

7ci fgY[.]Cj Yfj]Yk

]b'k f]h]b['hc'h\Y'8YUb'UbX'dfcj]XY'U```cf][]bU``cf'WYfh]Z[YX'gi ddcfh]b['XcW a YbhUh]cb"

 $: cf'a\ cfY']bZcfa\ Uf]cb'UVci\ hih\Y'UfhYbXUbWY'dfchcWc`g']b'h\Y': UWV`hmicZ5fhg'UbX'GcW]U`\\ GW]YbWYg.'\underline{\ htdg.} \#k\ k\ k''Ufhg''i\ bgk''YXi''Ui\ \#W\ ffYbHghi\ XYbhg\#UWUXYa\]W]bZcfa\ Uf]cb\#dfchcWc`g!\ [i\]XY`]bYg\#UWUXYa\]W]bZcfa\ Uf]cb#dfchcWc`g!\ [i\]XY`]bYg#UWUXYa\]W]bZcfa\ Uf]cb#dfchcWc`g!\ [i\]XY`]bYg#UWUXYa\]W]bZcfa\ Uf]cb#dfchcWc`g!\ [i\]XY`]bYg#UWUXYa\]W]bZcfa\ Uf]cb#dfchcWc`g!\ [i\]XY`]bYg#UWUXYa\ [i\]XY`]$

5 WUXYa]W = b Zcfa Uhlcb.

: cf`YggYbh]U``ghi XYbh`]bZcfa Uh]cb`fY`Uh]b['hc.`fYei Yghg`Zcf`YI hYbg]cb/fYj]Yk 'cZa Uf_g/cWW dUh]cbU``\YU`h\
UbX`gUZYhm'YI Ua]bUh]cb`dfcWXi fYg/gdYW]U``Wcbg]XYfUh]cb`]b`h\Y`Yj YbhcZ]``bYgg`cf`a]gUXj Ybhi fY/
ghi XYbhYei]hmUbX`X]gUV]`]hm'UbX`ch\Yf`YggYbh]U``UWUXYa]W]bZcfa Uh]cbž
gYY`\hdg.#k k k "Ufhg"i bgk "YXi "Ui #W ffYbhghi XYbhg#UWUXYa]W]bZcfa Uh]cb#dfchcWc`g![i]XY`]bYg#

7ci fgY 8YHJ] g

7 fYX]hDc]bhg *

Gi a a UfmcZh\Y 7ci fgY

5 hh Y WcbWi g]cb cZh]g Wci fgY h Y gh XYbhk] ` VY UV Y hc

- %"; YbYfUhY`ZYUhi fYgʻcZj Ufmjb[``Yb[h\gʻcb`XYUX`]bYžhc``Yb[h\žWcbZcfa]b[`hc`fYei]fYa YbhgʻcZ X]ZZYfYbh[YbfYgʻ]bʻj Uf]ci gʻa YX]Uʻci hYhq
- &" D`UbžfYgYUfWXžglfi WhifY'UbX'k f]lY'ZYUhifYgžei Yf]Yg'UbX'd]lWXYg
- "FY`mcb'kY``!XYjY`cdYX`fYdcfh]b['UbX'bYkg'[Uh\Yf]b['g_]``g
- ("I bXYfghJbX'dfcZYgg]cbU``YX]hcf]U``dfcW/ggYgžYh\]Wg`UbX'h\Y'XYa UbXg'cZh\Y'a Uf_Yhd`UW/
-) "Kcf_'Ug'dUfhcZU'hYUa'hc'WfYUhY'ZYUhifYg'Zcf'aU]bghfYUa'aYX]U
- *" HU_Y`cb`h\Y`W\U``Yb[Y`cZbYk`ghcfmihY``]b[`!hYV\\b]ei Yq

HYUWX]b[GhfUhY[]Yg

 $H\g`Wci fgY`Wca V]bYg`CB9`Hk c!\ci f`gYa]bUf\#k YY_`K + \ga U```UbX``Uf[Y`[fci d`X]gWi gg]cbgž`]b!WUgg k cf_g\cdgžYj U`i Uh]cbžYI YfW]gYg`VUgYX`cb`Wci fgY`fYUX]b[gž`\UbXci hg`UbX`gYa]bUf`WcbhYbhž'UbX`Zci f UggYggYX`hUg_g`k]h\`XYUX`]bYg''``$

5ggYgga Ybh

5@5GG; BA 9BHG A I GH 69 GI 6A #H98 5G K CF8 8C7I A 9BHG fBC D8: gt" MCI A I GH # 7@ 89 5 7 C J 9F G < 99 H DF C J & # ; MCI F GHI 89 B H BI A 69 F 5B 8 9B F C @ A 9B H B 5A 9 fl # GH B 5A 9 : C @ C K 98 6M: 5A @ MB 5A 9 t 5 G K 9@ 5G 7 C I F G 9 / 5 G G; BA 9B H BI A 69 F z G 9A # 5 F ; F C I D 85 M 5 B 8 H A 9" MCI A I GH DF C J & 9 H < 9 B 5A 9G 5B 8 7 C B H 5 7 H 8 9 H 5 @ G C : 5 @ # H 9 F J 9 K 9 9 G K # < # H 9 F J 9 K D 65 7 9 z 8 5 H 9 z H A 9 5 B 8 K < 9 H < 9 F H < 9 # 8 H 9 F J 9 K K 5G 7 C B 81 7 H 98 # 10 9 F G C B z C F 6 M H 9 @ 9 D < C B 9 z 9 A 5 @ C F G ? M D 9 " 5 @ # 8 H 9 F J 9 K G A I G H 69 7 C B 81 7 H 98 # 5 I G H F 5 @ 5 5 B 8 A I G H 69 F 9 7 C F 8 9 8 fG A 5 F H D < C B 9 5 I 8 £ F 9 7 C F 8 # ; G 5 F 9 5 7 7 9 D H 5 6 @ P 2 B C B C H G I 6 A # F 9 7 C F 8 # ; G 6 I H F 9 H 5 # H < 9 A 5 G 9 J # 9 B 7 9 C : H < 9 5 7 7 I F 5 7 M C : MC I F E I C H 5 H £ B G " 5 @ K 5 M G G I 6 A # 15 B 5 7 7 I F 5 H 9 9 G H A 5 H 9 C : H < 9 B I A 6 9 F C : K C F 8 G G I 6 A # H 9 8 " 8 C B C H B 7 @ 8 9 7 C J 9 F G < 9 9 H z # H 9 F J 9 K 9 9 8 9 H 5 @ G C F F 9 : 9 F 9 B 7 9 @ G H G B H < 9 7 C I B H C : K C F 8 G G I 6 A # H 9 8 " F 9 E I £ 9 A 9 B H G 8 \$: 9 F : C F 9 5 7 < 5 G G \$ B A 9 B H "

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GhcfmiD]hWX	%\$I	\$-#\$,#&\$% `\$\$\$`5A	&ž(
G\cfh: YUh fY'	&) ।	&+#\$, #&\$% `\$).\$\$`DA	%ž&ž ž(ž) ž*
5i h\cf#(YbfY#di V`]WUh]cb 5ddfU]gU`	&) ।	%#\$-#&\$% `\$\$\$`5A	(
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8YHJ]`g. ') \$\$`k cfXg"`Gh XYbhg`k]```VY`UggYggYX`cb`h\Y`dfUWf]Wb`]mž`UddYU``UbX`gi]hUV]`]mmcZh\Y]f`ghcfm]XYU`hc`h\Y`HUf[Yh'Ui X]YbWYž`UbX`h\Y`WUf]mmUbX`dYfgi Ug]j YbYgg`cZh\Y]f`k f]h]b["A Uf_]b[`Wf]hYf]Už`[fUXYg UbX`ei U`]hUh]j Y`ZYYXVUW_"

Gi Va]gg]cb bchYg.5 d]hW.]g Ua YggU[Yirc Ub YX]rcf h.UhZU[g Ugrcfm]XYUž UbX Uf[i Yg Zcf h.Y grcfmg bcj Yimžg][b]Z]wUbW UbX UddYU`hch.Y di V]wUhjcb cf dfc[fUa 'g'hUf[YhUi X]YbW"Gi Va]hU'd]hW. h.Uhk]``Zcfa 'h.Y VUg]g cZmci f G\cfh. YUhi fY 5gg][ba YbhHk c"D]hW.]b[i]g U'HK C GH5; 9 DF C 7 9GG" \pm GhU[Y C bYž mci 'k]``YI d'U]b mci f d]hW.]b wUgg]b K 99? " "H\Ybž VUgYX cb ghi XYbhUbX hi hcf ZYXVUw z mci 'k]``F 9J \pm 9 MC I F D \pm 7 \pm 10bX gi Va]hj]U A ccXY Vm-5A H< I F G85M-H< '5I; I GH &\$% "HU_Y UXj UbHU[Y cZh\Y]b! wUgg k cf_g\cd Ybj]fcba Ybhhc fY Z]bY mci f 'd]hW. UbX ZYUhi fY]XYU" Mci 'A I GH gHUhY h\Y; 9BF 9]b k \]W. 'h\Y ghcfmk]``VY k f]hhYb fWx ccgY Z ca ' \pm A 9F G \pm B z 7 C @C I F z HF 9B 8 G z 5B 5@NG \pm 2 G HM@9 z C D \pm E B cf F 9J \pm K \pm UbX h\Y H5F; 9H DI 6@ \pm 5 H \pm B fh\Y bYk gdUdYfz a U[Un]bYzk YVg]hY cf dfc[fUa 'mci 'h.]b_k ci 'X VY]bhYfYghYX]b mci f ghcfm \pm Nci f d]hW. 'a i gh '% \pm Ybh]Zm mci f ghcfm[YbfY UbX bYk g Ub['Y \pm Cc_"K \ Uhlg 'h\Y ghcfmUVci hB K \ m]g]hfYY j UbhB K \ mbck 3 & \pm XYbh]Zm h\Y]bhYbXYX 'di V ']WUhlcb" 7]hY Yj |XYbW 'h\ Uhdfcj Yg mci f 'ghcfm]q k Y`!qi |hYX 'hc h\Y 'hUf[Yhdi V]WUhlcb" UbX

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

5ggYgga Ybh& G\cfh: YUh fY

GhUfhXUhY. Bch5dd`]WUV`Y

@Yb[h\.-\$\$!%\\$\$\$kcfXg

8 YHU]`g. '%\$\$\$'k cfXg"'D`Ub`UbX`k f]hY`U`g\cfhZYUh fY`Ufh]WY`]b`Ub'Uddfcj YX`[YbfY"'Gh XYbhg`k]``VY
UggYggYX`cb`h\Y`Zi YbWnUbX`UWW fUWncZh\Y]f`k f]h]b[ž'cb`ghcfmghfi Wh fYž'UbX`i bXYfghUbX]b[`cZh\Y`[YbfY
j U`i Yg`cZh\Y`Zcfa `]b`k \]W\`h\Ym\Uj Y`W\cgYb`hc`k f]hY"A Uf_]b[`Wf]hYf]Už[fUXYg`UbX`ei U`]hUh]j Y`ZYYXVUW_"`

Gi Va]gg]cb'bchYg. Gi Va]hU'-\$\$!\%\$\$\$'k cfX'G<CFH': 95HI F 9'5FH=7 @9"'H\Y'k cfX'\%'i bh'Udd`]Yg'hc h\Y'hYI hcZh\Y'Uff]\WY'cb`m''\Mci 'g\ci `X'BCH'\Wci bh'fY\ZYfYb\W'g'cf']bhYfj]Yk YY'\Wcb\U\WiXYhU]`g']b'mci f'k cfX \\Wci bh''\Mci f'ghcfmA I GH'\Y'k f]\hhYb']b'cbY'cZh\Y'\Zc``ck]b['Uddfcj YX'[YbfYg.'=\A A 9FG\&B\Z'7C\@CI F\Z'

Gi Va]gg]cb bchYg. Gi Va]hUb 5ddfU]gU`cZUʻZYUhi fY k f]hYfʻCF di V`]WUhjcb Wjh]b['h\fYY`Ufh]WYg`k f]hhYb`]b h\Y`gUa Y`Uddfcj YX`[YbfY`VmcbY`Ui h\cf`CF 'h\fYY`Ufh]WYg`k f]hhYb`]b`h\Y`gUa Y`[YbfY`VmX]ZYfYbhUi h\cfg Vi hdi V`]g\YX`Vmh\Y`gUa Y`bYk gdUdYfža U[Un]bY`cf`k YVg]hY"`7CD \Rightarrow G`C: '5@' '5FH \Rightarrow @9G`A I GH`69 D5GH98 ' \Rightarrow HC 'MCIF' K CF8'8C7" 'BC ' \Rightarrow BH9FJ \Rightarrow K G'5F9'F9EI \Rightarrow 98 $\overset{?}{z}$ Vi hei chYgʻZfca 'fYZYfYbWYg UbX`Ufh]WYgʻUbX`Vcc_gʻUfY`Wca di `gcfm]b`\Y`d]b['hc 'gi ddcfhmci f`Uf[i a Ybh'K f]hY`Ub`Yb[U[]b[]bhfcXi Whjcbz`XYgWf]V]b['h\Y`dc]bhg`mci 'k]``VY`X]gW gg]b[$\overset{?}{z}$ UbX`gi ddcfhh\Ya 'k]h\`Yj]XYbWY``YUX]b['hc WcbWi g]cbg"'8Ya cbgh \Rightarrow G`C: '5@' '5FH \Rightarrow @9G`A I GH`69

Gi Va]gg]cb bch/g.K f]h/ U Z/Uh f/ Ufr]W/]b cb/ cZh/Y Zc ``ck]b[[Ybf/g. ; 9B9F5@: 95HI F9zB9K G CF =GGI 9!65G98: 95HI F 9ž657?; FCI B89F cfDFC: =@9"GKUHY h\Y'; 9BF 9 UbX'H5F; 9H DI 6@-75H-CB"-1-10W1 XY'ei chYg'7ca '5H'@95GH'HK C'-18H9FJ-9K G'h\Uhmci \Uj Y'WcbXi WhYX BD9FGCB']b'5i glfU`]U"'Dfcj]XY'Ya U]`'UbX'd\cbY'WcbHUWgžZcf'U```]bHYfj]Yk YYg'ei cHYXž'UbX'h\Y'XUHYž ha Y'UbX'`c\\Uh\cb'k\YfY'U```]bhYfj]Yk g'hcc_'d`U\\"'F Y\\cfX'U```]bhYfj]Yk g'UbX'_YYd'h\Y'fY\\cfX]b['i bh]` 8YWYa VYf'&\$% "'GHUHY'k \Yh\Yf'YUVX]bHYfj]Yk 'k Ug'WcbXi WYX]b!dYfgcbz'cf'j]U'Ya U]`cf'd\cbY'cf'G_mdY" @jghih\Y`gci fWrg`cZU```ZJWhU`jbZcfa Uhjcb`i gYX`Vf]YZmUbX`jbZcfa U``m`=B`H<9`H9LH`fKc`BCH`i gY dUfYbh\YqYqE"Dfci]XY'fYZYfYbWY'`]qhWhhb['h\Y'qci fWY'cZU```ZUWhq'i qYX']b'h\Y'Ufh\WYž']bWi X]b['I F @``]b_q hc k YV du[Yqži q]b[hk Y < Ufj UfX fYZYfYbW[b['qmqhYa "'9a VYX]b hk Y hYl hcZmci f UfhWY k]hk WUdh|cb UbX d\chc WfYX]hg Uh`YUqhHK C GH-@@D<CHCG H5? 9B 6MMCT f@UbXqWJdY: cfa Uht"7]hY h\Y gci fW/q cZ Ubmch\Yfd\chcgigYX"\\d\X\\WhY\\bh\YgYg\bh\YhY\hk\\YfYmcikciXigYCB9\\bZ![fUd\\\ZCB9 i]XYc 'UbX'C B 9 'dcXWUgh' ' & 'U 'bch' 'Uh'h\ Y 'YbX 'cZghcfmž'XYgWf]VY 'h\ Y 'WcbhYbhcZh\ YgY 'a i `ha YX]U Y'Ya Ybhg"'8c'BCH']bWi XY'h\]g'bchY']b'mci f'k cfX'Wci bh'5GG9GG9A 9BH'7F +19F =5 'K =@F9K 5F8.%L E i U`]lmcZfYdcfhlb[z'UWW fUWmUbX'UllYbhlcb'lc'XYlU]\"'&L'5ddfcdf]UllY glfi Wi fYz'WcblYbh'UbX''ci fbU`]qhlW ZYUhi fY k f]h]b['ghmY"' Ł5XYei UhY fUb[Y cZUddfcdf]UhY gci fWg UbX YI dYfngž UbX YZZYWh]j Y Wkc]WY UbX i qY cZei chyg (ŁGi]hUV] imnZcf WkcqYb di V i Which UbX [YbfY i) ŁDfcXi Whi Y i bhyfi jyk q

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

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

 $Gh\ XYbhg\ 'UfY\ 'YI\ dYWhYX\ 'hc\ 'di\ hh\ Y]f\ 'bUa\ Yg\ 'UbX\ 'gh\ XYbhbi\ a\ VYfg\ 'cb\ 'Yj\ YfmdU[\ Y\ 'cZh\ Y]f\ 'Ugg][\ ba\ Ybhg\ ''$

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

- K cf_'gi Va]hhyx'%5'hc'% 'XUmg'UZhYf'h\Y'gh]di `Uhyx'XYUX`]bY'k]``'VY'UggYggYX'UbX'ZYYXVUW_dfcj]XYX'Vi h'U'a Uf_'cZnYfc'k]``'VY'fYWcfXYX'''=Zh\Y'k cf_'k ci `X'\Uj Y'fYWf]j YX'U'dUgg'a Uf_'Vi h'Zcf h\Y'`'UhYbYgg'UbX'h\Y'k cf_']g'U'Wca di `gcfm'Wci fgY'Wca dcbYbh'f\i fX`Y'fYei]fYa Ybhz'U'gh XYbh'k]`` VY'XYYA YX'hc'\Uj Y'a Yhh\Uh'fYei]fYa Ybh/
- K cf_'gi Va]hhYX`&\$`cf`a cfY`XUmg`UZhYf`h\Y`gh]di `UhYX`XYUX`]bY`k]```bchVY`UWW\dhYX`Zcf UggYgga YbhUbX`k]```fYWY]j Y`bc`ZYYXVUW_ža Uf_'cf`[fUXY"'=Zh\Y`UggYgga YbhHUg_']g`U`Wca di `gcfm Wca dcbYbhcZh\Y`Wci fgY`U`gh XYbhk]```fYWY]j Y`Ub`l bgUh]gZJWcfm: U]``fl : Ł`[fUXY`Ug`U`fYgi `hcZ i bgUh]gZJWcfmdYfZcfa UbWY`]b`Ub`YggYbh]U``Wca dcbYbhcZh\Y`Wci fgY"

H\]g']bZcfa Uh]cb']g'U`gc'Uj U]`UV`Y'Uh

\hdg.#k k k "Uffg"i bgk "YXi "Ui #W ffYbhgh XYbhg#UWJXYa]W]bZcfa Uhcb#dfchcWc`g![i]XY`]bYg#

GdYWJU`7cbg]XYfUhJcb5dd`JWUhJcbg

 $\label{thm:condition} $$Mci `WUb`Udd`m'Zcf'gdYW]U``Wcbg]XYfUh]cb`k \Yb`]``bYgg`cf`ch\Yf'W]fW a ghUbWfg`]bhYfZYfY`k]h\`mci f UggYgga Ybh'dYfZcfa UbWf''$

G]W_bYggža]gUXj Ybhi fY'cf'ch\Yf'W]fW a ghUbWrg'VYmcbX'mci f'Wcbhfc``a Um

ł DfYj Ybhmci Zfca Wca d`Yhjb['U'Wci fgY'fYei]fYa Ybhž

ł? YYd mci Zfca 'UttYbX]b['Ub'UggYggUV'Y'UWt]]tmž

ł Ghod moi igi Va]hh]b[iUggYggUV Y k cf_ Zcf U Wci fgYž

ł G][b]Z]WUbhmUZZYWimci fidYfZcfa UbWijbiUggYggUV`Yik cf_žVYi]hUiZcfa U``YbX!cZlgYa YghYfiYl Ua]bUh]cbž'U WUqqihYqhž'Ui`UVcfUhcfmhYqhž'UiqYa]bUfidfYqYbhUh]cbicfiUbmch\YfiZcfa icZiUqqYqga Ybh'

cfilia fth Yfixyfuljgi]bify`uhjcbihciGdYWju`i7 cbg]XYfuhjcbi]bWi X]b[iiK \Ybihci5dd`mižii<ckihci5dd`mi`ubXiiGiddcfhjb[i8cWia Ybhuhjcbiid`YugYifyZyfihcih\YiGdYWju`i7 cbg]XYfuhjcbik YVg]hY.ii\hdg.#ghiXYbhibgk "YXii"ui #gdYWju`iWcbg]XYfuhjcb

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

D`U[]Uf]ga i]g`i g]b[ih\Yik cfXg`cf`]XYUg`cZch\Yfg`UbX'dfYgYbh]b[ih\Ya iUg`mci f`ck b"'=hWJb'hU_Y'a Ubm Zcfa gžZfca iXY`]VYfUhY'W\YUh]b[ihc'UWW]XYbhU`mWcdm]b[iZfca iU'gci fWY'k]h\ci hUW_bck iYX[Ya Ybh'

IBGK [fcidgdu[]Uf]ga]bhch\yzc``ck]b[WUhY[cf]Yg.

7 cdm]b[.'i g]b['h\Y'gUa Y'cf'j Yfmg]a]`Uf'k cfXg'hc'h\Y'cf][]bU`hYl h'cf']XYU'k]h\ci h'UW_bck `YX[]b['h\Y gci fW'cf'i g]b['ei chUh]cb'a Uf_g"'H\]g'U`gc'Udd`]Yg'hc']a U[Ygž'Ufh'UbX'XYg][b'dfcYWhgž'Ug'k Y``'Ug dfYgYbhUh]cbg'k \YfY'gca YcbY'dfYgYbhg'Ubch\Yf'g']XYUg'cf'k cfXg'k]h\ci h'WfYX]h'

⇒ Uddfcdf]UhY 'dUfUd\fUg]b[...7\Ub[]b[...7\Ub[]b[...7\Ub[]b[...7\Ub[]b[...7\Ub]b]b[...7\Ub]b]b[...7\Ub]b]b[...7\Ub]b]b[...7\Ub]b]b[...7\Ub]cfa CfXg`UbX`d\fUgYg`k\]'Y 'a cghmfYhJ]b]b[...h\Y`cf][]bU`gfi Wh fY 'UbX#cf'dfc[fYgg]cb`cZ]XYUg`cZh\Y`cf][]bU`žUbX`]bZcfa Uh]cb`k]h\ci hU_bck`YX[Ya Ybh'H\]g`U`gc Udd`]Yg`]b`dfYgYbhUh]cbg`k\YfY`gca YcbY`dUfUd\fUgYg`Ubch\Yf'g`]XYUg`cf`k cfXg`k]h\ci h`WfYX]h`UbX`hc d]Y\\]b[...hc[Yh\Yf`ei chYg`UbX`dUfUd\fUgYg`]bhc`U`bYk`k\c`Yžk]h\ci h`Uddfcdf]UhY`fYZYfYb\\]b[..."

7 c``i g]cb.'k cf_jb['k]h\ch\Yfg'Vi hdUgg]b['cZZh\Y'k cf_'Ug'U'dYfgcb'g']bX]j]Xi U``k cf_"'7 c``i g]cb'U`gc]bWi XYg'dfcj]X]b['mci f'k cf_'hc'Ubch\Yf'ghi XYbhVYZcfY'h\Y'Xi Y'XUhYžcf'Zcf'h\Y'di fdcgY'cZh\Ya d`U[]Uf]g]b['UhiUbmh]a Yž'dUm]b['Ubch\Yf'dYfgcb'hc'dYfZcfa 'Ub'UWUXYa]WhUg_ž'ghYU']b['cf'UWei]f]b[Ubch\Yf'dYfgcb'g'UWUXYa]Wk cf_'UbX'Wcdm]b[']hz'cZYf]b['hc'Wca d'YhY'Ubch\Yf'dYfgcb'g'k cf_'cf'gYY_]b[dUma YbhZcf'Wca d'Yh]b['UWUXYa]Wk cf_"

±bUddfcdf]UhY`W]hUh]cb.`7]h]b[ˈgci fWYg'k\]WX`\Uj Y`bchVYYb`fYUXžk]h\ci hUW_bck`YX[]b[`h\Y`″gYWcbXUfm″gci fWY`Zfca 'k\]WX`_bck`YX[Y`cZh\Ya`\Ug'VYYb`cVhU]bYX"

8 i d`]\W\r\cb`ffgY`Z\d`U[]\Uf]ga "Ł`gi Va]\r\b[`mci f`ck b`k cf_ž]b`k \c`Y`cf`]b`dUffzk\YfY`]h\Ug`dfYj]ci g`m VYYb`dfYdUfYX`cf`gi Va]\r\X`Zcf`Ubch\Yf`UggYgga Ybhcf\\cki fgY`UhI_BGK_`cf`Ubch\Yf`i b]j Yfg]\r\d

7 cffYWnfYZYfYbWlb['dfUWnWyg.

- DUfUd\fug]b[ž'gi a a Uf]q]b[ž'YggUmk f]hb['UbX'ha Y'a UbU[Ya Ybh
- 5ddfcdf]UhY'i gY'cZUbX'Uhtf]Vi h]cb'Zcf'U'fUb[Y'cZa UhYf]U`g']bWi X]b['hYl hž']a U[Ygž'Zcfa i `UY'UbX WbWYdhg"

±0X]j]Xi U``Ugg]ghUbWr`]g`Uj U]`UV`Y`cb`fYei YghZfca `H\Y`@YUfb]b[`7 YbhY`f<u>\hd.#k k k "`Wi bgk "YXi "Ui #</u>" Gh XYbhg`UfY`U`gc`fYa]bXYX`h\UhWUfYZ ``hja Y`a UbU[Ya Ybh]g`Ub`]a dcfhUbhdUfhcZgh XmUbX`cbY`cZh\Y]XYbh]Z]YX`WUi gYg`cZd`U[]Uf]ga `]g`dccf`hja Y`a UbU[Ya Ybh'`Gh XYbhg`g\ci `X`U``ck `gi Z]W]Ybhhja Y`Zcf fYgYUfW\žXfUZjb[`UbX`dfcdYf`fYZYfYbW]b[`cZgci fWrg`]b`dfYdUf]b[`U``UggYgga Ybh']hYa g"

IBGK @]VfUfmU`gc`\Ugʻh\Y`9@G9`hcc``UjU]`UV`Y`hc`Ugg]ghmci`k]h\`mcif`ghiXmUhIBGK "'9@G9`]gXYg][bYX`hc`]bhfcXiVW`bYk`ghiXYbhg`hc`ghiXm]b[`UhIBGK`Vih]hWUb`U`gc`VY`U`[fYUhfYZfYg\Yf`Xif]b[`mcifqhiXm"

7 ca d'Yhlb['h\Y'9@&9'hi hcf]U`'UbX'ei]n'k]`'YbUV'Y'mci 'hc.

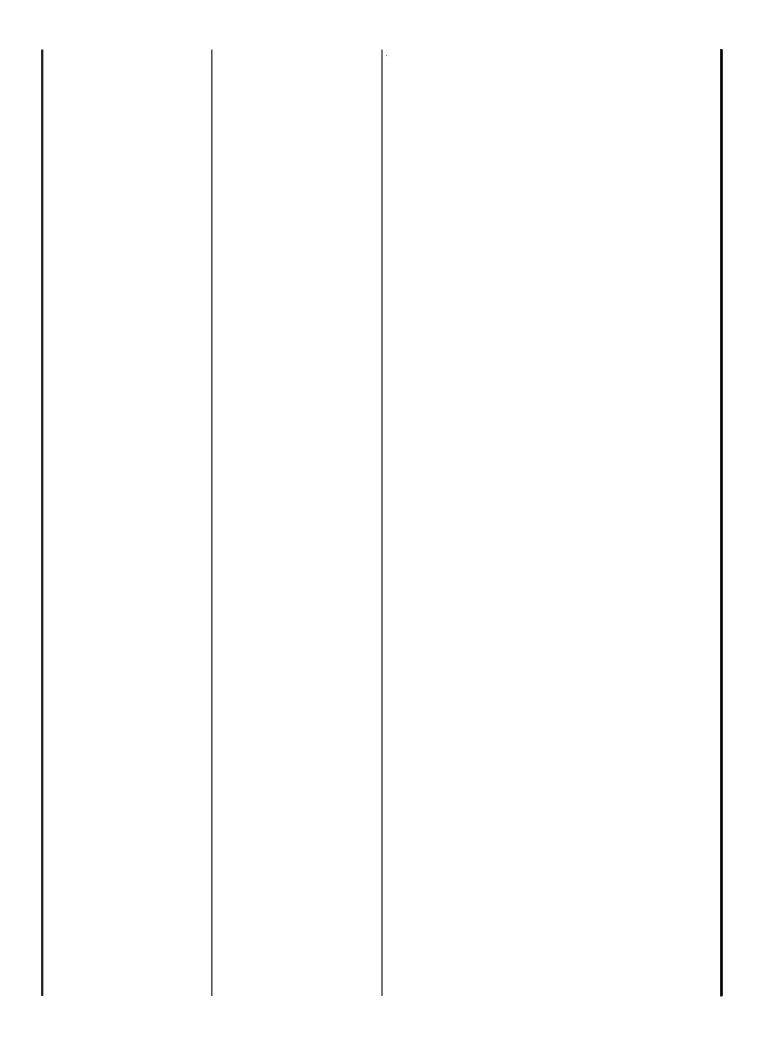
٥

7ci fgY GWX YXi `Y

J]Yk 'WUgg'ha YhUV'Y

H]a YHJV`Y

8 UhY	Hmd Y	7 cbhYbh
K YY_'%'&' '>i `m!'&- '>i `m	GYa]bUf	5B BHFC8I 7H€BHC: 95HI F9K FHB; + h h]g WUgg k Y gi fj YmhY a UbmX]ZYfYbhhmdYg cZ ZYUhi fY k f]h]b[žU X]j YfgY UbX h\f]j]b[gYWcf cZ a YX]U a Uf_Yhg": fca 'gcVYf'UbU`mg]g hc YgWUd]gh hfUj Y`UbX Wcbgi a Yf]bXi `[YbWYžh\YfY 'UfY 'ZYUhi fY Ufh]WYg Zcf'U``HUghYg UbX di fdcgYgžYUW cZh\Ya k]h\]mg ck b Wcbj Ybh]cbg UbX 'UZZcfXUbWYg" K \Uh _]bXg cZZYUhi fY Ufh]WYg k]``mci 'fYgYUfW 'UbX k f]hY h\]g gYa YghYf3`
		GA 5@; FCI D:57H=J+HM:'H\Y'WUgg'k]``X]j]XY]bhc'ga U``[fci dg']b'k\]W\'ghi XYbhg'g\UfY'h\Y]f ghcfm]XYUg'UbX'ghUfhhc'h\]b_'UVci hh\Y'ZYUhi fY [YbfYg'h\Yma][\hhfmh\Y]f'\UbX'Uh'
K YY_'&.'' \$'>i `m!') 5i [i gh	GYa]bUf	:F5A=B; '5B8'D+H7<=B; 'MCIF'GHCFM' <ck'xcugd]f]b['zyuhifykf]hyfg'wcbj]bwyyx]hcfg'hc'giddcfh h\Y]f'dfcYWg3'H\]g'WUgg'YId`cfYg'h\Y'gYWfYhg'cZ h\Y'giVWYggZ\`"d]hW\""</ck'xcugd]f]b['zyuhifykf]hyfg'wcbj]bwyyx]hcfg'hc'giddcfh
		DF 9!7@5GG F 958 B; F YUX UbX dfYdUfY h\Y X]gW gg F]W_Yhgcb /; fU\Ua f&\$%+Ł7 < 5DH9F ') '; YbYfUh]b[: fYg\Ghcfm=XYUg' UbX 7 < 5DH9F ', 'GYY]b[h\]b[g Zcfmci fgY Z/5B8 5@0 D+7 < 9G @C 75H98 B H < 9 K 99? & A C C 8@9 C @8 9F]bW X]b[F cYh\Y z'? Uh\fmb f&\$%\$ŁH\Y GWYbW fB ch5fhzcZh\Y A U[Un]bY D]hW z'H\Y : i hi fY cZ: fYY UbW WcbZYfYbW z'GhUbZcfX I b]j Yfg]hm >i bY '% !% z'&\$%\$" fgYY A ccXY K YY_ & Zc XYfŁ \hd.##ZYY UbW "ghUbZcfX"YXi #Ydcfhg#d]hW #



) "'8 c'mci 'bYYX'hc'Xc']bhYfj]Yk g3' ≠gcžk \c'k]``mci hU`_'hc3' < Uj Y'h\YmU[fYYX'hc'gdYU_'hc'mci 3 *"'K \Uh`cWUhjcbg'k]``VY'j]g]hYX'UbX'XYgWf]VYX']b mci f'ghcfm3 +"'K]``mci 'hY``'h\Y'ghcfm']b'%ghdYfgcb'cf'' fX dYfgcb3'GUmk \m3 , "'BUa Y'h\Y'hUf[Yhdi V`]WUhjcb" 5GG ≑ BA 9BH'%'GI 6A €G € BG. '5ZhYf'dfYgYbh]b[fX\Midiln\X']b'\Wsgg'Sb\X't\W\M\h]b\Y'fgfad'X\W\V\V\V\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
K YY_'(.'% '5i [i gh!'% 5i [i gh!'%	GYa]bUf	F9G95F7 < žK F +H-B; /: 95HI F9; 9BF9G & 5B5@VG - 6 žCD - B - C B žF9J - 9K G (a) h\]g WUgg k Y YI d`cfY h\Y fYgYUfW. UbX k f]h]b['df]bW]d`Yg Wca a cb`mUdd`]YX`]b`dc`Ya]WU`žUbU`mi]WU``UbX Yj U`i Uh]j Y`ZYUhi fY`k f]h]b[" DF9!7@5GG`F958-B; G. F]W_Yhgcb /; fU\Ua 7 < 5DH9F ·- '':]bX]b['h\Y f][\hghfi Wi fY`Zcf`h\Y grcfm'5B8 fff Yj Yb[Y`cZh\Y`BYfXgfiFZWBSde DWh[Wi cb`HUm`cf`Gk]ZhfK YY_ (`: c`XYfL'5B8 K]brcbžH]a 'f&\$% L'"H\Y`7 K cfX. 'Gca Y`h\ci [\hg UVci hWUgg`]b`5i ghfU`]U"" H\Y`A cbh\`mž8YWYa VYf&\$%'!%(\\hdg.#k k k "h\Ya cbh\`m`Wca "Ui #ggi Y#&\$% #XYWYa VYf#%'.), %*(\$\$#]a Ik]bhcb#Wk cfX Ghi XYbhg`g\ci `X`U`gc`UWW\gg`YI Ua d`Yg`cZh\Y]f W\cgYb`ZYUhi fY`[YbfYg`]b`h\Y`; 9BF9`@-6F5F Mcbh\Y`A ccX`Y`Wci fgY`g]hY"
K YY_').'&\$'5i[igh!'&* 5i[igh	; fci d'5Whjj]hm	

	DF 9!7@5GG'F 958 +B; G.'''F]W_Yhgcb'/'; fU\Ua

		F958 B; G. 7 UdchYžHfi a Ub fl/b) \$L" "5 HfU]b F]XY H\fci [\GdU]b"" H\Y BYk Mcf_YfZGYdhYa VYf &ž %) \$"\hd.#k k k "bYk mcf_Yf"Wca #a U[Un]bY#/b) \$#\$ - #\$&#J!f]XY!h\fci [\!gdU]b 5B8 <]``Z?YbXU``Z f5bhUfWfWWfi]gY di hg k \U`YgZgYU`gZdYb[i]bg]b dUggYb[Yfg' d]Wh fYgfiH\Y 5i ghfU`]Ub" &+ 5i [i gh &\$%* fbYY A ccXY K YY_'%\$ ZcXYfL
K YY_'%%', 'C WcVYf'!'%(C WcVYf	GYa]bUf	A I @H=A 98=5. H\Y'bYk Zfcbf]Yf. g`]XYg\ck gža i `f]! a YX]U'ghcfmfY``]b[žj]gi U`'UbX']bfYfUWf]j Y ZYUhi fYgž UbX'XUhU'j]gi U`]nUf]cb" . ; I 9GH'@97HI F9F. H65
		DF 9!7@5GG*CB@B9*J - 9K - B; '5; Ua Y*cZG\Uf_ UbX*A]bbck '` \htd.#k k k "bmt]a Yg"Wca #bYk g[fUd\]Wg#&\$% #%\$#&+# gci h\!WX]bU!gYU#bXYI "\ha_`
		-B!7@5GG'AI@H≠A98=5'57H=J=HM5B8 GI6A=GG£B
K YY_'%&.'%) 'C WcVYf'! &%'C \$ /cVYf	GYa]bUf B%J <i>∜</i> ‰	IA @ 7F: ;5Eł 43>3@57 ~ 36HA 535K;@ 5A @F7?&BA D3DK &CDOBJFGDDYOJ D;F; ØP9 I GHI 89BHG'5F9'F9EI ≠98'HC'F958'H<9 ; C@@CK -B; '5FH=7@9G'8IF-B; 'H<9'F958-B; K99?.
		7 c\YbžF c[Yff&\$%) と"7 \Uf]Y < YVXc'g'A i `h]!A]``]cb! 8 c``Uf`D]`Y`cZHfU[YXmA cbYm'"'J Ub]hm: U]fž'5i [i gh &\$%) "' \htd.#k k k "j Ub]hmZU]f"Wca #bYk g&\$%) #\$+#W\Uf]Y! \YVXc!a cbYml]b! ZUbW

	[UnU! &\$%(\$, \$% ' Wh`k "\ha `
K YY_'% .'&&'CWhcVYf'! &, 'CWhcVYf	D5H <k "="" "'ui<="" "byk="" \$\rightarrow="" '9="" '<="" '@="" '@w'="" 'a="" 'byk="" 'cb="" 'ci="" 'g="" 'g\ci="" 'h\y="" 'k="" 'rc="" 'ubx="" 'uh="" 'x'vfck="" 'yx]rcfž="" 'zyuhi="" .="" 35h="" 5mg="" 6="" 6@="" 7="" 9="" 9!="" 958="" :="" @5gg="" @9=""]b=""]by=""]r\="" ad="" b="" b9k="" bgk="" bxur]cb="" byrk="" ca="" cb@b9="" cbb="" cf_'k="" cfa="" cfb]b[="" cfh\m'cf[="" cfy][="" ci="" czh\y="" czi="" d@5h:="" df="" di="" ei="" f="" f]r]b[="" fbu`]ga="" fy="" ghi="" gk="" grxbyrma="" gy="" hc="" hhž="" i="" j="" k="" td="" v`]g\]b[="" v`]wur]cb="" w'="" wugg="" x]b[="" x]rcf="" xybh="" xybhg="" xyx]wuryx="" y="" yf="" yfu'x="" yvg]ry="" yy_%="" yyr]b[="" yzcfy="" zcfa="" zk="" zkž="" ž]bwi="" €b=""></k>

FYgci fW/g

DfYgWf]VYX F Ygci fWyg

5```ghi XYbhg`a i ghidi fW\UgY`h\Y`Zc``ck]b['hYI hVcc_'

•

 $F_{W_Y} = \frac{1}{2} M_Y + \frac{1}$

.

 $H\setminus [g:H] h [g:U] U U Y:Uh h Y:Lb] Yfg] m Vcc_ghcfY:Zcf:difW UgY"$

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FYWca a YbXYX FYgci fWYg

IBGK @-6F5FMG9FJ=79G

.

 $5 \text{ ```A UghYfg'ghi XYbhg'UfY'YbhjhYX'hc'U'Wcbgi `hUhjcb'k]h\'cbY'cZh\Y'YZJWYbhUbX'\Y`dZ\'F9G95F7 < @-6F5F-5BG'Uhh\Y'I BGK '@]VfUfmcb'h\Y'a U]b'Wa di g"'Ghi XYbhg'cZA 8-5) $$* 'UfY'GHFCB; @M 9B7CIF5; 98 'hc'hU_Y'UXj UbhU[Y'cZh\]g'gYfj]WYg"'Ghi XYbhg'k \c'\Uj Y'BCH'gci [\h'UbX'i bXYf[cbY'UfY'V] fYgYUfW\'Wcbgi `hUhjcb'UfY'a]gg]b['Ub']a dcfhUbhcddcfhi b]mhc'gWcfY'\][\Yf'[fUXYg']b'h\]g'fYgYUfW\'UbX k f]h]b['Wci fqY''$

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9B; @=G< '@5B; I 5; 9'GI DDCFH

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9bfc`a Ybh']b'l BGK 'g'D9@9'DFC; F5A 'UbX'fUb[Y'cZZfYY'9b[`]g\'Wcbj YfgUh]cb'WUggYg']g'< \neq <@MF97CAA9B898'Zcf'ghi XYbhg'Zfca '9b[`]g\'Ug'U'GYWcbX'@Ub[i U[Y'VUW_[fci bXg"]

F958-B; G

GYY'a UhYf]U`g'Uj U]`UV`Y'cb'h\Y'Wti fgY'A ccX`Y'g]hY"

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

Gh XYbhZYYVUW_`]g`]bj]hYX'j]U'h\Y'a m91 dYf]YbWf'gi fj Ym]b'h\Y'gYWbX`\U'ZcZgYa YghYf": YYVUW_`Zfca dfYj]ci g'mYUfg`\Ug'Wbhf]Vi hYX'lc 'W\Ub[Yg`]b'W ff]W'`i a 'UbX'UWfj]hJYgž'UbX`]g'Ub']a dcfrUbhdUfhcZh\YXYj Y`cda YbhUbX']a dfcj Ya YbhcZWci fgYg"'

⇒a U[Y'7fYX]h

 $6YUVW' < c'[XUm'D < CHC'7F98 + H.7 \f]ghcd\Yf'? fYa a Yf'' & $\%+$

7F = 7CG

7F =7 C G 'Dfcj]XYf'7cXY. '\$\$\$-,;