

HfUi Yf i a 'A Uf]gU 6i f[Yf. 'FcgYb\Y]a! 7cdg'!=_cbY'j Yf`Aggh'X]Y'GYf]Y°

A Uf]gU 6i f[Yf j Yf Aggh bUW &) '≯J\fYb X]Y
/ ei ch/F cgYb\Y]a !7cdg/ ei ch/" → f 5VgW]YX ``Ògh VY]
?c``Y[Yb i bX : Ubg 6YXUi Yfb Ui g"



A Uf]gU'6i f[Yfž'X]Y'gY]h'XYf'YfghYb': c`[Y'XYf'FY]\Y']a ' $\frac{1}{2}$ \f'&\$\$\$ a]h'Gd]Y`gdU» 'i bX'7\Ufa Y'XUg'Di V`]_i a 'VY[Y]ghYfhY'i bX'a]h

XYa 'GUhn' 9g'[UVUh'U'@Y]W\ 'ni f'?i `hZ][i f'Uj UbW]YfhYž'k]fX'bcW\
V]g'<YfVgh'&\$&) 'ZØf'X]Y'&) "'GhUZZY`'j cf'XYf'? Ua YfU'ghY\Yb"'8]Y
`YhnhYb'&%': c`[Yb'k i fXYb'gY]h'9bXY'A Àfn'[YXfY\h'i bX'g]bX'ZØf
X]Y'5i gghfU\`i b['UV'C_hcVYf'&\$&) '[Yd`Ubh": Øf'6i f[Yf'gY`Vgh
k Uf'X]Y'9bhgW\Y]Xi b[ž'X]Y'GYf]Y'ni 'j Yf`UggYbž'b]W\h'Y]bZUW\"'G]Y
VYgW\fY]Vh'g]Y'U'g' gW\k Yfž'UVYf'bchk YbX]['i bX'ZfYi h'g]W\'Ui Z
bYi Y'<YfUi gZcfXYfi b[Yb']b'i bhYfgW\]YX`]W\Yb'Fc``Yb"' A Ub'a i gg
Ui Z'XUg'<Yfn'\ÒfYb'i bX'Y][YbY'9bhgW\Y]Xi b[Yb'hfYZZYb ž'gc'X]Y
GW\Ui gd]Y`Yf]bž'X]Y'a]h') %'\\Y\fYb'XYb'b\W\ghYb'GW\f]hh']b']\fYf
?Uff]YfY'k U[Yb'a ÒW\hY"

?c``Y[Yb'nY][Yb'g]WX'VYhfcZZYb

8]Y?c``Y[Yb'jcb'AUf]gU'6if[Yf'gW\Y]bYb'g]W\'Y]bgh]aa]['ØVYfXYb'5VgW\]YX'ni kibXYfb'ibX'ni 'gcf[Yb'''={cf'*/Zh}\\ZYYf'gY]h\&\\$-a]h'6if[Yf'nigUaaYbUfVY]hYh\ZYVYnY]W\bYh']\fYb'5iggh]Y[U`g' GW\cW_Yf'ibX'\YVh']\fY'nYbhfU`Y'6YXYihib['Z\Øf'X]Y'GYf]Y\Yfjcf'''=\D'Y]bYa'\A\b`]W\Yb'HYbcf'\Ai \(\text{y}\)Yfy'a 'A\b`]W\Yb'HYbcf'\Ai \(\text{y}\)Yf'gY]bY\HfUif][_Y]h'ibX'VYnY]W\bYhY'6if[Yf'U`g' 8]UaUbh \(\text{z}\XYggYb\)\\Y\Yb'Y]bYb'k]W\h][Yb'JYf'igh'\Z\Øf'X]Y'DfcXi_h]cb'VYXYihYh''\A\Ø``Yf'nY][h'g]W\'YXcW\'cdh]a]gh]gW\'\ØVYf'6if[Yfg'ni_\Øb\Zh][Y\DfcY_hY'ibX']gh'\ØVYfnYi[h\Z\Ugg'g]Y'gW\\bY``bYiY'Fc``Yb'\Z]bXYb\k]fX''

8]Y'DfcXi nYbh]b'9`]gUVYh\'J]``chh]'\À`h'g]W\'VYnØ[`]W\'Y]bYf
a Ò[`]W\Yb'BUW\Zc`[Yf]b'VYXYW_h"8YfnY]h'`Ui ZYb'VYfY]hg'YfghY
D`Ubi b[Yb'ZØf'X]Y'&* "'GhUZZY``XYf'GYf]Yž'k cVY]'Mci bYg'H]gg]bhY'U`g
a Ò[`]W\Yf'BUW\Zc`[Yf'[Y\UbXY`h'k]fX"'6]g`Ub['\UhhY'H]gg]bhY
'YxcW\'`YX][``]W\'JYfhfYhi b[Yb'ZØf'6if[Yf'ØVYfbca a Ybž'gcXUgg
bcW\'cZZYb'V`Y]Vhž'k Yf'`Yhnh`]W\'XUg'9fVY'XYf'VY`]YVhYb'GY_fYhÀf]b
UbhfYhYb'k]fX"

9]b 6`|W_ |b X |Y Ni _i b Zh

 $8 \ UfghY``Yf]b`hfYhYb`_ObbYbž'k]fX`g]WX`nY][Yb"`9]bYg`ghY\h`ZYgh A Uf]gU`6i f[Yf'\]bhYf`Aggh`Y]bYb`V`Y]VYbXYb`9]bXfi W_ž'b]WXh`bi f`]b XYf`GYf]Yž'gcbXYfb`Ui WX`]a `<YfnYb`]\fYf`: Ubg`i bX`?c``Y[Yb"`8]Y GYf]Yž'X]Y`]a a Yf`X]YbghU[g`i a `%- .&) `I\f`]a `N8:!@j YghfYUa `Ui Z <math>\times mb$ `Ui g[YghfU\`h`k]fXž'k]fX`g]WXYf`kY]hYf\]b`j cb`]\fYb dfA[YbXYb`A ca YbhYb`dfcZ]h]YfYb"

K À\fYbX'k]f'i bg'Ui Z'X]Y `YhnhYb': c`[Yb'a]h'6i f[Yf'ZfYi Ybž'V`Y]Vh X]Y'<cZZbi b[ž'XUgg']\fY'5Vk YgYb\Y]h'VY]'XYb' FcgYb\Y]a !7cdg b]W\h'ni '[fc\gamma'gY]b'k]fX'''K Ug'XYb_h']\f'ØVYf']\fYb'5VgW\]YX3'\scmb VYf]W\hYh'ØVYf'X]Y'9a ch]cbYb'fi bX'i a ']\fYb'F \emptyset W_ni ['i bX'k Ug U`g'BÀW\ghYg'Z \emptyset f'X]Y'GYf]Y'UbghY\h'''9]b'k Y]hYfYf'5fh]_Y``Ui Z' FcgYb\Y]a &('V]YhYh'9]bV`]\W_Y']b'X]Y']bhYfbYb'JYf\UbX`i b[Yb \emptyset VYf']\fY'BUW\Zc`[Yž'k À\fYbX'N8:\Yi hY'ni gÀhn`]\W\Y'8YhU]`g'ni]\fYf'?Uff]YfY'VY`Yi W\hYh''

8 Y hU]`g	
Cfh	FcgYb\Y]a ž8Yi hgWX`UbX
EiY``Yb	• k k k "^c mb "X Y
	k k k "fcgYb\Y]a &("XY
	• k k k "nXZ\Yi hY"XY

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z. 'bU[!VUmYfb"XY