

7ci fgY 8YHJ] g

7 fYX]hDc]bhg *

Gi a a UfmcZh\Y 7ci fgY

H\Y'5 ffg/ 'GcVJU\`GVJYbW\g'7 UdglcbY']g'U'a i `h]!X]gVJd`]bUfm\wci fgY'h\Uhdfcj]XYg'mci 'k]h\ 'Ub'cddcfhi b]hm hc'fYZYWhcb'mci f'X]gVJd`]bUfmghi X]Yg'cj Yf'h\Y'dfYj]ci g'h\fYY'`Yj Y`g'cZghi Xm'' \delta'dUfh]W\ 'Ufz'h\Y'Wci fgY'k]`` Wcbg]XYf'WUgg]Wg']b'h\Y'`]hYfUhi fY'cZ`]VYfU`'YXi WUh]cb'hc'Ug_'hc'k \UhYI hYbhmci f'ghi Xm\Ug'`]j YX'i d'hc'h\Y j Uf]ci g'WcbW\dh]cbg'UbX']XYU'g'cZU'i b]j Yfg]lmYXi WUh]cb'''Mci '\Uj Y'U'W\UbW\'hc'h\]b_'UVci hmci f'ck b X]gWJd']bY']b'Wcbj YfgUh]cb'k]h\ 'ghi XYbhg'Zrca 'ch\Yf'X]gWJd']bYgz'k \]'Y'XYj Y`cd]b['mci f'ck b'Uk UfYbYgg'cZ h\Y'X]gWJd']bUfm_bck 'YX[Y'UbX'i bXYfgHUbX]b['mci '\Uj Y'UWei]fYX"

H\Y`WcifgY`]g`U]a YX`Uh`Ugg]gh]b[`mci`k]h\`h\Y`hfUbg]h]cb`Zfca `mcif`W`ffYbh`XY[fYY`hc`mcif`fc`Y`]b`h\Y`kcfXUg`W]h]nYbg`]b`Yad`cmaYbh`cf`Zfh\Yf`YXiWUh]cb"

BchY. 'H\Y'Wti fgY'k]``'VY'a UXY'Uj U]`UV`Y'Zcf'Gi a a Yf'gYgg]cb'dfcj]X]b['a cfY'ZYI]V]`]hm'Zcf'ghi XYbhg a YYh]b['h\]g'fYei]fYa YbhcZh\Y]f'dfc[fUa #a U'cf'': cf'ghi XYbhg'Zcf'k \ca 'gi a a Yf']g'bchmci f``UghgYgg]cb cZYbfc`a Ybhz'mci 'a i ghcVhU]b'Uddfcj U`'Zca 'mci f'a U'cf''\cbj Ybcf'hc Ybfc``]b'h\Y'WUdghcbY'dfcj]XYX'mci \Uj Y'Wta d'Yh'X'h\Y'bYWggUfm'Wti fgYg']b'mci f'a U'cf'''9bfc`a Ybh']b'h\Y'WUdghcbY'fYei]fYg'ZJW'`hm Uddfcj U`'''D'YUgY'WtbhUWh\Y'<u>L BGK '5fhgz'8Yg][b'UbX'5fW\]hYWh fY'Ghi XYbhGYfj]W</u>g"

7 ci fgY @YUfb]b[Ci hWca Yg

%" 5fn]W `UhY`Ub`i bXYfghUbX]b[`cZh\Y`h\YcfYh]WU``UbX`a Yh\cXc`c[]WU``df]bV\]d`Yg`cZh\Y]f`X]gW]d`]bY &" 8Ya cbghfUhY`Wca dfY\Ybg]cb`cZYh\]WU``UbX`gcW]U``fYgdcbg]V]`]h]Yg`]b`h\Y`dfUWf]WY`cZh\Y]f`X]gW]d`]bY \" 5fn]W `UhY`h\Y`k Umg`]b`k\]W\`h\Y]f`X]gW]d`]bUfmhfU]b]b[`Wci `X`VY`i gYX`]b`Z fh\Yf`ghi Xmcf`h\Y`k cfX cZk cf

 $(\ "\ 7\ f]h]WU``mYj\ U`i\ UhY`UbX`fYZYWficb`_YmUf[\ i\ a\ Ybhg`UbX`XYVUhYg`]b`h\Y`\ i\ a\ Ub]h]Yg`UbX`gcW]U` aWYbWfq"`$

HYUWX]b[GhfUhY[]Yg

H\Y'5ffg/'Gc\JU\G\JYb\Wg'7UdghcbY'dfcj]XYg'ghi XYbhg'k]h\h\Y'cddcfhi b]hmhc'fYZY\Wicb'h\Y]f X]g\Jd']bUfmghi X]Yg'cj Yf'h\Y'dfYj]ci g'h\fYY'`Yj Y`g'cZghi XmUbX'h\]b_'UVci h\ck 'h\Y'g_]``g'UbX'Uhhf]Vi hYg h\Ym\Uj Y'[U]bYX'dcg]hJcb'h\Ya 'hc'VY'U[Ybhg'cZ\W\Ub[Y']b'gc\JYhm''Ghi XYbhg'\Wcbg]XYf'h\Y'd'U\W'cZhfi h\']b `]VYfU``]XYc`c[m\u00e4UbX'Yl Ua]bY'_Ym\\U``Yb[Yg'\u00e4U\u00e4U\\u00e4U\\u00e4U\\u00e4U\\u00e4U\u00e4U\u00e4U\u00e4U\u00e4U\\u00e4U\u0

5g'k Y``'Ug'XYa cbghfUhjb['h\Y]f'i bXYfghUbX]b['cZh\Y'h\YcfYhjWU`'Zci bXUhjcbg'cZh\Y]f'X]gWjd`]bYžghi XYbhg k j``'Wcbg]XYf'h\Y'Yh\]WU`'UbX'qcWjU`'fYqdcbq]V]`jhjYg'UqqcWjUh'X'k jh\'h\Y]f'UfYU'cZghi Xm'

H\Y`Wci fgY`k]```VY`ghi XYbh\W`bhfYX`UbX`gYa]bUf`Xf]j Yb"`H\YfY`UfY`hk c`a U`cf`Ugg][ba Ybhg.`Ub`YI hYbXYX Wf]h\WU``UWUXYa]WYggUmž`UbX`U`hk c`dUfhYI YfW]gY`]b`k\]W\`ghi XYbhg`]XYbhJZmUb`UWcf`cf`]bgh]hi h]cb dcg]h]cbYX`hc`fYgdcbX`hc`U`W\U``Yb[Y`hc`]VYfU`]ga ž`UbX`dfcdcgY`U`fYgdcbgY`hc`]h`cb`h\Y]f`VY\U`Z'

5ggYgga Ybh

 $@UhY`dYbU`h]Yg`k]```VY`]a\ dcgYX`Uh'h\Y`i\ gi\ U``fUhY`cZ) \ i\ \ `dYf`XUmž`ghUfh]b[``Uh'\&.$\%'h\Y`XUm'UZhYf`'h\Y`Xi\Y`XUhY`]b`YUW\`WUqY"$

91 h/bg]cbg a i ghVY gci [\hij]U h\Y VV/bhfU`]gYX gmghYa "UbX VY Udd`]YX Zcf VYZcfY h\Y Xi Y XUhY"

 $K \ cfX'Wci \ bh']bZ']b[\ Ya \ Ybhg'k\]```VY']a \ dcgYX'Uhhh\Y'fUhY'cZ' \ i \ ``Zcf'Yj \ Yfm%$$'k \ cfXg'fcf'dUfhih\YfYcZ'h\Uh mci f'Ugg][ba \ Ybh']g'cj \ Yf'h\Y'gYh`]a \]h''H\YfY']g'Ub'U``ck UbW''cZŽ'cf'-'%$i \ /]"Y"']Zmci f'X]gW gg]cb'dUdYf']g %('\$'k \ cfXg'mci 'k\]```cgY'' \ i \ "'-Z]h']g'%('\%'k \ cfXg'mci 'k\]````cgY'' \ i \ "'-Z]h']g'%('\%'k \ cfXg'mci 'k\]````cgY'' \ i \ "'-Z]h']g'%('\%'k \ cfX'Wci \ bh']bWi \ XYg'U``'hYI \ h]b'h\Y'a \ U]b'VcXmcZh\Y \ Ugg][ba \ Ybh''\=\b!hYI \ hfYZYfYbW'\g'UfY']bWi \ XYX"'C \ b`mh\Y'fYZYfYbW''\]ghcf'V]V`]c[fUd\mUbX'h\Y'cj \ YfU``'h]hY']g \ YI \ WI \ XYX"$

5 'dYbU'hmcZ'ı k]``'VY']a dcgYX'Zcf'ZU]'i fY'hc'i gY'h\Y'<Ufj UfX'f]b!hYl hz'gmghYa 'cZfYZYfYbW]b["'GYY\hdg.#gh XYbh'i bgk "YXi "Ui #\Ufj UfX!fYZYfYbW]b["

Mci 'ghUbX'hc'`cgY'VYhk YYb') 'UbX'&\$'a Uf_g'Zcf'dccf'fYZYfYbW]b['UbX'Uhhf]Vi h]cb'cZgci fWrg"'H\YfY']g'5 @CH'cZUgg]ghUbW''Uj U]`UV`Y'hc'mci 'hc'\Y`d'mci '`YUfb'UVci hfYZYfYbW]b['z'Uhhf]Vi h]cb'UbX'Uj c]X]b[d`U[]Uf]ga "'-₹mci 'UfY'bchgi fY'>I GH'5G? "'GYY'\hdg.#ghi XYbh'i bgk "YXi "Ui #gi ddcfh fYZYfYbW]b[Ugg][ba Ybhg"

⊋mci 'gi Va]hk cf_'Zcf'h\]g'Wci fgY'h\Uhmci '\Uj Y'U`fYUXmgi Va]htYX'Zcf'UggYgga Ybh']b'Ubch\Yf'Wci fgY'Uh h\]g'I b]j Yfg]lmcf'Ubmch\Yf']bgh]hi h]cbž']b'k \c'Y'cf']b'dUfhž'cf']Zmci 'Wcdma UhYf]U''Zca 'Ubch\Yf'gci fW''UbX Xc'bchUhf]Vi hY'h\Uha UhYf]U''hc']hg'cf][]bU''Ui h\cfž'mci f'k cf_'k]``'VY'fYZYffYX'hc'h\Y'GW\cc`'Ghi XYbh'9h\]Wg C Z]WYf'Zcf'Ub']bj Ygh][Uh]cb']bhc'U'dcgg]V'Y'W\Uf[Y'cZUWUXYa]Wa]gWcbXi Wf''GYY \htdg.#ghi XYbh'i bgk "YXi "Ui #d'U[]Uf]ga

5ggYgga YbhHUg_g

5ggYgga Ybh'tUg_	K Y][\h	8i Y [.] 8UhY	Gh XYbh@YUfb]b[Ci hWca Ygʻ5ggYggYX
GYa]bUf'fYZYWjcb'	&\$ı	% #\$*#&\$&%`%%) - `DA	' Ž'(
F YgYUfV% 'YggUm') \$1	&' #\$+#&\$&%`%%) - `DA	%ž [.] &ž [.] '
HU_Y!\ca Y`Ugg][ba Ybh	' \$ı	% #\$, #&\$&%`%%) - `DA	%ž [:] &ž [:] (

5ggYgga Ybh'8YhJ]`g

5ggYgga Ybh'% 'GYa]bUf'fYZYWh]cb

GhUfhXUhY. Bch5dd`]WUV`Y

@Yb[h\.'+) \$ k cfXq

8YW]`q.

 $5 \text{ Wf} \text{ [h]WU^T} \text{ fYZYWh]} \text{ Y'gi a a UfmicZ+) } \text{ k'cfXg'cb'Ub'Ugg]} \text{ bYX'gYa]bUf'X]gW gg]cb'': YYXVUW_j \text{ [JU']bX]}]Xi U^Waa Ybhg''$

5XX]h]cbU`XYhU]`g.

H\]g`Wci`X`VY.`U`a YX]U`cf[Ub]gUh]cb/U`[cj Yfba Ybh'U[YbWhžigi W\`Ug`ca Vi Xga Ub`cf`U'dUfh]W``Uf`dc`]W\Zcf\W'/U`df]j UhY`Wca dUbm'U`bch'Zcf`dfcZ]hcf[Ub]gUh]cb`cZgca Y`gcfh'U`g\Wcc``cf`i b]j Yfg]lm'UbX`gc`cb"`=Zmci`UfY`i bgi fY`cZk \Yh\Yf'h\Y`]bgh]hi h]cb`mci`\Uj Y`WcgYb`]g`Uddfcdf]UhYž`Ug_`h\Y`Wcbj Ybcf"

H\Y`fW\U``Yb[Yg`hc``]VYfU`]ga fi]bWi XY`h\Y`f]gY`cZfdcghlfi h\fz`]XYbh]hmidc`]h]Wgždcdi`]ga žWcfdcfUh]ga ž'UbX fVi VV`Y`a YX]Uf'ï=Zmci `UfY`]bhYfYghYX`]b`U`W\U``Yb[Y`VYmcbX`h\YgYžmci `UfY`ZfYY`hc`k f]hY`cb`]hz`Vi h[U]b`h\Y Uddfcj U``cZh\Y`Wci fqY`Wcbj Ybcf"

Mci 'g\ci `X'dfcj]XY'U'g\cfhUbU`mg]g'cZ\ck 'h\Y'cf[Ub]gUh]cb']g'UZZYWhYX'Vmih\Y']ggi Y'UbX#cf'\ck 'h\Y cf[Ub]gUh]cb'\Ug'h\Y'WUdUW]mmihc'UZZYWh'h\Y']qqi Y']b'qcW]Ymm'r

Mci 'g\ci `X`]XYbh]Zm`_YmXmbUa]\Mg`]\bZi Yb\Mj\b['h\Y'cf[Ub]\gUh]\cbfg`Yb[U[Ya Ybhk]\h\'h\Y']\ggi Y. ']\mg`Z]\bUb\Mj\U`]\b\M'bh]j]\gUh]\cbfg`Yb[U[Ya Ybhk]\h\'h\Y']\ggi Y. ']\mg`Z]\bUb\Mj\U`\gzik\c']\h]g`U\W\ci b\H\V`Y'\nc''

 $:]bU``m\~{z}`mci 'g\ci `X'a U_Y'U'Vf]YZUf[i a Ybh']bX]WUh]b['k \Uh'mci 'VY`]Yj Y'UfY'h\Y'df]a UfmifYUgcbg'Zcf'h\Y W\U``Yb[Y'Uf]q]b[''$

 $\label{thm:continuous} \begin{tabular}{ll} Hi & fb \end{tabular} $$ Hi & fb \end{tabular} $$ h' \end{tabular} $$ I' \end{tabular} $$$ I' \$

5ggYgga Ybh& FYgYUfW YggUm

GhUfhiXUhY. \$ %

 $\label{thm:continuous} \begin{tabular}{ll} Hi fb]h]b"gYh]b[."H\]g"Ugg][ba Ybh]g"gi Va]hhYX"h\fci [\Thi fb]h]b"UbX"gh XYbhg"WUb"gYY"Hi fb]h]b"g]a]"Uf]hm fYdcfhg" \end{tabular}$

5ggYgga Ybh' . HU_Y!\ca Y Ugg][ba Ybh

GhUfhXUhY. Bch5dd`]WUV`Y

8YW]`q.

5 Wf]h]WU`UbU`mg]g`cZUgg][bYX`Ufh]WYg`fl%2&) \$ k cfXgŁ": YYXVUW_j JU']bX]j JXi U`Wca a Ybhg"

5XX]h]cbU`XYhU]`q.

#b 'th\Y' Z|bU``Ugg][ba Ybhimci 'g\ci `X'dfcdcgY'U'fYgdcbgY'Zfca 'th\Y']bgh]h h]cb 'mci 'Yl Ua]bYX']b'Ugg][ba Ybh %hc'cbY'cZh\Y'W\U``Yb[Yg'hc'`]VYfU`]ga "''\/ci 'g\ci `X'Yl d'U]b'\ck 'mci f'fYgdcbgY'Wb'VY'Yl dYWYX'hc'UZZYWh h\Y'k]XYf'g]h Uh]cb'UbX'dfcj]XY'U'Wca dfY\Ybg]j Y'UbU`mg]g'cZh\Y'YZZYWg'cZh\Y']bgh]h h]cbfg'W\Ub[Y']b dfUWf\Wf"

Mci f'fYgdcbgY'g\ci `X'bchU]a 'hc'fYgc`j Y'h\Y'W\U``Yb[Y'U'hc[Yh\Yf"'F Uh\Yfž']hg\ci `X'VY'Ub']bhY``][Ybhž'k Y``! fYUgcbYX'fYgdcbgY'h\Uha Uff]Yg'XYdh\'cZh\ci [\hcb'h\Y'W\U``Yb[Y'ZJWYXž'Uk UfYbYgg'cZh\Y']bgh]hi h]cb'g fYgci fWYg'UbX'U]a gž'UbX'U'XY[fYY'cZWfYUh]j]hm'UbX'Wf]h]WJ``h\YcfmVUgYX'cb'h\Y'g_]``g'XYj Y`cdYX']b'mci fXY[fYY"

Hi fb]h]b'gYh]b[.'H\]g'Ugg][ba Ybh]g'gi Va]hhYX'h\fci [\'Hi fb]h]b'UbX'gh XYbhg'Xc'bchgYY'Hi fb]h]b g]a]'Uf]hmfYdcfhg"

5 hm/b XUb WY F Yei]fYa Ybhg

 $\hbox{Ghi XYbhg'UfY'ghfcb[`mYbWci fU[YX'hc'UhhYbX'U```WUggYg'UbX'fYj]Yk ``YWhi fY'fYWcfX]b[g''] }$

7ci fgY'GWXYXi `Y

<u>J]Yk "WUgg"hja YHUV"Y</u>

H]a YtUV`Y

FYgci fWfg

DfYgWf]VYX F Ygci fWYg

7 ci fgY fYUX]b[g UbX UbX UggYgga Ybha UhYf]U`g k]``VY Uj U]`UV`Y cb`]bY]b A ccX`Y"

FYWca a YbXYX FYgci fWYg

Bch'Uj U]`UV`Y"

7ci fgY 9j U`i Uh]cb UbX 8Yj Y`cda Ybh

 $\label{eq:conditional} \text{Ghi XYbhZYXVUW_'k } \text{``VY'[Uh\YfYX'h\fci [\ \]bZcfa U``dYfgcbU``ZYYXVUW_'UbX'h\Y`Ubcbma ci g`cb`]bY a m91 dYf]YbWr`gmghYa "$

 $\label{thm:condition} \text{H\Y'dfYgYbh'} \text{In}' \text{fuh'} \text{cb'cZh'} \text{]} g'\text{Wci} \text{ fgY'fYZYW} \text{g'ghi XYbh'} \text{ZYXVUW} \text{`} \text{Zfca'dfYj} \text{]} \text{ci g'} \text{]} \text{h}' \text{fuh'} \text{cbg'fY} \text{[UfX]b['h'\Ya Yg UbX'gYa']} \text{buf'ghm'} \text{'Wc'`UVcfuh'} \text{cb''}$

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

Hi fb]h]b Gi Va]gg]cb

Image: Ybwei bhyfu'dfcv'ya k \yb'uhhya dhjb['hc'gi va]hmci f'Ugg][ba Ybhh\fci [\ 'Hi fb]h]bž'd'YUgY

Hy'Yd\cby'9| hy'fbu''Gi ddcfhcb'-',) '' ' ' %cf'Ya U]''h\Ya 'cb'Y! hy'fbu'hy'hgi ddcfh4 i bgk "YXi "Ui "''Gi ddcfh
\ci fg'UfY', .\$\$Ua '-'%\$.\$\$da 'cb'k YY_XUmg'UbX'-.\$\$Ua '-').\$\$da 'cb'k YY_YbXg'fl *) 'XUmg'U'mYUft"'=Z'mci
UfY'i bUV'Y'hc'gi va]hmci f'Ugg][ba YbhXi Y'hc'U'ZJi 'hk]h\ 'Hi fb]h]b'mci 'a UmUdd'mZcf'Ub'Y! hy'bg]cbž'Vi hmci
a i ghfYhJ]b'mci f'h]W_Yhbi a VYf'Zfca '9! hy'fbU''Gi ddcfhfU'cb['k]h\ 'Ubmch\Yf'fy'Yj UbhXcW a Ybhgt'hc
]bWi XY'Ug'Yj]XYbW' hc'gi ddcfhmci f'Y! hy'bg]cb'Udd']WUh]cb"'=Zmci 'Ya U]''9! hy'fbU''Gi ddcfhmci 'k]'`
Ui hca Uh]WJ'`mfYW']j Y'U'h]W_Yhbi a VYfZ'Vi h]Zmci 'hy'Yd\cby'mci 'k]``bYYX'hc'gdYW]Z]WJ'`mUg_'Zcf'cby''
Hi fb]h]b'U'gc'dfcj]XYg'i dXUhy'g'cb'h\Y]f'gmghYa 'ghUh' g'cb'Hk]hyf''

; YbYfU`mž'UggYgga YbhiHug_g'a i ghVY'gi Va]hhYX'Y`YVWfcb]\WJ``mij]U'Y]h\Yf'Hi fb]h]b'cf'U'A ccX`Y Ugg][ba Ybh''=b']bgHJb\W'g'k \YfY'h\]g']g'bchdcgg]V`Yž']hk]```VY'gHJhYX'cb'mci f'\\circ i fgY'g'A ccX`Y'g]hY'k]h\U`hYfbUh]j Y'gi Va]gg]cb'XYHJ]`g"

cfi]bZcfa Uhjcbicbi\ckihcigi Va]hUgg][ba Ybhgicbi]bYij]UiA ccXiY.i\hdg.#gh XYbhi bgk "YXi "Ui #\ck! gi Va]hUgg][ba Ybha ccXiY

5 WUXYa]W<cbYghmUbX D`U[]Uf]ga

D`U[]Uf]ga i]gii g]b[ih\Yik cfXgicfi]XYUgicZch\YfgiUbXidfYgYbh]b[ih\Ya iUgimci fick b"i=hWJbihU_Yia Ubm Zcfa gžZfca iXYi]VYfUhYiWXYUh]b[ihciUWW]XYbhU`mWcdm]b[iZfca iUigci fWYik]h\ci hiUW_bck iYX[Ya Ybh'

IBGK [fcidg'd'U[]Uf]ga]bhc'h\Y'Zc``ck]b['WUhY[cf]Yg.

• i bXYfgHJbX'mci f'f][\hg'UbX'fYgdcbg]V]`]h]Yg'Ug'U'gh XYbh'Uhil BGK