HYfa 'C bY''##'&\$&%

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A]bYfU``F Ygci fV\g'9b[]bYYf]b[

7 ci fgY⁻Cj Yfj]Yk

GHJZZ7cbHJWhi8YHJ]`g

7cbj Ybcfg

BUa Y	9a U]`	5j U]`UV]`]m	@cWUhjcb	D∖cbY
; \]g`U]b`6ci fb]j U`	["Vci fb]j U`4 i bgk "YXi "Ui	Hihcf]U`g`UbX `YWMifYg.`HiYgXUm %da`—`(daž`]b! dYfgcb`cf`cb`]bY UbX`VmUddc]bhaYbh	C`X`AU]b 6i]`X]b[`f?%)ŀž Fa`%)*	Ž*%'&'-\$*) &\$'*

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<u>9b[]bYYf]b['Gh XYbhGYfj]Wg</u>'

9. a YfY"hYUW b[4 i bgk "YXi "Ui

K. <u>k k k "Yb[]bYYf]b["i bgk "YXi "Ui #a]bYfU`g!YbYf[mfYgci fWfg</u>

7cifgY[·]8YHJ]`g

7 fYX]hDc]bhg***

Gi a a UfmcZh\Y'7ci fgY

Nci ik c_Yii dih]gia cfb]b['UbXia cghi]_Yim`cc_YX'Uhimci f`a cV]Yid\cbY''8]Ximci '_bck ih\Uhih]giXYj]WY U`cbY'WcbhU]bg'UVci h) \$`X]ZYfYbhYYa Ybhg3'=ha i ghVY'W\Uf[YX'`]_Y'U``cZmci f`Y`YWfcb]WXYj]WYg''6i h \ck ']g'h\Y'YYWf]W]mdfcXi WX3'K \Yh\Yf`]h]giZfca 'fYbYk UVY'YbYf[mgci fW/g'cf'bchz'h\YmU``fY'mcb a YhU`g'UbX'a]bYfU`g'hc`cdYfUhY'cf'hc`VY'Vi]'h''K \YfYj Yf`mci ``cc_'mci 'gYY'a YhU`g'UbX'a]bYfU`g'UbX'Ug fYa chY'Ug']ha UmgYYa z`U``'h\YgY'[ccXg`ghUfhYX']b'U'd]h''=b'h\]giVci fgY mci 'k]``XYj Y`cd'Ub'Uk UfYbYgg'Zcf h\Y']a dcfhUbWi'cZh\Y'a]b]b[']bXi ghfm]b'ci f``]j Yg''Hc[Yh\Yfzk Y'k]``YI d`cfY'\ck Wea a cX]h]Yg'UfY YI hfUWhYX'Zfca 'h\Y'[fci bX'UbX'k \c'UfY']bj c'] YX'Uhij Uf]ci g'gHU[Yg'cZh\Y'a]b]b['cdYfUh]cb''H\Y'hcd]Wg Wej YfYX']b'h\]g'Wei fgY'UfY'[Yc`c[mza]b]b[za]bYfU`dfcWi'gg]b[zgUZ/mzh\Y'a]b]b[']bXi ghfmžk \]W 'Ya d`cmg dYcd'Y'cZj Uf]ci g'VUW_[fci bXg'fY''[''[Yc`c[]ghgža]b]b['Yb[]bYYfgž'Wj]]`Yb[]bYYfgža YW\Ub]WU`Yb[]bYYfgž Ybj]fcba Ybhz'UbX'YWebca]Wg''K Y'k]``U`gc'X]gW gg'Ya d`cmUV]`]mi]b'h\Y'a]b]b[']bXi gffmžk \]W.Ya d`cmg dYcd'Y'cZj Uf]ci g'VUW_[fci bXg'fY''['''[Yc`c[]ghgža]b]b['Yb[]bYYfgž'Wj]]`Yb[]bYYfgža YW\Ub]WU`Yb[]bYYfgž Ybj]fcba Ybhu`Yb[]bYYfgždfcWigg' 'WYa]WU`Yb[]bYYfgž`Uk mYfgžZ]bUbWi'zYWEbX cZZ/fg'Wea dYhhj Y d`Uf]Yg''K \mbchWea Y'UbX'YUfb'UVci hcbY'cZh\Y'd]``Ufg'cZh\Y'5i ghfU`]Ub'YWebca mUbX'U'dcHYbhJU` Ya d`cmYf3

7 ci fgY 5]a g

H\]gʻWcifgYʻU]agʻhcʻdfcj]XYʻUʻVUg]W]bhfcXiWhjcbʻhcʻa]b]b[ʻUbXʻh\Yʻ5ighfU`]Ubʻa]bYfU`gʻ]bXighfmʻʻ=h]gʻcZ fY`YjUbWYʻZcfʻghiXYbhgʻZicaʻUʻk]XYʻfUb[YʻcZX]gW]d`]bYgʻk]h\`Ubʻ]bhYfYghi]bʻh\Yʻa]bYfU`gʻ]bXighfmžk\]WV Yad`cmgʻg_]`YX`kcf_Yfgʻk]h\`X]ZZYfYbh'hYW\b]WU`VUW_[fcibXg"`GhiXYbhgʻk]```YUfbʻh\YʻZibXUaYbhU`gʻcZ

4

%%" 6Y]b['UWf] Y ``]ZY!`cb['`YUfbYfg"

VY'UWWYggYX'VmWjW_jb['h\Y'AccX`Y']Wcb'cb'h\Y'\caY'dU[Y'cZAml BGK "

UbX'fYqi `hq'Zcf'Uqq][ba Ybhq'YhWk \YbYj Yf'Uj U]`UV'Y'WUb'VY'Zci bX']b'@HA G" 5 WcffYgdcbXYbW/g\ci XVYibXYffU_Ybiig]b[h\YYa U] ZJW]mik]h\b@HA G"

@YUfb]b[/ HYUWX]b[A UbU[Ya YbhGmghYa fl@HA GŁ

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- " < Uj]b['< G97 WcbgWci gbYgg %\$" 5k UfYbYgg`cZgi gHJ]bUV]`]mža i `H]!W `h fU``UbX`[`cVU``]ggi Yg

5qqYqqa Ybhq'k [```HU_Y'H\Y'Zcfa cZU'Wca V]bUh|cb'cZ]bX]j [Xi U``Uqq][ba Ybhqž']bX]j [Xi U``dfYqYbHUh|cbqžd`i q [fcid'dfYgYbfUf]cbg'UbX'U'Z]bU``YIUa"'H\YfY']g'Ub'cdf]cbU``Z]Y`X'ff]d']bWiXYX']b'f\Y'WcifgYž'k]f\'U'fY`UfYX]bX]i]Xi U``Uqq][ba YbH'`: cf'h\cqY'k \c`Xc`bchUHYbX'h\Y`Z]Y`X'H]dž'h\YfY`]q`Ub'U'hYfbUHj Y`a U'cf Ugg][ba Ybh''H\YfY']g'U'Wcgh'UggcWjUhYX'k]h\'h\Y'ZjYX'hf]d'UbX'd`UWYg'UfY'``]a]hYXz'gc'df]cf]mik]``'VY'[]j Yb hc 'ghi XYbhg Ybfc ``YX']b h\Y'A]b]b['9b[]bYYf]b['Dfc[fUa "

H\Y`@YUfb]b['/ 'HYUWX]b['A UbU[Ya YbhGmghYa `f@HA GŁ'i gYX'k]h\ 'h\]g'Wci fgY`]g'H9@H'A ccX'Y'k \]WX 'WUb

: cfid hc XUhY]bZcfa Uh/cb cb `YWh fYq UbX k cf_q\cdqžqYY h\Y 7 U`YbXUf qYWh/cb]b @HA G UbX h\Y GW\cc`

Giddcfha Uhrflu: Zcfh, gwcifgy bwiXb[zwcd]YgcZYWifYbchrgzfYwca a YbXYXfYUXb[gzUgg][baYbhg

7\Ub[Yg]bh\Y`YWifYgVXi YžgYa]bUfgžkcf_g\cdgUbX`Ugg][baYbhXUhYgk]``VY`dcghYX`cbh\Y

i]g`]a dcftUbhit\Uhigh XYbhg`fY[i`Uf`mW\YW_`@HA G`Zcf`W\Ub[Yg`]b`WU`YbXUf`Yj Ybhg`UbX`Zcf`Ya U]` a YggU[Yg" +i]g ghfcb[`mfYWca a YbXYX h\Uhigh XYbhg i gY h\Y a U]`fYX]fYWf]cb ZJW]]mhc Zcfk UfX @HA G

5ggYgga Ybh

H\Y'GW\cc``\Ug'U'fYdcfhik f]hjb[`[i]XY'fFK; Ł'Uj U]`UV`Y'Zcf'U```ghi XYbhg`hU_]b[`a]b]b[`Yb[]bYYf]b[Wci fgYg"`J]Yk 'h\]g'k YVg]hY'hc`Xck b`cUX'U'WcdmicZh\Y'[i]XY.

<u>\htdg.#k k k "Yb[]bYYf]b["i bgk "YXi "Ui #a]bYfU`g!YbYf[ml</u> fYgci fWYg#g]hYg#a]bY#]`Yg#di V`]WUh]cbg#A 95SF YdcfhK f]h]b[: i]XYSY6cc_S&\$% YX"dXZ

 $H \ Y \ F \ K \ ; \ \ "]g \ U \ g \ U \ J \ U \ Y \ h \ fci \ [\ h \ Y \ A \ cc \ X \ Y \ k \ Y \ V \ g] \ H \ c \ Z \ h \]g \ W \ ci \ fg \ Y \ "$

5ggYgga YbhHUg_g

5ggYgga Ybh'HJg_	K Y][∖h	8iY`8UHY	

8YHJ]`g.

5ggYgga YbhWf]hYf]U'ZcfYUWX ']b!WUgg'UWf]j]h]Yg'fY]hYf'ZUWY!hc!ZUWY'cf']b'U'j]fhi U'WUggfcca Ł'k]``'VY YI d'U]bYX'Uhih Y'glUfhcZh Y'UWf]j]hmUbX']g'XYgWf]VYX'k]h.'h Y'lUg_']b'h Y'lUg_'XYgWf]dh]cb'''; YbYfU``m ghi XYbhg'k]```bYYX'hc'YI d`cfY'UbX'UbU`mgY'[]j Yb'hcd]Wg'UbXž']b'U'hYUa ž'dfcj]XY'U'k f]hYb'fYgdcbgY'hc'h Y []j Yb'ei YfmUhih Y'YbX'cZh Y'UWf]j]hmZcfYj U'i Uh]cb'''H\YfY']g'bc'gi Vgh]hi hY'Zcf'h YgY']b!WUgg'UWf]j]hjYg'' Ghi XYbhg'bYYX'hc'a U_Y'gi fY'h YmUhhYbX'WUgg'hc'YY'UVY'hc'gYW fY'h Y'a Uf_g'UggcWJUhYX'k]h.'h.]g UggYgga Ybh''5dd`]WUh]cb'YI YfW]gYg'k]``'VY'UggYggYX'VUgYX'cb'U'fYdcfhifF Ŀz'k \]WX'Zcf'h Y'ZUWY!hc!ZUWY XY']j YfmcZh Y'Wci fgY'a Um]bWi XY'U'X]gW gg]cb'fBE'cf'U'dfYgYbrUh]cb'fDE''

5ggYgga Ybh' . HYUa 'dfc YWh

GhUfhXUhY. Bch5dd`]WUV`Y

8YHJ]`g.

9UWX '[fci d'k]``dfYdUfY`cbY`fYdcfhVUgYX`cb`U`a]b]b[`Z]bUbV]U``dcfhZc`]c"`8YHJ]`gʻcZh\Y`UggYggaYbh Wf]hYf]U`UfY`Uj U]`UV`Y`]b`h\Y`XYgWf]dh]cb`cZh\Y`HUg_"`6f]YZnžighi XYbhg`gY`YVhig\UfYg`cZa]b]b[`Wca dUb]Yg Zca`h\Y`5i ghfU`]Ub`GYWif]h]Yg`9I W\Ub[Y`fbGL Ł"`H\YmhfUW_h\Y`g\UfYg`cj Yf'h\Y`Wci fgY`cZh\Y`hYfa`UbX X]gWigg`h\Y`V\Ub[Yg`]b`h\Y`j U`i Uh]cb`cZh\Y]f`a]b]b[`Wca dUb]Yg"`H\Y`Z]bU``a Uf_`]g`XYhYfa]bYX`Zfca`U fYdcfhigi Va]hHYX`Uhih\Y`YbX`cZh\Y`hYfa"`5`[fci d`a Uf_`]g`Ugg][bYX`UbX`]bX]j]Xi U``a Uf_g`UfY`gWU`YX`Zfca``U dcfh]cb`cZh\Y`[fci d`a Uf_`VUgYX`cb`h\Y`Wcbhf]Vi h]cb`cZYUW\`[fci d`a Ya VYf"`+b`UXX]h]cb`hc`h\Y`fYdcfhž ghi XYbhg`Ybfc``YX`]b`h\Y`ZJVW!hc!ZJVW`Vbci fgY`k]``dfYgYbhh\Y]f`]bj`Ygha YbhghfUhY[mždcfhZc`]c`UbX`dcfhZc`]c dYfZcfa UbWY`]b`U`g\cfhWUgg`dfYgYbfUh]cb"

Hi fb]h]b`gYh]b[.`H\]g`Ugg][ba Ybh]g`gi Va]hhYX`h\fci [\`Hi fb]h]b`UbX`gh XYbhg`WUb`gYY`Hi fb]h]b`g]a]`Uf]hm fYdcfng"



- | BGK "@YUfb]b["7 YblfY"! "<u>k k k "`Wi bgk "YXi "Ui</u>
- 7 ci bgY``]b['gi ddcfh! '<u>k k k "Wci bgY``]b["i bgk "YXi "Ui</u>

9ei]HUV`Y`@YUfb]b['GYfj]Wfg

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

Mci f``YWi fYf`UbX`H\Y`I b]j Yfg]mik]```YI dYWimci f`gi Va]HYX`Ugg][baYbhg`UfY`Hi`mmci f`ckb`kcf_"`I BGK \Ug`j YfmWYUf`[i]XY`]bYg`cb`k\Uhd`U[]Uf]ga`]g`UbX`\ck`hc`Ujc]X`]H`D`U[]Uf]ga`]g`i g]b[`H\Y`kcfXg`cf]XYUg`cZcH\Yfg`UbX`dfYgYbh]b[`H\Ya`Ug`mci f`ckb"`D`U[]Uf]ga`]g`U`HmdY`cZ]bH``YWi U``H\YZh``=iWUb`HU_Y a UbmZcfa gžZfca`XY`]VYfUHY`W\YUH]b[`hc`UWW]XYbHU``mWcdm]b[`Zfca`U`gci fWY`k]H\ci HUW_bck`YX[YaYbH

- VfcUXVUbX WcbbYWfjcb f&) * _V]h#gYWcf ZUghYfŁ
- UV]`]hmihc`j`]Yk`ghfYUa]b[`j`]XYc`fN][\`cf``ck`XYZ]b]h]cb`I_BGK``HJ`cdh]cbgŁ

A cfY]bZcfa Uh]cb UVci hgmghYa `fYei]fYa Ybhg]g Uj U] UV Y Uh<u>k k k "ghi XYbh'i bgk "YXi "Ui #a ccX Y!gmghYa !fYei]fYa Ybhg</u>

5\WWgg]b[7cifgYAUHYf]U`gH\fci[\AccX`Y

7 ci fgY'ci h]bYgžgi ddcfha UhYf]U`gʻUfY'i d`cUXYX'hc'A ccX`Yž'h\Y'i b]j Yfg]mighUbXUfX'@YUfb]b[A UbU[Ya YbhGmghYa 'f@A GŁ'' =b`UXX]h]cbžcb!`]bY'Ugg][ba Ybhigi Va]gg]cbg'UfY'a UXY'i g]b['h\Y Ugg][ba YbhXfcdVcl 'ZUVJ`]hmidfcj]XYX']b'A ccX`Y'' 5``Ybfc``YX'ghi XYbhg'UfY'Ui hca Uh]WU``m`]bWi XYX']b A ccX`Y'Zcf`YUW\'Wci fgY'''Hc'UWWYgg'h\YgY'XcW a Ybhg'UbX'ch\Yf'Wci fgY'fYgci fWYgžd`YUgY'j]g]h' <u>k k k "a ccX`Y'hY`h'i bgk "YXi "Ui</u>

< ck KY7 cbHJWhMci

5 hhļa Ygžh\Y'GW\cc``cf`mci f`Wci fgY'Wcbj Ybcfg`a UmbYYX'hc`WcbhUWhimci `UVci himci f`Wci fgY'cf`mci f Ybfc`a Ybh'`Mci f`Wci fgY'Wcbj Ybcfg`k]```i gY'h\Y'Ya U]``Z bWf]cb'k]h\]b`A ccX`Y'cf`kY'k]```WcbhUWhimci `cb mci f`4 ghi XYbh'i bgk "YXi "Ui `Ya U]``UXXfYgg"

K Y'i bXYfgHUbX'h\Uhimci 'a Um\Uj Y'Ub'YI]gh]b['Ya U]`'UWVci bhUbX'k ci 'X'dfYZYf'Zcfimci f'I BGK 'Ya U]`g'hc VY'fYX]fYWYX'hcimci f'dfYZYffYX'UWVci bh''D`YUgY'gYY']bghfi W1]cbg'cb'\ck 'hc'fYX]fYWhimci f'I BGK Ya U]`g.''<u>< ck 'WUb'=Zcfk UfX'a mYa U]`g'hc'Ubch\Yf'UWVci bh3″</u>

< ck Mci 7Ub 7cbHJWhIg

K Y`UfY`U`k Umg`fYUXmhc`Ugg]ghimci`k]h\`mcif`]bei]f]Yg"`Hc`YbgifY`mcif`eiYgh]cb`]g`X]fYWhYX`hc`h\Y`WcffYWh dYfgcbž'd`YUgY`igY`h\Y`YaU]``UXXfYgg`VY`ck`Zcf.

- 9bfc`a Ybhcf`ch\Yf`UXa]b`ei Ygh]cbg`fY[UfX]b[`mci f`dfc[fUa.` \hhdg.## bgk]bg][\h'a]WfcgcZtWfa dcfhU`g"Wca # YV!Zcfa g#
- 7 ci fgY`]bei]f]Yg`g\ci `X`VY`X]fYWhYX`hc`h\Y`7 ci fgY`7 cbj Ybcf

⊨a U[Y[·]7fYX]h

IBGK GN/8B9M

7F*⊒*CG

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

5W_bck `YX[Ya YbhcZ7ci bhfm

 $\label{eq:constraint} \begin{array}{l} K_{1}^{T}(UW_{bck}^{T}X_{l}^{T}) & K_{1}^{T}(UX_{l}) \\ F(UX_{l}) & F(UX_{l}) \\ F(UX_{l}) & F(UX_{$