

8cddY`Ui gghY``i b[']b '6Ui hnYb. '? i bgh nk]gWXYb '9]bgUa _Y]h i bX '@YVYb

9f`YVYb`G]Y`X]Y`8cddY`Ui gghY``i b['j cb`A]`Ub`DYgWXY``i bX AU[XU`YbU`Aig]U``]b`6Ui hnYb.`?i bghk Yf_Y`]b`GhY]b\Ui g`i bX @Ui Yb[U`Yf]Y`j ca `%("'>j b]`V]g'' \$"'>j b]`&\$&)"



6Ui hnYbž'8Yi hgWX`UbX'!?i bgh'i bX'?i`hi f'Z]bXYb']b'6Ui hnYb
X]YgYf'HU[Y'Y]bY'[Ubn'VYgcbXYfY'6Ø\bY"5a ''\$"\$b]'&\$&) 'k]fX
X]Y'8cddY`Ui gghY``i b['j cb'A]`Ub'DYgWXY``i bX'A U[XU`YbU
Aig]U`']b'XYf'@Ui Yb[U`Yf]Y'i bX']a 'gcn]c_i `hi fY``Yb'NYbhfi a
GhY]b\Ui g'YfÒZZbYh"'8]YgY'5i gghY``i b['j Yfgdf]W\h'b]W\h'bi f'Y]bY
VYY]bXfi W_YbXY'5bgUa a `i b['j cb'K Yf_Ybž'gcbXYfb'Ui W\h]YZ[Y\YbXY'9a ch]cbYbž'X]Y'X]Y'VY]XYb'?Øbgh`Yf']b']\fYb
5fhYZU_hYb'ni a '5i gXfi W_'Vf]b[Yb"

DYgWXY`ž'VY_Ubbh'Ui g':]`a 'i bX'H\YUhYfž'YfnÀ\`h'j cb'gY]bYf
_Øbgh`Yf]gWXYb'FY]gYž'X]Y'9bXY'XYf'%-, \$Yf'\\\J\fY'a]h'XYf'A U`YfY]
VY[Ubb"'Ni bÀW\gh'Yl dYf]a Ybh]YfhY'Yf'Ui Z'A ÒVY`b'i bX
6`YW\hUZY`bž'VYj cf'Yf'gY]h'\&\('X)[]hU`Y'A U`YfY]'a]hhY`g']DUX']b

gY]bYb'GW\UZZYbgdfcnYgg']bhY[f]YfhY"'GY]b'Gh]``]ghYldfYgg]j'ibXVf]b[h'cZhYl]ghYbn]Y``Y': fU[Yb'UiZ'XYb'Dib_h"'6YgcbXYfgVff@\fYbX']gh'gY]b'6]`X'Y]bYg'_`Y]bYb'kY]»Yb'<ibXYgž'XUg'b]W\hbif'9]bgUa_Y]hž'gcbXYfb'UiW\'GW\ihnVYX@fZb]g'h\YaUh]g]Yfh"Aig]U`ž'[YVcfYb'%-*, ']b'7nõghcW\ckUž'Vf]b[h'a]h']\fYb[fC»ZcfaUh][Yb'2`[YaÀ`XYb'Y]bY'[Ubn'Y][YbY'DYfgdY_h]jY'UiZXUg'AYbgW\gY]b']b'XYf'BUhif'Y]b"

9]b : Ygh XYf 6Y[Y[bi b[Yb

8]Y`cZ]n]Y``Y`9fÒZzbi b[`XYf`5i gghY``i b[`Z]bXYh`Ua '%("'¾ b]'i a %+.\$\$`I\f`]a 'GhY]b\Ui g`ghUhhž`k c`X]Y`?Øbgh`Yf`dYfgÒb`]W\Ubk YgYbX`gY]b`k YfXYb"`I a '&\$.\$\$`I\f`Zc`[h`XYf`nk Y]hY`HY]``XYf5i gghY``i b[`]b`XYf`@Ui Yb[U`Yf]Y"`6Ygi W\Yf`_ÒbbYb`g]W\Ui Z'Y]bYk]`XYf`A]gW\i b[`Ui g`DcfhfÀhgž`NY]W\bi b[Yb`i bX`_`Ugg]gW\Yb`²`!
5fVY]hYb`ZfYi Ybž`X]Y`[YgW\]W_h`X]Y`I bhYfgW\]YXY`i bX
; Ya Y]bgUa _Y]hYb`XYf`VY]XYb`?Øbgh`Yf`g]W\hVUf`a UW\Yb"

 $8 \ Yf' 9]b`UXi b[`ni f'5i gghY``i b[`_Ua 'j cb'H\ca Ug'? Yfbž'Y]bYa : fYi bX'j cb'DYgW\Y`"8]Y'K Yf_Y'k i fXYb'a]h'j]Y`'<math>\Rightarrow$ hi]h]cb Ui g[Yk À\`hž'i a 'X]Y'?cbhfUghY']\fYf'Gh]`f]W\hi b[Yb'ni f'; Y`hi b['ni Vf]b[Yb''K À\fYbX'A i g]U``Y]b'k Yb]['a Y\f'NY]h'ZØf']\fY'5fVY]hYb VYbOh][hž'[Y\h'DYgW\Y``cZh'YI dfYgg]j 'Ub'gY]bY'H\Ya Yb'\YfUb'' GY]bY'H\YUhYfYfZU\fi b[ž'i bhYf'UbXYfYa 'U`g'FY[]ggYi f'Ub'XYf 6Yf`]bYf'J c`_gVØ\bYž'Z]Y \Rightarrow h'g]W\Yf`]W\']b'gY]bY'_Øbgh`Yf]gW\Yb DYfgdY_h]j Yb'Y]b''

² ZZbi b[gnY]hYb i bX a Y\f

 $: \varnothing f'X]Y'?i bgh`]YV\setminus UVYf'[]Vh`Yg'[i hY`BUWXf]WX hYb.`8]Y$ $5i gghY``i b[Yb`g]bX`k À\fYbX`XYf`fY[i `ÀfYb`² ZZbi b[gnY]hYb ni [Åb[`]WX"-a `GhY]b\Ui g`]gh`X]Yg'j cb`A cbhU[`V]g': fY]hU[nk]gWXYb'- `i bX`%, `I \fž`]b`XYf`@Ui Yb[U`Yf]Y'j cb`8 cbbYfghU[`V]g GcbbhU[`j cb`%*`V]g`&$`I \f`gck]Y`bUWX`JYfZ\varnothing[VUf_Y]h"`Gc`_Ubb YXYf`\bhYfYgg]YfhY`X]Y`Ya ch]cbU`Y`GWXUZZYbg_fUZh`XYf`VY]XYb?Øbgh`Yf`]b`Fi \Y`Yf`YVYb"$

 $8]YgY`8cddY`Ui~gghY``i~b[~]b`6Ui~hnYb~]gh`a~Y\f`U`g`bi~f`Y]bY$

5bgUa a `i b['j cb'?i bghk Yf_Yb' 'g]Y'V]YhYh'Y]bYb'h]YZYb'9]bV`]W_
]b'X]Y'GYY'Yb'XYf'VY]XYb'?Øbgh'Yf'i bX'`ÀXh'XUni 'Y]bž'ØVYf'X]Y
YI]ghYbn]Y``Yb': fU[Yb'XYg'@YVYbg'bUWkni XYb_Yb"'9]b'6Ygi Wk
`c\bh'g]Wk']b''YXYa :: U``ž'VYgcbXYfg'ZØf'X]Y'Yb][Ybž'X]Y'g]Wk'ZØf'X]Y
_i `hi fY``Y'J]Y`ZU`h'XYf'FY[]cb']bhYfYgg]YfYb"'K Y]hYfY

\(\partial Zcfa Uh]cbYb'ni 'X]Yg'\(\hat{A}\f][Yb'9j Ybhg']b'XYf'; U`Yf]Y'6i X]gg]bž'X]Y
X]Y'?i bghgnYbY']b'6Ui hnYb'VYfY]WkYfh\(\hat{A}\g)bX'i bhYf'?i bghj YfY]b
6Ui hnYb'ni 'Z]bXYb"

8 Y hU]`g	
Cfh	6Ui hnYbž'8Yi hgWX`UbX
EiY``Yb	• k k k "gUYWX g]gWXY"XY
	k k k "ghY]b\Ui g!VUi hnYb"XY
	_i bghj YfY]b!VUi hnYb"XY

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