g]WXhbU\aY`ibUVX]b[VUfY`6YghUbXhY]`Y`g]WXYfYb`: U\fYbgg]bX''

9]bY'VYggYfY'5i Z_`Àfi b['ni f'JYf_Y\fgg]W\Yf\Y]h'_ÒbbhY
a Ò[`]W\Yfk Y]gY'XUni 'VY]hfU[Ybž'gc`W\Y'I bZ\``Y'ni 'fYXi n]YfYb
i bX'X]Y'U``[Ya Y]bY'G]hi Uh]cb'Ui Z'i bgYfYb'GhfU» Yb'ni 'j YfVYggYfb"
9g'V`Y]Vh'ni '\cZZYbž'XUgg'X]Y'VYhfcZZYbYb': U\fYf]bbYb'g]W\
gW\bY```Yf\c`Yb'i bX'X]Y'@Y\fYb'Ui g'X]YgYa 'J cfZU```b]W\h']b
J Yf[YggYb\Y]h'[YfUhYb"

JYf_Y\fgi bZÀ``Y`Ui Z`XYi hgW\Yb`5i hcVU\bYb. 9]b`]a a Yf`k]YXYf_Y\fYbXYg`DfcV`Ya

I bZÀ``Y`Ui Z'5i hcVU\bYb`g]bX``Y]XYf`Y]bY`\Ài Z][Y`FYU`]hÀh`]b
8 Yi hgW\`UbX"'@Ui h`Y]bYf`GhUh]ghU!I a ZfU[Y`[UV`Yg`]a `\\\f`&\&\\
Yhk U`&\(\frac{z}{A}\)``]cbYb`dc`]nY]`]W\`fY[]ghf]YfhY`JYf_Y\fgi bZ\\``Y`]a
[UbnYb`@UbX"'8]Y`<Ui dhi fgUW\Yb`g]bX`cZh`ØVYf\Ò\hY
; YgW\k]bX][_Y]h\(\frac{z}{S}\)`Yb_i b[`Ua `GhYi Yf`i bX`i bYfk UfhYhY
6fYa ga UbÒj Yf\(\frac{z}{S}\)K]Y`g]Y`Ui W\`]b`X]YgYa `: U```ni `VYcVUW\hYb k UfYb"

GdYn]Y```Ui Z'XYf'5+ž'Y]bYf'XYf'k]W\h][ghYb
5i hcVU\bj YfV]bXi b[Yb']b'8Yi hgW\`UbXž'_ca a h'Yg']a a Yf'k]YXYf
ni 'gW\k YfYb'I bZ\A``Yb"'9]bY'VYgcbXYfY'<YfUi gZcfXYfi b['ghY``h'X]Y
\c\Y'JYf_Y\fgX]W\hY'Ub'k YY_XUmg'XUfž'k Ybb'DYbX`Yf'i bX'@_k!
: U\fYf'[`Y]W\nY]h]['i bhYfk Y[g'g]bX"'\DgVYgcbXYfY'Ui Z'XYb
GhfYW_YbUVgW\b]hhYb']b'XYf'B\A\Y'[fc\yYf'Gh\AXhY'_Ubb'Yg'gW\bY``
ni '_f]h]gW\Yb'G]hi Uh]cbYb'_ca a Yb"

A U» bU\a Yb ni f'I bZU``j Yf\Øhi b['Ui Z 5i hc VU\bYb

I a `XYf`ghY][YbXYb`NU\``Ub`JYf_Y\fgi bZÀ``Yb`Ui Z`XYi hgW\Yb5i hcVU\bYb`Ybh[Y[Ybni k]f_Ybž\UVYb`X]Y`6Y\ÒfXYbj YfgW\]YXYbY`A U» bU\a Yb`Yf[f]ZZYb"`8 Uni `[Y\ÒfYb`i bhYfUbXYfYa `XYf`9]bgUhn`j cb`JYf_Y\fg_Ua YfUgž`VYggYfYf6YgW\]`XYfi b[`i bX`fY[Y`a À»][Y`; YgW\k]bX][_Y]hg_cbhfc``Yb"Ni XYa `k]fX`Ui Z`5i Z_`Àfi b[g_Ua dU[bYb`[YgYhnhži a ::U\fYfb`X]Y; YZU\fYb'j cb`5V`Yb_i b[`i bX`ØVYf\Ò\hYf`; YgW\k]bX][_Y]hVYk i ggh`ni `a UW\Yb"

9]b'k Y]hYfYg'k]WXh][Yg'±oghfi a Ybh'g]bX'J Yf_Y\fg]bZcfa Uh]cbYb']b 9WXhnY]hž'X]Y'ØVYf'a cV]`Y'5ddg'i bX']a 'FUX]c'VYfY]h[YghY``h k YfXYb"'8]YgY'GmghYa Y']bZcfa]YfYb'5i hcZU\fYf'ØVYf'GhUi g'i bX I bZÀ``Y'Ui Z']\fYb'Fci hYbž'k Ug'XUVY]'\Y`ZYb'_Ubbž'[YZÀ\f`]WXY G]hi Uh]cbYb'ni 'j Yfa Y]XYb"

2 _cbca]gWX Y '5 i gk]f_i b['j cb J Yf_Y\fgi bZÀ``Yb

JYf_Y\fgi bZÀ``Y`\UVYb`b]W\h'bi f`a YbgW\`]W\Yž'gcbXYfb`Ui W\k]fhgW\UZh`]W\Y`?cbgYei YbnYb"@Ui h'XYb'GhUh]gh]_Yb'XYg
GhUh]gh]gW\Yb'6i bXYgUa hg'_cghYb'JYf_Y\fgi bZÀ``Y']b'8Yi hgW\`UbX
X]Y'; YgY``gW\UZh'A\f`]W\`a Y\fYfY'A]``]UfXYb'9i fc"'8]YgY'?cghYb
gYhnYb'g]W\`Ui g'X]fY_hYb'?cghYb'k]Y'a YX]n]b]gW\Yb
6Y\UbX`i b[Ybž'Dc`]nY]!'i bX'6Yf[i b[ga U»bU\a Yb'gck]Y
]bX]fY_hYb'?cghYb'Xi fW\'GhUi g'i bX'DfcXi _h]j]hÀhgj Yf`i ghY
ni gUa a Yb"

8 Y f' Øb [ghY 'I b ZU```Ui Z'XY f' 5 + 'j Y f X Y i h`] W h' X] Y gY 'D f c V `Y a Uh] Y] b X f] b [`] W " 8 Y f' X U X i f W 'j Y fi f g U W hY 'F Ø W ghU i 'ZØ\ f hY 'n i a Ugg] j Y b 'J Y f n Ò[Y fi b [Y b ž' X] Y 'g c k c \ ``D Y b X `Y f' U `g' U i W @] Y ZY f j Y f _ Y \ f' V Y h f U ZY b " G c `W X Y `Gh Ò fi b [Y b ' _ Ò b b Y b 'g W b Y `` n i k Y] h Y f Y b 'k] f h g W U Z h`] W X Y b 'J Y f` i g h Y b 'ZØ\ f Y b ž' X U 'j Y f g d À h Y h Y @] Y ZY f i b [Y b ' i b X '5 f V Y] h g n Y] h Y b 'V Y h f c ZZY b 'g] b X "

8 YhU]`a

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