: `cf]XU'; fm'7cbj]Whg'79C']b'' %'6]``]cb A YX]WUfY': fUi X'GWUbXU`

; Ufmi7clži: `cf]XUi79CžiWcbj]WhYXicZii %6 A YX]WUfYiZfUi X/gWXYa YihUf[YhYXiji `bYfUV`YiVYbYZ]W]Uf]Ygih\fci [\iXYWY]hZi `dfUWh]WYg"



Dc`_'7ci bhmž'l G5'!' =b'U`UbXa Uf_'fi`]b[ž'; Ufm'7clž'h\Y'+-!mYUf! c`X'79C'cZ'Dck Yf'A cV]`]hm'8cWhcf'Flž'@@7'f8A 9FlŁž'\Ug'VYYb Wcbj]WhYX'Vm'U'ZYXYfU`'^l fm']b': `cf]XU'Zcf'\]g'W\bhfU`'fc`Y']b'U ghU[[Yf]b['V]``]cb!Xc``Uf'A YX]WUfY'ZfUi X'gWXYa Y"'H\]g'g][b]Z]WUbh j]Whcfm'Zcf'`Uk 'YbZcfW\a Ybh'i bXYfgWcfYg'h\Y'hYbUWJhm'k]h\'k\]W\Ui h\cf]h]Yg'UfY'hUW_`]b['\YU`h\WUfY'ZfUi X'h\Uh'g]d\cbg'j U`i UV`Y fYgci fW\g'Zfca 'Wfi W]U`'gYfj]W\g''H\Y'^l fm'Zci bX'gi ZZ]W]Ybh Yj]XYbWY'h\Uh'7cl 'cfWXYghfUhYX'U'ZfUi Xi `Ybh'cdYfUh]cb'U]a YX'Uh \i bXfYXg'cZ'h\ci gUbXg'cZ'A YX]WUfY'VYbYZ]W]Uf]Ygž'i h]`]n]b[a]g`YUX]b['hUWh]Wg'gi WX'Ug'XYWYdh]j Y'a U]`Yfg'UbX'hY'Yj]g]cb'UXgž Wci d`YX'k]h\'WU``g'Zfca 'cZZg\cfY'WYbhYfgž'hc'i fY']bX]j]Xi U`g']bhc \]g'k YV'cZ

XYVW]h"\hhdg.##kkk"hUadUZd"Wca#Uf]ncbU!WYc!Wcbj]WhYX!Vm!

7cl gʻgWk Ya YʻX]Xʻbchʻa YfYʻmʻghcdʻUhʻa]gʻYUX]b[ʻUXj Yfh]g]b[/]h]bj cʻj YXʻgYWʻf]b[ʻdYfgcbUʻ']bZcfa Uh]cbʻi bXYfʻZUʻgYʻdfYhYbgYgž k\]Wk k Ugʻh\Ybʻi gYXʻhcʻdfcWʻfYʻa YX]WUʻʻmi bbYWʻggUfmʻ]hYa gž gi WkʻUgʻcfh\ch]WVfUWʻgʻUbXʻdU]bʻWfYUa gʻʻ<]gʻWca dUbm [YbYfUhYXʻZ]Wh]h]ci gʻXcWhcfgʻcfXYfgžʻWU]a]b[ʻh\Uhʻd\mg]WJUbgʻ\UXh\cfci [\`mYl Ua]bYXʻVYbYZ]WJUf]Ygʻk\Ybžʻ]bʻZUWhž'h\YfYʻ\UXʻVYYb`]hhʻYʻhcʻbcʻWcbgi `hUh]cbʻUhʻUʻʻʻʻ YXYfUʻʻUi h\cf]h]Ygʻ\Uj YʻghUhYXh\Uhʻh\YgYʻZfUi Xi `YbhʻWU]a gʻʻYXʻhcʻcj Yfʻʻ %ʻV]``]cbʻVY]b[ʻV]``YXʻhc A YX]WUfYʻUbXʻch\Yfʻ]bgi fYfgžʻfYgi `h]b[ʻ]bʻa cfYʻh\Ubʻʻ *\$`a]``]cb]bʻdUmci hgʻZfca 'A YX]WUfYʻUbXʻdf]j UhYʻ]bgi fYfgʻ

H\Y'6fcUXYf'7cbhYlh'cZ'<YU`h\WUfY:fUiX

H\]g`WUgY`]g`bch`Ub`]gc`UhYX`]bW]XYbh`]b`h\Y`fYU`a `cZ`\YU`h\WUfYZfUi X/fUh\Yfž']h`Z]hg`]bhc`U`hfci V`]b[`hfYbX`h\Uh`\Ug`gYYb\YU`h\WUfY`ZfUi X`dYfg]ghYbh`m`YgWU`UhY"`BUh]cbk]XYž`\YU`h\WUfYZfUi X`Wcghg`h\Y`I b]hYX`GhUhYg`Ufci bX``%\$\$`V]``]cb`YUW\`mYUfž`k]h\AYX]WUfY`ZfUi X`UVWci bh]b[`Zcf`U`ghU[[Yf]b[``*\$`V]``]cb`cZ`h\UhhchU`"\hhdg.##[fck h\U"Wca #V`c[#a YX]WUfY!a YX]WUJX!\YU`h\WUfY!ZfUi X!ghUh]gh]Wg`9j]XYbWY`]bX]WUhYg`h\Uh`UddfcI]a UhY`m`%\$I`cZ`U``\YU`h\WUfY`gdYbX]b[`]g``cgh`hc`ZfUi Xi`Ybh`UWh]j]h]Yg`YUW\`mYUfžUZZYWh]b[`Wci bh`Ygg`]bX]j]Xi U`gž`dUfh]W'`Uf`m`gYb]cf`W]h]nYbg`k\cUfY`cZhYb`h\Y`a cgh`ji`bYfUV`Y`j]Wh]a g"

A cfYcj Yfž'h\Y'ghUh]gh]Wg'fYj YU`'U'hfci V`]b['f]gY']b'j Uf]ci g'hmdYg'cZ\YU`h\WUfY'ZfUi Xž']bWi X]b['h\Y'U`Ufa]b[']bWfYUgY']b'hY`Y\YU`h\ZfUi Xž'k\]W\"gUk 'U'+)ı 'i dh]W_'VYhk YYb'&\$&\$'UbX'&\$&("'7cl g\WUgY'\][\`][\hg'U'gdYW]Z]WUgdYWh'cZ'h\]g'VfcUXYf']ggi Yžg\ck WUg]b['\ck 'Wf]a]bU`g'Yl d`c]h'hY`Ya YX]W]bY'd`UhZcfa g'hcYl YW'hY'X]g\cbYgh'V]``]b['dfUWh]WYg"'G\cW_]b[`mž'cbY!h\]fX'cZ A YX]WUfY'ZfUi X'WUgYg']bj c`j Y'ZfUi Xi `Ybh'WU]a g'Zcf'Xi fUV`Ya YX]WU`'Yei]da Ybhž'Ub'UfYU'k\YfY'j][]`Ubh'cj Yfg][\h']g'gcfY`mbYYXYX"

@Y[U`FUa]Z]WUh]cbg'UbX:ihifY'5Wh]cbg

K\]'Y'; Ufm'7cl'bck'UkU]hg'gYbhYbW]b[z'ZUW]b['U'aUl]a ia cz'&\$
mYUfg']b'df]gcb'Zcf'Wcbgd]fUWm'U`cb[g]XY'UXX]h]cbU`dYbU`h]Yg'Zcf
ch\Yf'Wcbj]Wh]cbgz'h\Y']a d`]WUh]cbg'cZ'\]g'Wcbj]Wh]cb'f]dd`Y
h\fci[\ci h'h\Y'\YU`h\WUfY'gmghYa "'I "G"'5hhcfbYm'<UmXYb'D"
C 6mfbY'\Ug'gdc_Yb'WUbX]X`m'UVci h'h\Y'gi VghUbh]U``\Ufa 'WUi gYX
Vm'gi W\ZfUi X'gW\Ya Ygz'bch'cb`m'YfcX]b['h\Y']bhY[f]hm'cZ
A YX]WUfY'Vi h'U`gc'a]gUddfcdf]Uh]b['hUldUmYf'Xc``Ufg"'H\Y
]a dcfhUbW'cZ'di fgi]b['UbX'dfcgYW'h]b['h\YgY'WUgYg'WUbbch'VY
cj YfghUhYXz'Ug']`i ghfUhYX'Vm'h\Y'+, '\YU`h\WUfY'dfcj]XYfg
dfcgYW'hYX'Vm'h\Y'8YdUfha Ybh'cZ'\$\frac{1}{2}\$gh]WY']b'&\$&(\zeta'Ua ci bh]b['hc
cj Yf'`&\$\$a]``]cb']b'Z]bYg'Zcf'ZfUi X!fY`UhYX
cZZYbgYg"\hhdg.#c][''\\g"[cj #fYdcfhg#U``#&\$&(\zeta\YU`h\!WUfY!ZfUi X!
UbX!UVi gY!Wcbhfc`!dfc[fUa !fYdcfhlZ]gWU`!mYUf!&\$&' #

Gi WX 'dfcgYW' h]cbg``YUX 'hc 'U'bchUV`Y'fYWcj YfmcZ'Zi bXgž'k]h\ 'cj Yf &") 'V]``]cb']b'\YU`h\ WUfY'ZfUi X'gYhh`Ya Ybhg'VY]b['fYWcj YfYX'Vm h\Y'8YdUfha YbhcZ'*j gh]WY']b'&\$&('U`cbY"'H\]g']g'a UXY'dcgg]V`Yh\fci [\'Wc``YWh]j Y'YZZcfhg'Xf]j Yb'Vm'h\Y'<YU`h\ '\pgi fUbWYDcfhUV]`]hm'UbX'5WWci bhUV]`]hm'5Wh'fk \D55\z'k\]WX'YghUV`]g\YX'UZfUa Yk cf_'Zcf'Wca VUh]b['\YU`h\ WUfY'ZfUi X'Wca dfY\Ybg]j Y`m"H\Y'UWh'a UbXUhYg'Ubbi U``fYdcfh]b['hc'Ybgi fY'hfUbgdUfYbWm'UbXUWCi bhUV]`]hm'k]h\]b'h\Y'A YX]WUfY'Hfi gh': i bX"

 $\label{thm:condition} $$5g.5a Yf] WU WC bh] bi Yg hc [fUdd Y k]h\ h\]g cb[c]b[VUhh Y U[U] bgh \ YU h\ WUfY ZfUi Xž h\ Y ``UhYgh fi `]b[gYfj Yg Ug U fYa]b XYf c Z h\ Y b Y W gg] hm Zcf j][]`Ub W `Ub X]bhY[f]hm k]h\]b ci f `\ YU h\ WUfY gmgh Ya "' \delta g i d hc `U `` c Z i g dc `] W na U_Yfg ž \ YU h\ WUfY 'd f cj] XYfg ž Ub X 'd Uh] Y b hg hc 'ghUm']b Zcfa Y X `Ub X 'd f c U Wh]j Y ']b `Wca V Uh] b [h\ YgY `XY W]hZ ` 'd f U Wh] W g h\ Uh i b XY fa]b Y ci f `\ YU h\ WUfY]bhY[f]hm'$

8 YhU]`g	
Cfh	Dc`_'7cibhmž'lG5
EiY``Yb	• k k k "hUa d UZd "Wca
	• [fck h\U"Wca
	• c]["\\g"[cj

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z. 'a Y]b!k]Yb "bYh