

$5b_ØbX$][ib['XYg'GhUfhg'XYg'IB#G! A Uf_hd`UhnYg

 $8 Y f'a]h'GdUbbib['Yfk UfhYhY'I B + IG!A Uf_hd`Uhn']gh'Yhnh'`]| Y$ ibXa Uf_]Yfh'Y]bYb'VYXYihYbXYb'AY]`YbqhY]b']a'6YfY]W XYf'JYfa Ò[YbqUb`U[Y'XifW.'6`cW W.U]b!HYW.bc`c[]Y" I B + HG']gh'VYfY]hz'X]Y'5b`U[Y`UbXgWXUZh'ni 'fYjc`i h]cb]YfYbz|bXYa 'Yq'X]Y'Hc_Yb]q]Yfi b['j cb'fYU`Yb'JYfa Ò[Ybqk YfhYb fFK 5gŁYfa Ò[`]WXhii bX gc XYb DfcnYgg ZØf 5b Y[Yf $j\ YfY\]b\ ZUVX\ hz^{*}\]\ fY\ ^Dc\ fhZc\ ^]c\ g\ 'ni\ ^X\]j\ Yfg\]Z\]n\]YfY\ b\ 'i\ b\ X\ ^Z\emptyset f$ JYfa Ò[YbqY][YbhØa YfžXYb'K Yfh']\fYf'6YqhÀbXY ZfY]ni gYhnYb"'A Uf_hd`Uhn'Yhnh'`]j Y'A]h'XYf'9]bZØ\fi b['XYg $\label{eq:bound} I \ B \ \# G! A \ Uf_hd`UhnYg`Yfa \ O[`]W\&h`X]Y`D`UhhZcfa \ X]Y`bU\&h`cgY$ I a k UbX`i b['j cb'GUW\k YfhYb'k]Y' =a a cV]`]Ybž'?i bgh'i bX Fc\ghcZZYb']b'Bcb!: ib[]V`Y'Hc_Ybg'fB: HqŁ"'8]YgY hc_Yb]q]YfhYb'JYfa Ò[YbqkYfhY'q]bX'bib'UiZ'XYa ZcfhqWXf]hh`]WXYb'AUf_hd`Uhn'ZØf'XYb'<UbXY`'jYfZØ[VUf'ibX V]YhYb'VY]qd]Y``cqY'@|ei]X]hÀh'ibX'Ni[Ub['ni'Y]bYa / Ua d∧Y``]d/



"8 Yf a]h GdUbbi b['Yfk UfhYhY I B #G!A Uf_hd`Uhn]gh Yhnh `]j Y i b X a Uf_]Yfh Y]b Yb VYXYi hYb XYb A Y]`YbghY]b]a '6 YfY]W 'XYf J Yfa Ò[YbgUb`U[Y Xi fW '6`c W_W U]b! HY W bc`c[]Y " I B #G]gh VYfY]h Z'X]Y '5 b`U[Y`Ub XgW UZh ni 'fYj c`i h]cb]YfYb Z']b XYa 'Yg X]Y Hc_Yb]g]Yfi b['j cb 'fYU`Yb 'J Yfa Ò[Ybgk YfhYb 'fF K 5gŁ Yfa Ò[`]W h i b X 'gc 'XYb 'Dfcn Ygg 'ZØf'5 b`Y[Yf'j YfY]b ZUW h Z']\ fY 'Dcfh Zc`]cg 'ni X]j Yfg]Z]n]YfYb 'i b X 'ZØf'J Yfa Ò[YbgY][YbhØa Yf Z'XYb 'K Yfh']\ fYf 6 YghÀb XY 'ZfY]ni gYhnYb"

A $Uf_hd`Uhn''Yhnh'`]j Y$

A]h'XYf'9]bZØ\fi b['XYg'I B \times HG!A Uf_hd`UhnYg'Yfa Ò[`]W\h'X]Y
D`UhhZcfa 'X]Y'bU\h`cgY'I a k UbX`i b['j cb'GUW\k YfhYb'k]Y
\times a cV]`]Ybž'?i bgh'i bX'Fc\ghcZZYb']b'Bcb!:i b[]V`Y'Hc_Ybg
fB: HgŁ"'8]YgY'hc_Yb]g]YfhYb'J Yfa Ò[Ybgk YfhY'g]bX'bi b'Ui Z'XYa
ZcfhgW\f]hh`]W\Yb'A Uf_hd`Uhn'ZØf'XYb'<UbXY`'j YfZØ[VUf'i bX'V]YhYb
VY]gd]Y``cgY'@]ei]X]h\h'i bX'Ni [Ub['ni 'Y]bYa '[`cVU`Yb'Di V`]_i a "

± XYb'_ca a YbXYb'K cWXYb'K]fX'I B ± G'Y]bY'FY]\Y'j cb'B: Hgž'X]Y j YfgWX]YXYbY'fYU'Y' = a cV]']Yb'fYdfÀgYbh]YfYbž'Ui Z'XYa

A Uf_hd`Uhn'j YfÒZZYbh`]WXYb"'8]YgY']a a cV]']YbVYnc[YbYb'B: Hg

k YfXYb'X]fY_h'j cb'I B ± G'j Yfk U`hYhž'k Ug'Y]bYb'\c\Yb'Ei U`]hÀhg!

i bX'Ni j Yf`Àgg][_Y]hgghUbXUfX'[Yk À\f`Y]ghYh"'5b`Y[Yf'\UVYb'X]Y

A Ò[`]WX_Y]hž'X]YgY'B: Hg'ni 'Yfk YfVYb'i bX'gc'Y]bYb'HY]`VYg]hn'Ub
\cWX k Yfh][Yb'J Yfa Ò[Ybgk YfhYb'ni 'Yfk YfVYbž'X]Y'ni j cf

i bYffY]WXVUf'k UfYb"'8]YgY'9bhk]W_`i b['gc```XYb'Ni [Ub['ni

± bj Ygh]h]cbga Ò[`]WX_Y]hYb'XYa c_fUh]g]YfYbž'X]Y'9]bhf]hhgVUff]YfYb
gYb_Yb'i bX'XYb'Gd]Y`fUi a 'gck c\``ZØf'9]bnY`!'U`g'Ui WX'ZØf
]bgh]hi h]cbY``Y'5b`Y[Yf'Yfk Y]hYfb"

Ni _ØbZh][Y'@]YZYfi b[Yb.'GY_i bXÀfa Uf_hd`Uhn'i bX'B: H! 9fghY``i b[gX]YbghY

A]h'6`]W_'Ui Z'X]Y'Ni _i b Zh'ZfYi h'g]W\'I B #Gž'X]Y'bÀW\ghYb'D\UgYb XYf'9bhk]W_`i b['gY]bYf'D`UhhZcfa 'VY_Ubbh'ni '[YVYb.

- %" GY_i bXAfa Uf_hd`Uhn.'9g']gh'Y]b'GY_i bXAfa Uf_hd`Uhn']b
 9bhk]W_`i b[ž'Ui Z'XYa '5b`Y[Yf']\fY'B: Hg'ZfY]'\UbXY`b
 _`ObbYb"'8]YgYf'A Uf_hd`Uhn'k]fX'X]Y'@]ei]X]hAh'Yf\O\Yb
 i bX'Y]bY'DfY]gZ]bXi b[']b'9W\hnY]h'i bX'Y]bYb'<UbXY`'fi bX
 i a 'X]Y'I \f'Yfa O[`]W\Yb"'9f'k]fX'5b`Y[Yfb'Y]bY
 XmbUa]gW\Y'I a [YVi b['V]YhYbž']b'XYf'g]Y'dfcV'Ya `cg
 hc_Yb]g]YfhY'J Yfa O[Ybgk YfhY'_Ui ZYbž'j Yf_Ui ZYb'i bX
 \UbXY`b'_ObbYb"</pre>
- &" Hc_Yb]g]Yfi b['U`g`GYfj]WY. I B #IG`k]fX`]b`? ØfnY
 Hc_Yb]g]Yfi b[gX]YbghY`UbV]YhYbž'X]Y`Yg
 J Yfa Ò[YbgY][YbhØa Yfb`Yfa Ò[`]WXYbž']\fY
 J Yfa Ò[Ybgk YfhY`]b`B: Hg`i a ni k UbXY`b"`8]YgYf`8]Ybgh
 k]fX`XYb`DfcnYgg`XYf`J Yfa Ò[Ybgk Yfh!Hc_Yb]g]Yfi b[

fUh]cbU`]g]YfYb'i bX']\b'ZØf'Y]bY'VfY]hY'DU`YhhY'j cb JYfa Ò[YbgY][YbhØa Yfb'ni [Àb[`]W\'i bX'YZZ]n]Ybh a UW\Yb"8i fW\'X]Y'6YfY]hghY``i b['X]YgYf'Hcc`g'a ÒW\hY I B \dignormal{H}G'Y]bY'VfY]hY'DU`YhhY'j cb'JYfa Ò[Ybgk YfhYb i bhYfghØhnYbž'j cb'\dignormal{A} a cV]`]Yb'V]g'\]b'ni 'V]`XYbXYf'?i bgh i bX'XUfØVYf'\]bUi g"

$8]YAUWhXYfIB + HG!Hc_Yb$

 \Rightarrow "A]hhY`di b_h'XYg'I B \Rightarrow IG!2 _cgmghYa g'ghY\h'XYf'I B \Rightarrow IG!Hc_Ybž XYf'gY]bYb' \Rightarrow \UVYfb'nU\`fY]WXY'J cfhY]`Y'V]YhYh'''8]YgYf'Hc_Yb']gh ZØf'XYb'Ni [f]ZZ'Ui Z'X]Y'8]YbghY'XYf'D`UhhZcfa 'i bX'X]Y'HY]`bU\a Y Ub']\fYa 'Y]bn][Ufh][Yb'K]fhgWXUZhga cXY``'j cb'YbhgWXY]XYbXYf 6YXYi hi b["'Ni 'XYb'k]WXh][ghYb': i b_h]cbYb'XYg'I B \Rightarrow IG!Hc_Ybg [Y\ÒfYb.

- 8YZ`Uh]cbÀfY`A YWX Ub]ga Yb. I B +HG`]a d`Ya Ybh]Yfh`Y]bY
 i a ZUggYbXY`Hc_Yb!6i fb!GhfUhY[]Yži a `XYb`Hc_Yb!K Yfh
 ni `ghY][Yfb"`9]b`DfcnYbhgUhn`U``Yf`A]YhY]bbU\a Yb`i bX
 =a a cV]`]YbhfUbgU_h]cbYb`Ui Z`XYf`D`UhhZcfa `k]fX
 j Yfk YbXYhži a `I B +HG!Hc_Yb`ni fØW_ni _Ui ZYb`i bX`ni
 j YfVfYbbYbž'k cXi fWX`XUg`; YgUa hUb[YVch`fYXi n]Yfh`i bX
 X]Y`?bUdd\Y]h`Yf\Ò\h`k]fX"`8]YgYg`XYZUh]cbÀfY`A cXY``
 ghY``h`g]WXYfž'XUgg`a]h`ni bY\a YbXYf`D`UhhZcfa U_h]j]hÀh
 Ui WX`XYf`K Yfh`XYf`Hc_Yb`ghY][h"
- 91 _`i g]j Y'J cfhY]`Y'ZØf'Hc_Yb!=b\UVYf.
 - D`UhhZcfa ni [f]ZZ. ±0\UVYf'Yf\U`hYb'DfYa]ia!
 Ni [f]ZZ'Ui Z'Y]bY'FY]\Y'j cb'Hcc`g'i bX'GYfj]WYgž
 XUfi bhYf'Yfk Y]hYfhY'5ggYh!
 Hc_Yb]g]Yfi b[gd`UhhZcfa Yb'i bX
 DcfhZc`]ca UbU[Ya YbhgmghYa Y"

 - $\bullet \ 9fk \ Y]hYfhY \ 5bU \ mgYb \ \ 9l \ \ i \ g]j \ Yf \ Ni \ [\ f] \ Z \ Ui \ Z$

- 7ca a i b]hm!A]h[`]YXgWXUZh. 8Yf 6Yg]hn j cb I B +HG!Hc_Yb [Yk À\fh Ni [Ub[ni Yl _`i g]j Yb 7ca a i b]hm!; fi ddYbž]b XYbYb 5b Y[Yf g]WX j YfbYhnYbž 9f_Ybbhb]ggY Ui ghUi gWXYb i bX Ni [f]ZZ Ui Z 9I dYfhYbUbU`mgYb i bX 5b`U[YghfUhY[]Yb Yf\U`hYb _ÒbbYb"
- JYf[Øbgh][hY'@Y]ghi b[Yb. Hc_Yb! ₺\UVYf Yf\U`hYb'Yf\YV`]W\Y'FUVUhhY'Ui Z'; YVØ\fYb']a Ni gUa a Yb\Ub['a]h'XYf'Hc_Yb]g]Yfi b['j cb a a cV]`]Yb'i bX'UbXYfYb'JYfa Ò[Ybgk YfhYbž'k Ug X]Y'Bi hni b['XYf'I B +HG!D`UhhZcfa 'ZÒfXYfh"

8]YgY'A YWW Ub]ga Yb'i bX'J cfhY]'Y'n]Y'Yb'XUfUi Z'UVž'XYb'9fZc`['XYf D`UhhZcfa 'a]h'XYf'K YfhghY][Yfi b['XYf'Hc_Yb']b'9]b_`Ub['ni Vf]b[Ybž'XUg'J YfhfUi Yb'XYf'5b`Y[Yf'ni 'ghÀf_Yb'i bX'Y]bY`Ub[Zf]gh][Y'BUWW\U`h][_Y]h'g]WWYfni ghY``Yb"

BY\a Yb'G]Y'Ub'XYf'fYj c`i h]cbÀfYb'FY]gY'hY]`

8 Yf'GhUfh'XYg'I B +HG!A Uf_hd`UhnYg']gh'bi f'XYf'5bZUb["'+bj YghcfYbž J Yfa Ò[YbgY][YbhØa Yf'i bX'6`cW_WXU]b!9bh\i g]UghYb'g]bX Y]b[Y`UXYbž'g]WX I B +HG'Ubni gWX`]Y» Ybž'i a 'X]Y'; fYbnYb'XYf J Yfa Ò[YbgUb`U[Y'bYi 'ni 'XYZ]b]YfYb"'CV'Yg'i a 'X]Y 8]j Yfg]Z]n]Yfi b['Y]bYg'5b`U[YdcfhZc`]cg'cXYf'X]Y': fY]gYhni b['XYg K Yfhg'j cb'J Yfa Ò[Ybgk YfhYb'[Y\hž'I B+HG'V]YhYh'Y]bY Y]bn][Ufh][Y'i bX']bbcj Uh]j Y'D`UhhZcfa ž'i a 'X]YgY'N]Y`Y'ni YffY]WXYb"

6`Y]VYb`G]Y`XfUb`ZØf`_ca a YbXY`]a a cV]`]YbVYnc[YbY`B: H! @]gh]b[gž`X]Y`j cb`l B \(\delta\) Yfk U`hYh`k YfXYbž`gck]Y`ZØf`X]Y 9]bZØ\fi b[`XYg`GY_i bX\)fa Uf_hd`UhnYg`i bX`XYf Hc_Yb]g]Yfi b[gX]YbghY''; Ya Y]bgUa `VUi h`l B \(\delta\)G`Y]bY i a ZUggYbXYfYž`YZZ]n]YbhYfY`i bX`hfUbgdUfYbhYfY`Ni _i bZh`ZØf`XUg J Yfa \(\delta\)[Ya Ybh'Ui Z' $A \ Y \ f'XUf \emptyset V Y f'`Y fb Y b'`9 - B < 9 + 49B `YgYb'`G]Y'] \ fY `K Y] * Yg'DUd]Y f'` c X Y f'`Zc`[Yb'`G]Y'] \ bYb'`]b'`X Y b'`gcn]U`Yb'`A Y X]Yb.$

HY]`Y'X]YgYb'5fh]_Y`

? UhY[cf]Yb

EiY``Y.'7c]b`]gh"a Y

8 YhU]`g

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