

91 !;]dZY`. GhfY]h'i a '=gfUY`'i bX FØghi b[gdfc[fUa a ']a ': c_i g°

91!;]dZY``]b`6fØggY``&\$&).`G]WXYf\Y]hgghfUhY[]Ybž'BU\cgh!?f]gY'i bX'A][fUh]cbgZfU[Yb`]a :: c_i g"'9bhgWXY]XYbX`ZØf9i fcdUg'Ni_i bZh"



K]YXYbž'² ghYffY]WX '! '5a '&* "' '* b] '&\$&) 'hfUZYb'g]WX 'X]Y
Yi fcdÀ]gWXYb'GhUUhg! 'i bX'FY[]Yfi b[gWXYZg'ni a '9I!
Gca a Yf[]dZY`']b'6fØggY`"8]YgYf'ZUbX'i ba]hhY`VUf'bUWX'XYa
B5HC!;]dZY`']b'8Yb'< UU['ghUhh'i bX'ghUbX'[Ubn']a 'NY]WXYb'j cb
G]WXYf\Y]h'i bX'JYfhY]X][i b["'6YgcbXYfg'X]Y'G]hi Uh]cb']a 'BU\Yb
CghYb'gcf[hY'ZØf'\]hn][Y'8]g_i gg]cbYb'i bX'i bhYfgWX]YX`]WXY
A Y]bi b[Yb'i bhYf'XYb': Ø\fi b[gj YfhfYhYfb"'? `Y]bY'NY]hi b[
VYf]WX hYhž'XUgg'%' 'XYf'Di b_hY']b'XYf'GWX'i ggYf_`Àfi b['XYg
;]dZY`g'g]WX'a]h'X]YgYb'H\Ya Yb'Ui gY]bUbXYfgYhnhYb"

9]b 'nYbhfu`Yg'H\Ya U'k Uf'XUg'G5: 9!Dfc[fUa a ž'Y]b 'bYi Yg J YfhY]X][i b[gXUf`Y\YbgdU_Yhž'XUg':]bUbn]Yfi b[Yb']b'<Ò\Y'j cb V]g'ni '%) \$'A]``]UfXYb'9i fc'VYfY]hghY``h''8]Y'9i fcdÀ]gW\Y ?ca a]gg]cb \UhiXUa]hiXYb K Y['[YYVbYhži a 'XYb A]h[`]YXghUUhYb A]hhY` 'ZØf' \Dightarrow j Ygh]h]cbYb ']b '6YfY]WXY' k]Y
: `i [UVk Y\f'i bX '8fc\bYbhYWXbc`c[]Y'ni f'J YfZØ[i b['ni 'ghY``Yb" ?ca a]gg]cbgdfÀg]XYbh]b I fgi `U'j cb 'XYf'@YmYb 'VYhcbhY' X]Y
8f]b[`]WX_Y]hžXUgg '9i fcdU'a Y\f'J YfUbhk cfhi b['ZØf'gY]bY'Y][YbY G]WXYf\Y]h'ØVYfbY\a Yb 'a ØggY"'8]Y'9I !J YfhfYhi b[
VYnY]WXbYh'X]Y'9]b][i b['U`g'k Y[k Y]gYbXYb 'GWXf]hh'ni f
GhÀf_i b['9i fcdUgž'XU'X]Y'A]h[`]YXghUUhYb']bbYf\U`V'j cb'gYWXg
A cbUhYb'bUh]cbU`Y'D`ÀbY'j cf`Y[Yb'a ØggYbž'X]Y'XUbb'j cb'XYf
?ca a]gg]cb'VYk YfhYh'k YfXYb"

$I bY]b][Y]h ØVYf XYb BU\Yb CghYb$

Hfchn'XYf': cfhgWkf]hhY']a 'JYfhY]X][ib[gVYfY]Wk'V'Y]Vh'X]Y
G]hi Uh]cb']a 'BU\Yb'CghYb'Y]b': U_hcfž'XYf'GdUbbib[Yb']bbYf\U'V
XYf'9I 'j YfghÀf_h''K]Y'? 'Y]bY'NY]hib['ZYghghY``hž'[]Vh'Yg
k Yb][Yf'JYfghÀbXb]g'ZØf'X]Y']gfUY`]gWkY'Dc`]h]_"'Jcf'U``Ya 'X]Y
FY[]Yfib[gWkYZg'jcb'GdUb]Yb'ibX'G`ckYb]Yb'_f]h]g]YfhYb'VY]a
;]dZY``X]Y'\iaUb]hÀfY'? UhUghfcd\Y']b'; UnU'ibX'ZcfXYfhYb'Y]bYb
K UZZYbgh]``ghUbX'gck]Y'X]Y': fY]`Uggib['U``Yf'; Y]gY`b"'8]YgY
H\YaYb'gd]Y[Y`b'h]YZYfY'; fÀVYb'k]XYfž'X]Y'g]Wk'ibhYf'XYb
YifcdÀ]gWkYb'GhUUhYb'UiZhib"

2 ghYffY]WXg'? Ubn`Yf'7\f]gh]Ub'GhcW_Yf'Yf[f]ZZ'YVYbZU``g'XUg'K cfh i bX'h\Ya Uh]g]YfhY'X]Y'<YfUi gZcfXYfi b[Yb'fi bX'i a 'X]Y
8 f]hhghUUhYbZfU[Yb'i bX'XYb'GWXi hn'XYf'5i »Yb[fYbnYb"' ♣ba]hhYb
X]YgYf'8 YVUhhYb'ZcfXYfhY'I b[Ufbg'DfYa]Yf'J]_hcf'CfV½b'Y]bY
FYVY``]cb'[Y[Yb'VYghY\YbXY'A][fUh]cbgfY[Y`b'i bX'ghY``hY'gY]b
JYhc'[Y[Yb'Y]b'bYi Yg'GUb_h]cbgdU_Yh'[Y[Yb'Fi gg`UbX'Ui gž'k Ug
X]Y'9]b][_Y]h']bbYf\U`V'XYf'I b]cb'k Y]hYf'Ui Z'X]Y'DfcVY'ghY``h"

cfhgWxf]hhY VY]a A][fUh]cbgdU_h

Hfchn:XYf:8]ZZYfYbnYb:]a '6YfY]WX:XYf:5i »Ybdc`]h]_'[UV:Yg:Ui WXdcg]h]j Y:BUWXf]WXhYb.:8]Y:9I!?ca a]gg]cbgdfÀg]XYbh]b:I fgi `U'j cb XYf:@YmYb:j Yf_ØbXYhY::cfhgWXf]hhY:VY]a 'A][fUh]cbgdU_h":8]Y A]h[`]YXghUUhYb:nY][Yb:g]WX:Y]b]['XUf]bž:XUgg:Y]b:[Ya Y]bgUa Yg Jcf[Y\Yb:VY]:XYf:A][fUh]cb:i bj Yfn]WXhVUf:]gh":8Ug:?Ud]hY:`ØVYf

 $X]Y \cap _f U]bY \cap _g Y \partial _h]Y \rangle \cdot Ui \ Z' V \cap _f Y]hYb \cap _Ni \ gd \ fi \ WX \ Z' Ui \ WX \cap _k Y \cap _$

8]Y'<YfUi gZcfXYfi b[Ybžj cf'XYbYb'X]Y'9I 'ghY\hžg]bX'j]Y'ZÀ'h]["
K À\fYbX'X]Y'5i ZghcW_i b['XYf'JYfhY]X][i b[gUi g[UVYb'i bX'XYf
]bbcj Uh]cbgUV\Àb[][Y'5bgUhn'VY]a 'G5: 9!Dfc[fUa a ']b'X]Y
f]W\h][Y'F]W\hi b['k Y]gYbž'k]fX'X]Y'Bchk YbX][_Y]h'Y]bYg']bhYfbYb
?cbgYbgYg'ØVYf'X]Y'Dc']h]_']a 'BU\Yb'CghYb'i bX'UbXYfY
Xf]b[']W\Y': fU[Yb']a a Yf'_`UfYf"'9g'V'Y]Vh'UVni k UfhYbž'k]Y'g]W\
X]Y'9I ']b'XYb'_ca a YbXYb'A cbUhYb'dcg]h]cb]YfYb'k]fX"

8 YhU]`g	
Cfh	K]YXYbž ² ghYffY]WX
EiY``Yb	 k k k "_`Y]bYnY]hi b["Uh [Yfa Ubm"fYdfYgYbhUh]cb"YWYi fcdU"Yi k k k "Yi fcdUf`"Yi fcdU"Yi

6Ygi WXYb G]Y i bg Ui Z a Y]b!k]Yb bYh