

GUWX gYbž8Yi hgWX`UbX'!8]Y'7cfcbU!DUbXYa]Y'\Uh'X]Y

a dZVYfY]hgWXUZh']b'XYf'; YgY``gWXUZh'Yf\YV`]WX'VYY]bZi gghži bX
X]Yg'k]fX'j cb' & ZY_h]c`c[Y'H\ca Ug'; fØbYk U`Xž'XYa'7\YZ'XYf
gÀWXg]gWXYb' a dZ_ca a]gg]cbž'XYi h`]WX'\Yfj cf[Y\cVYb'' @Ui h
Y]bYa'6Yf]WXh'j cb'`j n''XY'g]bX'VYgcbXYfg']b'GUWXgYb'g][b]Z]_UbhY
@ØW_Yb'VY]'XYb'5i ZZf]gWXi b[g]a dZ b[Yb'ZØf'9fk UWXgYbY'ni
VYcVUWXhYb''GU]gcbU`Y' a dZ b[Ybž'k]Y'[Y[Yb' & Zi YbnUž'7cfcbU
i bX'FGJ ž'k YfXYb'b]WXh'Ui gfY]WXYbX'[Ybi hnhži bX'Ui WX
GhUbXUfX]a dZ b[YbžYhk U'[Y[Yb'8]d\h\Yf]Y'i bX'?]bXYf`À\a i b[ž
k YfXYb'j YfbUWX`Àgg][h"

; $f\emptysetbYk\ U`X`Z\emptyset\backslash fh`X]Y`j\ YfghAf_hY`=a\ dZg_Ydg]gžX]Y`gY]h`Yhk\ U`%$`V]g$ %) '\$\J\fYb`VYghY\hž`]b`YfghYf`@]b]Y`Ui\ Z`X]Y`bY[\ Uh]j\ Yb\ 5i\ gk\]f_i\ b[\ Yb`XYf`DUbXYa\]Yb`ni\ f\ØW_"`8]Y`G_Ydg]g`\Uh`]b\ GUW\ gYbžY]bYa\ ik\ U\f\\UZhYb`<\chgdch'X]YgYf`9bhk\]\W_`i\ b[\ ž\\YgcbXYfg`ni\ [\ Ybca\ a\ Yb\"`K\ A\fYbX`XYf`DUbXYa\]Y`Yf\]Y`hYb\ =a\ dZYa\ dZY\`i\ b[\ Yb`cZh`XYb`7\UfU_hYf`Y]bYf`8fUb[\ gU`]Yfi\ b[\ ž`k\ Ug\ X]Y`5_nYdhUbn`k\ Y]hYf`j\ Yff]b[\ YfhY\"`A\ YbgW\ Ybž`X]Y`g]W\`[\ Y[\ Yb\ =a\ dZi\ b[\ Yb`YbhgW\ Y]XYbž`gY\Yb`g]W\`ni\ bY\a\ YbX`U`g\ K\]XYfghAbX`Yf`[\ Y[\ Yb`XYb`GhUUhž`k\ Ug`X]Y`8]g_i\ fgY`fi\ bX`i\ a\ =a\ dZi\ b[\ Yb`_ca\ d`]n]YfhYf`a\ UW\ h"

?f]h]_ Ub XYf ?ca a i b]_Uh]cb

 $8\,Yf^*A\,YX]n]b\,Yf^*Z\!cfXYfh^*Y]b\,Y^*_f]h]gW\!\!,\,Y^*,\,\,V\,Yfd\,f\varnothing Z\!\!,\,\,b\,[\,\,^*XYf^*7\,cfc\,b\,U!$

A U» bU\a Yb]b GUW\gYb "6YgcbXYfg VYa Åb[Y`h Yf X]Y ?ca a i b]_Uh]cb nk]gW\Yb ; Y]a dZhYb i bX I b[Y]a dZhYb "K À\fYbX ZfØ\YfY J]fi gj Uf]UbhYb X]Y =a dZi b['ni f J Yf\]bXYfi b['XYf J]fi gØVYfhfU[i b['fYW\hZYfh][hYbž'[]`h X]Yg'b]W\ha Y\f ZØf X]Y Ca]_fcb!J Uf]UbhY "8]YgY \ddot{y} bXYfi b['\Uh'ni 'Y]bYf 'k Y]hYfYb J Yfk]ffi b['VYnØ[`]W\ XYf =a dZbchk YbX][_Y]h [YZØ\fhž'k Ug'X]Y 5_nYdhUbn XYf =a dZi b[Yb 'k Y]hYf VYY]bhfÀW\h][h"

8]Y = dZg]hi Uh]cb :nY][h:g]WX :b]WX h:bi f:]b:XYf:VfY]hYb:6Yj \hat{O} :_Yfi b[\hat{z} gcbXYfb:YVYbZU``g:]a:DZY[YdYfgcbU`":9]bY:la:ZfU[Y:ØVYf:X]Y = dZVYfY]hgWX UZh:j cb:DZY[Y_fÀZhYbž:VYf]WX hYh:j cb:da:WbWW]"b`a:"b]\"[cj \hat{z} :nY][h \hat{z} :XUgg:j cb:')):VYZfU[hYb:DZY[Y_fÀZhYb')\$ \hat{z} +1:VYfY]hg:[Y]a:dZh:k:UfYb:cXYf:Y]bYb:ZYghYb=a:dZhYfa]b:\UhhYb":8YbbcWX:Y\bhYb''(\hat{z} (1:Y]bY:=a:dZi:b[:UV":9]b<<Ui>Ui:dh[fi:bX:ZØf:X]Y:5V`Y\bi:b[:k:Uf:X]Y:5b[:gh:j:cf]

8Yf'K Y['bUW 'j cfbY

8]Y I a $ZfU[Y'jYfXYih']WhizXUgg'(+z*i-XYf'DZY[Y_fAZhY'Y]bY$ \Rightarrow d $ZdZ]WhiUV'YhbYbz'kcVY]'bif'&'z'(i-X]YgY'VYZØfkcfhYb"'8]Y [Yf]b[Y'<math>\Rightarrow$ d $ZVYfY]hgWhUZhz'jcf'U``Ya'ibhYf'DZY[Y_fAZhYb']b$ DZY[Y\Y]a Ybz'gck]Y'X]Y'U``[YaY]b'ghY][YbXY' \Rightarrow d $Zg_Ydg]g$ YfZcfXYfb'Xf]b[YbX'5iZ_`Afib[g_UadU[bYb"'8]YgY'gc``hYb'g]Whycf'U``Ya'UiZ'X]Y'Ÿb[ghY'XYf'AYbgWhYb'_cbnYbhf]YfYbz'ia'XUg JYfhfUiYb']b'X]Y'bchkYbX][Yb' \Rightarrow dZib[Yb'k]YXYf\YfnighY``Yb'ibXY]bY'VfY]hYfY'5_nYdhUbn'ni'ZÔfXYfb"

J c f ZU``	Gcbgh][Yg
Cfh	GUWN, gY bž′8 Yi hgWN`UbX
Ei Y``Yb	• k k k "`j n"XY
	• da WbWW]"b`a "b]\"[cj

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z. 'b!U["X Y