

D`Òb'YbhXYW_Yb.'GYYbž'; YgWX]WXhY'i bX $_i$ `]bUf]gWXY'< Ò\Ydi b_hY

 $9bhXYW_Yb^*G]Y^*X]Y^*fY]nj^*c^*Y^*GhUXh^*D^*Ob.^*j^*cb^*a^*U^*Yf]gWXYb^*GYYb^*ØVYf^*\]ghcf]gWXY^*<][^*][^*hg^*V]g^*\]b^*ni^*_i^*]bUf]gWXYb^*;^*Yb@ggYb^*i^*bX^*gdUbbYbXYb^*Ci^*hXccf!5_h]j^]hAhYb^*$



K]``_ca a Yb`]b`D`ÒbžY]bYf`W\Ufa UbhYb`GhUXh`]a `< YfnYbGW\`Ygk][!<c`ghY]bgžX]Y`a]h`]\fYf`a U`Yf]gW\Yb`@UbXgW\UZh`i bXfY]W\Yb`; YgW\]W\hY`VY[Y]ghYfh"`9]b[YVYhhYh`nk]gW\Yb`Y]bYfJ]Y`nU\``[`]hnYfbXYf`GYYb`i bX`i a [YVYb'j cb`X]W\hYb`K À`XYfbžV]YhYh`D`Òb`b]W\h'bi f`UhYa VYfUi VYbXY`5i gV`]W_Yž`gcbXYfb`Ui W\

Y]bY: Ø`Y; cb:5_h]j]hÀhYb:ZØf:YXYb; YgWa UW_"CV:Xi:X]Y
]Xm``]gWXYb: I ZYf:XYg:D`ObYf:GYYg:Yf_i bXYbž:X]Y:\]ghcf]gWXYb
GWXAhnY:XYf:GhUXh:YbhXYW_Yb:cXYf:X]Y:_i `]bUf]gWXYb
? Ogh`]WX_Y]hYb:XYf:FY[]cb:[Yb]Y»Yb:a OWXhYgh: D`Ob:\Uh:ZØf
YXYb:Yhk:Ug:ni:V]YhYb":\D:X]YgYa:5fh]_Y:`bY\a:Yb:k]f:X]WX:a]h:Ui Z
Y]bY:FY]gY:Xi:fWX:X]Y:k:i bXYfVUfYb::UWYhhYb:X]YgYf
VYnUi:VYfbXYb:GhUXh":A UWX:X]WX:VYfY]hž:X]Y:bUhi:fgWXObYb:GYYb
ni:Yf_i bXYbž:]b:X]Y:VYk:Y[hY:;YgWX]WX:hY:Y]bni:hUi:WXYb:i bX:X]Y
VYghY:`c_U`Y:?ØWXY:ni:dfcV]YfYb":@Ugg:i bg:[Ya:Y]bgUa
\YfUi:gZ]bXYbž:k:Ug:D`Ob:ni:Y]bYa:i bj:Yf[Ygg`]WXYb:FY]gYn]Y`
a UWX.h°

8]Ya U`Yf]gWXYb GYYb j cb D`Òb Yf_i bXYb

$$\begin{split} &\text{D`\^Ob} \check{z} \text{Y} \text{Jb} [\text{YVYhhYh'}] b \text{X} \text{JY'VYnUi VYfbXY'} < c \text{`ghY}] b \text{JgWXY'} GWXk Y] n\check{z}' \text{Jgh} \\ &\text{Y} \text{Jb'k U} \text{fYg'DUfUX} \text{JYg'} Z \emptyset \text{f'B Uhi f'} \text{JYV} \text{UVYf'i bX'K UggYfgdcfh'Yf''} 8 \text{JY} \\ &\text{GhUXh'} \text{Jgh'j cb'Y} \text{JbYf'J} \text{JY'nU} \text{'''j cb'GYYb'i a [YVYb} \check{z}' \text{X}] Y \text{'b} \text{JWX h'bi f} \\ &\text{UhYa VYfUi VYbXY'5i gV'} \text{JW_Y'V} \text{JYhYb} \check{z}' \text{gcbXYfb'Ui WX'nU} \text{`fY} \text{JW} \text{Y} \\ &\text{: fY} \text{JnY} \text{Jha O}[\text{`'}] \text{WX}_{\text{Y}} \text{JhYb'} \text{VYfY} \text{Jh} \text{U'hYb'''Ni 'XYb''VY}_{\text{UbbhYghYb'}} \text{GYYb} \\ &\text{nA} \text{``Yb'XYf'D`ObYf'} \text{GYY} \check{z}' \text{XYf'HfUa a Yf'GYY'i bX'XYf'?'Y} \text{bYb'D'ObYf} \\ &\text{GYY'''} \text{XXYf'X} \text{JYgYf'GYYb'} \text{Uh'gY} \text{bYb'Y} \text{JYbYb'7} \text{Ufa Y'i bX'V} \text{JYhYh} \\ &\text{j YfgWX} \text{JYXYbY'5}_{\text{h}} \text{j} \text{JhAhYb'} \text{Z} \emptyset \text{f'X} \text{JY'} \text{[UbnY': Ua]} \text{']Y''} \end{aligned}$$

8 Yf'D`ÒbYf'GYY']gh'XYf'[fÒ» hY'i bX'VY_UbbhYghY'GYY']b'XYf
FY[]cb"'A]h'Y]bYf': `ÀWXY'j cb'Yhk U'' \$'Ei UXfUh_]`ca YhYfb'Y][bYh
Yf'g]WX'\Yfj cffU[YbX'ZØf'Y]b'VfY]hYg'GdY_hfi a 'Ub
K UggYfgdcfhUfhYb"'<]Yf'_ÒbbYb'G]Y'gY[Y`bž'gi fZYbž'Ub[Y`b'cXYf
[Ya Øh`]WX'a]h'Y]bYa 'Fi XYfVcch'ØVYf'XUg'K UggYf'[`Y]hYb"'8]Y
nU\`fY]WXYb'6i WXhYb'i bX'j YfghYW_hYb'I ZYfghY``Yb'`UXYb'XUni 'Y]bž
X]Y'bUhØf`]WXY'GWXÒb\Y]h'XYg'GYYg']b'j c``Yb'NØ[Yb'ni '[Yb]Y»Yb"

6YgcbXYfg'VY`]YVh']gh'XUg'GW k]a a Yb']a 'D`ÒbYf'GYY"'8]Y'I ZYf g]bX'a]h'gW\ÒbYb'GhfÀbXYb'i bX'@]Y[Yk]YgYb'Ui g[YghUhhYhž'X]Y dYfZY_h'g]bXž'i a 'g]W\'Ub'Y]bYa 'gcbb][Yb'HU['ni 'YbhgdUbbYb"'8]Y VYghY'NY]h'ZØf'Y]bYb'6Ygi W\']gh'nk]gW\Yb'A U]'i bX'GYdhYa VYfž k Ybb'X]Y'K UggYfhYa dYfUhi fYb'Y]b`UXYbX'g]bX'i bX'nU\`fY]W\Y J YfUbqhU'hi b[Yb'Ua 'GYY'qhUhhZ]bXYb"

9]b k Y]hYfYf a U`Yf]gW\Yf Cfh']gh XYf HfUa a Yf GYYž XYf Yhk Ug UVgY]hg XYf < Ui dhfci hYb ``]Y[h'i b X XUXi fW\ Y]b Y fi \][Y C UgY V]YhYh" <]Yf _ ObbYb 'Ui g[YgW\]`XYfhY 'K Ub XYfk Y[Y i b X F UXk Y[Y YbhXYW_h'k YfXYbž'X]Y g]W\ i a 'XYb 'GYY gW\`Ab[Y`b"'BYVYb'XYf bUhØf`]W\Yb 'GW\ Ob\Y]h]gh XYf 'HfUa a Yf 'GYY'Ui W\ Y]b \Yfj cffU[YbXYg 'N]Y`'ZØf 'J c[Y`VYcVUW\ hi b[Yb"'A]h Yhk Ug ; `\OW_ '_ObbYb 'G]Y '\]Yf 'gY`hYbY '5fhYb']b']\fYa 'bUhØf`]W\Yb @YVYbgfUi a 'VYcVUW\ hYb"

5_h]j]hÀh	D`ÒbYf'GYY	HfUa a Yf GYY
GWk]a a Yb	\psi_	从
GY[Y`b	\psi_	BY]b
K UbXYfb	\psi_	从
5b[Y`b	¥J	¥

8]Y? `Y]bY'D`ÒbYf'GYY']gh'Y]b'j YfghYW_hYg'¾ k Y`ž'XUg'cZh

ØVYfgY\Yb'k]fX"'A]h'Y]bYf': `ÀW\Y'j cb'bi f'(ž&'E i UXfUh_]`ca YhYfb

V]YhYh'Yf'Y]bY'fi \][Y'5ha cgd\ÀfY'i bX']gh']XYU``ZØf'Y]b

i b[YghÒfhYg'D]W_b]W_'cXYf'Y]bYb'YbhgdUbbhYb'5b[Y`hU["'8Ug

[`Ug_`UfY'K UggYf'n]Y\h'b]W\h'bi f'GdcfhUb[`Yf'Ubž'gcbXYfb'Ui W\
X]YYb][Ybž'X]Y'Y]bZUW\'X]Y'GYY`Y'VUi a Y`b'`UggYb'a ÒW\hYb"'<]Yf

_ÒbbYb'G]Y'cZh':]gW\Yf'VYcVUW\hYbž'X]Y'[YXi `X]['Ui Z']\fYb

[fc»Yb': Ub['k UfhYb"

9]b 'VYgcbXYfYg'9f`YVb]g'V]YhYh'g]WX 'VY]a '6cchZU\fYb'Ui Z'X]YgYb GYYb"'9g'[]Vh'j YfgWX]YXYbY'6cchgj Yf`Y]\Yž'X]Y'\delta bYb'X]Y
A O[`]WX_Y]h'V]YhYbž'Ybhk YXYf'Y]b'Fi XYfVcchž'Y]b'? Ubi 'cXYf'gc[Uf Y]b'_`Y]bYg'A chcfVcch'ni 'a]YhYb"'9]bY'6cchghci f'Ui Z'XYa 'D`ObYf GYY']gh'b]WXh'bi f'YbhgdUbbYbXž'gcbXYfb'Ui WX'Y]bY\Yfj cffU[YbXY'A O[`]WX_Y]hž'X]Y'a U`Yf]gWXY'@UbXgWXUZh'ni [Yb]Y\Yb'i bX'X]Y'i a `]Y[YbXYb'K À`XYf'i bX': Y`XYf'j ca 'K UggYf Ui q'ni 'gY\Yb"

K Ybb'G]Y'Y]b'k]f_`]W\'Y]bn][Ufh][Yg'9f`YVb]g'gi W\Ybž'gc``hYb'G]Y VY]'Y]bYa 'XYf'j]Y`Yb'J **YfUbghU`hi b[Yb**'Ua 'K UggYf j cfVY]gW\Ui Yb"'J ca ':]gW\YfZYgh'V]g'ni '6cchgfYbbYb'V]YhYb'X]YgY 9j Ybhg'b]W\h'bi f'I bhYf\U`hi b[ž'gcbXYfb'Ui W\'X]Y'; Y`Y[Yb\Y]hž fY[]cbU`Y'GdYn]U`]hÀhYb'ni 'dfcV]YfYb'i bX'a]h'9]b\Y]a]gW\Yb']bg ; YgdfÀWX 'ni '_ca a Yb"'8]Y'j]Y`Yb'GhÀbXY'i bX'5_h]j]hÀhYb'V]YhYb Yhk Ug'ZØf'\$\daggarrightarrow\daggarrightarrow\daggarrightarrow\daggarrightarrow\daggar

Ni gUa a YbZUggYbX``Àggh'g]W\ 'gU[Ybž'XUgg'X]Y 'GYYb'j cb'D`Òb \Rightarrow bYb'Y]bY': Ø``Y'j cb'A Ò[`]W_Y]hYb'V]YhYbž']b'X]Y'\Yff`]W\Y'BUhi f Y]bni hUi W\Yb"'CV'VY]a 'GW\k]a a Ybž'5b[Y`bž'K UbXYfb'cXYf Y]bZUW\'bi f'VY]a '9bhgdUbbYb'Ua 'I ZYf' '\]Yf'Z]bXYh'YXYf'Yhk Ug bUW\'gY]bYa '; YgW\a U_"'J\YfdUggYb'G]Y'b]W\h'X]Y'; Y`Y[Yb\Y]hž X]Y'GW\\Ob\Y]h'X]YgYf'FY[]cb'ni 'Yf_i bXYb'i bX'g]W\']b']\fY'fi\][Y 5ha cgd\\AfY'ni 'j\Yf\]YVYb"

<]ghcf]gW\Y`<][\`][\hg`i bX`; Y\Y]a b]ggY`XYf GhUXh`D`Òb</pre>

 $\label{thm:condition} D`Ob\check{z}'Y]bY'WAUfa UbhY'GhUXh']a' < YfnYb'GWA'Ygk][!<c`ghY]bg\check{z}']gh fY]WA'Ub'; YgWA]WAhY'i bX'_i `hi fY``Ya' '9fVY''8]Y'VYY]bXfi W_YbXY JYfV]bXi b['j cb'BUhi f'i bX'\]ghcf]gWAYf'5fWA]hY_hi f'a UWAh'D`Ob ni 'Y]bYa 'ZUgn]b]YfYbXYb'N]Y`ž'XUg'j]Y`Y'; Y\Y]a b]ggY'i bX; YgWA]WAhYb'ni 'YfnÀ\`Yb'\Uh''HUi WAYb'k]f'Y]b']b'X]Y'\]ghcf]gWAYb <][\`][\hg'XYf'GhUXh'i bX'YbhXYW_Yb'k]fž'k Ug'g]Y'ni 'Y]bYa VYgcbXYfYb'Cfh'a UWAh'$

9]bYg'XYf'VYa Yf_Ybgk YfhYghYb'; YVÀi XY']b'D`Òb']gh'XUg'GWX`cggD`Òbž'XUg'Y]bY'Y]bXfi W_gj c``Y'?i`]ggY'V]`XYh"'I fgdfØb[`]WX']a '%&" \\J\f\i bXYfh'U`g'6i f['YfVUi hž'k i fXY'XUg'GWX`cgg']a '@Ui ZY'XYf \\J\f\i bXYfhY'a Y\fZUWX'i a [YVUi hi bX'Yfk Y]hYfh"'< Yi hY \\Y\YfVYf[h'Yg'b]WXh'bi f'XUg'gWX`Ygk][!\c`ghY]b]gWXY \@UbXYgh\YUhYfž'gcbXYfb'Ui WX'Y]b'VYY]bXfi W_YbXYg'A i gYi a "'8]Y\]ghcf]gWXYb'FÀi a Yž'XUfi bhYf'X]Y'dfÀWXh][Y'GWX`cgg_UdY``Yž [YVYb'9]bV`]W_Y']b'XUg'@YVYb'XYf'gWX`Ygk][!\c`ghY]b]gWXYb 5XY`qZUa]`]Yb'i bX'XUg'@YVYb']b'j Yf[Ub[YbYb'NY]hYb"

9]bY'k Y]hYfY'\]ghcf]gW\Y'GhÀhhY']gh'X]Y'Gh"'B]_c`U]!?]fW\Y'Z'X]Y']a%) "' \exists U\f\i bXYfh'YfVUi h'k i fXY"'8]Y'[ch]gW\Y'?]fW\Y'VYY]bXfi W_h Xi fW\']\fY'\c\Yb'; Yk \bullet YY'i bX'X]Y'k i bXYfgW\ \bullet bYb'; `UgZYbghYf" 9]b'VYgcbXYfYg'A Yf_a U`'XYf'Gh"'B]_c`U]!?]fW\Y']gh'XYf'U`hY' : f]YX\cZZ'Ui Z'XYa 'j]Y`Y'dfca]bYbhY'DYfg \bullet b`]W_Y]hYb'VY[fUVYb

 $g]bXžXUfi bhYfA]h[`]YXYfXYg'gWX`Ygk][!\c`ghY]b]gWXYb'5XY`g"`8]Y ?]fWXY'i bX'XYf': f]YX\cZ'g]bX'Y]b'fi \][Yf'Cfh'XYf'6Yg]bbi b['i bX `UXYb'XUni 'Y]bžX]Y'; YgWX]WXhY'XYf'FY[]cb'ni 'fYZY_h]YfYb"$

- GWX`cgg`D`Òb. I fgdfØb[`]WX`Y]bY'6i f[ž'\Yi hY'Y]b AigYia i bX'H\YUhYf"
- $Gh"B]_c`U]!?]fWXY.; ch]gWXY`5fWX]hY_hi f`i bX`\]ghcf]gWXY; fUVghÀhhYb"$
- 6Øf[Yf\Uigijcb"%+)(."9]b"6Y]gd]Y``ZØf"X]Y"6Ui_ibgh XYg"%, ""*\J\f\ibXYfhg"

8]Y'5`hghUXh'j cb'D`Òb'gY`Vgh']gh'Y]b'k Y]hYfYg'<][\`][\h"'<]Yf
Z]bXYh'a Ub'Yb[Y'; UggYbž'X]Y'j cb'[i h'Yf\U'hYbYb
: UW\kYf_\Ai gYfb'[Yg\Ai a h'g]bX"'8]YgY'5fW\]hY_hi f'Yfn\A\`h
; YgW\]W\hYb'Ui g'Y]bYf'NY]hž']b'XYf'D`\Ob'Y]b'k]W\h][Yg
<UbXY`gnYbhfi a 'k Uf"'6YgcbXYfg'Y]bY'_`Y]bY'Fi bXY'Xi fW\'X]Y'
GW\i ghYf[UggY'i bX'5a 'A Uf_h'gc``hY'b]W\h'j Yfg\Ai a h'k YfXYb"
\D`XYb'5`hghUXh[UggYb'_Ubb'a Ub']b'_`Y]bYb'7UZ\Ag'Y]bY'DUi gY
Y]b`Y[Yb'i bX'X]Y'\]ghcf]gW\Y'5ha cgd\\AfY'[Yb]Y*Yb"

9]bii bVY_UbbhYg; Y\Y]a b]gij cbiD`Òbi]ghiXYfiD`ÒbYf

A Uf_hd`UhnžiXYfigY]hid\\f\i bXYfhYbiXUgiNYbhfi a iXYgi< UbXY`g
i bXiXYfigcn]U`Ybi5_h]j]hÀhYbiXYfiGhUXhiV]`XYh"iCVk c\`iXYfiD`Uhn
hfchnigY]bYfi`Ub[Ybi; YgWX]WXhYicZhiØVYfgY\Ybik]fXži]ghiYfiY]b
`YVYbX][YfiCfhžiUbiXYa iK cWXYba Àf_hYii bXiJ YfUbghU`hi b[YbghUhhZ]bXYb"i<]Yfik]fXiXYi h`]WXžik]YiX]YiGhUXhiX]YiHfUX]h]cbYbiV]g
\Yi hYiVYk U\fhii bXi[`Y]WXnY]h][ia cXYfbi[YV`]YVYbi]gh"

Ni gàhn`]WX []Vh'Yg'a Y\fYfY']bhYfYggUbhY'A i gYYb']b'D`Òbž'X]Y'X]Y ; YgWX]WXhY'XYf'GhUXh'Xc_i a Ybh]YfYb"'8 Ug'? fY]ga i gYi a 'D`Òb V]YhYh'Y]bY'i a ZUggYbXY'GUa a `i b['ni f'fY[]cbU`Yb'; YgWX]WXhY j cb'XYf'GhY]bnY]h'V]g'ni f'BYi nY]h"'6YgcbXYfg'gdUbbYbX'g]bX'X]Y 5i gghY``i b[Yb'ni f'@ØX]b[\Ui gYb\U`V]bgY``gck]Y'ni f'; YgWX]WXhY XYg'K UggYfg'i bX'XYf'GYYb']b'XYf'FY[]cb"'9g']gh'XYf']XYU`Y'Cfhž i a 'bcWX'a Y\f'ØVYf'X]Y'\]ghcf]gWXY'9bhk]W_`i b['D`Òbg'i bX'gY]bYf I a [YVi b['ni 'YfZU\fYb"

B Ua Y	9fVUi h	6YXYi hi b[

B Ua Y	9fVUi h	6YXYi hi b[
GWX `c gg ˙D`Òb	%""纵\f\i bXYfh	5XY`gg]hnž'\Yi hY
		H\YUhYfibX
		AigYia
Gh" B]_c `U]!?]fWX Y	%) "'划\f\i bXYfh	; ch]gW\Y
		5fWX]hY_hifž:f]YX\cZ
		a]h˙dfca]bYbhYb
		DYfgÒb`]W_Y]hYb
?fY]ga i gYi a ˙D`Òb	%- "`刬\f\i bXYfh	8c_i a YbhUh]cb [.] XYf
		fY[]cbU`Yb
		; YgWX]WXhY

8]Y'FY[]cb'i a 'D'Òb']gh'Ui W.'VY_Ubbh'ZØf']\fY'K UggYfa Ø\'Ybž'j cb
XYbYb'Y]b][Y'fYghUi f]Yfh'i bX'ni [Àb[`]WX'g]bX"'8]YgY'A Ø\'Yb
nYi [Yb'j cb'XYf']bXi ghf]Y``Yb'J Yf[Ub[Yb\Y]h'XYf'GhUXh'i bX'V]YhYb
Y]bYb'9]bV']W_']b'X]Y'hYWXb]gWXY'9bhk]W_`i b["'6YgcbXYfg'X]Y'
K UggYfa Ø\ `Y']b'GÒ_Ua d']gh'Y]bYb'6Ygi WX'k Yfh"'G]Y']gh'Y]bY
XYf'À'hYghYb'A Ø\`Yb']b'XYf'FY[]cb'i bX'nY][h'UbgWXUi `]WXž'k]Y'X]Y
?fUZh'XYg'K UggYfg'[Ybi hnh'k i fXYž'i a 'X]Y'A YbgWXYb'ni
j Yfgcf[Yb'i bX'ni 'VYgWXÀZh][Yb"

 $\label{eq:linear_continuous_con$

±g[YgUa hi]ghiD`Òb Y]bY GhUXhžX]Y gck c\`; YgWk]Wk hg]bhYfYgg]YfhY U`g'Ui Wk '?i `hi fVY[Y]ghYfhY ']b ']\fYb '6Ubb 'n]Y\h'' A]hi]\fYb Ui h\Ybh]gWkYb '\]ghcf]gWkYb 'GhÀhhYbž'XYf'WkUfa UbhYb '5`hghUXhii bX `YVYbX][Yb 'J YfUbghU`hi b[Yb '[]Vh'Yg'\]Yf'j]Y``ni 'YbhXYW_Yb'''5`gc gWkbUddYb 'G]Y 'g]Wk '⇒ fY 'K UbXYfgWki \Y'i bX 'VYfY]hYb 'G]Y 'g]Wk XUfUi Z'j cfž']b 'X]Y 'ZUgn]b]YfYbXY'; YgWk]WkhY'j cb 'D`Òb Y]bni hUi WkYb°

?i`]bUf]gWXY'; YbØggY.'9ggYb'i bX'Hf]b_Yb']b

D`Òb']gh'b]W\h'bi f'Y]b'Cfh'j cb'UhYa VYfUi VYbXYf'@UbXgW\UZh'i bX
fY]W\Yf'; YgW\]W\hYž'gcbXYfb'Ui W\'Y]b'k U\fYg'DUfUX]Yg'ZØf
: Y]bgW\a YW_Yf''8]Y'`c_U`Y'; Ughfcbca]Y'V]YhYh'Y]bY'VfY]hY'DU`YhhY
_Ògh`]W\Yf'GdY]gYb'i bX'; Yhf\\ab_Yž'X]Y'gck c\``hfUX]h]cbY``Y'U`g
Ui W\'a cXYfbY'9]bZ\@ggY'j YfY]bYb'''9[U`ž'cV'G]Y'Y]b': Ub'XYf
\Yfn\UZhYb'; Yf]W\\hY'g]bX'cXYf'X]Y'g\@\Yb'JYfgi W\i b[Yb
VYj cfni [Ybž'\]Yf']gh'Z\@f'YXYb'; YgW\\a UW_'Yh\\Ug'XUVY]"

9]b 'nYbhfu`Yf'Di b_h'XYf'd`ÒbYf'?i `]bUf]_'g]bX'X]Y'j]Y`Yb FYghUi fUbhg'i bX'7UZÅgž'X]Y'fY[]cbU`'dfcXi n]YfhY'Ni hUhYb j Yfk YbXYb"'8]Y'BÀ\Y'ni 'XYb'GYYb'i bX'K À`XYfb'a UW\h'Yg a $\tilde{O}[`]WX\check{z}Zf]gWXY':]gWXY\check{z}K]`X'i bX'gU]gcbU`Yg'; Ya <math>\tilde{\mathcal{O}}gYX]fY_h'j$ cb XYb'i a `]Y[YbXYb'9fnYi [Yfb'ni 'VYn]Y\Yb"'<]Yf'g]bX'Y]b][Y hmd]gWXY'; Yf]WXhYž'X]Y'G]Y'Ui $Z' \Rightarrow fYf'[Ughfcbca]gWXYb$ 9bhXYW_i b[ghci f'Xi fWX'D`Òb'dfcV]YfYb'gc``hYb.

- D`ÒbYf:]gWX [Yf]WX hY.; Yb]Y» Yb'G]Y'ZUb[Zf]gWXYb':]gWX Ui g'XYb'i a `]Y[YbXYb'; Yk ÀggYfbž'k]Y'ni a '6Y]gd]Y` NUbXYf'cXYf'<YWX hž'cZh'ni VYfY]hYh'bUWX 'hfUX]h]cbY``Yf'5fh a]h'`c_U`Yb'?fÀi hYfb"
- K]`X[Yf]Wk hY. '♣ 'XYb'K À`XYfb'fi bX'i a 'D`Òb'[]Vh'Yg fY]Wk`]Wk 'K]`X"'FYghUi fUbhg'V]YhYb'cZh'K]`XVfUhYb'Ubž'k]Y FY\!'cXYf'K]`XgWkY]b!'i bX'Yf[ÀbnYb'g]Y'a]h'_Ògh`]WkYb 6Y]`U[Yb"
- FY[]cbU`Y`6UW_k UfYb. `DfcV]YfYb`G]Y`X]Y`_Ògh`]WXYb
 6fÒhWXYb`i bX`?i WXYbž`X]Y`]b`nU\`fY]WXYb`6ÀW_YfY]Yb
 Zf]gWX`[YVUW_Yb`k YfXYb"`6YgcbXYfg`VY`]YVh`g]bX`X]Y
 D`ÒbYf`GWXb]hhYb ž`Y]bY``c_U`Y`GØ»][_Y]h"

9]b 6 Ygi W]a 'c ZZ]n]Y ``Yb 'Hci f]ga i gdcfhU `'j cb 'D `Òb '\]`Zh \[
\text{\tin}\text{\tet

 $: \emptyset f `Y W h Y `: Y] b g W a Y \underline{W} Y f `[] V h `Y g `] b `D `Ob `n U \setminus `f Y] W Y `K Y] b g h V Y b$

i bX'6]Yf[ÀfhYbž']b'XYbYb'G]Y'`c_U`Y'6]YfY'i bX'K Y]bY'[Yb]Y» Yb _ObbYb"'8]Y'FY[]cb'GW\`Ygk][!<c`ghY]b']gh'VY_Ubbh'ZØf']\fY \Yfn\UZhY'6fUi _i bgh'i bX'V]YhYh'Y]bY'J]Y`nU\`'j cb'6]YfgcfhYbž'X]Y G]Y'i bVYX]b[h'dfcV]YfYb'gc``hYb"'5i W\'X]Y'5i gk U\`'Ub'fY[]cbU`Yb K Y]bYb']gh'gdUbbYbXž']bgVYgcbXYfY'k Ybb'G]Y'X]Y'?ca V]bUh]cb a]h'`c_U`Yb'?ÀgYd`UhhYb'[Yb]Y» Yb'a OWXhYb"

6Y`]YVhY; Ughfcbca]Yb]b D`Òb

BUa Y'XYg	GdYn]U`]hÀh	6YgcbXYf\Y]hYb
FYghUi fUbhg		
5`hY'GWi'Y	J YfgWX]YXYbY	<]ghc f]gW\ Y g
	:]gWX [Yf]WX hY	5a V]YbhY
< Ui g'XYf'%\$\$'6]YfY	7 fUZh ⁻ 6]Y fY	; fc»Y'5i gk U\`'Ub
		`c_U`Yb [.] 6]YfYb
GYYdZYfXWXYb '7 UZÅ	?UZZYYgdYn]U`]hÀhYb	8]fY_h'Ua 'GYY'a]h
	ibX'?iWXYb	\Yff`]W\Ya '6`]W <u></u>

9]b'k Y]hYfYg'VYa Yf_Ybgk YfhYg'<][\`][\h'XYf'd`ÒbYf'; Ughfcbca]Y]gh'XYf'k ÒWXYbh`]WXY'A Uf_hž'XYf'YXYb': fY]hU['ghUhhZ]bXYh''<]Yf_\ObbYb'G]Y'Zf]gWXY'fY[]cbU`Y'DfcXi_hY'_Ui ZYbž'i bX'j]Y`Y'GhÀbXYV]YhYb'?cghdfcVYb'Ub'''9]b'6Ygi WX'X]YgYg'A Uf_hYg']gh'Y]bY\Yfj cffU[YbXY'A Ò[`]WX_Y]hž'X]Y'`c_U`Y'9gg_i `hi f'_YbbYbni `YfbYbi bX'j]Y``Y]WXh'Y]b][Y'Ni hUhYb'ZØf'X]Y'Y][YbY'?ØWXY'a]h'bUWX<Ui gY'ni 'bY\a Yb"

GWX`]Y»`]WX`]gh'XUgʻgU]gcbU`Yʻ5b[YVch']b`D`Òb`Y]b`kY]hYfYf; fi bXžk Ufi a `X]Y`_i`]bUf]gWXY`9bhXYW_i b[ghci fʻgcʻgdUbbYbX`]gh"\8]Y`c_U`Yb`FYghUi fUbhgʻdUggYb`]\fY`A YbØgʻfY[Y`a À»][`Ub`X]Y\\fYgnY]hYb`UbžʻgcXUggʻG]Y`]a a Yf`k]YXYf`bYi Y`i bX`Ui ZfY[YbXY\\YgWXa UW_gYf`YVb]ggY`Yfk UfhYb`_ÒbbYb"`CV`GdUf[Y`]a

: fØ\`]b[ž'9fXVYYfYb']a 'Gca a Yfž'?ØfV]g']a '< YfVgh'cXYf'ZYgh`]W\Y ; Ubg']a 'K]bhYfž'X]Y'd`ÒbYf'?ØW\Y'nY`YVf]Yfh'X]Y'J]Y`ZU`h'XYf BUhi f"

A]h'U```X]YgYb'k i bXYfVUfYb'_i `]bUf]gW\Yb'Cdh]cbYb']gh'D`Òb'XYf]XYU`Y'Cfhž'i a ' \Rightarrow fY'; YgW\a UW_g_bcgdYb'ni 'j Yfk Ò\bYb''CV'VY]a UVYbX`]W\Yb'8]bbYf']b'Y]bYa 'XYf'j]Y`Yb'FYghUi fUbhgž'VY]a 6fi bW\']b'Y]bYa 'W\Ufa UbhYb'7UZ\^cXYf'VY]a '5i gdfcV]YfYb fY[]cbU`Yf'GdYn]U`]h\AhYb'Ui Z'XYa 'A Uf_h' 'YXYf'6]ggYb']b'D`Òb']gh Y]bY'9bhXYW_i b[zX]Y'V`Y]Vh''

Ci hXccf!5VYbhYi Yf. 'K UbXYfb'i bX FUX7U\fYb'fi bX'i a 'D'Òb

$$\label{eq:decomposition} \begin{split} D\grave{o}b\check{z}'Y]bY'a&\;\;U\grave{Y}f]gW\&Y'GhUXh']a\;\;'< YfnYb'GW\&\grave{Y}gk\;][\;\;!< c\grave{g}hY]bg\check{z}']gh\\ b]W\&h'bi\;\;f'ZØf'gY]bY'VYY]bXfi\;\;W_YbXYb'GYYb'i\;\;bX'\&\;]ghcf]gW\&Yb\\ GY\&Vgk\;\;ØfX][\;\;_Y]hYb'VY_Ubbh\check{z}'gcbXYfb'V]YhYh'Ui\;\;W&\;'Y]bY':\;Ø\grave{`}Y'Ub\\ Ci\;\;hXccf!5_h]j\;\;]h\grave{A}hYb\check{z}'X]Y'BUhi\;\;f!'i\;\;bX'5VYbhYi\;Yf\grave{`}]YV\&UVYf\\ VY[\;Y]ghYfb'''9[\;U\grave{z}'cV'G]Y'g]W\&'ZØf'Y]bY'K\;\;UbXYfi\;\;b[\;'Xi\;fW\&'X]Y\\ gUbZhYb''< \varnothing[\;Y\grave{`}'cXYf'Y]bY'FUXhci\;f'Ybh`Ub[\;'XYf']Xm\grave{`}]gW\&Yb\\ @UbXgW\&UZh'YbhgW\&Y]XYb\check{z}'D\grave{`}Ob'\&\&^h'ZØf'YXYb';\;YgW\&a\;UW_'Yhk\;Ug\\ VYfY]h'' \end{split}$$

8]Y FY[]cb i a 'D`Òb ']gh'[YdfÀ[h'j cb 'Y]bYf'UVk YWkg`i b[gfY]WkYb@UbXgWkUZh'a]h'K À`XYfbž'K]YgYb ii bXž'bUhØf`]Wkž'nU\`fY]WkYbGYYb"'9]b 'VYgcbXYfg'VY`]YVhYf'K UbXYfk Y[']gh'XYf'D`ÒbYf'GYYFi bXk Y[ž'XYf'G]Y 'ZUgh'j c``ghÀbX]['i a 'XYb'[fÒ»hYb'GYYGW `Ygk][!<c`ghY]bg'ZØ\fh"'8]YgY'K UbXYfi b['V]YhYhUhYaVYfUi VYbXY'5i gV`]W_Yž'X]Y'A Ò[`]Wk_Y]hž'X]Y'`c_U`Y'H]Yf!'i bXDZUbnYbk Y`h'ni 'VYcVUWkhYb'i bX'nU\`fY]WkY'[Ya Øh`]WkY'D`ÀhnYZØf'Y]b'D]W_b]W_"

<]Yf'g]bX'Y]b][Y'XYf'VYghYb'K UbXYfk Y[Y']b'XYf'l a [YVi b['j cb D`Òb.

- D`ÒbYf'GYY'FibXkY[..7U"'%)'_a ž']XYU``ZØf'U``Y 5`hYfg[fiddYb'ibX':]hbYgg`YjY`g"
- K UbXYfi b['ni a 'GWX `cgg'D`Òb.'9]b'_i fnYf': i » a UfgWX

ZØ\fh'G]Y'ni a 'a U'YghÀh]gW\Yb'GW\`cggž'XUg'Ybhk YXYf'ni :i > 'cXYf'a]h'XYa ': U\ffUX'YffY]W\h'k YfXYb'_Ubb"'8Yf K Y['V]YhYh'\Yff`]W\Y'5i gV`]W_Y'Ui Z'X]Y'GhUXh'i bX'XYb GYY"

B Uhi fd Uf_ '< c`ghY]b]gWX Y 'GWX k Y]n. '9]b 'Yhk Ug
 Ubgdfi WX gj c``YfYf'K UbXYfk Y['Xi fWX 'X]Y '\Ø[Y`][Yž
 k U`XfY]WX Y '@UbXgWX UZh'i bX 'Ybh`Ub['UbXYfYf'GYYb"'DYfZY_h
 ZØf'B Uhi fZchc[fUZYb"

K Ybb'G]Y'XUg'5VYbhYi Yf'Ui Z'nk Y]'FÀXYfb'Yf'YVYb'a ÒW hYbž'g]bX X]Y'FUXk Y[Y'fi bX'i a 'D'Òb'YVYbgc'fY]nj c``"'5i Z[fi bX'XYg'[i h Ui g[YVUi hYb'i bX'VYgW]'XYfhYb'FUXk Y[YbYhnYg'_ÒbbYb'G]Y'ZfY] YbhgWXY]XYbž'k]Y'k Y]h'cXYf'k]Y'gWXbY``'G]Y'ZU\fYb'a ÒWXhYb"'8]Y gUbZhYb'< Ø[Y`'i bX'a U`Yf]gWXYb'@UbXgWXUZhYb'a UWXYb'XUg FUXZU\fYb'\]Yf'ni 'Y]bYa ; Ybi gg"

6Y`]YVhY`FUXhcifYb`]b`XYf`FY[]cbia ZUggYb.

- D`Òb'bUW\'A U`YbhY.'9]bY'WU"'%\'_a '`Ub[Y': U\fh'Xi fW\ K À`XYf'i bX'K]YgYbž'X]Y'Ui W\'Y]bYb'5VghYW\Yf'ni a 8]Y_gYY'V]YhYh"
- 8]Y`la[YVib[`XYg`; fc»Yb`D`ÒbYf`GYYg.'9]bY FibXZU\fh'jcb'YhkU'&)`_a ž'UiZ'XYf'G]Y'Ub'aY\fYfYb 6UXYaÒ[`]WX_Y]hYb'jcfVY]_caaYb"
- FUXk Y['Xi fW\ XYb BUhi fdUf_. '8Yf'K Y['ZØ\fh'G]Y
 Xi fW\ 'X]Y 'VYY]bXfi W_YbXY BUhi f'i bX'j cfVY]'Ub
 \]ghcf]gW\Yb'Gh\AhhYb"

5b'j YfgW\]YXYbYb'Di b_hYb'Ybh`Ub['XYf'K UbXYf!'i bX'FUXk Y[Y Z]bXYb'G]Y'j]Y`Y'; Y`Y[Yb\Y]hYb'ZØf'Y]bY'Yf\c`gUa Y'DUi gY"'8UVY] _\ObbYb'G]Y'`c_U`Y'?\Ogh`]W_Y]hYb'[Yb]Y\\Yb\z'gY]'Yg']b'Y]bYa 'XYf W\Ufa UbhYb'7UZ\Ag'cXYf'Ub'XYb'_\Y]bYb'\=\&\]\gggh\AbXYb\z'X]Y'c\Zh']b\XYf'B\A\Y'XYf'GYYb'd`Uhn]Yfh'q]bX"

9]b`VY`]YVhYf`<U`h`]gh`X]Y`K U`XgW\Ab_Y`Ua `D`ÒbYf`GYYž'k c
Zf]gW\Yž'fY[]cbU`Y`; Yf]W\hY`i bX`; YhfÀb_Y`gYfj]Yfh`k YfXYb"`<]Yf
_`ObbYb`G]Y`g]W\`bUW\`Y]bYf``Ub[Yb`5_h]j]hÀh`YbhgdUbbYb`i bX
Y]bYb`6`]W_`Ui Z'XUg`K UggYf`k YfZYb"

8]Y'VYghY'NY]h'ZØf'CihXccf!5VYbhYiYf']b'D`Òb']gh']a 'gdÀhYb
:fØ\`]b['V]g']b'XYb'ZfØ\Yb'<YfVghž'kYbb'XUg'KYhhYf'a]`X'ibX'X]Y
BUhif']b'jc``Yf'6`ØhY'ghY\h"'5VYf'UiW\']a'<YfVgh'ibX'K]bhYf
_`ObbYb'G]Y'X]Y'Fi\Y'ibX'XYb':f]YXYb'XYf'BUhif'[Yb]Y»Yb"'8]Y
ZUfVYbZfc\Yb'6`ÀhhYf']a'<YfVgh'ibX'X]Y'gW\bYYVYXYW_hYb'KY[Y]a'K]bhYf'V]YhYb'Y]bY'[Ubn'UbXYfYž'UVYf'YVYbgc'fY]njc``Y
?i`]ggY"

 $C\ V'G]Y'bib'X]Y': fY]\ Y]h'VY]a \ 'FUXZU\ fYb'cXYf'X]Y'9f\ c`ib['VY]a \\ K\ UbXYfb'gi\ WXYbž'D`Ob']gh'XYf']XYU`Y'Cfh'ZØf'\$\{f'b\AW,ghYg'CihXccf!} \\ 5VYbhYi\ Yf'''DUW_Yb'G]Y'\$\$\{fYb'Fi\ W_gUW_ž'gW,bUddYb'G]Y'g]W\ '\$\{fYb'YgW,i\ Y'cXYf'\$\{fYb': U\ ffUX\ Y`a'ibX'YbhXYW_Yb'G]Y'X]Y'ibVYfØ\ fhY'GW\ Ob\ Y]hž'X]Y'X]YgY'GhUXh'ni'V]YhYb'\Uh''$

: Ua]`]YbZfYi bX`]WXY'5_h]j]hÀhYb'i bX 5hhfU_h]cbYb

D`ÒbžY]bY'a U`Yf]gWXY'GhUXh']b'GWX`Ygk][!<c`ghY]bžV]YhYh'b]WXh bi f'UhYa VYfUi VYbXY'BUhi f'i bX'\]ghcf]gWXY'GhÀhhYbž'gcbXYfb Ui WX'Y]bY': Ø``Y'j cb'5_h]j]hÀhYbž'X]Y'gdYn]Y``'ZØf': Ua]`]Yb [YY][bYh'g]bX"'CV'Xf]bbYb'cXYf'XfUi »Ybž'ZØf''YXYb'; YgWXa UW_i bX''YXYg'5`hYf']gh'Yhk Ug'XUVY]"'<]Yf'g]bX'Y]b][Y'XYf'VYghYb ZUa]`]YbZfYi bX`]WXYb'5_h]j]hÀhYb'i bX'5hhfU_h]cbYbž'X]Y'D`Òb'ni V]YhYb'\Uh

- GWk k]a a Yb']a 'D'ÒbYf'GYY. '8Yf'D'ÒbYf'GYY']gh'Y]b
 ZUbhUgh]gWkYf'C fh'ZØf'Y]bYb': Ua]']YbUi gZi ["'=a 'Gca a Yf _Ubb'X]Y'[UbnY': Ua]']Y']a '_'UfYb'K UggYf'gWk]a a Ybž g]Wk'Ua 'GhfUbX'YbhgdUbbYb'cXYf'6YUWkj c''YmVU'''gd]Y'Yb"
- 6cchgZU\fYb i bX 'HfYhVcch'a]YhYb. '9]b k Y]hYfYg <][\`][\h'Ua 'D`ÒbYf'GYY']gh'XUg'6cchZU\fYb"'A]YhYb'G]Y

- Y]b 'HfYhVcch'cXYf'Y]b 'Fi XYfVcch'i bX'Yf_i bXYb 'G]Y 'X]Y; Yk ÀggYf" '8]Y '?]bXYf'k YfXYb 'Yg'`]YVYbž'U_h]j ']a '6cch'ni gY]b 'i bX'X]Y 'gW\ ObY'l a [YVi b['ni '[Yb]Y) Yb"
- 6Ygi WX ']a 'K]`XdUf_'9Y_\c`h. 'Bi f'Y]bY'_i fnY'5i hcZU\fh
 j cb'D`Òb'YbhZYfbhž'V]YhYh'X]YgYf'K]`XdUf_'Y]bY
 \Yfj cffU[YbXY'; Y'Y[Yb\Y]hž'\Y]a]gWXY'H]YfY'\Ui hbU\'ni
 Yf`YVYb"'9g'[]Vh'nU\`fY]WXY'H]YfUfhYbž'GhfY]WXY`nccg'i bX
 gdUbbYbXY': Ø\fi b[Yb"
- : fY]nY]hdUf__ < UbgUdUf__ . I b[YZÀ\f'Y]bY'Ghi bXY'j cb D`Òb'YbhZYfbh']a 'gWX ÒbYb'G]Yf_gXcfZ']gh'XYf'< UbgUdUf__ Y]b'VY`]YVhYg'N]Y`'ZØf': Ua]`]Yb"'A]h'Ui ZfY[YbXYb : U\f[YgWXÀZhYb'i bX'5hhfU_h]cbYb'ZØf'U``Y'5`hYfg[fi ddYb]gh'Yg'XYf'dYfZY_hY'Cfh'ZØf'Y]bYb'HU[YgUi gZi ["

K YbbʻXUgʻK YhhYfʻa U`ʻb]W\hʻa]hgd]Y`hž′[]VhʻYgʻnU\`fY]W\Yʻ≢bXccf! 5_h]j]hÀhYbž′X]YʻGdU» ′ZØf′X]Yʻ[UbnYʻ: Ua]`]Yʻj YfgdfYW\Yb.

- 6Ygi WX ']a 'D`ÒbYf'?i bgh\Ui g. '8 Ug'?i bgh\Ui g'V]YhYh
 fY[Y`a À»][Y: Ua]`]Ybk cf_g\cdg'Ubž']b'XYbYb'?]bXYf
 _fYUh]j 'k YfXYb'_ÒbbYb"'<]Yf'_ÒbbYb'g]Y'a U`Ybž'VUghY`b
 i bX']\fY: UbhUg]Y'Ui g`YVYb' 'Y]b'hc``Yg'9f`YVb]g'ZØf'X]Y
 _`Y]bYb'? Øbgh`Yf"
- Gd]Y`Y! ii bX '9f`YVb]gk Y`h' K]``mg'K i bXYf`UbX .
 8]YgY '\DXccf!Gd]Y`\U``Y']b'D`Ob']gh'Y]b'YWkhYg'DUfUX]Yg'ZØf
 ?]bXYf"'A]h'Y]bYf'J]Y`nU\``jcb'Gd]Y`[YfAhYbž'<ØdZVif[YbibX'?`YhhYfk AbXYb'_ObbYb'g]Wk'X]Y'?`Y]bYb'UighcVYbibX'j]Y`Y'bYiY':fYibXY'Z]bXYb"

 $9VYbZU^*g^ni^Ya^dZY^Yb^g]bX^X]Y^nU^*fY]WXYb^DUf_g^ibX$ $Gd]Y^d^AhnY^]b^ibX^ia^D^Obz^i]b^XYbYb^X]Y^?]bXYf^ib[YghOfhgd]Y^Yb^_ObbYb.$

DUf_#Gd]Y`d`Uhn	6YgcbXYf\Y]hYb	GhUbXcfh

DUf_#Gd]Y`d`Uhn	6YgcbXYf\Y]hYb	GhUbXcfh
GhUXhdUf_'D`Òb	; fc» Y F UgYbZÀW Ybž	a '< YfnYb'jcb'D`Òb
	Gd]Y`[YfÀhYž	
	GdUn]Yfk Y[Y	
K U`Xgd]Y`d`Uhn	BUhifbU\Yf	8]fY_h'Ua 'K U`X
9]W <u></u> \cfgh	Gd]Y`d`Uhnž	
]bhYfU_h]jY	
	Gd]Y`ghUh]cbYb	
5VYbhYi Yfgd]Y`d`Uhn	<c`n_cbghfi _h]cbybž<="" td=""><td>BÀ\Y'D`ÒbYf'GYY</td></c`n_cbghfi>	BÀ\Y'D`ÒbYf'GYY
GWX]`Z	GUb X_UghY b ž	
	; f]``a Ò[`]W_Y]hYb	

9]b'5i gZi [']b'X]Y'BUhi f'_Ubb'Ui W\'gdUbbYbX'ZØf'X]Y'[UbnY: Ua]\']Y'gY]b"'8]Y'FY[]cb'fi bX'i a 'D\`Ob'V]YhYh'nU\\`fY]W\Y K UbXYfk Y[Y'i bX'BUhi ffYgYfj UhYž'X]Y'cZh'_]bXYfZfYi bX\`]W\ [YghU\hYh'g]bX.

- K UbXYfi b['ni a '6i b[gVYf[.'8Yf'\OW\ghY'6Yf[GW\Ygk][!<c`ghY]bg'V]YhYh'b]W\h'bi f'Y]bY'hc``Y'5i gg]W\hž gcbXYfb'Ui W\'Y]bYb'[i h'a Uf_]YfhYb'K UbXYfk Y[ž'XYfUi W\'ZØf''Øb[YfY'?]bXYf'a UW\VUf']gh"
- B Uhi fYI _i fg]cbYb^]a 'D`ÒbYf'GYYb`UbX.'8]Y
 I a [YVi b[']gh']XYU`'ZØf'[YZØ\fhY'B Uhi fhci fYbž'VY]'XYbYb
 X]Y': Ua]`]Yb'X]Y'\Y]a]gW\Y': `cfU'i bX': Ui bU'YbhXYW_Yb
 _`ObbYb"'C Zh'k YfXYb'Ui W\'gdYn]Y``Y'Dfc[fUa a Y'ZØf'?]bXYf
 Ub[YVchYb"

D`Òb']gh'k]f_`]W\ Y]b'k i bXYfVUfYf'C fh'ZØf': Ua]`]Ybž'i a [Ya Y]bgUa Y'NY]h'ni 'j YfVf]b[Yb'i bX'i bj Yf[Ygg`]W\Y 9f]bbYfi b[Yb'ni 'gW\UZZYb''CV'VY]a 'Gd]Y`Yb']a ': fY]Ybž'VY] _fYUh]j Yb'K cf_g\cdg'cXYf'VY]a '9bhXYW_Yb'XYf'BUhi fž'\]Yf'[]Vh Yg'ZØf'YXYb'Yhk Ug'ni 'Yf`YVYb''6Ygi W\Yb'G]Y'X]Y'cZZ]n]Y``Y K YVgY]hY'j cb'D`Òb'ZØf'k Y]hYfY' \oplus Zcfa Uh]cbYb'i bX' \oplus gd]fUh]cbYb ni ' \Rightarrow fYa 'bÀW\\ghYb': Ua]`]YbUi gZi [

9j Ybhgʻi bXʻ: Ygh]j Uʻg. '8 Ugʻ_i `hi fY``Yʻ@YVYb]bʻD`ÒbʻYf`YVYb $8]Y `GhUXh'D`\grave{O}b\check{z}'Y]b[YVYhhYh']b'X]Y'kibXYfVUfY'@UbXgWkUZh'XYf < c`ghY]b]gWkYb'GWkKY]n\check{z}']gh'b]Wkh'bif'ZØf']\fY'GYYb'ibX \]ghcf]gWkYb'GhÀhhYb'VY_Ubbhž'gcbXYfb'UiWk'ZØf']\f'`YVYbX][Yg_i`hifY``Yg'@YVYb'''8Ug'[UbnY'&U\f'ØVYf'Z]bXYb']b'D`\grave{O}b'nU\`fY]WkY9jYbhg'ibX':Ygh]jU`g'ghUhhž'X]Y'gckc\``9]b\Y]a]gWkY'U`g'UiWk6YgiWkYf'Ubn]Y\Yb'''8]YgY'5b`ÀggY'V]YhYb'Y]bY'Uig[YnY]WkbYhYA \grave{O}[`]Wk_Y]hž'X]Y'`c_U`Y'?i`hifž'HfUX]h]cbYb'ibX'X]Y'\Yfn`]WkY;UghZfYibXgWkUZh'XYf'D`\grave{O}bYf'ni'Yf`YVYb''$

9]bY'XYf'VYXYi hYbXghYb'JYfUbghU`hi b[Yb']gh'XUg'D`ÒbYf'GYYZYghž XUg'À\f`]W\']a '5i [i gh'ghUhhZ]bXYh''<]Yf'_ca a Yb'X]Y'A YbgW\Yb ni gUa a Ybž'i a 'XfY]'HU[Y'`Ub['@]j Y!A i g]_ž'HUbnUi \mathbb{Z} \D\(fi b[Yb i bX'_i `]bUf]gW\Y'? Ògh`]W_Y]hYb'ni '[Yb]Y\Yb'''8 Ug'GYYZYgh'V]YhYh Y]b'UVk YW\\g`i b[gfY]W\Yg'Dfc[fUa a '\Z\D\f'U``Y'5`hYfg[fi ddYbž Y]bgW\`]Y\"\]W\.

- ?cbnYfhY``c_U`Yf'6UbXg'i bX'?Øbgh`Yf
- 9ggYbgghÀbXY'a]h'GdYn]U`]hÀhYb'XYf'FY[]cb
- A Uf_ghàbXY a]h'?i bgh\UbXk Yf_'i bX'fY[]cbU`Yb
 DfcXi _hYb
- : Ua]`]YbU_h]j]hÀhYb k]Y ?]bXYfgWka]b_Yb i bX Gd]Y `Y

9]b'k Y]hYfYg'<][\`][\h']gh'XYf'D`ÒbYf'K Y]\bUW\hga Uf_hž'XYf']a
5Xj Ybh'ghUhhZ]bXYh'i bX'6Ygi W\Yf'Ui g'bU\'i bX'ZYfb'Ubn]Y\h''8Yf
A Uf_h'j Yfk UbXY`h'X]Y'\deltabYbghUXh']b'Y]b'k]bhYf`]W\Yg'K i bXYf`UbX
a]h'ZYgh`]W\Yf'6Y`Yi W\hi b['i bX'[Ya Øh`]W\Yb'6i XYb'''<]Yf'_Ubb
a Ub.

- \bullet < UbX[YZYfh][hY; YgWXYb_YibX'8Y_cfUh]cbYb'_UiZYb
- <Y]»Yb; `Ø\kY]bii bXiUbXYfYik]bhYf`]WXYi@YW_YfY]Yb [Yb]Y»Yb
- 8]Y ZYgh`]WXY 5ha cgd\AfY XYf GhUXh Yf`YVYb

6YgcbXYfg'ZØf': Ua]`]Yb'i bX'?]bXYf'g]bX'X]Y'Gca a YfZYghgd]Y`Y']a : fY]`]W\hh\YUhYf'D`Òb'Y]bY'k i bXYfVUfY'; Y`Y[Yb\Y]hž'_i `hi fY``Y 8UfV]Yhi b[Yb'i bhYf'ZfY]Ya '<]a a Y``ni '[Yb]Y»Yb"'8]Yg'g]bX'Y]b][YXYf'JYfUbghU`hi b[Ybž'X]Y'k À\fYbX'X]YgYf': Yghgd]Y`Y'Ub[YVchYbkYfXYb.

8 Uhi a	JYfUbghU`hib[6YgWxfY]Vib[
[´ k	H\YUhYfUi ZZØ\fi b[Y	?`Ugg]gW\Y'i bX
	b	nY]h[YbÒgg]gW\Y
		GhØW_Y'k YfXYb
		Ui Z[YZØ\fh"
5i [i gh	?cbnYfhfY]\Y	@]j Y!A i g]_`a]h
		fY[]cbU`Yb'ibX
		ØVYffY[]cbU`Yb
		?Øbgh`Yfb"
GYdhYa VYf	?i`hifY``Yf'HU[K cf_g\cdg'i bX
		5i gghY``i b[Yb'ni f
		`c_U`Yb'?i bgh'i bX
		?i`hif"

9]b 'VYgcbXYfg'ZYggY`bXYg'9fY][b]g']gh'XUg'D`ÒbYf'K Y]bZYghž'XUg
]a 'gdÀhYb'Gca a Yf'ghUhhZ]bXYh"'<]Yf'_ÒbbYb'K Y]b`]YV\UVYf'Y]bY
J]Y`nU\`'j cb'K Y]bYb'Ui g'j YfgWX]YXYbYb'5bVUi [YV]YhYb
8 Yi hgWX`UbXg'dfcV]YfYb"'9g'[]Vh'Ui WX.

- : Ø\fi b[Yb'i bX'HUgh]b[g
- @j Y!A i g]_ i bX HUbn
- @YW_YfY`GdY]gYbž'X]Y`dYfZY_h`ni `XYb`K Y]bYb`dUggYb

: Øf'U``Yž'X]Y'g]W\'ZØf'gdcfh`]W\Y'< YfUi gZcfXYfi b[Yb']bhYfYgg]YfYbž]gh'X]Y'D`ÒbYf'GhUXha Y]ghYfgW\UZh']a 'K UggYfgdcfh'Y]b'Ai gg" I bhYfgW\]YX`]W\Y'8]gn]d`]bYbž'j cb'? Ubi !FYbbYb'V]g'ni K]bXgi fZ]b[!K YhhVYk YfVYbž'a UW\Yb'X]Y'J YfUbghU`hi b['ni 'Y]bYa Ui ZfY[YbXYb'9f`YVb]g"'Ni gW\Ui Yf'_ÒbbYb'X]Y'Ui ZfY[YbXYb K Yhh_Àa dZY'Ua 'K UggYf'j YfZc`[Yb'i bX'X]Y'5h\`YhYb'UbZYi Yfb"'

9]b'k Y]hYfYg'_i `hi fY``Yg'9fY][b]g']gh'XUg'D`ÒbYf':]`a ZYgh]j U`ž'XUg
]a :: fØ\`]b['ghUhhZ]bXYh"' <]Yf'k YfXYb'?i fnZ]`a Y'j cb'`c_U`Yb
:]`a Ya UW\Yfb'gck]Y']bhYfbUh]cbU`Y'6Y]hfÀ[Y'dfÀgYbh]Yfh"'8]YgY
J YfUbghU`hi b['ZÒfXYfh'b]W\h'bi f'XUg':]`a \UbXk Yf_ž'gcbXYfb
V]YhYh'Ui W\'Y]bY'D`UhhZcfa 'ZØf'_fYUh]j Y'HU`YbhY"'6Ygi W\Yf'_ÒbbYb
Ub'8]g_i gg]cbYb'i bX'K cf_g\cdg'hY]`bY\a Ybž'X]Y'j cb': UW\`Yi hYb
XYf':]`a]bXi ghf]Y'[Y`Y]hYh'k YfXYb"

8 Yf'_i `hi fY``Y'? U`YbXYf'j cb'D`Òb'k ÀfY'b]W\h'j c``ghÀbX]['c\bY'X]Y?i bgha Y]`Y'D`Òbž'X]Y'Y]ba U``]a '\\J\f'? Øbgh`Yf'Ui g'XYf'FY[]cb ni gUa a YbVf]b[h''8]Y'GhUXh'k]fX']b'Y]b'f]Yg][Yg': fY]`i ZhUhY`]Yf j Yfk UbXY`hž'k c'X]Y'6Ygi W\Yf'X]Y'A Ò[`]W_Y]h'\UVYbž'X]Y'5fVY]hYb`c_U`Yf'? Øbgh`Yf'ni 'gY\Yb'i bX'\DhYfj]Yk g'a]h']\bYb'ni 'ZØ\fYb'' 8]Y'?i bgha Y]`Y'ZÒfXYfh'XYb'5i ghUi gW\'j cb'\XYYb'i bX'?fYUh]j]hÀh nk]gW\Yb'? Øbgh`Yfb'i bX'XYf'; Ya Y]bgW\UZh''

9[U`ni k Y`WkYf'*J\fYgnY]h'G]Y'D`Òb'VYgi WkYbž'X]Y'GhUXh'\Uh
]a a Yf'Yhk Ug'ni 'V]YhYb"'Jcb'ZfÒ\`]WkYb': YghYb']a ': fY]Yb'V]g'\]b
ni 'VYg]bb`]WkYb'K Y]\bUWkhga Àf_hYb'[]Vh'Yg'nU\`fY]WkY
; Y`Y[Yb\Y]hYbž'X]Y'?i `hi f'j cb'D`Òb'\Ui hbU\'ni 'Yf`YVYb"'8Yf
6Ygi Wk'Y]bYg'X]YgYf'9j Ybhg'cXYf': Ygh]j U`g']gh'Y]bY
\Yfj cffU[YbXY'A Ò[`]Wk_Y]hž'X]Y': fYi XYž'X]Y'; UghZfYi bXgWkUZh
i bX'X]Y'?fYUh]j]hÀh'XYf'D`ÒbYf'ni 'YbhXYW_Yb'i bX'X]Y'`c_U`Y
@YVYbgUfh'Ui Z'Ui h\Ybh]gWkY'K Y]gY'ni '[Yb]Y*Yb"K Ybb'G]Y'a Y\f
ØVYf'_ca a YbXY'9fY][b]ggY'YfZU\fYb'a ÒWkhYbž'VYgi WkYb'G]Y'X]Y
cZZ[n]Y``Y'K YVqY]hY'j cb'D`Òb'\]Yf"

8 YhU1`a

6Ygi WXYb G]Y i bg Ui Z Y]bY!fY]gY "XY