

7ci fgY[·]Cj Yfj]Yk

7ci fgY 8YHJ] g

 $\label{thm:condition} $$HY'bcfa\ U''k\ cf_cux'YI\ dYWfuhcbg'cZU'ghi\ XYbh'ufY'uddfcI\]a\ UhY'm'&) '\ci\ fg'dYf'hYfa\ 'Zcf'YUW\'I\ C7ž\]bWi\ X]b[\ 'WUgg'Wcbh'uWfi\ci\ fgž'ch\Yf''YUfb]b[\ 'UWhjj\]h]Ygž'dfYdUfUhjcb''UbX'hJa\ Y'gdYbh'cb''U'''UggYggUV'Y\ k\ cf_'''$

Mci 'g\ci `X'U]a 'hc'gdYbX'UVci h* '\f#k _'cb'h\]g'Wci fgY"'H\Y'UXX]h]cbU``h]a Y'g\ci `X'VY'gdYbh]b'a U_]b[gi fY'h\Uhmci 'i bXYfgHJbX'h\Y'a UhYf]U'ž'Wca d'Yh]b['h\Y'gYhXY`]j YfUV'Ygž'Z fh\Yf'fYUX]b[ž'UbX'd'Ubb]b["

$H\Yg]g$; i]XY]bYg

• H\Y'dfYfYei]g]hYg'Zcf'H\Yg]g'6'fGC @5(-) &# () &£'UbX'H\Yg]g'7'fGC @5(-)' # ()' £'UfY'H\Yg]g'5 fGC @5(-) \# () \%£'UbX'H\Yg]g'6'fGC \@5(-) &# () &£Z'fYgdYWhJ Y`m'

.

5ggYgga Ybh

H\Yg]g [·] 7 [·] HUg_	8iY'8UhY	; fUXYX
H\Yg]g Gi Va]gg]cb		

5ggYgga Ybh'hUg_	K Y][\h	8iY'8UHY	7 ci fgY @YUfb]b[Ci HWca Yg 5ggYggYX
%"'H\Yg]g'Dfc^YWhUbX'F Ydcfh	* \$1	\$) #\$, #&\$&&`%&.\$\$`DA	%ž'&ž'' ž'(ž')
&""J]XYc'dfYgYbfUf]cb)	\$) #\$, #&\$&&`\$) .\$\$`DA)
' "'DUffjWjdUfjcb	% \$I	Bch5dd`]WUV`Y	%ž'&ž'' ž'(ž')

5ggYgga Ybh% H\Yg]g Dfc YWhUbX F Ydcfh

5ggYgga Ybh`Yb[h\. Bc'a cfY'h\Ub', \$'dU[Yg

Gi Va]gg]cb bch/g. Gi Va]hhc Vch\ h\ Y Hi fb]h]b Ugg][ba YbhUbX h\ Y [fUX]b[Zcf h\ Yg]g gYW]cb

8i Y'XUhY.'\$) #\$, #&\$&&'%&.\$\$'DA

8YUX`]bYZcfUVgc`i hYZU]`.'') XUmg'UZhYf'h\YXiY'XUhY

H\Yg]g`7`Wcbh]bi Yg`h\Y`dfc^YWik cf_"`H\Y`_YmXY`]j YfUV`Y`]g`h\Y`K f]hhYb`F Ydcfh'`H\Y`Zc``ck]b[`Wci fgY UggYgga Ybhg`fY`UhY`hc`h\Y`ghi XYbhg`fYgYUfW\`d`Ubb]b[`z`WcbXi Wh]b[`h\Y`fYgYUfW\`dfc^YWhUbX`k f]h]b[`h\Y`fYgi`hg`]b`X]ZYfYbhZcfa g"

H\]g`Ugg][ba Ybh]g`gi Va]hhYX`h\fci [\`Hi fb]h]b`UbX`gh XYbhg`Wb`gYY`Hi fb]h]b`g]a]`Uf]hmifYdcfhg"

5ggYgga Ybh'Wf]hYf]U

Ghi XYbhgia i ghigi Va]hilbiYYWfcb]WWcdmcbimj]Uih fb!]hi]bicbiA ccXYJ5B8i]bihXYhXyg]gia Uf_]b[igYWfcbVmilligha i ghigi Va]hilbiYiYbhi kyfYiUighi XYbhi\UgiVYYbiUZYWhXiVmUbi]ibYggicf
a]gUXj Ybhi fYzhiYma i ghigi Va]hilgia i WicZhiXyfThiXyg]giUgidcgg]VYžUbXihXybicX[YiUiFYei YghiZcfGdYW]Uii7cbihXfci [\il BGK iGhi XYbhi7YbhfUii1Ghi XYbhgik\ciXcibchigi Va]hiVmhXYiXYUXi]bYik]iiVidYbUi]gYXii5biYl hybg]cbicZha Yia UmcbimVYi[fUbhXxiUzhYfiYwW]dhcZUiiFYei YghiZcfGdYW]Uii7cbg]XYfUhjcbikZhiAiibuiidhicziii2cfhiXyi]bWca diYhYihXyg]giUbXicbimi bXYfYl WidhjcbUiiWffW a ghUbWg VYmcbXihXyighi XYbhfgiWcbhfciii2cfhiXyfiXYhU]igidiYugYigYYihXyigYwfjcbiVYickihJhYXiiHXYg]giK]hiXfUk Uiž Gi gdYbg]cbzUbXihJa Yi9l hYbg]cbiii; i]XUbWiiZcfik f]hjb[ihXyihXyg]gzUbXihXyigdYwJZwhhcbgiZcfi]ng dfYgYbhUhjcbik]iiVYidcghYXicbiA ccXiYii9UW ighi XYbhi]giYl dYwhYXihcigi Va]hihXy]fick bi]bX]ji JXi UiihXyg]giHXYhXig]gia i ghiVYiUghUbXUicbYid]YWiicZk cf_zikXyfYiyj Ybi]Zghi XYbhgiXUjiYik cf_YXi]biUi[fci di]ha i ghiVYiUVYihciVyij]yk XXXUgiUbi]bX]ji]Xi Uiid]YWiicZk cf_cbi]hgick bii

5XX]h]cbU`XYhJ]`g

 $HY'a Uf_b[Wf]hYf]U']g'Uj U]`UV`Y'cb'a ccX`Y$

5ggYgga Ybh& J]XYc dfYgYbhJh]cb

5qqYqqa Ybh``Yb[h\.'' a]bi hYq

Gi Va]gg]cb'bchYg. Gi Va]hhc'h\Y'Jc]WH\fYUX'DfYgYbhUh]cbg'i bXYf'5ggYgga YbhZcf'H\Yg]g'Gi Va]gg]cbg GYWh]cb

8i Y'XUhY. '\$) #\$, #&\$&&'\$) .\$\$'DA

8YUX`]bY'Zcf'UVgc`i hY'ZU]`.'') 'XUmg'UZhYf'Xi Y'XUhY

± UXX]h]cb hc gi Va]ht]b['U'h\Yg]gžghi XYbhg 'UfY'YI dYVMYX'hc 'dfYgYbh'U'j]XYc 'dfYgYbh'Uh]cbž']b k YY_'%\$"'H\Y j]XYc 'dfcj]XYg 'fY`Yj Ubh']b zcfa Uh]cb 'UVci hh\Y]f 'dfc YWnža cfY 'XYhU] 'g 'cb 'k \Uhhc ']bWi XY'k]``'VY'di hcb 'h\Y a ccX`Y'Wci fgY'g]hY"

5ggYgga Ybh'Wf]hYf]U

8YHJ]`g`WJb`VY`Zci bX`cb`a ccX`Y

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 $H\[g']g'[\]j\ Yb'\Vm'mci\ f'gi\ dYfj\]gcf'k\]W\&'\UggYggYg'mci\ f'Yb[\ U[\ Ya\ Ybh'UbX'dUff]W]dUf]cb'fh\fci\ [\ \ci\ hh\Y g]g'dfc\ YWh$

5XX]h]cbU`XYhJ]`g

GYY'AccX`Y'Zcf'XYhJ]`g

5 http://bxubww.F.Yei]fYa Ybhg

7ci fgY GWX YXi `Y

H Y f Y U

J]Yk Wugg'ha Yhuv'y

H]a YHJV`Y

FYgci fW/g

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Mci f'gi dYfj]gcf'k]``dfcj]XY'UVWWgg'hc'h\Y'fYgci fWYg'mci 'bYYX"

FYWca a YbXYX FYgci fWYg

- GHJfhik cf_'cb'mci f'hcd]WUg'gccb'Ug'mci 'WUb"'H\]g'k]```[]j Y'mci 'd'YbhmcZh]a Y'hc'UXXfYgg dfcV'Ya g'h\Uh'mci 'a Um'YbWci bhYf'cb'h\Y'k Um'
- D`Ub'h\Y'dfc[fYgg'cZmcif'h\Yg]g'ig]b[žZcf'Yl Uad'Yž'U'; 5BBH'W\Uff\z'UbX'fYj]gY'h\Y'd`Ub'Ug']h dfcWYYXg"
- GHJfhiVmdYfZcfa]b[`'U'fYj]Yk 'cZh\Y'Uj U]`UV`Y``]hYfUhi fY'cb'fYgYUfW\'Wca d`YhYX']b'h\Y'gUa Y'UfYU Ug'mci f'dfc'YWf'H\]g'k]```\Y'd'mci 'Z fh\Yf'XYZ]bY'mci f'hcd]WUbX'h\Y'X]fYWf]cb'mci f'h\Yg]g'k]```H_Y"
- CfXYf'a UhYf]U`g'Ug'gccb'Ug'mci 'UfY'gi fY'k \Uhmci 'bYYX"
- 7` V@afW]g'V]V`]c[fUd\]WgcZtk UfY'th\Uh'U``ck g'mci 'tc'a UbU[Y'mci f'fYZYfYbWrg']b'U'XUtUVUgY"

······UbXžcZWci fgYžXfi ['hf]U`gžVcXmh]ggi Yg`UbX'ch\Yf`a YX]WU``UWfj]]h]Yg"

 $\label{eq:continuous} 5 \cdot gc \check{z}' dfc \cdot \Upsilon W g' \cdot]bj \cdot c'j \cdot]b[\cdot Ub]a \cdot U \cdot g' k \cdot] \cdot \cdot b Y Y X \cdot Y h \cdot] W g' \cdot Uddfcj \cdot U \cdot ''$

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

 $\label{thm:continuous} IBGK ``Ug`Ub`cb[c]b[`Wcaa]haYbhhc`ZcghYf]b[``U`W`hifY`cZ`YUfb]b[`]bZcfaYX`Vm`UWJXYa]W]bhY[f]hm'`5``IBGK `ghiXYbhg`UjY`U`fYgdcbg]V]`]hmhc`UX\YfY`hc`h\]g`df]bW]d`Y`cZUWJXYa]W]bhY[f]hm'D`U[]Uf]gaibXYfa]bYg`UWJXYa]W]bhY[f]hm`UbX`]g`bchhc`YfUhYX`UhIBGK "`B'SY[Sde_SfG@EI[eVW{\WSeaXafZWbeS`VbSee[YfZW_aX\Sekagdai`ž$

Mci 'UfY'U'gc'fYa]bXYX'h\UhWUfYZ ``h]a Y'a UbU[Ya Ybh]g'Ub']a dcfhUbhdUfhcZgh XmUbX'cbY'cZh\Y]XYbh]Z]YX'WUi gYg'cZd`U[]Uf]ga ']g'dccf'h]a Y'a UbU[Ya Ybh'Gh XYbhg'g\ci `X'U``ck 'gi Z]W]Ybh'h]a Y'Zcf fYgYUfW\žXfUZ\]b['UbX'h\Y'dfcdYf'fYZYfYbW]b['cZgci fW/g']b'dfYdUf]b['U```UggYgga Ybh'hUg_g''

Zd`U[]Uf]ga `]gʻZci bX`]bʻmci fʻk cf_ʻk \Ybʻmci ʻUfY`]bʻZ]fghmYUfžmci fʻ`YWi fYfʻk]``cZYfʻmci ʻUgg]ghUbWYʻhc
]a dfcj Yʻmci fʻUWUXYa]Wg_]``g"'H\Yma UmiUg_ʻmci 'hcʻ`cc_ʻUhgca Yʻcb`]bY fYgci fWYgž'UhHYbX`h\Yʻ@YUfb]b[
7 YbhfYžcfʻgca Yh]a YgʻfYgi Va]hmci fʻk cf_ʻk]h\ʻh\YʻdfcV`Ya `Z|I YX"'<ck Yj Yfʻa cfYʻgYf]ci gʻ]bghUbWYgʻ]bʻZ]fgh
mYUfžgi W\ʻUgʻghYU`]b['Ubch\Yfʻghi XYbhgʻk cf_ʻcfʻdUm]b['gca YcbY'hcʻXcʻmci fʻk cf_ža UmiVY`]bj Ygh][UhYXfYʻgYf]ci gʻ]

a dcfhUbhi@]b_g.

 $5 \text{ ``ghi XYbhg'UfY'Yl dYWhYX'hc'fYUX'UbX'VY'ZJa]']Uf'k]h\ \text{'I BGK'}; i]XY`]bYg'UbX'Dc`]WYg''' + b'dUfh]W'`Ufžghi XYbhg'g\ci `X'VY'ZJa]']Uf'k]h\ 'h\ Y'Zc``ck]b[.$

(E5 HY b X Ub WY

CE BGK '9a U] '5XXfYqq

UGdYWU`7cbq]XYfUhcb

(191 Ua q

(Eddfcj YX'7 U'W' \Uhcfg

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8]gWU]a Yf

7F = 7CG

7F = 7CG Dfcj]XYf 7cXY. \$\$\$-,;

5W bck `YX[Ya YbhcZ7ci blfm

 $K Y : UW\underline{b}ck `YX[Y : h, Y : 6YXY[U : dYcd `Y : k \c : UfY : h, Y : hfUX]h\underline{b}cb U ``W ghcX]Ubg : cZh, Y ``UbXg : cb : k \] WX : I B G K ? Ybg]b[hcb : WUa di g :]g ``cWUhYX"$

5ddYbX]I . '9b[]bYYfg'5i ghfU`]U'f95Ł'DfcZYgg]cbU` '9b[]bYYf'7ca dYhYbWm GHJbXUfX

Dfc[fUa =bhybXYX=@YUfb]b['Ci hWca Yg	
?bck `YX[Y`UbX'g_]```VUgY	
D9%"%7ca dfY\Ybg]j Yž'h\YcfmVUgYX'i bXYfghUbX]b['cZh\Y'i bXYfd]bb]b['bUhi fU`'UbX d\mg]\WJ`'g\WJYb\Wg'UbX'h\Y'Yb[]bYYf]b['Z bXUa YbhJ`g'Udd`]\WJV`Y'hc'h\Y'Yb[]bYYf]b['X]g\WJd`]bY	
D9%"&"7cbWYdh U``i bXYfgHJbX]b['cZh\Y'a Uh\Ya Uh]Wgžbi a Yf]WJ``UbU`mg]gžgHJh]gh]Wgž'UbX Wca di hYf`UbX`]bZcfa Uh]cb'gW]YbWYg'k\]W\'i bXYfd]b'h\Y'Yb[]bYYf]b['X]gW]d`]bY	
D9%" '=b!XYdh\'i bXYfghUbX]b['cZgdYW]U`]ghVcX]Yg'cZ_bck `YX[Y'k]h\]b'h\Y'Yb[]bYYf]b[X]gW]d`]bY	
D9%'('8]gWfba YbhcZ_bck `YX[Y 'XYj Y`cda YbhUbX'fYgYUfWX 'X]fYWf]cbg'k]h\]b'h\Y Yb[]bYYf]b['X]gW]d`]bY	
D9%) '? bck 'YX[Y'cZYb[]bYYf]b['XYg][b'dfUWjWY'UbX'WcbhYl hi U`'ZJWcfg']a dUWjb['h\Y Yb[]bYYf]b['X]gWjd`]bY	
D9%"* I bXYfgHJbX]b['cZh\Y'gWcdYž'df]bW]d`Ygž'bcfa gž'UWVci bHJV]`]h]Yg'UbX'Vci bXg'cZ gi gHJ]bUV`Y'Yb[]bYYf]b['dfUWfJWY']b'h\Y'gdYW]ZJWX]gW]d`]bY	
9b[]bYYf]b['Udd`]WUh]cb'UV]`]hm	
D9&"%5dd`]WUh]cb`cZYgHUV`]g\YX`Yb[]bYYf]b[`a Yh\cXg`hc`Wca d`Yl `Yb[]bYYf]b[`dfcV`Ya gc`j]b[
D9&"&": `i YbhiUdd`]WUh]cb'cZYb[]bYYf]b['hYVXb]ei Ygžhcc`g'UbX'fYgci fWYg	
D9&" '5dd`]WUh]cb`cZgmghYa Uh]WYb[]bYYf]b[`gmbh\Yg]g`UbX`XYg][b`dfcWYggYg	
D9&"('5dd`]WUh]cb'cZgmghYa Uh]WUddfcUWXYg'hc'h\Y'WcbXi WhUbX'a UbU[Ya YbhcZYb[]bYYf]b[dfcYWng	
DfcZYgg]cbU`'UbX'dYfgcbU`'Ultf]Vi hYg	
D9' "%'9h\]WU`'WcbXi Wh'UbX'dfcZYgg]cbU`'UWWci bHJV]`]hm	
D9' "&'9ZYWAj Y'cfU`'UbX'k f]MYb'Wcaaib]WUAjcb']b'dfcZYgg]cbU`'UbX'`Um'XcaU]bg	
D9' "' '7 fYUhjj Yž']bbcj Uhjj Y'UbX'dfc!UWhj Y'XYa YUbci f	
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D9' ") 'C fXYf'mia UbU[Ya YbhcZgY`Zi'UbX`dfcZygg]cbU``WcbXi Wh	
D9' "* '9ZZYWNjj Y'NYUa 'a Ya VYfg\]d'UbX'NYUa 'YUXYfg\]d	