

BYi Yf'DfÀg]XYbh'B[i Ya U'hf]i a d\]Yfh'VY] \]ghcf]gW\Yf'K U\`']b'; UVi b'

; YbYfU`'6f]WY'C`][i]'B[iYa U'kifXY'U`g'G]Y[Yf'XYf'YfghYbDfÀg]XYbhgW\UZhgkU\`'; UVibg'gY]h'XYa 'DihgW\'&\$&' 'Yf_`Àfh"



@]VfYj]``Yž; UVi b !; UVi b \UhiY]bYb bYi Yb DfÀg]XYbhYb.

; YbYfU``6f]W'`C`][i]'B[iYa U'kifXY'nia 'G]Y[Yf'XYf'YfghYb
DfÀg]XYbhYbk U\``gY]h'XYa 'Di hgWk'j cb &\$&' 'Yf_`Afh"'@Ui h'XYb
j cf`Ai Z][Yb '9f[YVb]ggYb 'XYg' \DYba]b]ghYfg' < Yfa Ubb
\(\alpha \alpha \cdot b \text{ Uhi 'h'Yf\]Y'h'B[iYa U'VYY]bXfi W_YbXY' - \$\vec{z}') 'DfcnYbh'XYf
Gh]a a Yb 'i bX'gYhnhY'g]Wk'[Y[Yb'g]YVYb'UbXYfY'? UbX]XUhYb
Xi fWk"'8]Y'K U\`VYhY]`][ib['`U['VY]'Yhk U'+\$'DfcnYbh'XYf'fibX
- &\$"\$\$\$'fY[]ghf]YfhYb'K U\`VYfYWkh][hYb"'8]Yg'kifXY'jcb'
HU[YggWk Ui 'a]h'Y]bYf'6YhY]`][ib['jcb', +'DfcnYbh']b'9]b_`Ub[
[YVfUWkhz'k Ug'Ui Z'XUg'[fc*Y'\DhYfYggY'XYf'6Yj\O`_Yfib['\]bk Y]gh"

B[iYa Už'XYf'gY]h'XYa 'ibV`ih][Yb'GhUUhgghfY]W\']a '5i[igh'&\$&', VYf[Ub[gdfÀg]XYbh']ghž'k Uf'XYf'_`UfY': Uj cf]h']b'X]YgYa

K U\`_Ua dZžXYf'j cb'gY]bYf'8ca]bUbn']b'XYb'A YX]Yb'i bX'XYf
K YfVYk]f_i b['[YdfÀ[h'k Uf"'D`U_UhY'gY]bYf'?cbhfU\YbhYbž
]bgVYgcbXYfY'XYg'ZfØ\YfY'FY[]Yfi b[gW\YZg'5`U]b!7`Ui XY'6]`]Y'6m
BnYž'k UfYb']b'XYf'< Ui dhghUXh'@]VfYj]``Y'_Ui a 'g]W\hVUf"'6m'BnY
Yf\]Y`h'`YX][`]W\'Yhk U'XfY]'DfcnYbh'XYf'Gh]a a Yb"

8Yf?cbhYlh'XYg'DihgWXYg

BUWW XYa 'Di hgWW 'k i fXY '5`] '6cb[c'CbX]a VU'i bhYf'< Ui gUffYgh [YghY``h"'8]Yg'ZØ\fhY'ni 'Y]bYf'K Y``Y'XYf': Y]Yf`]WW_Y]hYb']b @VfYj]``Yž'k c'<i bXYfhY'j cb'A YbgWW Yb'X]Y'bYi Y'a]`]hÀf]gWW Y: Ø\fi b['i bX'B[i Ya U'ZY]YfhYb"'HU[YggWW Ui 'VYf]WW hYhž'XUgg'X]Y A]`]hÀfg'X]Y'A UWW hØVYfbU\a Y'j Yf_ØbXYhYb'i bX'X]Y'6Yj Ò`_Yfi b[j cb'Y]bYa 'BYi UbZUb['ZØf'; UVi b'hfÀi a h"

6`]W_']b'X]Y'Ni _i bZh

8]Y'bYi Y'J YfZUggi b['g]Y\h'ZØf'XYb'DfÀg]XYbhYb'Y]bY'5a hgnY]h'j cbg]YVYb'\J\fYb'j cfž'X]Y'Y]ba U`'j Yf`Àb[Yfh'k YfXYb'_Ubb"'9]b][Ydc`]h]gWXY'; Y[bYf'k YfZYb'B[i Ya U'j cfž'Yf'k c``Y'g]WX'Ub'XYf A UWXh'\U`hYb"'8Yf'9]bZi gg'XYg'A]`]hÀfg'Ui Z'X]Y'dc`]h]gWXY'Ni _i bZh; UVi bg'_ÒbbhY'g]WX'U`g'dfÀ[YbX'\YfUi gghY``Ybž']bgVYgcbXYfY']b?cffY`Uh]cb'ni 'XYb'nU\`fY]WXYb'a]`]hÀf]gWXYb'A UWXhØVYfbU\a Yb]b'UbXYfYb'UZf]_Ub]gWXYb'@ÀbXYfb']b'XYb'`YhnhYb'\J\fYb"

 $8] Y K U Yb] b ; UV i b g] b X Y] b k Y] h Y f Y g ? Ud] h Y Y f Y h i f V i Yb h Y b d c Yg X Y g X g Z Ub X Y g Z X Ug g c k c \ j c b < c Z D i b [U Y g X Y g$

Ui WX 'j cb'G_Ydg]g'[YdfÀ[h']gh": 5N'\YVh'\Yfj cfž'XUgg'X]Y
FYU_h]cbYb']bhYfbUh]cbU`'i bhYfgWX]YX`]WX 'g]bXž']bgVYgcbXYfY
bUWX'XYa '_`UfYb'K U\`Ui g[Ub['ZØf'B[i Ya Už'XYggYb'5[YbXU'g]WX
j cb'UbXYfYb'@ÀbXYfb']b'XYf'FY[]cb'UV\YVYb'_ObbhY"

8 YhU]`g	
J cfZU``	K U\`Yb
Cfh	@]VfYj]``Yž'; UVi b
EiY``Yb	• k k k "ZUn"bYh
	• k k k "hU[YggW\Ui "XY
	• k k k "hU[YggW\Ui "XY

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