

GU]gcbghUfh'&\$&(#&).'6Y`]YVhYg'H\YUhYf! 5Vc']b'6cf_Yb'gWX`A[h'Y]b°

9fZU\fYb'G]Y'U``Yg'ØVYf'XYb'VY`]YVhYb'H\YUhYfUVcbbYa Ybh! $J Yf_U i Z']b'6cf_Yb'''G]WXYfb'G]Y'g]WX'Yhnh'H]W_Yhg'i bX \\ [Yb]Y<math>*$ Yb'G]Y'gdUbbYbXY'5i ZZØ\fi b[Yb°

5a '8cbbYfghU[ž'XYa '&&"'5i [i gh'&\$&(ž'[]b['XYf'Jcfj Yf_Ui Z'ZØf X]Y'VY']YVhY'JYfUbghU'hi b[gfY]\Y' H\YUhYf']a '5VcbbYa Ybh ']b XYf'GhUXh'6cf_Yb'ni '9bXY"'8Yf'[fc»Y'Ni gdfi W\'nY][hž'k]Y'gY\f X]Y'6Øf[Yf'Ub'_i 'hi fY'`Yb'5b[YVchYb']bhYfYgg]Yfh'g]bX"': Øf'X]Y _ca a YbXYb'H\YUhYfUi ZZØ\fi b[Yb'[]Vh'Yg'bi f'bcW\'Y]bY VY[fYbnhY'5bnU\`'Ub'H]W_Yhgž'X]Y'Ua 'GUa ghU[ž'XYa '&("'5i [i gh &\$&(ž'ni f'JYfZØ[i b['ghY\Yb'kYfXYb"'8]Y'JYf_Ui ZgghY``Yb'g]bX'X]Y Hci f]gh! \DZcfa Uh]cb']a ': 5F6'gck]Y'X]Y'Cb`]bY!D`UhhZcfa _i 'hi f[Ya Y]bXYVcf_Yb"fYgYfj]I "XYž'k c'\DhYfYgg]YfhY'g]W\'gcZcfh]\fY'D`AhnY'g]W\Yfb'_ObbYb"

8]Y?i`hif[YaY]bXY`\UhiY]b`gdUbbYbXYg`Dfc[fUaa`ZØf`X]YGU]gcb`&\$&(#&)`nigUaaYb[YghY``h"'+b`GiaaY`bYibH\YUhYfUiZZØ\fib[Ybž`XUfibhYf'jYfgWX]YXYbY`?caÒX]Yb`ibXGhØW_Yž`X]Y`UiZ`VY_UbbhYb`FcaUbYb`VUg]YfYbž`V]YhYb`Y]bYbUVkYWXg`ib[gfY]WXYb`5VYbX`ZØf`H\YUhYfZfYibXY"'5``YJYfUbghU`hib[Yb`kYfXYb`]b`XYf`GhUXh\U``Y`JYbbY\cZ`ghUhhZ]bXYbibX`VY[]bbYb`YkY]`g`ia`&\$`I\f"`NigWXUiYf`XØfZYb`g]WX`UiZibhYf\U`hgUaY`5VYbXY`ibX`_bUW_][Y`8]U`c[Y`ZfYiYbž`X]Y`gckc\`nia`@UWXYb`U`g`UiWX`nia`BUWXXYb_Yb`UbfY[Yb"

: YghghY\YbXY HYfa]bY]a ', VYfV`]W_

8]Y'JYfUbghU`hi b[gfY]\Y'ghUfhYh'Ua 'A]hhk cW\ž'XYa '&) " GYdhYa VYf'&\$&(\check{z} 'a]h'XYf'?ca \check{O} X]Y' 9]b[YgW\`cggYbY

; $YgY``gWXUZh \check{z}`X]Y`Ui Z`XYa `6YghgY``Yf'j cb`$Jb`K Y]`Yf'VUg]Yfh'' K Y]hYfY`HYfa]bY`i a ZUggYb.$

- %\$"'C_hcVYf'&\$&(' 8]YbYf'nkY]Yf'<YffYb \check{z} Y]bY ?ca \check{O} X]Y'bUW\' \approx \b'j cb'8 \varnothing ZZY`"
- %&"'Bcj Ya VYf'&\$&(''' Nk Y]'A ÀbbYf'[Ubn'bUW_h 'a]h Fi Zi q'6YW_'i bX'DYhYf'?fYa Yf"
-) "'8 YnYa VYf'&\$&(''' 8fY]'A ÀbbYf']a 'GW\bYY ž'Y]b GhØW_'bUW\'9f]W\'? ÀghbYf"
- %("'>Ubi Uf'&\$&) '': Y\`Yf']a 'GmghYa ž'Y]bY'?ca ÒX]Y a]h'>Øf[Yb'HUffUW\"
- %%"'A Àfn'&\$&) '' 8]Y'GhfY]W\Y'XYg'GWUd]b 'bUW\
 A c`]ÄfY"
-) "'A U]'&\$&) ' ' Ei]W_]Yg' 'GW\bY``Y'Biaa Yfb'nif'@U[Y XYf'BUh]cb ž'Y]bY'U_hiY``Y'GUh]fY"

8]YgY'5i gk U\``nY][h'X]Y'J]Y`ZU`h'XYg'H\YUhYfgž'XUg'j cb
_`Ugg]gW\Yf'8fUa Uhi f[]Y'V]g'\]b'ni 'a cXYfbYbž'gUh]f]gW\Yb
5i ZZØ\fi b[Yb'fY]W\h''8Yf'A]I 'Ui g'YhUV`]YfhYb'i bX'Ui ZghfYVYbXYb
BUa Yb']b'XYf'H\YUhYf`UbXgW\UZh'gdf]W\h'Y]b'VfY]hYg'Di V`]_i a 'Ub
i bX'V]YhYh'gck c\``[fc»Y'I bhYf\U`hi b['U`g'Ui W\'h]YZYfY
9]bg]W\hYb"

 $: \varnothing f^*X]Y \Upsilon b][Yb\check{z}^*X]Y^*g]WX^*Z \varnothing f^*XYb^*H]W_Yh_Ui Z^*]bhYfYgg]YfYb\check{z}^*ghY Yb X]Y^* \oplus Zcfa Uh]cbYb^*Ui Z^*XYf^*K YVg]hY^*XYf^*?i^*hi f[Ya Y]bXY^*ni f JYfZ \varnothing [ib["'5i WX^*X]Y^*Hcif]gh! <math>\oplus$ Zcfa Uh]cb^*]a^*: 5F6^*]ghY]b nYbhfU^Yf^5b^*Ui Zdib_h^*Z \varnothing f^*U^*Y^*: fU[Yb^*fibX^*ia^*XUg^*Dfc[fUaaibX^*X]Y^5i ZZ \varnothing Yfib[Yb^*K Yf^*Ub^*Y]bYa^*XYf^*JYfUbghU^*hi b[YbhY]^*bYXaYb^*a^*OW hYž^*gc^*hY^*g]WX^*VYY]^Ybž^*XYbb^*X]Y^*BUWXZ fU[YnY][hz^*XUgg^*X]Y^*H]W_Yhg^*gWX^*bY^**j Yf[f]ZZYb^*g]bX"

$K \]WX h][Y ? c b hU_hX UhY b$

 $K \ Yf'a \ Y \ f' + b \ Zc fa \ Uh]c \ b \ Yb \ V \ Yb \ Oh][\ hz'' _ Ubb \ 'g]W \ `Ub \ 'X]Y$

: UWX UV hY]`i b['?ca a i b]_Uh]cb'XYf'GhUXh'6cf_Yb'k YbXYb"'8]Y DfYggYghY``Y'k]fX'j cb': fUi '\(\frac{1}{2}\)]U';]fbh\'[Y`Y]hYh'i bX']gh'i bhYf'XYb Zc`[YbXYb'?cbhU_hXUhYb'YffY]WXVUf.

GhUXh'6cf_Ybž: UWXUVhY]`ib['?caaib]_Uh]cb

=a D]YdYfgU[Yb'%+

(*' &) '6cf Yb

HY`YZcb.'f\$&, *%L'-'-!%\$*

HY`YZUI.'f\$&, *%L'-'-!*&!%\$*

9!AU]`. dfYggYghY``Y4 $Vcf_Yb"XY$

8]Y`\c\Y`6YhY]`][ib[`Ua `Jcfj Yf_Ui ZibX`XUg
UVk YWkg`ib[gfY]WkY`Dfc[fUa a `nY][Ybž`XUgg`X]Y`?i`hifgnYbY`]b
6cf_Yb`Z`cf]Yfh"`8]Y`6Øf[Yf`gWkÀhnYb`X]Y`A Ò[`]Wk_Y]hž`]b`XUg
H\YUhYf`YVYb`Y]bnihUiWkYbž`ibX`X]Y`J]Y`ZU`h`Ub`Ub[YVchYbYb
GhØW_Yb`]gh`Y]b`_`UfYf`±bX]_Uhcf`XUZØfž`XUgg`_i`hifY``Y`9jYbhg
k Y]hYf\]b`Y]bY`k]Wkh][Y`Fc``Y`]a `qhÀXh]qWkYb`@YVYb`qd]Y`Yb"

8 Ugʻ_i`hi fY``Yʻ5b[YVch`XYfʻGhUXhʻ6cf_Ybʻ]ghʻb]Wkhʻbi fʻUi ZʻXYb H\YUhYfVYfY]WkʻVYgWkfÀb_hžʻgcbXYfbʻi a ZUgghʻUi WkʻY]bYʻJ]Y`nU\`j cbʻJYfUbghU`hi b[Ybʻ]bʻUbXYfYbʻ?i bghlʻi bXʻ?i `hi fgdUfhYb"'8]Y GhUXh``Y[hʻ[fc»YbʻK Yfh`XUfUi ZžY]bYʻVfY]hYʻDU`YhhYʻUb__Øbgh`Yf]gWkYbʻ8UfV]Yhi b[YbʻUbni V]YhYbžʻi a 'X]Yʻ6Øf[Yf]bbYb i bXʻ6Øf[Yfʻni 'a ch]j]YfYbžʻUbʻ_i `hi fY``Ybʻ5_h]j]hÀhYb hY]`ni bY\a Ybʻi bX`XUgʻ; Ya Y]bgWkUZhg`YVYbʻni 'ZÒfXYfb"

8]Y: OfXYfi b['XYf'?i 'hi f'\Uh']b'8Yi hgW\`UbX'Y]bY'`Ub[Y HfUX]h]cb"'J]Y`Y'GhÀXhY'i bhYfghØhnYb'U_h]j '`c_U`Y'?Øbgh`Yf'i bX H\YUhYf[fi ddYb'Xi fW\'Z]bUbn]Y``Y'Ni gW\ØggY'i bX cf[Ub]gUhcf]gW\Y'<]`ZY"'8]Yg'hfÀ[h'b]W\h'bi f'ni f'GhY][Yfi b['XYf@YVYbgei U`]hÀh'VY]ž'gcbXYfb'Ui W\'ni f'k]fhgW\UZh`]W\Yb 9bhk]W`i b['XYf'FY[]cb"

?i `hi fY``Y 'J]Y`ZU`h]b '6cf_Yb

6cf_Yb']gh'VY_Ubbh'ZØf'gY]bY'J]Y`ZU`h'Ub'JYfUbghU`hi b[Ybž'X]Y

ØVYf'XUg'H\YUhYf'\]bUi g[Y\Yb"'Jcb'Aig]_ZYgh]j U`gž
?i bghUi gghY``i b[Yb'V]g'\]b'ni '@Ygi b[Yb'i bX'K cf_g\cdg'k]fX

Y]bY'VfY]hY'DU`YhhY'[YVchYbž'X]Y'j YfgWX]YXYbY' +bhYfYggYb'i bX

5`hYfg[fi ddYb'Ubgdf]WXh"'8]YgY'_i `hi fY``Y'J]Y`ZU`h']gh
YbhgWXY]XYbX'ZØf'XUg'gcn]U`Y'@YVYb']b'XYf'GhUXh'i bX'ZÒfXYfh'XUg
Ni gUa a Yb[Y\Òf][_Y]hg[YZØ\`i bhYf'XYb'9]bk c\bYfb"

9]b 6`]W_ Ui Z X]Y Z]b Ub n]Y ``Y b 5 gd Y _hY

8]Y::]bUbn]Yfi b['_i`hi fY``Yf`DfcY_hY`]b`6cf_Yb`YfZc`[hcZha U`g Xi fWX`ÖZZYbh`]WXY; Y`XYf`gck]Y`Xi fWX`Gdcbgcf]b['j cb``c_U`Yb I bhYfbY\a Yb"'=b`XYb``YhnhYb`*J\fYb`k i fXY`Y]b VYgcf[b]gYffY[YbXYf`HfYbX`VYcVUWXhYh`J]Y`Y`?i`hi f]bgh]hi h]cbYb_Aa dZYb`a]h`g]b_YbXYb`A]hhY`b`Ui Z[fi bX'j cb < Ui g\U`hg_Øfni b[Yb"'8]Yg`\Uh`XUni `[YZØ\fhž`XUgg`Y]b][Y JYfUbghU`hi b[Yb`bi f`a]h`[fc»Ya '5i Zk UbX`fYU`]g]Yfh`k YfXYb_ObbYb"

9]b'6Y]gd]Y`ZØf'YfZc`[fY]W\Y'Z]bUbn]Y``Y'I bhYfghØhni b[']gh'X]Y
DUfhbYfgW\UZh'nk]gW\Yb'XYf'GhUXh'i bX'`c_U`'UbgÀgg][Yb
I bhYfbY\a Yb"'8]YgY'Gdcbgcf]b[g'\Y`ZYb'b]W\h'bi f'VY]'XYf
:]bUbn]Yfi b['j cb'J YfUbghU`hi b[Ybž'gcbXYfb'ghÀf_Yb'Ui W\'X]Y
6]bXi b['nk]gW\Yb'K]fhgW\UZh'i bX'?i `hi f"'NU\`Yb'VY`Y[Ybž'XUggGhÀXhY'a]h'Y]bYa 'U_h]j Yb'_i `hi fY``Yb'@YVYb'Ui W\'k]fhgW\UZh`]W\VYggYf'UVgW\bY]XYbž'XU'g]Y'a Y\f'Hci f]ghYb'Ubn]Y\Yb'i bX'X]Y
@YVYbgei U`]hÀh']\fYf'6Yk c\bYf'Yf\O\Yb"

 $: \varnothing f'X]Y'_ca \ a \ YbXY'H\YUhYfgU]gcb'k \]fX'Ui \ Wk'Yfk \ UfhYhž'XUgg'X]Y\\ H]W_Yhj \ Yf_Ai \ ZY'Y]bYb'g][\ b]Z]_UbhYb'6Y]hfU['ni f':]bUbn]Yfi \ b['XYf5i \ ZZ\@\fi \ b[Yb'`Y]ghYb''8]Yg'nY][hž'k]Y'k]Wkh]['Yg']ghž'X]Y'`c_U`Y; Ya \ Y]bgWk \ UZh']b'X]Y'?i `hi fUfVY]h'Y]bni \ VYn]Y\Yb'i \ bX'X]Y'HY]`\UVYUb'_i `hi fY``Yb'J YfUbghU`hi \ b[Yb'ni 'ZÒfXYfb''$

K Y]hYfY = DZcfa Uh]cbYb'i bX'8YhU]`g'ØVYf'X]Y'_i `hi fY``Yb'5b[YVchY]b'6cf_Yb'_ObbYb' = bhYfYgg]YfhY'Ui Z'XYf'K YVg]hY'XYf
?i `hi f[Ya Y]bXY'X]Y!_i `hi f[Ya Y]bXY"XY'Y]bgY\Ybž'k c'Ui WXU_hi Y``Y'JYfUbghU`hi b[Yb'i bX'gdYn]Y``Y'5b[YVchY'XUf[YghY``hg]bX"

8 YhU]`g

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