

I bZU``Z`i WX h'Ui Z'6UX'< YfgZY`XYf A Uf_hd`Uhn. NYi [Yb [Ygi WX h°

9]b %\$! Å\f][Yf A Ubb k Uf XYf; YgWk ÀX][hY]b X]YgYa "J cfZU``" 9f j Yfgi WkhYž Ui Zg]Wk "Ui Za Yf_gUa "ni 'a UWk Ybž]bXYa "Yf a Y\fa U`g ni f' < i dY [f]ZZ" 'Hfchn 'gY]bYf 'J Yfgi Wk Yž k UfbhY]\b XYf : U\fYf Y]bYg 'Xi b_`Yb 'G_cXU'b]Wkhj cf" 'GhUhhXYggYb 'fUa a hY 'X]YgYf 'XYb CdY` XYg '1 b[Yb 'A UbbYg" K Ug 'VYgcbXYfg 'VYgcf[b]gYffY[YbX]gh 8 Yf 'J Yfi fgUWk Yf YbhgWk]YX 'g]Wk ž j cb 'XYf I b ZU``ghY``Y 'ni 'Z]Y\Ybž c\bY'g]Wk i a 'XYb 'YbhghUbXYbYb 'GWk UXYb 'ni '_Øa a Yfb"

8 YhU]`gʻni a ˈJ cfZU``

 $8 \ Yf'Yb \ hghUb \ XYb \ 'GWW \ UXYb \ 'Ua \ 'C \ dY \ 'k \]fX'Ui \ Z'fi \ bX' \& \$\$'9i \ fc \\ [YgWW \ Ahnhž'Y]b \ 'gi \ a \ a \ Yž'X]Y'ZØf'j \]Y \ 'Y' \ b[Y'5i \ hc ZU \ fYf'Y]b \ Ygd \ gd \ ØfV \ UfY' \ 6Y \ 'Ughi \ b['gY]b' _Ubb''' \ 8 \ Yf' \ J \ cfZU \ '\ Uh'b]WW \ h'bi \ f \\ fYWW \ h']WW \ Y' = a \ d']_Uh]c b \ Yb \ Z'gc b \ XYfb'' k \]fZh'Ui \ WW': fU[Yb' ØVYf'X]Y \\ J \ YfUb \ hk \ cfhi \ b[']a \ 'GhfU \ Ybj \ Yf_Y \ f'Ui \ Z'''9]b'' I \ b \ ZU \ 'X]YgYf' 5 fhž'VY] \\ XYa \ 'XYf' \ J \ Yfi \ fgUW \ Yf'Y]b \ ZUWW' \ j \ YfgWW \ UZh''$ $j \ cb'' \ bg]WW \ Yf' \ Yh']b' \ XYf'; \ Ya \ Y]bgWW \ UZh''$

8]Y'Dc`]nY]'6UX'<YfgZY`X'\Uh'bi b'X]Y'9fa]hhìi b[Yb'Ui Z[Ybca a Yb i bX'V]hhYh'X]Y'2 ZZYbh`]W_Y]hii a 'A]h\]`ZY"'\dotbgVygcbXYfY'gi W\Yb g]Y'bUW\'NYi [Ybž'X]Y'a Ò[`]W\Yfk Y]gY'Yhk Ug'[YgY\Yb'\UVYb'cXYf\dotbZcfa Uh]cbYb'\OVYf'XYb'[YZ\OW\hYhYb': U\fYf'cXYf'XYggYb: U\fnYi ['[YVYb'_\ObbYb'': \Off'<]bk Y]gY']gh'X]Y'Dc`]nY]ghUh]cb'6UX <YfgZY`X'i bhYf'XYf'HY`YZcbbi a a Yf'\\$**\&\#' &!\\$'YffY]W\VUf'' 5`hYfbUh]j'_\Ubb'Ui W\'X]Y'Cb`]bYk UW\Y'XYf'Dc`]nY]']b'<YggYb_cbhU_h]Yfh'k YfXYb''

8]Y'HUhgUW\Yž'XUgg'XYf'I bZU```]a 'ÒZZYbh`]W\Yb'FUi a ž'Ub'Y]bYa
j cb'j]Y`Yb'ZfYei Ybh]YfhYb'C fhž'ghUhhZUbXž']gh'VYa Yf_Ybgk Yfh"'9]b
A Uf_hd`Uhn']gh'b]W\h'bi f'Y]b'DUf_d`Uhnž'gcbXYfb'Y]b'nYbhfU`Yf
Di b_h'XYg'gcn]U`Yb'@YVYbg"'<]Yf'VY[Y[bYb'g]W\AYbgW\Ybž
ZØ\fYb'; YgW\AZhY'i bX'hUi gW\Yb'\Dzcfa Uh]cbYb'Ui g"'Gc`W\Y
J cfZA``Y'gW\AX][Yb'b]W\h'bi f'a UhYf]Y``Y'K YfhYž'gcbXYfb'Ui W\XUg
J YfhfUi Yb']b'X]Y'J YfUbhk cfhi b['XYf'J Yf_Y\fghY]`bY\a Yf"

8]YFY`YjUbn'XYg'JcfZU``g

8 Yf J cfZU```_ObbhY 'Ui W. 'XYb 'U_hi Y``Yb 'HfYbX'j cb

J Yf_Y\fgi bZà``Yb 'VY`Yi W.hYbž'VY]'XYbYb': U\fYf'Z]Y\Ybž'c\bY

g]W. 'XYb'? cbgYei YbnYb']\fYg' < UbXY`bg'ni 'ghY``Yb"' = Y]bYf'NY]hž

]b 'XYf'J Yf_Y\fgg]W.Yf\Y]h'Ub'j cfXYfghYf'GhY``Y'ghY\Yb'gc``hYž']gh

X]Yg'VYgcf[b]gYffY[YbX"'9g'fi Zh'b]W.h'bi f'X]Y'Dc`]nY]'Ui Z'XYb

D`Ubž'gcbXYfb'Yl d`]n]h'Ui W. 'X]Y'; Ya Y]bgW.UZhž'X]Y'Ui Z[Yfi ZYb']ghž

g]W. 'XYf'J YfUbhk cfhi b['VYk i ggh'ni 'k YfXYb"

BYVYb XYa 'a UhYf]Y ``Yb 'GW UXYb 'k]fZh XYf 'J cfZU ```Ui W 'Yh\]gW Y : fU[Yb 'Ui Z' 'K]Y 'j Yf\À `h 'g]W 'Y]b 'j YfUbhk cfhi b[gVYk i gghYf 5i hc ZU\fYf3 'K Y `W Y 'A U» bU\a Yb 'gc ``hYb '[Yhfc ZZYb 'k YfXYbž'i a gc `W Y ': `i W hYb 'ni 'j Yf\]b XYfb 3 '8]YgY 'i b X 'k Y]hYfY ': fU[Yb k YfXYb ']b 'XYb 'b ÀW ghYb 'HU[Yb 'g]W Yf`]W ']b 'XYf '6Yj Ò`_Yfi b[X]q_i h]Yfh k YfXYb"

8]Y'Dc`]nY]'fi Zh'XU\Yf'XUni 'Ui Zž'g]W\'U_h]j 'Ub'XYf'5i Z_`Àfi b[
gc`W\Yf'JcfZÀ``Y'ni 'VYhY]`][Yb"'<]bni '_ca a hž'XUgg'YXYf'9]bnY`bY
Xi fW\'gY]b'j YfUbhk cfhi b[gVYk i gghYg'JYf\U`hYb']a
GhfU» Ybj Yf_Y\f'ni f'G]W\Yf\Y]h'XYf'; Ya Y]bgW\UZh'VY]hfU[Yb'_Ubb"

5i W. 'k Ybb 'GUW gW ÀXYb '\ Ài Z]['fYdUf]Yfh 'k YfXYb '_ObbYbž'V `Y]Vh XUg '; YZØ\ `XYf I bg]W Yf\ Y]h 'i bX 'XYf '9bhh ài gW \i b['ØVYf 'XUg ZY\ `YbXY 'J YfUbhk cfhi b[gVYk i gghgY]b 'a UbW Yf J Yf_Y\fghY] `bY\a Yf 'VYghY\ Yb"

JYfUbhk cfhi b[]a GhfU» Ybj Yf_Y\f

I bUV\ $\abstrack{Ab[]["jcb"XYf"5igk Yfhib["XYf"Dc"]nY]ghUh]gh]_Yb"]gh"X]Yg Y]b"k Y]hYfYf"JcfZU""<math>\begin{align*} Z\begin{align*} Z\begin{align$

 $8]Y `6Yk c \bYf'j cb `6UX' < YfgZY`X'k YfXYb'g]Wk Yf`]Wk `Ui Za Yf_gUa Yf Xi fWk `X]YgYf'J cfZU```i bX'g]Wk `a Y\f'XYbb'`Y'VYk i gghž'k]Y'k]Wkh][5WkhgUa _Y]h']a `GhfU» Ybj Yf_Y\f']gh"'=a a Yf\]b'g]bX'k]f'U``Y'HY]` Y]bYf'; Ya Y]bgWk UZhž'X]Y'g]Wk `Ui Z'[Y[YbgY]h][Y'F <math>\emptyset$ W_g]Wk hbU\a Y i bX'J YfUbhk cfhi b['gh \emptyset hnYb'gc``hY"

<]bhYf[fi bX]bZcfa Uh]cbYb ni f J Yf_Y\fgi bZU``Z`i W\h</pre>

JYf_Y\fgi bZU``Zi W\hYb`g]bX`Y]b`Yfbgh\UZhYg`DfcV`Ya `]b`j]Y`Yb
Gh\XhYb`8Yi hgW\`UbXg"`@Ui h`5b[UVYb`XYg`GhUh]gh]gW\Yb
6i bXYgUa hYg`k i fXYb`]a `\J\f`&\&\YhK U`() "\\$\\$: \A``Y'j cb
i bYf`Ui VhYa `\9bh\ZYfbYb`j ca `I b\ZU``cfh`fY[]ghf]Yfh"\8]Yg`ghY``h
Y]bYb`5bgh]Y[`]a `J\Yf[`Y]W\`ni `XYb`J\cf\U\fYb`XUf"\8]Y`; f\ØbXY`Z\Øf
X]YgY`HUhYb`g]bX`j]Y`\Z\A`h][`i bX`fY]W\Yb`j cb`5b[gh`j cf`fYW\h`]W\Yb
?\cbgYei YbnYb`V]g`\]b`ni `i bni fY]W\YbXYa `gcn]U`Yb`6Yk i gghgY]b
\Z\Øf`X]Y`J\YfUbhk cfhi b[`VY]`J\Yf_Y\\fgi b\Z\A``Yb"`C\Zh`_ca a h`Yg`ni
Ya ch]cbU`Yb`F\YU_h]cbYb\Z`X]Y`XUni `Z\Ø\\fYb\Z`XUgg`X]Y
I\b\ZU``j\Yfi fgUW\Yf`X]Y`GnYb\Y`j\Yf`UggYb\Z`UbghUhh`g]W\`i a `XYb
\GW\UX\Yb`c\X\f`a \O[`]\W\YJ\Yf`YhnhY`ni `_\@a a \Yfb"

 $8] Y `Dc`] nY] `ibX`X] Y `; YgY``gWX UZh`gYhnYb``g] WX `jYfghÀf_h`XUZØf`Y] bž$

gc`WXY`JcfZÀ``Y`ni`fYXi n]YfYb"' \dip]h]Uh]j YbžX]Y`Ui Z`GYbg]V]`]g]Yfi b[i bX`5i Z_`Àfi b[`UVn]Y`Ybžg]bX`YbhgWXY]XYbXž`i a `XUg 6Yk i gghgY]b`ZØf`X]Y`DZ`]WXhYb`j cb`: U\fYfb`VY]`JYf_Y\fgi bZÀ``Yb ni `ghÀf_Yb"`Ni XYa `k YfXYb`hYWXb]gWXY`@Ògi b[Ybž`k]Y`8Ug\WUa gž]a a Yf`VY`]YVhYfž`i a `]a `: U``Y`Y]bYg`I bZU``g`6Yk Y]gY`ni `gUa a Y`b"

GhUh]gh]_Yb ni f'J Yf_Y\fgg]WX Yf\Y]h

 $\pm 0.6 \ Yni \ [\ 'Ui \ Z'X]Y \ 'Z]b \ Ubn]Y \ ``Yb \ : \ c \ [\ Yb \ 'Y]b \ Yf \ J \ Yf \ Yf \ b \ ZU \ ``Zi \ Wkh \]gh \ gh \ Uh]gh]gW \ 'ni \ 'VYc \ VUW \ hYb \ Z'X \ Ugg \ X]Y \ 'Xi \ fWk gWk b \]hh \]Wk \ Yb \ '? \ cgh Yb \ 'ZØf \ X]Y \ GWk \ UXYb gf Y[\ i \ ']Yfi \ b[\ 'VY] \ 'Yhk \ U \ &") $$$ \$9i \ fc \ 'dfc \ : \ U \ ```]Y[\ Yb" \ 8]YgY \ '? \ cgh Yb \ 'Yf[\ YVYb \ 'g]Wk \ 'Ui \ g 'XYb \ 'GWk \ AXYb 'Ua \ : \ U\ fn Yi \ [z \ < cbc f Uf Yb 'ZØf \ XYb 'I \ b ZU \ 'j \ Yfi \ fg UWk Yf" \

FYW\h`]W\Y'?cbgYeiYbnYb'jcb JYf_Y\fgibZU``Z`iW\hYb

8]Y'fYW\h`]W\Yb': c`[Yb'Y]bYf'JYf_Y\fgi bZU``Zi W\h'_ObbYb
Yf\YV`]W\'gY]b"'\d=b'8Yi hgW\`UbX'Xfc\Yb'XYb'HAhYfb'[Ya A\structure' z'%(&
XYg'GhfUZ[YgYhnVi W\Yg'; Y`XghfUZYb'cXYf': fY]\Y]hgghfUZYb'j cb'V]g
ni 'XfY]'\d\fYb"'Ni XYa 'k]fX']b'XYb'a Y]ghYb': A```Yb'Ui W\'XYf
: Ø\fYfgW\Y]b'ZØf'Y]bY'VYgh]a a hY'NY]h'Ybhnc[Yb"'8]Y'[YbUi Y
GhfUZY'\Ab[h'YXcW\'ghYhg'j cb'XYb'I a ghAbXYb'XYg'9]bnY`ZU``g'UVž
Yhk U'XYf'GW\kYfY'XYg'j Yfi fgUW\hYb'GW\UXYbg'i bX'XYa
J cfghfUZYbfY[]ghYf'XYg'HAhYfg"

8 UgʻJ YfV`Y]VYbʻUbʻXYfʻI bZU``ghY``Yʻ]ghʻb]W\hibi fʻY]bYʻfYW\h`]W\Yž gcbXYfbʻUi W\'Y]bYʻa cfU`]gW\YʻJ YfdZ]W\hi b["; YgW\ÀX][hYʻ\UVYb XUgʻF YW\hiUi Zʻ\bZcfa Uh]cbYbžʻi a `]\fYʻ5bgdfØW\Yʻ[Y`hYbX a UW\Ybʻni '_ObbYb"'8 Ufi a `]ghʻYgʻk]W\h][žʻXUggʻYXYf JYf_Y\fghY]`bY\a Yfʻg]W\`XYfʻF]g]_Ybʻi bXʻfYW\h`]W\Yb?cbgYei YbnYbʻY]bYfʻgc`W\Ybʻ< UbX`i b[`VYk i ggh']gh'i bX`VY] Y]bYa 'I bZU```Ub[Ya YggYbʻfYU[]Yfh"

8 Y hU] `c

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