7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

5dd`]WUh]cb'8YUX`]bY

5df]`%) h\ž%%) - da '9GH

8UhU'Dfcj]XYX

K \YbfYdcfh]b['UWUXYa]WmYUfXUhUZWUa di gYg'g\ci`Xi gYXUhUZfca 'UWUXYa]WmYUf&\$%+!&\$% ": cfYl Ua d`Yžh\Ybi a VYfcZ Wa a i b]hmVUgYXWa fgYg'dYfmYUfg\ci`XWaffY`UhYk]h\&\$%+!&\$% 'XUhU"

K \YbfYdcfh]b[i]bgh]hi h]cbu`XuhužVYgi fYhc]XYbh]Zmh\YgYa YghYf'UbX'mYUfik]h\]b'k\]W\h\YXUhU'k UgWc``YWhYX"H\UhXUhU g\ci`X'bchVYc`XYf'h\Ub&\$%+!&\$% ": cfYl Ua d`Yž]Z'mci f]bgh]hi h]cb'dUfh]W]dUhYX]b'h\YB5G79žBGG9žcf'ch\Yf'UggYgga Ybhhcc`g]b'h\YZU``cZ&\$%!&\$% žmci a Umi gYh\UhXUhU]b'mci f'fYdcfh]b["

K \YfYj YffYei YghYXzd`YUgY`dfcj]XY`]b_g'rc fY`Yj UbhWua di g'k YV`fYgci fWrg']b`UXX]h]cb'rc Yj]XYbWrdfcj]XYX`]b`h\Y Udd`]WUh]cb"FYj]Yk Yfg'a Umik Ubh'rc Yl Ua]bY'k YVg]hYg'rc dfcj]XY`UXX]h]cbU`WUf]Z]WUh]cb'rc Zh\Y`fYgdcbgYg']b`h\Y`Udd`]WUh]cb'r FYj]Yk Yfg'a UmU`gc Ug_Zcf'U'hY`Yd\cbY Wcbj YfgUh]cb'rc WUf]ZmYj]XYbWrdfcj]XYX"

IgYcZ8UhU

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

fZcf7UfbY[]YZcibXUh]cbigYcb`mŁ

H]h`Y

@]``]UbK]Wk]bg_mD\"8"z8]fYWrcfzCZZ]WrcZ7caaib]rm9b[U[YaYbhUbXDUfrbYfg\]dg

=bgh]hi h]cb

I b]j Yfq]hmcZGci h\: `cf]XUžHUa dU

A U]`]b[5XXfYgg%

(&\$& 9Ugh: ck `Yf5 j Ybi Yž5@B %)

A U]`]b[5XXfYgg'&

!!Ya dhm!

7]hm

HUa dU

GhUhY

: @

N1d.7cXY

' ' * &\$

D\cbYBi a VYf fY"["z̈% %&' !' ()!) * +, Ł

, %' !-+(!*+\$-

: i ``BUa YcZ=bgh]hi h]cbfgDfYg]XYbh#7\UbWY``cf

8f"'>i Xm; Ybg\UZh#DfcjcghFU'd\K]`Wtl

DfYg]XYbh#7\UbWY``cffgAU]`]b[5XXfYgg

(&\$&`9": ck `Yf`5 | Yž7; G'(\$%žHUa dUž: @' ' * &\$

DfYg]XYbh#7\Ub\\\`cffg9aU]`5XXfYgg

fWk]`WtI4igZ'YXi

7Ua di gUbX 7ca a i b]hm7cbhYl h

5"7 Ua di q.

Dfcj]XYUXYgWf]dh]cbcZmcifWJadigh\Uhk]``\Ydhcdfcj]XYUWtbhYlhZcfibXYfghUbX]b[\ck Wtaaib]mmYb[U[YaYbh]g YbUWhYX]bUkUmh\UhZ]ngh\YW`hifYUbXa]gg]cbcZh\YWJadig"NciaUmkUbhhc]bWiXYXYgWf]dhcfgcZgdYWJUhmdY fWtaaib]hmWt``Y[Yž`UbX[fUbhžaYX]WU`Wt``Y[YžZU]h\!VUgYXžYhWtZg]nYflbXYf[fUXiUhYUbX[fUXiUhY: H9tZ`cWJh]cbžib]eiY \]ghcfmUbXZcibX]b[žXYac[fUd\]WgcZghiXYbhdcdi`Uh]cbgYfjYXžUbXch\YfZYUhifYgh\UhX]gh]b[i]g\h\Y]bgh]hih]cb"Nci

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

a Umk Ubhhc Wcbgi `hmci f`Wa di g g`=D98 G`XUhU'f\hhdg.##b\W'g"YX"[cj #]dYXg#< ca Y#.]bXMci f7c``Y[YŁUbX'7 UfbY[]Y'6Ug]\W 7 `Ugg]Z]\Wh]cb`XUhU'f\hhd.##\WUfbY[]Y\Wugg]Z]\Wh]cbg"]i "YXi #cc_i d#cc_i d'd\dŁ"

HUa dUž: `cf]XU^]Ygʻa cfY h\Ub`&) \$ a] Ygʻbcfh\ cZh\YʻghUhY gʻgci h\Yfb h]d/Vi h]b %-) * žUʻbYk GhUhY I b]j Yfg]hmd`UbbYX Zcf HUa dUʻk ci `X VY h\Yʻgci h\Yfba cgh]b h\YʻgmghYa \ \YbWʻ]hgʻbUa Yžh\YʻI b]j Yfg]hmcZʻGci h\: `cf]XUʻfl G: Ł"H\YʻbYk i b]j Yfq]hmk UqʻVi]`hcb k \Uh\UX`VYYb UʻdʻfUWh]WʻVca V]b[fʻUb[YʻcZʻUb Uʻfa m'U]fZ]Y`X Xi f]b[K cf`X`K Uʻf`="

I G. k Y`Wa YX`]hg`Z]fghighi XYbhg`]b % *\$ža U_]b[`]hh\Y`Z]fgha U'cf`ghUhY`i b]j Yfg]hmd`UbbYXžWcbghfi WhYXžUbXcdYbYX`]b`h\Y &\$h\ W'bhi fm'':]ZhminYUfg`UhYfžh\Y`B G. `UbX`7 UfbY[]Y`: ci bXUh]cb`fYWc[b]nYX`I G. `Ug`VY]b[`Ua cb[`h\Y`hcd`fYgYUfW\\ii b]j Yfq]h]Yq`]b`h\Y`bUh]cb"

H\Y1 G: GmghYa]bWi XYg'h\fYY]bgh]hi h]cbg.1 G: Gh"DYhYfgVi f[žl G: GUfUgchU!A UbUhYYžUbX1 G: 'h\YUdd`]WUbh]bgh]hi h]cb"H\YgY]bgh]hi h]cbgW ffYbh`mUfYgYdUfUhY`mUWWYX]hYXVmh\Y7ca a]gg]cb'cb'7c``Y[YgcZh\YGci h\Yfb 5ggcW]Uh]cb'cZ7c``Y[Yg'UbXGW.cc`g'fG57G7C7E": ci fhYYb'7c``Y[YgWta df]gY1 G: .

7cY[YcZh\Y5fhg

 $7c^{Y}[YcZ^5fhg^UbX^GW]YbW^g$

7c``Y[YcZ6Y\Uj]cfU`UbX7caaib]hmGW}YbWfg

AiaU7c~Y[YcZ6ig]bYgg

7c``Y[YcZ9XiWUh]cb

7c``Y[YcZ9b[]bYYf]b[

DUhY`7c``Y[YcZ; `cVU`Gi qhU]bUV]`]hm

7c``Y[YcZ; fUXi UhYGhi X]Yg

<cbcfg7c``Y[Y</pre>

7c"Y[YcZA Uf]bYGWYbW

A cfgUb].7c``Y[Y.cZA YX]WbY

7c``Y[YcZBifq]b[

7c``Y[YcZDiV`]W<YU`h\

7c``Y[YcZD\Ufa UWn

K]h\`(' \(\) (&ghi XYbhg`UbX`%(\(\) \(

A cfY h\ub" \$\$\$\$\$1 G. ghi XYbhg'ufY i bXYf[fuXi UhYgž" (ı cZk \ca fYWl]j YDY``[fubhg" ± &\$% zl G. gg]l !mYuf [fuXi Uh]cb fuhYzcf'DY``fYW]d]Ybhg\]h*, ı z % dc]bhg\][\Yf'h\ub h\Ybuh]cbu''uj Yfu[Y"H\Y7\fcb]WY cZ<][\Yf'9Xi Wuh]cbfUb_YX I G. Hua du''ug %Zcf'[fYUhYgh]a dfcj Ya Ybh]b*!mYuf'[fuXi Uh]cbfUhYg'Ua cb['(!mYuf'di V`]W]bgh]hi h]cbg'f&\$%+Ł"9][\hYYb dYfW'bhcZl G. i bXYf[fuXi UhYg'UfY'z]fgh![YbYfuh]cb'ghi XYbhg"

A cfYh\Ub'%z \$\$ a]`]hUfmj YhYfUbg'UfYYbfc``YX'Uh'l G: "'6Yhk YYb'&\$%* UbX'&\$% žl G: 'k Ug'fUhYX'Z]fgh'cf'gYWcbX']b'A]`]hUfm H]a Yg'Ubbi U`` 6Ygh'Zcf'J Yhg 'Zci f!mYUf'Wc``Y[Y'fUb_]b[g"

A cfYh\Ub%\$\$\$\$1 G: HUa dU'ghi XYbhg'UfY [fUXi UhY'ghi XYbhg'H\Y7UfbY[]Y7`Uqg]Z|WUh]cbcZ=bgh]hi h]cbgcZ<][\Yf

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z[YX cb (#%) #&\$% "

9Xi WUh]cbfYWc[b]nYg1 G: HUa dU'Ug'8cWhcfU`1 b]j Yfg]h]Yg.'<][\YghFYgYUfW.'5Vh]j]hm'5acb[[fUXi UhYgW.cc`gžl G: HUa dU fUb_YX'h\]fX'bUh]cbU``mZcf'DYUW.'7cfdgj c`i bhYYfg]b'&\$%, žYUfb]b[h\Y' Hcd'DfcXi Wff fYWc[b]h]cb"\hhdg.## gZ"Udd"Vcl "Wca #g#) fd&\Y&k VVei \$`-b[a \$ei ci hhffUg. (

6"7ca a i b]hm

Dfcj]XY U XYgWf]dh]cb cZh\Y Wa a i b]hmf]YgŁk]h\]b k \]W. Wa a i b]hmYb[U[Ya Ybhhu_Ygd`UWfh\Uhk]``\Y`d hc dfcj]XY U WabhYl hZcfi bXYfghUbX]b[\ck Wa a i b]hmYb[U[Ya Ybh]gYbUWfYX]b Uk Umh\UhZ]hgh\Y W`hi fY`UbX`\]ghcfmcZh\Y dUfhbYfg\]d Wa a i b]hmf]YgŁ" Mci a Umk Ubhhc]bWi XY XYgWf]dhcfgcZgdYWJU hmdYffi fU`zi fVUbzWabgYfj Uh]j Yz`]VYfU`zYhWłzglnYfdcdi `Uh]cb zwabgYfj Uh]j Yz`]VYfU`zYhWłzglnYfdcdi `Uh]cb zwabgy i b]ei Y`\]ghcfmzXYa c[fUd\]WgcZWa a i b]hmdcdi `Uh]cb gYfj YX#Ya d`cmYXzUbX`ch\YfZYUhi fYgh\UhX]gh]b[i]g\`h\Y]bgh]hi h]cb UbX Wa a i b]hmf]YgŁ": cf`cWV Wa a i b]h]Ygzmci a Umk Ubhhc Wabgi `hmci f`Wfbgi g XUhU"

I G. ga U]b Wa di g]g^cWhYX]b <]``qVcfci [\ 7 ci bhmž: `cf]XU" <]``qVcfci [\ gdcdi `Uh]cb]g % % % 56 & "9h\b]WX]j Yfq]hm]q) \$" | K \]hY/&+"(| @Uh]bc/%) ") | 5Zf]WUb 5a Yf]WUb/' "-| 5g]Ub/\$"&| 5a Yf]WUb =bX]Ub#5`Ug_U'B Uh]j Y/UbX`&"+| ch\Yf" <]``qVcfci [\]qdUfhcZh\YHUa dU6UmUfYUžU`qcYbWta dUqq]b[D]bY``Uqž< YfbUbXcžUbXDUqWt7ci bh]Yq"HUa dU6Umq</p> dcdi`Uh|cb]g" 2%%2)--"K]h\ifVUbžqiVifVUbžUbXfifU`Ybj]fcbaYbhqžHUadU'6UmfYdfYqYbhqUa]WfcWcqacZh\Y1"G"+h]q Udufhczh\Y: \(\frac{1}{3}\)cfz WcbbYVM]b['Hua dužC f'UbxcžUbx'8 Untrobu'6YUW, žU'fY[]cb'h\UhxYWXYg'a cghghUhYY'YVM]cbg" <]``gVcfci [\]bdufh]W'`Uf]gUVY``kYh\YfVci bhržj ch]b[Zcfh\Yk]bbYf]bU``Vi hhk cdfYg]XYbh]U`Y`YWh]cbgg]bW'% &, "</pre> FY[]cbU`W\UfUWYf]qh]Wq]bZiYbWrh\YbUhifYcZIG: qWdaaib]hmdUfhbYfq\]dq. =bWdaY.CZ%% %() HUadU6Um \ci gY\c`Xgž(&i ^]j Y`Uh'h\Y`dcj Yfhm`Yj Y`cf5@=79'fUggYh`]a]hYXž]bWta Y`WtbghfU]bYXžYa d`cmYXt`Yj Y`"=b`&\$%* ž(*i `cZ : `cf]XU`\ci qY\c`XgVti `X`bch'UZZcfXVUg]WbYYXg'qi VX`Ug`\ci q]b[žW\]`X WUfYžZccXžhfUbqdcfhUh]cbžUbX`\YU`h\WUfY"Cb'Ubm [] | Yb b] [\hža cfY h\Ub +ž\$\$\$ HUa dU 6Uma Ybžk ca YbžUbX Wk] XfYb UfY \ca Y Yqq" 5 [Y. H\Y fY []cb q [fck]b[qYb]cf dcdi `Uh|cb|gbck % "&ı ž|bWfYUg|b| XYa UbX Zcf|Yf|Uhf|W\YU`h\ qYf| |Wfg/HUa dU'6UmfYg|XYbhgi bXYfU|YcZ% UWki bhZcf &&"-ı cZh\Ydcdi`Uh]cb"<]``gVcfci[\gdiV`]WgW\cc`X]ghf]Wh]gh\YbUh]cbgY][\h\`Uf[Yghžk]h\%*&cZ]hg&)\$gW\cc`g \text{WUgg]Z]YX'Ug'H]hY'%"1 "G"A]`]hUfm'<]\`gVcfci [\'UbX'D]bY\`Ug'7ci bh]Yg'fUb__;\text{%UbX',']b: `cf]XU\text{ZfYgdYWh]j Y`m\text{Zcf'bi a VYfg'cZ} j YhYfUbgžk]h\ Wc``YWh]j Y`ma cfY h\Ub%, ž\$\$\$"HUa dUqA UV8]``5]f: cfWY6UqYYa d`cmqa cfY h\Ub%) ž\$\$\$a]`]hUfmUbX Wijilub dyfqcbby "Allfubh: Ufa Kcf_yfq.5ddfclauhym) \$z\$\$\$ hc &\$\$z\$\$\$allfubhubx gyuqcbu Zufa kcf_yfqubx hvyff

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

Gci h\: `cf]XU'DfYq]XYbh'>i Xm; Ybq\UZh

I G: DfYg]XYbh>i Xm; Ybg\UZh\Ug\Y`dYX`hU_Y`h\Y1 b]j Yfg]hmcZGci h\: `cf]XUhch\Y`bYI h`Yj Y`"I bXYf\Yf`YUXYfg\]džI G: \Ugʻf]gYb hccbY`cZh\Y`hcd!h]Yfdi V`]WfYgYUfW\i b]j Yfg]h]Ygʻ]b h\Y Wti bhfm'H\Y`HUa dUʻ6UmUfYU\UgYj c`j YX`]bhccbY`cZh\Y a cghXmbUa]Wwta a i b]h]YgʻZcf\YUʻh\]bbcj Uh]cbʻ]bʻ5a Yf]WUʻUf[Y`mXi Y`hc I G: '< YUʻh\ fYgYUfW\žghi XYbhgʻUbX`ZUW`hm'H\Y X]j Yfg]hmcZh\Yghi XYbhy\cXm]gʻcbY`cZI G: gʻghfYb[h\gʻUbX`DfYg]XYbh; Ybg\UZhg\wta a]ha Ybhhc I dk UfXʻ6ci bXž@Uh]bc gW\c`Ufg\]dgʻUbX`UWWgʻgʻhc Wt``Y[Y\UgʻdU]X`X]j]XYbXg''=k]``a]gg\YfʻUddfcUW\UV`Y`ghmY`UbX`Wta a]ha Ybhhcci fʻWta a i b]hmž UbX`k]g\\YfžGhYj Y`UbX\Yf`gcbgk Y``cb\Y\UʻZcZU`[fUhYZ\`Vta a i b]hm′\hdg,##WUqhcf'\ci gY''[cj #bYk g#XcW a Ybhg]b[`Y''UgdI 38 cW a Ybh=8 1' - , +) +

5 "&"&"%K YV @b_f]Z'Uj U]`UV`YŁ GYY'UVcj Y

5"&"

7 Ua di g'di V`]WUh]cbg.

I G: A U[Un]bYžGhUfhcZUBYk '9fUž: U``&\$% | 5g: `cf]XUgbYk YghDfYYa]bYbhI b]j Yfg]hmžI G: 'cc]bg'h\YfUb_gcZ^f gh'hk c ch\Yf: `cf]XU'di V`]W]bgh]hi h]cbg'k]h\ h\]g'dfYgh][]ci g'XYg][bUh]cb ij Vch\ cZk \]W\ k YfY Zci bXYX a cfY'h\Ub '%\$\$ 'mYUfgVYZcfY I G: ": cfa U``mUddfcj YX Vmh\Y GhUhY I b]j Yfg]hmGmghYa cZ: `cf]XU'6cUfX cZ; cj Yfbcfgžh\Y'h]h'Y]g'h\Y W`a]bUh]cb cZ'mYUfg cZ\UfX k cf_ 'UbX ZcW gVmh\Y I G: 'Wa a i b]hmhc a U_Y h\Y i b]j Yfg]hmU'bUh]cbU```YUXYf`]b ghi XYbhgi WWggžfYgYUfW\UbX Wa a i b]hmYb[U[Ya Ybh''

\hhdg.##kkkk"i gZ"YXi #a U[Un]bY#XcWia Ybhg#UfWk]j Yg#&\$% !ZU``"dXZ

I G: A U[Un]bYz: U``&\$%, z =b`HUa dU'6Um'UbX`UWfcgg'h\Y`Wci bhfmzh\Y`M Yb[`]b[ZUa]`m]g`_bck b'Zcf]hg`Wca a]ha Ybh'nc h\Y Wca a i b]hmz 'gU]X`I G: 'GmghYa 'DfYg]XYbh'>i Xm; Ybg\UZh]b'UghUhYa Ybh'' K Y`UfY`[fUhYZi `hc`\Uj Y`gi W. Uk Y``!_bck b'UbX fYdi hUV`Y`ZUa]`m'UggcW]UhYX`k]h\`I G: "K Y`YgdYW]U``m'UddfYW]UhYh\Y`YZZcfhg'hc'dfca chY`WcfdcfUhY`UbX`gcW]U`fYgdcbg]V]`]hm Ug'dUfh'cZh\]g'bYk 'UZZ]`]Uh]cb"

\hhd.##bYk g"i gZ"YXi #Ufh]VW\#hYa d`UhYg#3U1,) *)/ n1&' &

5hl G: žk Y UfY Xf]j Yb Vmci f XYg]fY hc a U_Y U X]ZZYfYbWY]b h\Y ^]j YgcZci f ghi XYbhgżci f Wca a i b]h]Yg Ub X gcW]YhmUh ^Uf[YżgU]X l G: GmghYa DfYg]XYbh >i Xm; Ybg\UZh" C i f]bgh]hi h]cbU `ZcW g c b ghi XYbhgi WW gg\Ug VYYb WfbhfU hc h\YgY YZZcfhgžUb X k Y fY dfci X hc VY Uhh\Y ZcfYZfcbhcZXYj Y`cd]b[dcg]h]j Y W.Ub[Yg c b U bUh]cbU ``Yj Y`"=a WcbZ]XYbhh\]gbYk 5D@l Wc``UVcfUh]cb k]``\Y`d i ga U_Y Ub Yj Yb V][[Yf]a dUWržUg k Y``Ug Vi]`X]a dcfhUbhbYk WcbbYWn]cbg k]h\ ci f dYYfg Ufci bX h\Y Wci bhfm' \hd.##bYk q"i qZYXi #Ufh]WY#hYa d`UhYg#3U1, * +(/ n1 &' &

I G: BYk gžI G: GrighYa DfYg]XYbh'>i Xm; Ybg\UZh'Ubbci bW'gd'Ubg'hc ghYd Xck bžYZZYWh]j Y'>i `m&\$%-H\Y'I b]j Yfg]hmcZGci h\: `cf]XU'GrighYa]gcb'U'hfU'YWfcfmi b`]_Y Yj Yf VYZcfY]b]hg\]ghcfm"K Y'UfY fYUW\]b[a]`YghcbYgcbWf fYgYfj YX Zcfi b]j Yfg]h]Yghk]W'ci f'U[Y"K Y'UfY VY]b[fYWt[b]nYX VmYj YfmcbY Zfca "c\W'gi ddcfhYfg'hc ghUhY "YUXYfg'hc bUh]cbU''UbX'[`cVU'\][\YfYXi \Wh]cb'ghU_Y\c`XYfg''K Y Wbh]bi Y'hc a U_Y'[fci bXVfYU_]b[ghf]XYg]b fYgYUfW\zghi XYbh gi \WWrggzhYUW\]b['UbX \Waa a i b]hm]a dU\W''

\hhdg.##kkkligZ"YXi#gmghYa#dfYg]XYbh#h\Y!dfYg]XYbh"Ugdl

DfYg]XYbhg'K Y'Wta Y

K Y'UfY'U'Wca a i b]hmcZgWkc`UfgzgWjYbhjghg'UbX']bbcj Uhcfg'k \cj U'i Y'Yl WY``YbWY']b'U``k Y'Xc'UbX'k cf_Wc``UVcfUhjj Y`mk]h\ci f'dUfhbYfg'hc WfYUhY`\YU'h\mzdfcgdYfci gzUbX'gi ghU]bUV`Y Wca a i b]hjYg"\hhdg.##k k k "i gZ"YXi #UVci hli gZ#VfUbX!Vci bX`Ygg!Wca a i b]hm'Ugdl 3i ha Sgci fWY1Vci bX`Ygg!Wca a i b]hm'Ugdl 3i ha Sgci fWY1Vci bX`Ygg!Wca a i b]hm' i ha Sa YX]i a 1]a U[Y/i ha SwUa dU][b1ZUW`hm!fYWfi]ha Ybh

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

DfYg]XYbhg'6]c

Dfyg]XYbh; Ybg\UZh\Ug\YYb]bghfi a YbhU`]bYWbbca]WXYj Y`cda YbhYZcfhg]bh\Y`HUa dUʻ6UmfY[]cbžgYfj]b['Ug\W\U]fcZ H\Y; fYUhYf`HUa dUʻ7\Ua VYfcZ7ca a Yf\W`zh\Y`HUa dUʻ6UmDUfhbYfg\]džUbXh\Y; fYUhYf`HUa dUʻ7\Ua VYfcZ7ca a Yf\W`zh\Y`HUa dUʻ6UmDUfhbYfg\]džUbXh\Y; fYUhYf`HUa dUʻ7\Ua VYfcZ7ca a Yf\W`7ca a]hhYYcZ%\$\$"=b`&\$%, žg\Y`k]``\W\U]f`h\Y`HUa dUʻ<]``gVcfci [\'9\\bca]W8Yj Y`cda Ybh7cfd"H\Y`i b]j Yfg]hm\Ug\YYb`U\\Uh\mghZcfY\\bca]WXYj Y`cda YbhYZcfhg'U`cbY`[YbYfUhY`a cfY`h\Ub``(\$\$`a]``]cb`]b`ghUhYk]XYj Y`cda YbhYZcfhg'U`cbY`[YbYfUhY`a cfY`h\Ub`` \\$\$\$\$``cVgžUbX`fYhi fb`a cfY`h\Ub``) &a]``]cb`]b`hUl`fYj Ybi Yhc``c\W`žghUhYžUbX`ZYXYfU`[cj Yfba Ybhg''\hhdg.#k\kkk"i gZ'YXi #gmghYa #dfYg]XYbh#V]c[fUd\m`UgdI

6ci bX`Ygg:7ca a i b]hmž&\$%-

"5g'U'[`cVU``mYb[U[YX`i b]j Yfg]hmWta a]hhYX`hc`UXXfYgg]b['h\Y`W\U``Yb[Yg'cZh\Y`&%ghWfbhi fmžh\Y`k cf_cZh\Y`DYUWf'7cfdg gdYU_g'X]fYWfimhc'l G: f@ghfUhY[]W[cU``Zcf'dcg]h]j Y'gcW]YhU`W\Ub[Y""ÿ'>i Xm; Ybg\UZhzl G: GmghYa 'DfYg]XYbh\hhdg.##k k k "i g Z"YXi #UVci hli gZ#VfUbX!Vci bX`Ygg!Wta a i b]hm"Ugdl 3i ha Sgci fWf1Vci bX`Ygg! Wta a i b]hm'l ha Sa YX]i a 1]a U[Y/ i ha SWUa dU][b1ZUW`hm!fYWfi]ha Ybh

5"&" "%K YV@b_f]ZUi U]`UV`YŁ

!!Ya dhm!!

5"&"(

Ch\Yf.

CjYfh\Y`UghhYbmYUfgžDfYg]XYbh>i Xm; Ybg\UZhUbXDfcjcghFU'd\K]`Wtl\UjYkcf_YXWt``UVcfUh]jY`mhcgiddcfh
Wtaaib]mYb[U[YaYbh`cWb``mUbX'[`cVU``m"H\]gWtaa]haYbh]gXYacbghfUhYXh\fci[\Z]bX]b[žWiff]WilažcihfYUWXž
ZUWi`hmfYWt[b]h]cbžUbX'ghiXYbhgiWWrggYZZcfhg"'H\]g;gYWf]cb`cZh\Y'Udd`]Wbh]cb`kci`XbchVY'Wtad`YhYk]h\cihU`gcdfcj]X]b[`DfcjcghK]`WtlggHUhYaYbhgcZUZZ]faUh]cb`Zcf'Wtaaib]hmYb[U[YaYbh]b`\]g;mYUf`mUXXfYgg'hc`ZUW`hmcjYf'h\Y`Uqh'Z]jYmYUfq"

&\$%(5XXfYgg 5gmci k Y``_bck z=k ci `X h\cfci [\`mYb^cmXYj ch]b[h\]gk \c`Y`\ci f hc`\][\`][\h]b[Yei U``mg][b]Z]\Wbh \\b\bhf]Vi h]cbg'a UXY Vm\i bXfYXgcZl G: dfcZYgqcfg'UbX'qhi XYbhg'hc q\WYbW'zq\Wc`Ufq\]dzUbX'h\Y VYhhYfa YbhcZqc\WYhm'

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

f][cfžfY`Yj UbWłžUbX W ff]W`UfWt\YfYbWł H\Y]fdfcdcgU`V`YbXgh\YghUhYa UbXUhYXfYei]fYa Ybhg'Uh]ngZci bXUh]cbžk]h\WtfYY`Ya Ybhg']b WfYUh]j Yh\]b_]b[ž]bZcfa Uh]cb`]hYfUWhžU`cb[k]h\\ia Ub`UbX W`hi fU`X]j Yfg]hmYUW.[fci bXYX]b h\Y`]VYfU`Ufhgh\Uhk]``ž]b hi fbžgi ddcfh'U'dfcV`Ya VUgYX`UbX]bhYfX]gW]d`]bUfmUddfcUW.hc Yh\]WU`fYUgcb]b[UbX W]j]WYb[U[Ya Ybh"H\YfYei]fYX Wta d`Yh]cb`cZUh`YUghhk c]bhY`YWhi U`mfcVi gh\][\]a dUWhdfUWh]Wfgcf'< =Dgžgi W. UgfYgYUfW\Z]bhYfbg\]dgžYXi WUh]cb`UVfcUXžUbX`gYfj]Wf`YUfb]b[YI dYf]YbWfgž]g]bhYbXYX`hc`UXXYj Yb`XYYdYffY`Yj UbWf'hc`ci f`ghi XYbhg[YbYfU`YXi WUh]cb"

&\$% 5XXfYgg 5gmci _bck žZc``ck]b['dUggU[Yh\fci [\ "Y[]g`Uh]cbYUf`]Yfh\]gmYUfžh\Y1 G: '6cUfXcZ'Hfi ghYYg`\Ug'dfcj]XYX i g'k]h\ 'Ub]a dcfhUbhgYhcZ'df]bWJd`Yghc [i]XY ci f'% 'd`Ub 'Zcf Wcbgc`]XUh]cbžU'd`Ub h\ Uhk]`` "YUX'hc cbY'i b]j Yfg]hm [Yc[fUd\]WJ``mX]ghf]Vi hYX`UWfcgg'h\fYY WJa di gYgžk]h\ U'g\UfYX'a]gg]cbži bXYf'U'g]b[`Y'fY[]cbU``UWWfYX]hUh]cb`Vmh\Y Gci h\Yfb'5ggcWJUh]cb`cZ7c``Y[Yg'UbX'G G h\ U'g\UfYX'a]gg]cbži bXYf'U'g]b[`Y'fY[]cbU``UWWfYX]hUh]cb`Vmh\Y

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

%" I G: k]`žh\fci[\'U\&bh]biYX\&a a]haYbh'bc'ghiXYbh'giWWrggždfcXiWr'kY``YXiWJhYX'[`cVU`WJh]nYbg &"I G: k]``žh\fci[\']hg\][\!]adUWn'fYgYUfWX'UbX']bbcjUh]cbžWXUb[Y``]jYg'Zcf'h\YVYhYfž]adfcjY\YU'h\žUbX'ZcghYf gighU]bUV`Y`XYjY`cdaYbh'UbX'dcg]h]jY'gcWJYhU`WXUb[Y

"I G. k]``žUgʻU`\][\`mYZZYVM]jYaU^cfYV&bca]WYb[]bYžWfYUhYbYk dUfhbYfg\]dgʻhcVi]`X`U`ghfcb[`UbX`gi ghU]bUV`Y`Zi hi fY`Zcf: `cf]XU]b'h\Y`[`cVU`YV&bca m

H\YghfUhY[]Wd`Ub`UXcdhYX]b`&\$% k Ughc`YId]fY]b`&\$%, "I G: `HUa dU`XYj Y`cdYX`U`bYk ghfUhY[]Wd`Ub`]b`&\$%+!&\$%, k]h\
fYbYk YX`Ya d\Ug]g`cb`ghi XYbh'gi WWYgg'h\fci [\ Wca a i b]hmYb[U[Ya Ybh"H\]g'bYk d`Ub`ZcfYWUgh'h\YX]fYWh]cb`cZh\Y
i b]j Yfg]hmZcf`h\Y`bYIh'Z]j Y`mYUfg"< ck Yj Yfz]b`: YVfi Ufm&\$%-zh\YI G: `6cUfX`cZHfi ghYYgj chYX`hc YI hYbX`h\Y W ffYbh
ghfUhY[]Wd`Ub`hc`>i`m%z&\$&\$`Ug'h\Y'h\fYY WUa di gYg`i bXYf[c Wcbgc`]XUh]cb"'H\]g'k]``U``ck I G: hc WfYUhY`U`gmghYa!k]XY
ghfUhY[]Wd`Ub`k]h\`U`fYdfYgYbhUh]j Yjc]W'Zfca YUW\ WUa di g"

J]g]cb.`H\Y`Ib]jYfg]hmcZGcih\`:`cf]XU]g`U'[`cVU`fYgYUfW\`ib]jYfg]hmXYX]WUhYX`hc`ghiXYbh`giWWrgg`UbX`dcg]h]cbYX`Zcfa Ya VYfg\]d]b`h\Y`5ggcW]Uh]cb`cZ5a Yf]WUb`Ib]jYfg]h]Yg`f55I±"5g`:`cf]XUg``YUX]b[`a Yhfcdc`]hUb`fYgYUfW\`ib]jYfg]hmžIG:]qXYX]WUhYX`hc.

'Ghi XYbh'UWW'ggž`YUfb]b[žUbX'gi WW'gg'h\fci [\'U'j]VfUbhž]bhYfX]gW]d`]bUfmžUbX``YUfbYf!W'bhYfYX'fYgYUfW. Ybj]fcba Ybh |bWcfdcfUh]b['U'[`cVU`W ff]W`i a

FYgYUFW. `UbX`gWYbh]Z]WX]gWcj Yfmhc ghfYb[h\Yb'h\YYWbca mždfca chYWj]WW`hi fY`UbX`h\Y`UfhgžUbX`XYg][b`UbX`Vi]`X gi ghU]bUV`Y`Wa a i b]h]Yg'h\fci [\'h\Y`[YbYfUh]cbžX]ggYa]bUh]cbžUbX`hfUbg`Uh]cb`cZ'bYk '_bck `YX[Y`UWfcgg'U```UWUXYa]WUbX\YU`h\!fY`UhYX`X]gW]d`]bYg

DUfhbYfg\]dg'hc Vi]`X'g][b]Z]\Wbh``c\W``m\UbX`[`c\U``m\]bhY[fUhYX`i b]j Yfg]hm\\\&a a i b]hm\\&``U\\cfUh]cbg'h\fci [\'gci bX g\\\c`\Uf`m\UbX`Ufh]gh]\\W\\\hg\]bbcj Uh]cb"

A UbmcZh\Y Wt``Y[Yg\Uj Y'U'gc]bWtfdcfUhYX Wta a i b]hmYb[U[Ya Ybh]b h\Y]fa]gg]cb'ghUhYa Ybhg.
H\Y7c``Y[YcZh\Y5fhgj U'i Yg\Wta a i b]hmYb[U[Ya YbhUbXdUfhbYfg\]dg' Ug'Ua YUbg'cZX]g\Wtj Yfm\YYI dfYgg]cb\ZUbX
fYZY\Wj]cb'cb'ci f\ia Ub YI dYf]Yb\Wf UbX h\Yk cf'X]b'k \]\W.k Y^]j Y" H\Y7c``Y[YcZ5fhg'UbXG\]Yb\WfgghUhYg' 6m\WtbXi \Wj]b[
]bbcj Uh]j Y\ZjbhYfX]g\Wjd']b\UfmfYgY\Ufw\UbXg\Wc`Ufg\]d\Zk Y'UXj Ub\Wf_bck 'YX[Y]b'k Umgh\UhafYdUfY'i g'hc'UXXfYggj YI]b[
gc\WU'dfcV'Ya g'UbX Yb\Ub\Wfei U']hmcZ^]ZY Zcf'dYcd'Y'UbX \wta a i b]h]Yg" \hhdg.##k k k "i gZYXi #Ufhg#Uvci hi g#a]gg]cb"UgdI
H\Y7c``Y[YcZ6Y\Uj]cfU'UbX'7ca a i b]hmG\WjYb\Wfg\A]gg]cb']g' hc'UXj Ub\Wf_bck `YX[Yh\fci [\]]bhYfX]g\W]d`]bUfmhYU\W]b[\ZfYgYUf\W\ZUbX'gYfj]\Wfh\Uh]a dfcj Yg'h\Y \Wdd\Wj\mcZ]b\Zj]Xi U'g\ZUbX X]j YfgY \wta a i b]h]Yg'nc dfca chY'dfcXi \Wj] Y\Z
g\Uh]g\Zmjb[\Z\Y\U'h\m\Z\UbX'g\Z']j Yg'U\Wfcgg'h\Y^]ZYgd\Ub" \hhdg.##k k k "i g\Z'YXi #\W\\\\#\U\\\\#\\U\\\#\\fci [\] fl] cfci g'fYgYUf\\\\\Z
g\Uh]g\Zmjb[\Z\Y\U'h\m\Z\UbX'g\Z']j Yg'U\Wfcgg'h\Y^]ZYgd\Ub" \hhdg.##k k k "i g\Z'YXi #\W\\\\\#\\U\\\\#\fci [\] fl] cfci g'fYgYUf\\\\\Z
]bbcj Uh]j Y'hYU\X]b[\Z\Ug'k Y``Ug`c\W'`mUbX'[`c\U'\mYb[U[YX'd\UffbYfg\]dg" \hhdg.##k k k "i g\Z'YXi #\Xi \Wh]cb#U\ci hi g#a]gg]cb!
j]g]cb'UgdI

6"%"&"%"K YV@b_f]ZUj U]`UV`YŁ

\hhdg.##kkk"i gZ"YXi #cXg#XcWia Ybhg#ghfUhY[]Wd\Ubg# gZ!ghfUhY[]Wd\Ub!&\$%'!&\$%, "dXZ

6"%"&"&

GhfUhY[]Wid`Ub.

I G: j U`i YgW`hi fU`UbXYh\b]WX]j Yfg]hmUbX`UWWgg`U`cb[k]h\ UbYb\UbWYX`i bXYfghUbX]b[UbX`UddfYV]Uh]cb`cZh\Y`[`cVU`YI dYf]YbWY": fca XYj Y`cd]b[gci fWgcZWYUb YbYf[mhc]a dfcj]b[h\Y`ei U`]hmcZ`]ZY`Zcf`dYcd`Y`k]h\ X]gUV]`]h]Yg`UbX`YUX]b[h\Y`k Umcb'j YhYfUb g`fYgYUfW\ UbX`fY]bhY[fUh]cbžI G: fYgYUfW\ UbX`]bbcj Uh]cb`]g`X]fYWYX`hck UfX WfYUh]b[``cWU`žbUh]cbU`ž UbX`[`cVU`gc`i h]cbg'hc`gcWJYhmg'a cghX]ZZJW`hdfcV`Ya g"

=b UXX]h]cb hc VY]b[Ub]a dcfhUbhdUfhcZh\Y HUa dU 6UmYWcbca mzl G: i bXYfhU_Yg'Ua V]h]ci gWca a i b]hmlYb[U[YX fYgYUfWX UbX dUfh]W]duhYg]b a i h U`mVYbYZ]W]U dufhbYfg\]dg'h\UhYb\UbWrghi XYbh'UWWrgghc UWUXYa]Wdfc[fUa gzfYgYUfWXzUbX

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

Ya d`cma Ybhcddcfhi b]h]Yg"
5bX'Uhh\Y\YUfhcZh\Yi b]j Yfg]hm]g'U'Zi bXUa YbhU`Wa a]ha Ybhhc ghi XYbhgi WWYgg" fd"" Ł

H\YjU'i Yg'UbX`[cU'g'ci h`]bYX`]b'h\Yi G: GhfUhY[]WD`Ub'U'][b'k]h\ i G: g'Wtaa]ha Ybh'nc ghi XYbh'gi WWfgg'UbX Wtaai b]hm Yb[U[YaYbh'H\YgY'df]cf]h]Yg'Wb VY gYYb']b Vi X[Yh'U`cWbh]cbgždfc[f'Uaa]b[žUbX'gi ddcfh'Zcf'U'Wtaai b]hmYb[U[YaYbh]bZfUghfi WhifYh\Uh'Yg dc\Uh'yg'UVfcUX!VUgYXž\][\!ei U`]hmYXi Wbh]cb'h\Uh'U'gc ZcW'gYg'cb Wji]WfYgdcbg]V]`]hm'H\YgY'j U'i Yg

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

UWNjj jhjygžgmghYa UhjWU``mUggYggYgh\YYI hYbhhck\]Wkh\YmUfYUhhUjbYXžUbXi gYgh\YfYgi `hghcja dfcj YgYfj jWYg"; cU`h\fYY cZh\YI G: GhfUhY[jWD`Ub`&\$% !&\$% WkU``Yb[Ygh\YI b]j YfgjlmhcVYWda Y``U\][\`mYZZYWNjj Yža U'cfYWbca jWYb[jbYž WfYUhjb[bYk dUfhbYfg\]dghcVi j`X`Ughfcb[UbXgi ghUjbUV`YZi hi fY""""kjh\h\YcVYWNjj YcZ"YghUV`]g\Qb[Qa i hi U``m! VYbYZJWJU`dUfhbYfg\]dgfjbhYfbU`UbXYI hYfbU'Eh\UhYb\UbWfghi XYbhUWWfgg"""H\]gWda ajha YbhUhh\Yjbghjhi hjcbU``Yj Y`Zj`hYfg`Xck bh\fci [\YjYfm`YjY`cZi b]j Yfg]hm`]ZY"'=b`ZUWbžjh]ggi ZZJWJYbh`mWfbhfU`hc I G: 'UWhjj jhjYgh\Uhh\YI b]j Yfg]hm Udd`]YX`Zcf`UbX`fYWf]j YX`h\Y`TUfbY[]Y`: ci bXUhjcb WUgg]ZJWUhjcb UgʻU`7 ca ai b]hm9b[U[YX`UbX`fYgYUfWk]j Y

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

I b]j Yfg]hmcZGci h\: `cf]XU'GmghYa `DfYg]XYbh'ai Xm; Ybg\UZh'Ubbci bWX'cb GYdhYa VYf %\$ž&\$%, `\Yf XYVJg]cb hc ghYd Xck b Zfca `\Yf dcg]h]cbžYZZYWh]j Y'ai `m%ž&\$% "'< Uj]b[VYYb Uh'l G: g]bW' &\$\$\$ž8f"; Ybg\UZh']g'l G: g`cb[YghlgYfj]b['DfYg]XYbh'' \dd h]g]a dcfhUbh'hc i bXYfghUbX'h\Uh'U'h\ci [\'8f"; Ybg\UZh']gghYdd]b[Xck bžh\Y Wa a]ha Ybh'hc Wa a i b]hmYb[U[Ya Ybh fYa U]bg'ghfcb["'H\]gWa a]ha Ybh'k Ug'Yj]XYbWYX]b h\Y gYUfW. XYgWf]dh]cb Zcf'h\Y bYl h'DfYg]XYbhcZh\Y l b]j Yfg]hmcZGci h\: `cf]XU'GmghYa 'UbX']b h\Y WUbX]XUhY W\cgYb hc gYfj Y Ug'ci f'bYl h'dfYg]XYbhž8 f"'GhYj Y'7 i ffU``"

DfYg]XYbh'GYUfVX

H\YmaighU'gc'g\ck'UWtaa]haYbhhc'ZcghYf'h\Y'[fck]b['bUh]cbU'fYdihUh]cbcZh\Y'Ib]jYfg]hmcZGcih\:`cf]XUžk\]Wkbg]ghg'cZWJadigYg'b'ai`h]d'Y`cWJh]cbg]b'HJadUžGh"DYhYfgVif[žUbX'GUfUgchU!AUbUhYY'k]h\gmbYf[m]b'U``UgdYWfg'cZ]hg

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

ghuZZUbXidYfgcbbY`k]h\79YIdYfh]gY]bih\Yih\fYYWccfX]bUh]b[icZZ]WYgžh\Y]adYaYbhUh]cbicZUE9Dih\UhYad\Ug]nYgWtaaib]mYb[U[YaYbhzh\YyghUv]g\aYbhcZUbYkicf[Ub]nUh]cbU`ghfiWhifYžUbXih\Y]adYaYbhUh]cbicZUb'9b\UbWYX;YbYfU`9XiWUh]cbif9;9Łh\Uh]bhY[fUhYg\][\!]adUWhdfUWh]WYgžUbXiacghWf]h]WU``mžUXYeiUhYfYgcifWYU``cWUh]cbg'hc]adYaYbhh\YgYW\Ub[Yg"

H\YI b]j Yfg]hmcZGci h\: `cf]XU'k Ug'Uj YfmX]ZZYfYbh]bgh]hi h]cb]b &\$\$) #&\$%\$ k\Yb k\Y'Udd`]YX`Zcf'h\Y`7 UfbY[]Y`7 ca a i b]hm
9b[UX]**ZZvf'Vi**ik b Mgch 7`Ugg]Z]WUbgcb Ub]bih\dfih]z M\$l bu!\Udd`]YX`tognUxgonghYa k]h\blujd\CocYUb(?Job\Ub\Wax\di gYg. GUfUgchU!A UbUhYYžGh'
DYhYfgVi f[z@U_Y`UbXzUbX'h\Y`a U]b WJa di g]b HUa dU"G]bWf'h\Uhh]a YzGUfUgchU!A UbUhYY`UbX`Gh"DYhYfgVi f[VYWJa Y
gYdUfUhY`mUWWfYX]hYXzUbX'h\Y`aU_Y`UbX`WJa di g]g'bc`cb[YfdUfhcZh\YI G: gonghYa "8 UhU'UbX]bZcfa Uh]cb WcbhU]bYX`]b'h\]g
Udd`]WJh]cb dYfhU]bg'hc'h\Y'I G: HUa dU'WJa di g'cb`m'< ck Yj Yfz]b'A UfWX &\$%, zh\Y: `cf]XU'@Y[]g'Uhi fY'j chYX hc Wcbgc`]XUhY
h\Y`h\fYYI G: WJa di gYg'hc VY_bck b'Ug'I G: "fGYY XYgWf]dh]cb]b'%'&ch\Yft"

8 Ygd Ygd YWU'W m"]cb' YWUY žYXY Udd'h\YX dd'h]WUh]cb'h\h\YYjchYX'hcWcbgc`]XUhY

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

WccfX]bUhcfžUbX UXa]b]ghfUh]j Y Ugg]ghUbh"C 79k Ug Z bXYX VmDfcj cghK] Wcl k]h\ fYcWW ff]b[Z bXg'UbX]b &\$ & C 79 fYWr]j YX ghUhY Uddfcdf]Uh]cbg"C 79 gfYgdcbg]V]]h]YgYl dUbXYX UbX k UgfYbUa YX h\Y C ZZ]W cZ7ca a i b]hm9b[U[Ya Ybh'UbX DUfhbYfg\]dgfC 79Dt"C 79D g" (&(\$\$\$\$ Vi X[Yh]g Z bXYX h\fci [\ 9/; Z bXg"H\Y a]gg]cb cZC 79D]ghcYl dUbX UbX ghfYb[h\Ybi b]j Yfg]hmÿ Wca a i b]hmYb[U[Ya Ybh'cWJ`mUbX [`cVU`m]b gi ddcfhcZl G: ftgghfUhY[]Wdf]cf]h]Yg. ghi XYbh'gi WWrggž fYgYUfW. UbX]bbcj Uh]cbždUfhbYfg\]dgžUbX gci bX Z]bUbWJU`a UbU[Ya Ybh"

C 7 9D]g ghUZZYX VmU 8 cWcfU ! @Yj Y 8]fYVWcfža UghYfg! Yj Y 5 gg]ghUbh8]fYVWcfžh\fYY a UghYfg! Yj Y Dfc[fUa 'D`UbbYfgžUbX k c [fUxi UhY Ugg]ghUbhg" C 7 9D Ugc \Ughk c gcWJU k cf_]bhYfbgžhk c : K Gʻghi XYbhgžUbX UXa]b]ghfUh]j Yʻgi ddcfh" C 7 9D YUXg W ff]W \Uf Yb[U[Ya YbhYZzcfhg'UbX Wa a i b]hm\VUgYX ZUW \hmfYgYUfW\ UbX dUfhbYfg\]d XYj Y`cda Ybh" 5 XX]h]cbU``mžC 7 9D cj YfgYYgh\Y 7 ca a i b]hmGi ghU]bUV]`]hmDUfhbYfg\]d Dfc[fUa ff7 GGD\Zk\]W dfcj]XYgghi XYbh"YUfb]b[h\fci [\gigg]ghUbhX : YXYfU K cf_Ghi XmWa a i b]hmd`UWYa Ybhg" C 7 9D Ugc k cf_gk]h\"cWU gWxco`gh\fci [\h\fci [\h\f

7@7979YI dYf]YbWrgfU`][b]b['hc'l b]hYXBUh]cbg'Gi ghU]bUV`Y'8Yj Y`cda Ybh'; cU`gŁ]bWi XY'hk c'Ubbi U`XUmg'cZgYfj]Wrž fY[i`Uf'gYfj]WrYl dYf]YbWrgžUbXXca Ygh]WubX]bhYfbUh]cbU`U`hYfbUh]j Y'gYfj]WrVfYU_YI dYf]YbWrg"H\Y'7@79'U'gc'gYfj Yg'Ug I G: g'ghi XYbh'cf[Ub]nUh]cb'UbX'j c`i bhYYf'WYUf]b[\ci gY WbbYWh]b[Wa a i b]hmdUfhbYfg'k]h\cj Yf'*' \$'ghi XYbh cf[Ub]nUh]cbg"H\Y'7@79'WcfX]bUhYg'h\Y'@YUXYfg\]d'Ghi X]Yg'Dfc[fUa 'UWUXYa]Wa]bcf'f@GDŁ"

H\Y h\fYY df]a UfmWccfX]bUh]b[i b]hgžUgk Y``Ugh\Y; `cVU`7]h]nYbgDfcYWhfE 9DłźCZZJW cZ7cfdcfUhY DUfhbYfg\]dgž 8 YdUfha YbhcZ5h\`Yh]Wgž: ci bXUh]cb CZZJW cZ7UfYYfFYUX]bYggžWc``Y[Yg'UbXXYdUfha Ybhg'U``dUfh]WJdUhY cb U WUa di glk]XY7ca a i b]hm9b[U[Ya Ybh7ci bW]`f797Łh\Uha YYhga cbh\`m'7\U]fYXVmh\Y8]fYWhcfcZC79Džh\Y797 WccfX]bUhYqa i `h]X]gWJd`]bUfmdUfhbYfg\]dg'UbX'dfcYWhg'UbX'gi ddcfhg'UWc``UVcfUh]j YW`hi fYZcfWca a i b]hmYb[U[Ya Ybh'

\hdg.##k k k "i gZ"YXi #Yb[U[Ya Ybh#UVci h#a]gg]cb"Ugdl
\hdg.##k k k "i gZ"YXi #Yb[U[Ya Ybh#UVci h#]bXYl "Ugdl
\hdg.##k k k "i gZ"YXi #ghi XYbh!UZZU]fg#YUXYfg\]d!V]j]WYb[U[Ya Ybh#\hdg.##\YU'h\"i gZ"YXi #WUfY#dUh]Ybh!fYgci fW'g#ci hfYUW\\hhdg.##\YU'h\"i gZ"YXi #di V`]W\YU'h\#Wta a i b]hm!Yb[U[Ya Ybh k k k "i gZ"YXi #7@79
k k k "i gZ"YXi #6i ``GmbWffYei]fYg`c[]bŁ
\hdg.##k k k "i gZ"YXi #\cbcfg#W ffYbh!ghi XYbhg#Wta a i b]hm!gYfj]W""Ugdl

: i bX]b[

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

7"&"%

5gYj]XYbWrdfcj]XYXZcfimcifYUf]YfWUgg]ZJWlh]cbžmciXYgWf]VYX]bhYfbU`ViX[YhUfmU`cWlh]cbgXYX]WlhYXhcigiddcfh]b[]bgh]hih]cbU`Yb[U[YaYbhk]h\Waaib]mi'

 $: cffY!WUgg]Z]WUh]cb\tilde{z}XYgWf]VYk \land Uh'\land Ug'WkUb[YX\tilde{z}]Z'Ubmh\backslash]b[\check{z}k]h\land h\land Y']bhYfbU'\land X[YhUfm'U'\land WUh]cbg'g]bWfh\land Y'`UghWUgg]Z]WUh]cb''$

5 hh\Y h]a Y c Zh\Y &\$\$) WUgg]Z]WUh]c b ž Wcaai b]mmYb[U[Ya YbhYZZcffg Uhi G: k Ug\][\`mXYWfbhfU`]nYX žk]h\ U bi a VYf c Z c ZZ]Wfg dfcj]X]b[ci hfYUW žYb[U[Ya YbhždUfhbYfg\]d XYj Y`cda YbhžUbX gYfj]Wf!`YUfb]b[Wci fgY XYj Y`cda Ybh]b UXX]h]c b hc ch\Yf i b]hfYgdcbg]V]`]h]Yg"Hc[Yh\Yf h\Ym\UX U hchU` Vi X[YhU`cWUh]cb c Z Uddfcl]a UhY`m` %\$(\$\frac{x}{2}\ &\$"H\Y dfYj]ci g Udd`]WUh]cb]bWi XYX Vi X[YhU`cWUh]cbghc ci f fY[]cbU` WUa di gYgžk \]W. UfY bch]bWi XYX Jb h\]g XcWi a Ybh"

CjYfh\YdUgh%) mYUfgži G: \Ugj UghmYl dUbXYXWta a i b]hmYb[U[Ya YbhYZzcfhg"DYfa UbYbhVi X[YhUfmU`cWUh]cbgk YfY]a d`Ya YbhYX]b`&\$\% hc h\Y`C ZZ]WYcZ7ca a i b]hm9b[U[Ya YbhUbX DUfhbYfg\]dgfC 7 9DŁžUbX h\Y`7 YbhYf Zcf @YUXYfg\]d UbX 7]j]W9b[U[Ya YbhfYW]j YX UXX]h]cbU`Zi bXgZfca ghi XYbhZYYg" \b &\$\%+\zh\Y`C ZZ]WYcZ7cfdcfUhY DUfhbYfg\]dgfYWY]j YX Vi X[Yh'U`cWUh]cbgzUbX]b`&\$\%+\zh\Y`I G: 7 c``Y[YcZDi V`]W< YU`h\`UbX < cbcfg7c``Y[Yk YfYdfcj]XYX\Zi bX]b[\ZcfXYg][bUhYX ghUZZUgk Y``"

6YWJ gY I G: \Ug']b\fYUg]b[`m]bhY[fUhYX\da a i b]hmYb[U[Ya Ybhh\fci [\ci hh\Y\W ff]\W`i a \tilde{W} ff]\W`\Uf'U\f]] h]Yg'UbX ci hfYU\W YZZcffg'nc a cfY Zi ``mU][b k]h\]rg'a]gg]cb\tilde{z}hk ci `X\VYYI hfYa Y`mX]ZZ]\W`hnc dfcj]XY\Ub\U\W\fUhY\Ub\Umg]gcZh\Y\Zi ``Vi X[YhUfm]a d`]\Wh]cbg\tilde{U}\c\Wh]cbg\tilde{U}\tilde{U}\tilde{X}h\]fyg"7i ff]\W`\Uf'U\f\]j h]Yg'U'gc]b\W XY\ZU\W`hm]bhY[fUh]cbcZ7\9@]b h\Y]f\\tilde{I}\day\W\c\Y\f\]Yi b]rg'UbX\WfbhYfg\tilde{X}\Y\Uh\ci hfYU\W\h\fci [\ 1 G: < YU'h\ UbX'h\Y\A cfgUb]'7 c``Y[Y cZ'A YX]\MbY\tilde{X}h\Y\day\floor\

=b h\Y &\$%+! &\$% 'UWUXYa]WmYUfžh\Y Vi X[YhUfm'U`cWUh]cbg'Zcf'h\Y cZZ]WYggi ddcfh]b[']bgh]hi h]cbU`Yb[U[Ya Ybh'UbX dUfhbYfg\]d XYj Y`cda Ybhk]h\ h\Y Wa a i b]hmUg'h\Y]f'df]a UfmZ bWh]cb k Ug WabgYfj Uh]j Y`m&'a]``]cb Xc``Ufg"H\Y Vi X[Yh U`cWUh]cbg'Zcf'C 7 9D UbX 7 @7 9`\Uj Y Xci V`YX'g]bWf'h\Y`Ugh'Udd`]WUh]cb/I G: < YU'h\ C 7 9`\Ug']bWfYUgYX/UbX'bYk 'Z bX]b[VYWUa Y'Uj U]`UV'Y Zcf'h\Y C ZZ]Wf'cZ'7 cfdcfUhY DUfhbYfg\]dgz< cbcfg'7 c``Y[YzUbX'7 c``Y[YcZ'Di V`]W< YU'h\"

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z[YX cb (#%) #&\$% "

ci f'dUfhbYfg'hc fYUW\ h\Y]f'd\]`Ubh\fcd]W[cU`g"Ci f'Zci bXUh]cb'UbX WcfdcfUhY dUfhbYfg']b'dUfh]W``Uf']bWfYUg]b[`mZcW g'h\Y]f d\]`Ubh\fcdmcb'h\Y Wa a i b]h]Yg']b'k\]W\ h\Ym\Uj Y'U'dfYgYbWf/UbX'h\Ym]bWfYUg]b[`mgYY_Wa a i b]hmdUfhbYfg\]dg'
UWfcgg'U``UWUXYa]WX]gW]d`]bYg' hc a Ul]a]nY]a dUWhUbX YZZYWhW\Ub[Y"A cfYcj YfžWcfdcfUh]cbg'UbX'Zci bXUh]cbg
]bWfYUq]b[`mdUfhbYf'k]h\YUW\ch\Yf'hc Zi bX'dfc[fUa g'h\Uh'h\YmWcbq]XYf']bhY[fU'hc Wa a i b]hmk Y``!VY]b['"

H\Y1 G: ci bXUh]cb a U]bhU]bga cfY h\Ub (2* \$\$ UWWti bhggi ddcfh]b[1 G: GUWXYA]\WfYgYUfW.\ZUbX\Wta a i b]hm
Yb[U[Ya Ybhdfc[fUa g"H\YgY UW\ti bhg\UfY YghUV\]g\YX hc \UW\Ydhd\] \Ubh\fcd]\W\tbhf]\Vi h]cbg\Zcf\gdY\\Z]\\Xxcbcf!\X]fY\\YX\X\\ i gYgh\fci [\ci hh\Y1 G: GmghYa "A cghgi ddcfhYb\Ub\\a Ybhgh\UhYl hYbX1 G: dfc[fUa a]b[\VYmcbX\VUg]\\cdYfUh]b[\\text{wchy} ghg\\maxtra \\maxtra \text{yh} \\maxtra \text{yh} \\maxtra \text{cghgi ddcfhYb\Ub\\a Ybhgh\UhYl hYbX1 G: dfc[fUa a]b[\VYmcbX\VUg]\\cdYfUh]b[\\\text{wchy} \\maxtra \\maxtra \text{ghg} \\maxtra \maxtra \\maxtra \\maxt

H\YZc``ck]b[UfYYIUad`YgcZWcaaib]hmlYb[U[YXdfc[fUagh\UhWcbg]ghYbh`mfYWY]jYd\]`Ubh\fcd]WWcbhf]Vih]cbgUhlG:..

!<YU`h\WUfY`ZcfibXYfgYfjYX`dcdi`Uh]cbg.i G: <YU`h\`dfc[fUagž]bWiX]b[`HUadU'6UmGhfYYhAYX]W]bYž6F=8; 9`7`]b]WžMVcf Mcih\`7`]b]WžUbX`DYX]Uhf]WCihfYUW\žgYfjY`\caY`Yggžib]bgifYXžUbX`ibXYf]bgifYX`dcdi`Uh]cbg"

!?!‰gi WWrgg.H\Y1 G: 7c``Y[YcZ9Xi Wuh]cbcZZYfgdfc[fUa ggi W. Ug'H\Y; i g'5"GhUj fcg7YbhYf'Zcf: fYY9bhYfdf]gYUbX 9Wcbca]W9Xi Wuh]cbžHi hcf!5!6i ``žUbXh\YA cfh'HYUW.Yf@YUXYf5WUXYa mždfcj]X]b[fYgci fWrg'UbX'hfU]b]b[hcdfY!gYfj]Wr UbX]b!gYfj]WrhYUW.Yfgž]b'hi fb'hfUbgZcfa]b[h\YYXi WUh]cbU`YI dYf]YbWrcZh\Ya Ubmghi XYbhg'h\Ymk]``gYfj Y"

!9Xi Wuh]cb'5Xj cWuWm'H\Y: `cf]XU'7c``Y[Y5WW'gg'BYhk cf_fl75B'E'UXj UbW'gYXi Wuh]cb'UXj cWuWmždc`]WmžUbX'fYgYUfW.k]h\]b: `cf]XUZ]bWc`cfUh]cb'k]h\bia Yfci g'ghU_Y\c`XYfg'UWfcgg'h\Y'ghUhY"

!6i g]bYgg:H\YA i a U7c``Y[YcZ6i g]bYggdfcj]XYgZfYYfYgci fWfghch\YWta a i b]hmž]bh\YZcfa cZWtbgi `h]b[gYfj]Wfgj]Uh\YGa U``6i g]bYgg'8 Yj Y`cda Ybh7YbhYf/UbX`cWJž]b!XYdh\YWtbca]W]bX]Wlhcfgj]Uh\YUbbi U`GhUhYcZh\YFY[]cbfYdcfh"

!GiaaYf9bf]WaYbh`GH9A ZcfGWc`Ufg'UbX'H\Y`CWYUbc[fUd\m7UadZcf;]f`g'UfY'Ubbi U``giaaYfdfc[fUag'dfYdUf]b[`cWJ`mcih\ZcfUWJXYa]W]ZY'UbX'WUfYYfg']b`GH9A Z]Y`Xg"H\Y`K I G: GiaaYf5fhg'dfc[fUa'dfcj]XYg'Ub'YXi WUh]cbU`Ybf]WaYbhYIdYf]YbW'hc``cWJ`Uh!f]g mcih\"

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

ghfUhY[]WU``m]b`k Umg`h\Uh\Uj Y`fYU`YWcbca]WUbX`gcWJYhU``j U`i Y`hc`]hgWcaai b]h]Yg`]bWi X]b[`\YU`h\ WUfYžgi ghU]bUV]`]hmž YXi WUh]cbžfYgYUfWkžfYgci fWf`g\Uf]b[žUbX`XYj Y`cdaYbh""

%"H\Y:`cf]XU7c``Y[Y5VWYggBYhkcf_fl75BE]g`U1G:!\cghYX`cf[Ub]nUh]cb`Waaa]hhYX`hc]b\WYUg]b['dcghgYWbXUfmUWWYggUbX`UhhU]baYbhZcf:`cf]X]Ubg`hfUX]h]cbU``mibXYffYdfYgYbhYX`]b\][\YfYXiWUh]cb":75BYjc`jYX`Zfca'9B@579:`cf]XUffVUfbY[]Y5dd`]WUh]cb'&\$\$) ŁzUbYhkcf_VYhkYyb'Zcif:`cf]XUghUhYib]jYfg]h]Yg`hc]b\WYugY@Uh]bc'ghiXYbh'giWWYgg"

: 75B gk cf_Wta V]bYgfYgYUfW.Zdc`]WmUbU`mg]gžUXj cWWmžWtbj Yb]b[gžghUhYk]XY]b]h]Uh]j YgžUbX gi ddcfhcZ`cWU`Wt``Y[Y UWWggbYkk cf_gf@75B gUfY fY[]cbU`` Wt``YWh]j Y]a dUWh!gmiY WtU`]h]cbgk cf_jb[hc]bWfYUgY dcghgYWtbXUfmUWWgg UbX UhhU]ba Ybh]b h\Y]f Wta a i b]h]Yg"@75B gfYdfYgYbh+, i cZ: `cf]XU gdcdi `Uh]cbž]bWi X]b[Wti bh]Yg]b1 G: g [Yc[fUd\]WU`Zcchdf]bh": 75B dfcj]XYg@75B gk]h\ hYW\b]WU`Ugg]ghUbWf cb WtU`]h]cb!Vi]`X]b[žXUhU`UbU`mg]gž`YUfb]b[Wta a i b]h]YgžUbX ch\YffYgci fWfg"

5XX]h]cbU`mž: 75B WccfX]bUhYgʻghUhYk]XY`]b]h]Uh]j YgʻUbX`k YV]bUfgʻhc Vi]`X`UWc``Y[Y![c]b[W\`hi fY`]b`: `cf]XUʻgWkcc`g. 5dd`m Mci fgY`Z: `cf]XUʻfdUfhcZh\Y`5a Yf]WUb`7c``Y[Yʻ5dd`]WUh]cb`7 Ua dU][bL/: `cf]XUʻ7c``Y[Yʻ8 YW]g]cb`8 Umf]bgd]fYX Vmh\Y A]W\Y``Y`C VUa Ugʻ6YhhYfʻA U_YʻFcca `]b]h]Uh]j YLZUbX`h\Y`: `cf]XU`: 5: G5`7\U``Yb[Y": i bX]b['Zcf': 75B Wca YgʻZfca `[fUbhg UbX`fYgci fWYʻg\Uf]b["

&"7 m/Yf: `cf]XU. H\Y: `cf]XU7 YbhYf Zcf7 m/YfgYW f]hm]g'U'ghUhY! Zi bXYX cf[Ub]nUh]cb XYX]WlhYX hc 'dcg]h]cb]b[: `cf]XU'Ug'U bUh]cbU```YUXYf]b WhVYfgYW f]hmh\fci [\YXi WUh]cbžfYgYUfW.žUbX Waaib]hmci hfYUW."< cghYX Uhi G: ž7 m/Yf: `cf]XU'f7: k cf_qik]h\U``%&GhUhYI b]j Yfg]hmGmghYa 'cZ: `cf]XU'fGI GE]bgh]hi h]cbfci [\fffffffff cb]bf[:

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

U[YbXUg'h\fci [\\]f]b[ždi fWkUg]b[žUbX'dfcW'fYa Ybh]b'U'k Umh\UhWcbhf]Vi hYg'hc'Ub']bgh]hi h]cbU' Wca a]ha Ybh'hc Wca a i b]hmYb[U[Ya Ybh3

MYg

7"&") "U

D`YUgY XYgWf]VY Vi g]bYggcdYfUh]cb dfUWh]WYgh]YX hc h\Y`cWU`Wca a i b]hm

9Wcbca WUbX 7 ca a i b]hm8 Yi Y`cda Ybh

I G. Wta a YfWJU]nUh]cb ghfUhY[mg]a dUWhcb: `cf]XU gYWtbca mž" '-) 'a]``]cb cZh\Y1 G: '\deltabcj Uh]cb 9bhYfdf]gY g'Ubbi U`]a dUWhž]g'Zci bX]b'h\YfY[]cbžk \YfY'Uddfcl]a UhY`m%)) \$ dYcd`Y'UfY'X]fYWhmYa d`cmYX"% (*+fY`UhYX'cVg'UfY'gi ghU]bYX Ua cb['dUfhbYf'cf[Ub]nUh]cbg'UbXVi g]bYggYg'dfcj]X]b['[ccXg'UbX'gYfj]W'g'hc '\delta' cdYfUh]cbg"H\YYZZcfhdfcXi W'g'r " %(-a]``]cb]b \ci gY\c`X]bWta Y"

\$\&\\$\\Times \\\Times \\Times \\Times

Di fWXUqlb[UbX DfcW fYa Ybh

I G.]gWta a]hhYX hc Yb[U[]b[X]j YfgY Vi g]bYggYg]b h\Y dfcW fYa YbhcZ[ccXgžgYfj]WrgžUbX Wtbghfi Wh]cb WtbhfUWhg"I G: Wtbh]bi Yghc di fgi Y X]j YfgY Vi g]bYggYgZcf WtbhfUWh]b[cddcfhi b]h]YgUbX]gWta a]hhYX hc gYfj]b[h\Y i b]j Yfg]hmUbX gi ffci bX]b[Vi g]bYggWta a i b]hmh\fci [\ YXi Wlh]cbU UbX Wta a i b]hmci hfYUW. UWh]j]h]Yg"H\Y hUf[Yha Uf_YhcZh\Y C \ ZZ]W cZGi dd`]Yf8]j Yfg]hmfl G: C G8 ½]bWi XYgVi g]bYggYgck bYX Vmk ca Ybža]bcf]h]YgžUbX j YhYfUbg"@cWl Vi g]bYggYg]b h\YgY WlhY[cf]YgUfY dfYZYffYX"C h\Yf hUf[YhUfYUg]bWi XY U``I G: XYdUfha YbhgžUWXYa]Wi b]hgžUbX df]a Y WtbhfUWhcfgk \c UWh]j Y`mfYdfYgYbhI G:]b h\Y Vi g]bYggWta a i b]hmh\fci [\]bj c`j Ya Ybh]b Vi g]bYggUggcWJUh]cbgUbX cf[Ub]nUh]cbg"H\Y I G: C G8]g\ci gYX]b h\Y I b]j Yfg]hm7 cbhfc``YffigC \ ZZJW' i bXYf h\Y X]fYWh]cb cZUb 5 gg]ghUbhJ]W DfYg]XYbh"H\Y 5J D]g fYgdcbg]V`Y Zcfa cb]hcf]b[z̃]a d`Ya Ybh]b[z̃dfc[fYgghfUW_]b[z̃UbX UX A gha Ybhghc h\Y i b]j Yfg]hmfgX]j YfgY Vi g]bYgg i h\`n\Dloch d`Ub"

K]h\]b cbY mYUfzh\Y1 G: C G8 \\ugYb[U[YXzcbY cb cbYzk]h\ - \$\$Z hchU`Wa a i b]hmghU_Y\c`XYf cf[Ub]nUh]cbg UbX`YUXYfgz X]j YfgY Vi g]bYgg ck bYfgzgi dd`]YfX]j Yfg]hmdfcZYgg]cbU`g`UbX Vi g]bYgg`XYj Y`cda Ybhcf[Ub]nUh]cbg`Zfca `UWfcgg`h\Y`ghUhY`cZ: `cf]XU`UbX`bUh]cbU``m'H\]gWe``UVcfUh]cb']gYl WYdh]cbU``m\Y`dZi `]b`Yj YfU[]b[]bXi ghfm_bck `YX[Y`UbX`[U]b]b[]bg][\h]bhc]bXi ghfmVyghdfUWf)WYg`UbX`i `h]a UhY`mWebbYWf]b['gi dd`]Yfg`hc h\Y`cddcfhi b]h]Yg`UWfcgg`l G: "'H\]gYb[U[Ya Ybh]g`U`gc`U

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

]a dfcj Y'hfUW_]b['UbX'XcW' a YbhUh]cb VmZcfa U']n]b['UggYgga YbhZcf Wca a i b]hmdUfhbYfg\]dgzZcf XUhU'Wc``YWh]cb fY`UhYX'hc 79@Wci fgYg'ZU``]b['ci hg]XY'h\Y'9; 9žUbX'a cb]hcf]b['ghi XYbh``YUfb]b['ci hWca Yg"'H\YgY YZZcfhg'k]`` Wca d`Ya Ybh'h\Y'9; 9'UbX U``ck 'Zcf Wcbh]bi ci g`]a dfcj Ya Ybh' \hhdg.##k k k "i gZ"YXi #cXg#

' "&

8 YgWf]VY h\Y a YWkUb]ga gʻi gYX ZcfʻgmghYa Uh]WWWa di glk]XY UggYgga YbhʻUbX a YUgi fYa YbhcZh\Y ci hWca YgʻUbX]a dUWtgʻcZ]bgh]hi h]cbu` Yb[U[Ya Ybh''K \c]gʻfYgdcbg]V`Y Zcfʻ[Uh\Yf]b[XUhUž\ck "UfY h\Y XUhU'a UbU[YXž\ck 'cZhYb']g`]hi[Uh\YfYXžUbX \ck "UfY XUhU'i gYX3K \Uh'UggYgga Ybh'UbX a YUgi fYa Ybha YWkUb]ga gʻXcYgʻh\Y WWa di gʻgh]`` bYYX hc XYj Y`cd3Dfcj]XY fY`Yj Ubhk YV`]b_g''

I G: Wt``YWngW ff]W``Uf`XUhU`UVci h`]bgh]hi h]cbU`Yb[U[Ya Ybhh\fci [\`6UbbYfžl G: gYbhYfdf]gYd`Ubb]b[UbX`ghi XYbh]bZcfa Uh]cb gnghYa ia UbU[YX Vmh\Y`fY[]ghfUf"H\]g]bZcfa Uh]cb]gWt``YWnYX YUWX gYa YghYf hc i dXUhY W ff]W``Uf i b]hg dfc[fYgg'hck UfXg'[cU`g"H\Y`XUhU`UfY Wt``YWnYX`UbX`U[[fY[UhYX YUWX gdf]b[Zcf'h\Y`DD5 fYdcfhhc W ff]W``Uf i b]hgžj]U'h\Y Dfcj cghgcZZ]Wfžhc UW_bck `YX[Y`UWVta d`]g\a Ybhgž]b]h]UhY W Ub[Yg'hc _YYd YZCfhg]b dUWf k]h\ ghfUhY[]W[cU`gžUbX`]bZcfa [cU`!gYhh]b['UbX`UWUXYa]Wd`Ubb]b['Zcf'h\Y`i dWta]b['mYUf"5 'dcfh]cb cZh\Y`XUhU]g[YbYfUhYX Vmh\Y`9b\UbWfX; YbYfU` 9Xi WUh]cb f9; 9½]b k \]W\\][\!]a dUWfWti fgYgž]bWi X]b[Wta a i b]mHYb[U[YX`YUfb]b[žUfY Ya VYXXYX`h\fci [\ci hh\Y a U^cfgcZYUWX Wt``Y[Y"H\Y`fYa U]b]b['7 9@Wti fgYgYl]ghci hg]XY`h\Y`9; 9žUbX`UggcWJUhYX`XUhU`UfY WUdhi fYX`X]fYWh`m]b 6UbbYf`Zfca h\Y`XYdUfha Ybh"H\YgY`Wti fgYgžZcfa Yf`mXYg][bUhYX`UgʻgYfj]WY!`YUfb]b[ž\Uj Y VYYb`a UbU[YX`]b h\]gik Umdf]cf hc h\Y`UXcdh]cb`cZh\Y`9; 9"

5 ggYgga YbhcZh\Y'9; 9 W ff]W`i a `]g'i gYX Vmh\Y; YbYfU`'9Xi Wuh]cb'7 ci bW' ZcffYZ]b]b['h\Y W ff]W`i a 'hc'gi ddcfhghi XYbh `YUfb]b[' UbX UWX]Yj Ya Ybh]b fYUWX]b[' h\Y Y][\hghi XYbh`YUfb]b[' ci hWta Yg'fG@C gt"H\Y G@C g'UfY 'UggYggYX Uhh\Y]bgh]hi h]cbU```Yj Y`i g]b[ghUbXUfX]nYX fi Vf]Wg'fgYY``]b_gt": UW\`hmUggYgga Ybh]b '9b\UbWfX; YbYfU`'9Xi Wuh]cb Wti fgYg'cWW fg YUWX gYa YghYf"H\Y 'UggYgga YbhXUhU'UfY 'dfYgYbhYX']b h\Y [YbYfU` YXi Wuh]cb XUhU'XUg\VcUfX'UbX'UfY 'UWW'gg]V'Y 'mYUf!fci bX/

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

\hhdg.##k k k "i gZ"YXi #i bXYf[fUX#[YbYfU'!YXi WUh]cb!Wci bW]`#[YbYX!fYj]g]cb#fi Vf]W\VX"dXZ \hhdg.##k k k "i gZ"YXi #i bXYf[fUX#[YbYfU'!YXi WUh]cb!Wci bW]`#[YbYX!fYj]g]cb#fi Vf]W\fW\"dXZ

1 11

K \Uh'UfY'h\YW'ffYbh'Z|bX]b[g'Zfca 'h\Y'a YW\Ub]ga g'i gYX'Zcf'gmghYa Uh]WWUa di g!k]XY'UggYgga Ybh'UbX'a YUgi fYa Ybh 'UbX \ck 'UfY'h\YgY'X]ZZYfYbh'Zfca 'h\Y'Z|bX]b[g'g]bWY'h\Y''Ugh'WUgg]Z|WUh]cb3

±0 &\$%\$zi G: fYdcfhYX cb Ubi a VYfcZa YW.Ub]ga gi gYX ZcfignghYa Uh]WWa di gik]XY UggYgga Ybh'UbX a YUgi fYa YbhcZ Wa a i b]hmYb[U[Ya Ybh"H\YgY]bWi XYX Z]bX]b[g ZcW gYX cb gi fZUW "Yj Y XUhU gi W. Ug'h\Y bi a VYfcZWa fgygzZuW `hmzUbX ghi XYbhg]bj c`j YX]b Wa a i b]hmYb[U[YX UWh]j]h]Yg": UW `hmfYgYUfW. Uk UfXg'k YfY fYdcfhYX Ug'k Y``"Cj Yf'h\Y dUghXYWUXYz Ug'l G: `\UgYI dUbXYX fYgYUfW. UbX Yb[U[Ya YbhYZZcfhg]h\Ug'k cf_YX hc Wabh]bi ci g`m]a dfcj Y h\YgY a YW.Ub]ga g'fGYY" "&Ł Vm]bWfYUg]b['h\Yei U`]hmzei Ubh]hmzUbX XYdh\ cZ]bZcfa Uh]cb [Uh\YfYX `cWU``nzfY[]cbU``mUbX [`cVU``m"

A cghi G: [fUXi UhYgʻUhhf]Vi hYʻh\Y]fʻYXi WUh]cbʻhcʻYb\UbW]b['h\Y]fʻi bXYfghUbX]b[ˈcZˈ[`cVU`Wcbghfi Whg. [`cVU`]ggi Ygʻfi-ı Łž Wf]h]WU`UbU`mg]gʻcZ[`cVU`]XYUgʻzfi, ı Łżch\YfʻdYcd`YʻzW`hi fYgʻUbX`VUW_[fci bXgʻfi) ı ŁUbX`d`UW]b[ˈdYcd`Y`UbX`Yj Ybhgʻ]b\]ghcf]WU`WcbhYl hʻfi &ı Ł''; 7 DʻZci bX`&' ghi XYbhgʻdUfh]WJdUh]b[ˈ]bʻh\Y; `cVU`7]h]nYbgʻ5k UfX`hfUbgWf]dhXYg][bUh]cbʻgWcfY dYfZcfa Wca a i b]hmgYfj]WY`UbX`gWcfY`g][b]ZJWUbh`m\][\Yfʻh\Ub`h\Y]f`Wci bhYfdUfhgʻzZcfVch\: ccX`GmghYa gʻUbX`DU]X A UhYfb]hmʻ@YUj Yžj Uf]UV`YgʻZcW`g]b[ˈcb¹l b]hYX`B Uh]cbgʻGi ghU]bUV]`]hm; cUʻgʻ&`UbX; "

Ghi XYbhgff, I ŁYbhYf]b[I G: YI dYWhc VY dc`]h]WU`mYb[U[YX]b Wc``Y[YžUbX - +I YI dYWhc dUfh]W]dUhY]b gcW]U``m fYgdcbg]V`Y UWh]j]h]Yg"7 cbbYWh]j Y`mž[fUXi Uh]b[ighi XYbhgff, 'I ŁfYdcfhigUh]gZUWh]cb k]h\ h\YcZZJWrg UbXidfc[fUa giX]fYWhm]bj c`j YX]b UXj UbW]b[h\YgY Yb[U[Ya Ybh'UWh]j]h]Yg"H\]fhYYb UbX &i fYdcfhidcgh! [fUXi Uh]cb WUfYYfg k]h\ bcbdfcZ]h cf[Ub]nUh]cbg'UbX]b di V`]WgYfj]WYžfYgdYWh]j Y`m"FY[UfX]b[; 7 D XUhUžI G: [fUXi UhYgfYdcfhh\Y]f i b]j Yfg]hmYl dYf]YbWrg UbX YXi WUh]cb Wcbhf]Vi hY hc h\Y]f UV]`]hmhc VY [`cVU``mWca dYh]h]j Y"H\YgY ghi XYbhgff *I Ł]bX]WUhY Ub cV`][UhcfmgYbgY hc dcg]h]j Y`m]a dUWhigcW]Yhm'i

I G: ghi XYbhYb[U[Ya Ybh]g'hfUW_YX'Vma i `h]d`Y'dfc[fUa gi g]b[j Uf]ci g'UddfcUW.Yg"H\Y'7YbhYf`Zcf`@YUXYfg\]d`UbX'7]j]W 9b[U[Ya YbhfYWcfXYX'&z\$' , gYfj]W Yl dYf]YbWfg]b`&\$%+!&\$%, zhchU`]b[, z \$' "+) \ci fgf(" * \ci fg'dYfYl dYf]YbWf]b - UfYUg'X]gh]b[i]g\YX Vmh\Y`l B Gi ghU]bUV`Y`8 Yj Y`cda Ybh; cU`g"l G: ZfUhYfb]h]Yg'UbX'gcfcf]h]Yg`c[[YX' +z)' \ci fg'cZ gYfj]W Vm&z *&a Ya VYfg"

: UW `hmXcWa YbhYX Waaaib]mYb[U[YaYbhUWh]j]h]Yg]bg]l WUgg]Z]WUh]cbg. `HYUW.]b[`UbX`hfU]b]b[žFYgYUfW.Z7 fYUh]j Y#DYfZcfa]b[žDfcZYgg]cbU `GYfj]WYgž<cbcfgžUbX`ch\Yf`fWUhW.!U``Ł"K\]'Y &z, - `ZUW`hmfYdcfhYX Waaib]mYb[U[YaYbhUW]j]mrž+++ `fYdcfhYX Xc]b[`gc]b `hYUW.]b[`UbX`hfU]b]b[ž* %+]b `fYgYUfW. UbX`-\$ `fYWY]j YX`\cbcfg`Zcf`h\Y]f`YZZcfhg"FYgYUfW. Zb bX]b[`]g`fYdcfhYX Y`gYk\YfY`]b `h\]g`Udd`]WUh]cb"\hdg.#\YU`h\"igZ`YXi#U\YW#igZ\YU`h\gYfj]Wfy&fdg#UbbiU`!fYdcfhg

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

\hhdg.##k k k "i gZ"YXi #[\vd#Xc\wa Ybhg#[\vd!&\\$\%+!\&\%, !YI Y\w h]j Y!gi a a Ufm'dXZ \hhdg.##k k k "i gZ"YXi #[\vd#U\vci h!i g#[\vd!gi a a Ufm'c\Z] [`c\V\'!dfc[fUa a]b[!]a dU\w'dXZ

' "(

5fY'h\YfY'a YW\Ub]ga g'Zcf'XYZ]b]b['UbX'a YUgi f]b['ei U']hmcZWta a i b]hmYb[U[Ya Ybh'Vi]'h']bhc'UbmcZh\Y'XUhUWt``YWh]cb'cf Ug'UWta d'Ya YbhUfmdfcWfgg3

MYg

' "("U! 8 YgW

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

6Y[]bb]b['7c``Y[Y'Ghi XYbh'DUggk cfX'dfchYWYX; 7D`\hhdg.##k k k "i gZ'YXi #[Wd#XcW'a Ybhg#&\$%) eYdZi ``"dXZ\hhdg.##k k k "i gZ'YXi #[Wd#XcW'a Ybhg#eYdYIYW'h]j Ygi a a Ufm'dXZ

' ")

Cihwta Ygubx =a duwngcb ghi XYbhg

8 YqWf]VY cbY _YmZ|bX]b[Zfca W ffYbhXUhU UbX]bX]WUhY \ck mci Uff]i YX Uhh\]qZ|bX]b[.

I G. gʻlbghjhi hjcbUʻdUfhjWdUhjcbʻ]bʻh\YBUhjcbUʻGi fj YmcZGhi XYbhʻ9b[U[Ya YbhʻfB GG9łżh\Y6Y[]bb]b[ʻ7c``Y[YGi fj YmcZGhi XYbhʻ9b[U[Ya YbhʻfB GG9łżh\Y6Y[]bb]b[ʻ7c``Y[YGi fj YmcZGhi XYbhʻ9b[U[Ya YbhʻfB GG9łżh\Y1b]j Yfg]hmcZGci h\: `cf]XU" H\YUggYgga Ybhʻgi fj YmXYj Y`cdYXVmh\YCZZJW cZ7ca a i b]hmʻ9b[U[Ya YbhʻUbX DUfhbYfg\]dgdfcj]XYgWti fgY``Yj Y`]bZcfa Uhjcb Uvci hʻghi XYbhgʻdYfWdhjcbgʻhck UfXgWta a i b]hmYb[U[YX``YUfb]b["7i ffYbhXUhUʻZfca [fUXi Uhjb[ighi XYbhgʻgi [[Yghg¹ G: ighi XYbhg`\Uj Y[U]bYXUb]bWfYUgYX i bXYfghUbX]b[cZh\YWtbhf]Vi hjcbgʻh\YmWb a U_Y`]bʻh\YWta a i b]hmUbX h\Y]fʻfYgdcbg]V]`]hmhc dcg]hjj Y`m]a dUWhgcWjYhmʻʻ5XX]hjcbU``mž) - i cZ[fUXi Uhjb[ighi XYbhgʻZY`hghfcb[`mUVci h'n\]g Wtbhf]Vi hjcb"K Y`Uj YʻZci bXʻghUhjgh]Wb``mg][b]ZJWbh']bWfYUgYgʻ]bʻghi XYbhʻ]bhYfYghʻ]bʻhU_]b[a cfY Wta a i b]hmYb[U[YX Wti fgYg

H\YgY Z|bX]b[U][b k]h\ XUhU Zfca h\Y67 GG9 k \]W.]bX]WWhY ghi XYbhgYbhYf]b[I G: YI dYWhhc VY dc`]h]WW`mYb[U[YX fl , I Ł UbX gcW]U`mfYgdcbg]V`Y fl +I Ł":]bX]b[g Zfca XUhU'a YW.Ub]ga g UbX ghi XYbhYbfc``a Ybh]b 7 9 @#G@Wti fgYg gi VghUbh]UhY ghi XYbh]bhYfYghUbX XYg]fY hc dUfh]W]dUhY]b Wta a i b]hmYb[U[YX ~YUfb]b[Vch\]b UbX ci hcZh\Y WUggfcca ffYXi WUh]cb UVfcUXzi bXYf[fUXi UhY fYgYUfW. UbX]bhYfbg\]dg\t"Ghi XYbhgUfY YU[Yf hc Udd`mg_]``g`YUfbYX]b WUggfcca hc a U_Y U X]ZZYfYbWr]b h\Y Wta a i b]hm'H\]g gY`Z ghi Xm\][\`][\hg h\YYI hYbhcZWta a i b]hmYb[U[Ya YbhYZZcfhgVY]b[i bXYfhU_Yb Vm I G: ghi XYbhg]b W ff]W Uf UWl]j]h]Yg"5 XX]h]cbU`Wta a i b]hmYb[U[Ya YbhYZZcfhgUfY fYdcfhYX h\fci [\ci hh\]gUdd`]WUh]cb h\Uh\][\`][\hghiYfYgh]b Yb[U[Ya YbhYZZcfhgUfY fYdcfhYX h\fci [\ci hh\]gUdd`]Wlh]cb h\Uh\][\`][\hghi XYbhWcbhf]Vi h]cbg'UbX]bhYfYgh]b Yb[U[Ya Ybhh\fci [\ `YUXYfg\]d]b dfc[fUa gzfYgYUfW. UbX gYfj]Wr"

 $H\Y 9b\UbWYX; YbYfU`9Xi Wh]cb 5ggYgga Ybh'D`Ub`k]``dfcj]XYXUhU`UVci hh\Y9; 9`UbX`U`ck 1 G: hc`hfUW_UbX`UggYgg ghi XYbh``YUfb]b[ci hWca Yg`fYgi`h]b[Zfca h\Y9; 9`UbX`h\Y<][\=a dUWhDfUWh]WYg]bhY[fUhYX]bhc`h\YW`ff]W`i a "\hhdg.##k k k "i gZ"YXi # bXYf[fUX#[YbYfU`!YXi WUh]cb!Wci bW]`#[YbYX!fYj]g]cb#UggYgga Ybh''UgdI$

ı 11*

CihWta YgUbX =a dUWfgcb ZUW `hm

8 YqWf]VY cbY _YmZ|bX]b[Zfca W ffYbhXUhU UbX]bX]WUhY \ck mci Uff]i YX Uhh\]g Z|bX]b[.

 $5 _YmZ]bX]b[]ghY]bWfYUgY]b79WtifgYgUbXgWxc`UfgN]dUWh]j]hmWUff]YXcihVmZUW`hm'H\Ybia VYfcZWtifgYgcZZYfYXdf]cfhch\Y]adYaYbhUh]cbcZh\Y9; 9XYacbghfUhYgh\]g]bWfYUgY"GYjYfU`ZUWhcfg]bZiYbWfXh\]g`YjY`cZUWh]j]hm'7\Ub[Yg]bgh]hihYX]bhYbifYUbXdfcach]cb[i]XY`]bYgZc``ck]b[h\Y&$\%$7UfbY[]YUdd`]WUh]cbUW_bck`YX[YZUW`hm79YZZcfhg"6mig]b[U79UddfcUWXžZUW`hmWUbYb[U[Yk]h\h\YWaaib]hihYYWaaib]hmig]b[YIdYfh]gYhcUXXfYgggcW]YhU`WXU`Yb[Ygžk\]YWbbYWh]b[h\YcfmhcdfUW]WYZcfghiXYbhg"H\Y]bWfYUgYXXYg]fYhchYUWXig]b[U79UddfcUWX]gXYacbghfUhYXh\fci[\UhYbXUbWYUhh\Y79@5WUXYamcZZYfYXVmC79DUbX]bWfYUgYXWtifgYXYjY`cdaYbhZcfh\Y9; 9"$

5 \(\) bck \(\) YX[Ya Ybhc ZZUW \) hmg \(\) a a i b] \(\) hmy b[\(\) [Ya Ybh YZZcffg YI hYb Xg hc f YWc[b]h]cb \) h (ci [\ \ \ \ \ \) \(\) Yg XYd Ufha Ybhg \(\) b \(\) G: \(\) YUXYfg \)] d" \(\) H\] g] g \(\) f \(\) g \(\) hc Z \(\) b \(\) YUGY X \(\) Zc \(\) g \(\) b \(\) Y \(\) UW \(\) hmf Y \(\) b \(\) Y \(\) Y \(\) M \(\) hmf Y \(\) d \(\) h \(\) g \(\) y \(\) Y \(\) hmf Y \(\) d \(\) h \(\) Y \(\) Y \(\) hmf Y \(\) d \(\) h \(\) Y \(\) Y \(\) Y \(\) Hm Y \(\) b \(\) Y \(

DUgg]cb Zcfi g]b[Wca a i b]hmYb[U[YX a Yh\cXg]gYj]XYbWYX Vmei U']hUh]j Y XUhU'dfcj]XYX']b ZUW' hmYj U'i Uh]cbg"

A mgYfj]WY! YUfb]b[Wci fgY]bj][cfUhYXa Y UbX [Uj Ya Y UbY

hci Wdf q

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

1 11

Cihwta Yg = a dUWrgcb]bgh]hih]cb

8 YgWf]VYcbY_YmZ]bX]b[Zfca W ffYbhXUhU'UbX]bX]WUhY\ck mci Uff]j YX'Uh'h\]gZ]bX]b[...

7 i ffYbhXUhUcbWca a i b]hmYb[U[Ya Ybh]b fYgYUfWkZhYUWk]b[ZUbX gYfj]WY bchcb`mfYZYVWgUb]bWfYUgY]b h\Y ei Ubh]hmUbX

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

h\Uhih\Y`]bgh]hi h]cb'a YYhg`]hg'ghfUhY[]W[cU'g" 797 a Ya VYfg'k YfY`Ug_YX`hc'dUfh]W]dUhY`cb'cbY'cZ'Z]j Y k cf_]b[`[fci dg.

- !; fcid% FYj]Yk 'gcZhk UfY 'gmghYa g\W ffYbh`m]b i gY \Zcf\Waaib]\Wh]b[k]h\ 'ghi \XYbhg`Ub\X\Waaib]hm d\Ufhb\Yfg`Ub\X\Uj\U\`\Y\`Ub\U`mh]\Wq/
- !; fcid&.FYj]Yk 'Uj U]`UV`Ya UhYf]U`g`UbX`XYj Y`cd`U`d`Ub`Zcf`]XYbh]Zm]b['dYfZcfa UbW'a Yhf]Wg`UbX a YUqi fYg'Zcf`Ubbi U`fYdcfhg`fY`Uh]b['hc`Wca a i b]hmYb[U[Ya Ybh/
- !; fci d". 8 Yj Y`cd U'd`Ub Zcfigi ddcfh]b[]bWi g]cb cZei U`]hmWta a i b]hmYb[U[Ya Ybh]bhc HYbi fY/ Dfca ch]cb Udd`]WUh]cbg'UbXfYj]Yk dfcWfgqYg'UhXYdUfha Ybh'UbXWt``Y[Y ^Yj Y`g/
- !; fcid(.DfcXiWrUgYhcZ[i]X]b[eiYgh]cbgZcfWtaaib]hmdUfhbYfghcVYX]ghf]VihYXhcai`h]d`YUiX]YbWrg#Wtbgh]hiYbhg]bh\YWtaaib]hm"; fcid(kUghcXYjY`cdUbUWh]cbd`UbZcfcVhU]b]b[Wtaaib]hm]bdihcjYfh]aYUbXcbUfY[i`UfVUq]q/
- !; fcid). =b cfXYf hc Ya VYX Yb[U[Ya Ybh]bhc YUW Wc``Y[YžXYdUfha YbhžUbX i b]hžh\]gk cf_]b[[fcid k Ughc hU_Y Uh\fYY!dfcb[YX UddfcUW]bj c`j]b[bcb!UWUXYa]WUbX bcb!ghi XYbhUZZU]fg i b]hgžW/bhYfg UbX]bgh]hi hYgžUbX ghi XYbhcf[Ub]nUh]cbgžUbX XYj Y`cd Ud`Ub Zcf]bWi g]cb cZgi W i b]hg]b Wa a i b]hm Yb[U[Ya YbhYZZcfhg"

:]bX]b[qZfca; fcid%z"/)

; fci d %Zci bX 7 9 fYgYUfW k Ugʻi bXYf! fYdcfhYX]b hYfa gʻcZh\Y bi a VYfʻUbX Ua ci bhgʻcZWca a i b]hml Yb[U[YX [fUbhˈdfcdcgUˈg#Uk UfXgžXc``UfgˈdfcdcgYX#Uk UfXYXžUbX YI dYbX]hi fYgʻʻH\Y XUhU X]X bch'U``ck Zcf XYhYfa]bUh]cb cf YI hYbhˈhc k \]W dfc YWhgʻa YhYghUV`]g\YX Wf]hYf]U Zcf Wca a i b]hmlYb[U[YX fYgYUfW.ž]bWi X]b[fYW]dfcW]hmža i hi U`VYbYZ]hgžg\UfYX fYgdcbg]V]`]hmZcf h\Y WcbXi WhcZfYgYUfW.žUbX X]ggYa]bUh]cb hc Vch\ UWUXYa]WUbX Wca a i b]hmUi X]YbWrgʻʻ

 $\label{eq:continuity} $$C 79DVY[Ub'k cf_]b['k']h\ CGD'hc'hfUVV_[fUbhg'UbX'Uk UfXg'gdYV]Z]WU``m'ZcW'gYX'cbYI hYfbU`ci hfYUVX UbX'Yb[U[Ya Ybh'']]$$$

; fci d" Zci bX h\Uhk\]`Y1 G: =bgh]hi h]cbU`; i]XY`]bYgf&\$%(E]bWi XYX Wca a i b]hm!Yb[U[YX fYgYUfW\ž hYUW\]b[UbX gYfj]Wr]b h\Y hYbi fY UbX dfca ch]cb fH/ DEcZZUW hmUbX]bghfi WcfgžVm&\$%) žgYj Yb Wc``Y[Yg`\UX bchfYj]gYX h\Y]f[i]XY`]bYghc U`][b k]h\ h\]g'W\Ub[Y"

H\YC79Dkcf_YXk]h\Wc``Y[Yg'UbXXYdUfha Ybhg'hcfYj]gYH/D'[i]XY`]bYgžUbX%\$\$i cZh\YWc``Y[Ygbck]bWiXY``Ub[iU[Yh\UhgiddcfhgWcaaib]hm!Yb[U[YXhYUWX]b[žfYgYUfW\žUbXgYfj]WY"KYWcbh]biYhckcf_k]h\XYdUfhaYbhg'hcfYj]gYUbX]ad`YaYbh[i]XY`]bYg"

:]bX]b[gZfca; fcid) \UXh\Yacgh]a dUWhcbighi XYbhgUbX`U]Xh\YZci bXUh]cbZcfUbYk '9b\UbWX ; YbYfU`9Xi WUh]cb]a d`Ya YbhYX]b: U``&\$% "H\YbYk Wiff]W`i a]bWi XYghk cfYei]fYX'Wti fgYgdf]cf hc [fUXi Uh]cb/U'Wj]WYb[U[Ya Ybh'UbXYh\]WU`fYUgcb]b['Wti fgYf9F 7 9ŁUbX'U'<][\=a dUWh'DfUWh]WY 7 ci fgYf7 9@]g'U'XYg][bUhYX'< =D \text{Wti fgYt'}"

H\Y7caaib]hm9b[U[YaYbh7cibW]`aYaVYfgik]``Wbh]biYhcih]`]nYh\YZ]bX]b[gZfcah\]g UggYggaYbhhci]adfcjYWccfX]bUh]cbzgYfj]WfgzhfU]b]b[zdUfhbYfg\]dXYjY`cdaYbhzUbXZUWj`]hUh]cbcZ ZUW`hmdfcach]cbUbXhYbifY[i]XY`]bYgik]h\]bXYdUfhaYbhg"

DfcZYgg]cbU`8Yj Y`cda Ybh

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

("%

5gYj]XYbWrdfcj]XYXZcfmcifYUf]YfWUgg]Z]WWh]cbžmciXYgWf]VYXh\YkUmgh\Y]bgh]hih]cbcZZYfgdfcZYgg]cbUXYjY`cdaYbhgiddcfhZcfZUW`hm]bUbmYad`cmaYbhghUhigfhYbifYX#hYbifYhfUW_žZI```h]aYbcb!hYbifYhfUW_žUbXdUfhh]aYZUW`hmłzghUZZZUbX#hYbifYhfUW_žZI\``h]aYbcb!hYbifYhfUW_zUbXdUfhh]aYZUW`hmłzghUZZZUbX#cfWcaaib]hmdUfhbYfqk\cUfY]bjc`iYXk]h\Wadiq!Wcaaib]hmYb[U[YaYbh"

: cffY!WUgg]ZJWUh]cbžXYgWf]VYk\Uh`\UgW\Ub[YXž]Z'Ubmh\]b[žk]h\`dfcZYgg]cbU`XYjY`cdaYbh'ZcfWcaaib]mmYb[U[YaYbh' < ck`\UjYh\YWcbhYbhždfc[fUažUddfcUW\Ygžcf'UiX]YbWfZcf'dfcZYgg]cbU`XYjY`cdaYbhW\Ub[YX`g]bWfh\Y``Ugh'7UfbY[]Y WUqq]ZJWUh]cb3K\Uh`\UjYVYYb'h\Y`fYqi`hq3

G]bWrh\Y&\$\$) #&\$%\$ WUgg]Z]WUh]cbždfcZYgg]cbU`XYj Y`cda Ybhcddcfhi b]h]Yg Zcf Wca a i b]hmYb[U[Ya YbhfT 9½\Uj Y Yl dUbXYX Zcf Wca a i b]hmdUfhbYfgžghi XYbhgžUbX ZUW `hmcZU``Ya d`cma YbhghUhi gYg"5g'UX]fYWhfYgi `hžU``h\Y Wc``Y[Yg\Uj Y UXX]h]cbU`ZUW `hmhYUW.]b[\\][\!ei U`]hm7 9@Wci fgYg'UbX i bXYfhU_]b[Wca a i b]hmlVUgYX fYgYUfW.žci hfYUW. UbX gYfj]WV/ ghi XYbhgYb[U[]b[k]h\ h\Y Wca a i b]hma YUb]b[\(\frac{1}{2} \) `mYUbX a Ubma cfY Wca a i b]hmdUfhbYfg'gYY_]b[cddcfhi b]h]Yg'hc dUfhbYf k]h\ I G: "

=b A Um&\$%+zC 79D Zcfa U`]nYX 79@YXi WUh]cb Vm]a d`Ya Ybh]b['U`GYfj]WY!@YUfb]b[5 WUXYa mffYbUa YX 79@5 WUXYa mt"H\Y UWUXYa mjg'Ua i `h]!XUmk cf_g\cd \Y`X hk]WY UmYUf Zcfr &) ghUZZz[fUXi UhY ghi XYbhgzUbX ZUW `hmcZUbmghUhi g`hc ZUW]hUhY 79@Wti fgY XYj Y`cda Ybh'UbX gW.c`Uf`mk cf_"DUfh]WdUbhg`fYWf]j Y YXi WUh]cb fY`UhYX hc dYXU[c[mzWti fgY Wtbghfi Wh]cbz XYj Y`cda Ybh'cZa i hi U`mVYbYZ]WJU`dUfhbYfg\]dgzghi XYbh`YUfb]b[ci hWta YgzUggYgga YbhzUbX W`hi fU`\i a]`]hm'7 ca a i b]hm dUfhbYfg`UhhYbX UbX WUb XYj Y`cd dUfhbYfg\]dgik]h\ ZUW\`hm': UW\`hmfYWf]j Y gi ddcfhXi f]b[h\Y mYUf Zfca 'h\Y C 79D hYUa "

C 7 9D UbX h\Y 5 WUXYa mcZHYUW\]b['UbX @YUfb]b['dUfhbYf hc dfcj]XY k cf_g\cdg hc Yb\UbWY ZUW\ hmXYj Y`cda YbhZcf h\Y 9h\]WU F YUgcb]b['UbX 7]j]W9b[U[Ya Ybhf9F 7 9½fYei]fYa Ybh]b h\Y 9b\UbWYX; YbYfU '9Xi WUh]cb 7i ff]W\ i a ": UW\ hm UhhYbX k cf_g\cdg Zcf XYj Y`cd]b[\][\!ei U`]hmWti fgY gm`UV] hc a YYhighi XYbh`YUfb]b[ci hWta Yg"5XX]h]cbU`mžC 7 9D dfcj]XYg k cf_g\cdg h\fci [\ci hh\Y mYUf cb 7 9 fYgYUfW\ UbX gW\c`Ufg\]dždUfhbYfg\]d XYj Y`cda YbhžUggYgga YbhžUbX ZUW]\]hUh]b['ghi XYbh`YUfb]b[h\fci [\7 9"

H\Y7cbhYadcfUfm5fhAigYiacZYfg`Uib]eiYdfcZYgg]cbU`XYjY`cdaYbhUbX Waaib]mmYb[U[YaYbhcddcfhib]mmhc ZUW`hmUbX?!%&hYUW\Yfg"H\Y1G: =bgh]hihYZcf`FYgYUfW\]b`5fhž=bg]XY5fhdfc[fUacZYfg`Ub]bbcjUh]jY`Ufhg!VUgYX`YUfb]b[dfc[fUav&aV]b]b[igcW]U`ghiX]Yg`UbX`UfhhcX]gWigg`dfYgg]b[igcW]U`]ggiYg"DfcZYgg]cbU`kcf_g\cdg`UfY`UhhYbXYXVmZUW`hm]b`h\Y7c``Y[Yg`cZ'9XiWUh]cb`UbX`5fhg`UbX`GW]YbWfgžUbX`h\Y`<]``gVcfci[\7cibhmGW\cc``6cUfX`hcdfcj]XY`hYUW\Yfg`UbX`1G:ZUW`hmk]h\`h\Y`hcc`g`hc]bhY[fUhY WcbhfcjYfg]U`]ggiYg`]bhc`h\Y]f`hYUW\]b[idfUWf]Wfg"

H\YDfcjcghCZZJWrgdcbgcfgdfcZrgg]cbU`XYjY`cdaYbhZcfZUW`hmždfcZrgg]cbU`ghUZZžUbXWcaaib]hmaYaVYfgcbhcd]WgfY`UhYXhcGH9AYXiWuh]cb"AcghfYWrbhkcf_g\cdgZcWgYXcb]bhY[fUh]b[`\][\!]adUWndfUWn]Wrg]bhcGH9AYXiWuh]cbUbXWcaaib]wUh]b[cbGH9Ahch\YdiV`]WrH\YgYkcf_g\cdgUfYdUfhcZUbcb[c]b[gYf]YghcYb\UbWrGH9AibXYfghUbX]b[ž]bhYfYghžUbXg_]``g`]bWcaaib]hmYb[U[YXhYUWX]b[UbXfYgYUfWX"

C 7 9D c ZZYfg Wcaaib]mdUfhbYf]bhYfUWh]j Yk cf_g\cdg UbX Zcfiagh\fci[\aUhW\!idYj Ybhg"H\YgYYj Ybhgdfcj]XY

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

dcalhlcb XYaWaldhlcba

GYUFW. UbX fYWFi]ha Ybh'dc`]W]Yg'UbX dfUWf]WFgj Ufm\][\`mUWfcggi b]hgžWt``Y[YgžUbX XYdUfha Ybhg"
7c``Y[Ygžgi W. Ug'H\Y'7c``Y[YcZ6Y\Uj]cfU`UbX'7ca a i b]hm'GW]YbWFgžH\Y'<cbcfg'7c``Y[YžH\Y'7c``Y[YcZ6Y\Uj]cfU`UbX'7ca a i b]hm'GW]YbWFgžH\Y'<cbcfg'7c``Y[YžH\Y'7c``Y[YcZ6Y\Uj]cfU`UbX'7ca a i b]hm'YubX XYdUfha Ybhg'gi W. Ug'GcW]c`c[m²
Di V`]W5 Xa]b]ghfUh]cb UbX 5 bh\fcdc`c[mgdYW]Z]WU`mghUhY]b h\Y]f dcg]h]cb XYgWf]dh]cbg'h\YmgYY_
WbX]XUhYg'k]h\YI dYf]YbWf]b Wa a i b]hmYb[U[YX k cf_"5g'h\Y 9b\UbWXX; YbYfU`9Xi WUh]cb
Wff]Wi`i a VYWa Yg'Z ``m]bhY[fUhYX]bhc h\YI b]j Yfg]hmžk Y'YI dYWfh\Y'Wt``Y[Yg fYgdYWf]j Y
fYWfi]ha Ybh'dc`]W]Yg'hc fYZYWf7 9 YI dYfh]gY gdYW[Z]Whc h\YX]gW]d`]bY"

GhUZZ

GYUFW: UbX fYWfi]ha Ybhdc`]W]Yg#dfUWh]WYgZcfghUZZ]b h\Yi b]hg#XYdUfha Ybhgf7@79žC79DžC791G: < YU`h\žUbX`C7DžYhWZdf]a Uf]`mXYg][bUhYX`hcdfcj]XY`gi ddcfhZcfWcaai b]hmYb[U[YaYbhzWj]W Yb[U[YaYbhzUbXYIdYf]Ybh]U`YXi WJh]cb`gYY_YIdYfh]gY`]b`UbX`Wcaa]haYbhhc79`]b`h\Y]f`dcg]h]cb XYqWf]dh]cbg"

C 7 9DžDfc[fUa 'D`UbbYf'5bU`mgh

9| dYf]YbWr]bWaaib]mcihfYUWkUbXdUfhbYfg\]dVi]`X]b[/Y| dYf]YbWr]bUib]jYfg]mgYhh]b[/_bck`YX[YcZHUadU6UmUfYUbcbdfcZ]hUbX[cjYfbaYbhU[YbW]Yg Y| dYf]YbWrk]h\gYfj]WY!YUfb]b[UbXWaaib]hmYb[U[YaYbh"

: UW `hm

7c``Y[YcZ6Y\Uj]cfU`UbX7caaib]hmGWJYbWfg

5 gg]ghUbh'cf'5 ggcWlUhY'DfcZYggcf

5dd`]WUbhgk]h\XYacbghfUhYXWcbhf]Vih]cbghcdfcZYgg]cbU`cihfYUWXfY`UhYXhcVY\Uj]cfU`\YU`h\gYfj]WYgk\cUfY]bhYfYghYX]bXYjY`cd]b[Wc``UVcfUh]jYfYgYUfWXdUfhbYfg\]dgk]h\Ib]jYfg]hm Wc``YU[iYgžUgkY``Ug`cWJ`žghUhYUbXZYXYfU`U[YbW]Yg'UfYYbWcifU[YXhc'Udd`mFYWcfXcZWc``UVcfUh]jYkcf_k]h\Vch\UWUXYa]WUbXWcaaib]hmdUfhbYfg

7c``Y[YcZ9Xi WUh]cb.

5 gg]ghUbh#5 ggcWUhY DfcZYggcf

9| dYf]YbWrk]h\ Y| hYfbU dUfhbYfg\]dg'UbX Wa a i b]hmYb[U[Ya Ybh

DUhY`7c``Y[YcZ; cVU`GighU]bUV]`]hm

FYWfi]haYbhZcf8YUb

H\YDUhY`7c``Y[YcZ; `cVU``Gi ghU]bUV]`]hmk Ug `XYg][bYXhc ZcghYf`gi ghU]bUV`Y i fVUb`Ybj]fcba Ybhg`Vm bi fhi f]b['Wt``UVcfUh]j YfYgYUfW. UbXYXi WUh]cb`UWfcggh\Yi b]j Yfg]hmUbXa YUb]b[Zi `Yb[U[Ya Ybhk]h\ Wta a i b]h]Yg`cWU``mUbX`[`cVU``m'H\Y7c``Y[Y'Ya d`cmg'U'ga U``WtfYZUWV`hmUbX`ghUZZžVi h]hg`fYU` ghfYb[h\]g]hg'UV]`]hmhc dfcj]XY'h\Y\i V'Zcf'U'bYhk cf_cZgWkc`Ufg'UbX`dfcZYgg]cbU'g]bhYfYghYX']b k cf_]b['hc[Yh\Yf'hc [YbYfUhY'bYk _bck `YX[Y'UbX'dfYdUfY'U'bYk [YbYfUh]cb'cZ'dfcZYgg]cbU'g'hc\Y`d Wta a i b]h]Ygža i b]W]dU`]h]Yg'UbX Vi g]bYggYg'fYXi WY'h\Y]fYWt`c[]WU`Zcchdf]bhk \]`Y`]a dfcj]b['h\Y]f Zcfa 'UbX'Z bWh]cb'hc'a U_Y'h\Ya '\YU'h\]Yfža cfY``]j UV`Y'UbX'fYg]`]Ybh'

<cbcfg7c``Y[Y</pre>

FYWfi]haYbhZcf:UW`hmž

91 dYf]YbWkk]h\YghUV`]g\]b[UbXaUbU[]b[ghiXYbh]bhYfbg\]dgžgYfj]WY!`YUfb]b[dfcYVWgžUbX

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

Wff]W`Uf`dfUWh]Wag/XYacbghfUV`Y`YZZYWh]j YbYgg`Ug`U`hYUWXYf`Uh`h\Y`ib]j Yfg]hm`Yj Y` "HYUWX]b[``cUX]g`&#&žd`ig`\cbcfg`h\Yg]g`aYbhcf]b[ž]bhYfbg\]d#gYfj]WY!`YUfb]b[`XYj Y`cdaYbh'UbX``]U]gcb`hc`WJadig UbX`YIhYfbU`Ybh]h]Yg"""

5 b UV]`]hmhc hYUW. WUggYgk]h\ 'Ub]bhYfbUh]cbU` 'UbX#cf Wta dUfUh]j Y 'dYfgdYWf]j Y ']g\][\`mXYg]fYXžUg`]g U`XYa cbghfUhYX`fYWtfX`cZWta a i b]hmYb[U[Ya Ybh'UbX`Ub`]bhYfYgh']b]bhYfX]gW]d`]bUfm]bei]fm" 5 dd`]WUbhg`g\ci `X`\Uj YYI dYf]YbW' hYUW\]b[`\][\!UV]`]hmghi XYbhgžUbX`VY Wta ZcfhUV`Y`k cf_]b[`]b`U`]VYfU``Ufhg`gYhh]b[`h\Uh'ZcghYfg`ZUW``hmWt``UVcfUh]cb`UbX`ghi XYbhYb[U[Ya YbhVch\`]bg]XY`UbX`ci hg]XY h\Y WUggfcca "

) "&

±b h\Y dYf]cXg]bWrmci figi WWrggZ `WUgg]Z]WUh]cbžk \Uhž]ZUbmh\]b[ž\UgW\Ub[YX]b hYfa gcZ]bgh]hi h]cbU`dc`]W]YgZcf dfca ch]cb fUbX hYbi fY UhhYbi fY![fUbh]b[Wa di gYgŁh\UhgdYW]Z]WU`mfYj]Yk žYj U`i UhYžUbX fYk UfX ZUW`hmgW\c`Uf`mk cf_h\Uhi gYgWca a i b]hmlYb[U[YX UddfcUW\Yg'UbX a Yh\cXg3=Zh\YfY UfY gYdUfUhY dc`]W]YgZcf hYbi fYX#hYbi fY hfUW_žZ ``h]a Y bcb!hYbi fY hfUW_žUbX dUfhh]a Y ZUW`hmžd`YUqY XYqWf]VY h\Ya Uq'k Y``"

H\Y1 b]j Yfg]lmcZGci h\: `cf]XU]g'U'hYbi fY![fUbh]b[]bgh]hi h]cb"8 i f]b[h\Y &\$\$) #&\$%\$ 7 UfbY[]Y Udd`]WWh]cb dYf]cXž Wta a i b]lm!Yb[U[YX UddfcUWXYg'UbX a Yh\cXg'k YfY bchgdYV]Z]WU``mfYWt[b]nYX UbX fYk UfXYX]b h\Y dc`]W]Yg Zcf hYbi fY UbX dfca ch]cb Uh'h\Y]bgh]hi h]cbU```Yj Y` Zcf ZUW` hmcZ'UbmghUhi g" +b &\$%(žl G: ZUW` hmubX``YUXYfg\]d Uddfcj YX bYk [i]XY`]bYg Zcf hYbi fY UbX dfca ch]cb h\UhgdYV]Z]WU``m]bWi XY UbX fYk UfX Wta a i b]lm!Yb[U[YX UddfcUWXYg'UbX a Yh\cXg'Zcf ZUW` hm gW\c`Ufg\]džk \Yh\Yf ZUW` hmuUfY hYbi fYX cf bcb! hYbi fYX"H\YfY UfY bc gdYV]Z]W]bgh]hi h]cbU`[i]XY`]bYg'Zcf Wta a i b]lm!Yb[U[YX UddfcUWXYg'UbX a Yh\cXg'Zcf dUfh h]a Y ZUW` hm'H\YgY]bgh]hi h]cbU`dc`]W]Yg'i h]`]nY h\Y 7 UfbY[]Y XYZ]b]h]cb Zcf Wta a i b]lmYb[U[Ya Ybh"

\hhdg.##kkk"i gZ"YXi #dfcjcgh#XcWaYbhg#ZUW\`hmlUkUfXg#hlUbX!d![i]XY`]bYg!&\$%("dXZ

) "

-ZW ffYbhdc`]WJYgʻXcʻbchgdYWJZJWJ``mfYj]Yk žYj Uʻi UhYʻUbXʻfYk UfX Wtaai b]hmYb[U[YaYbhžXYgWf]VYʻh\Y`k cf_]bdfc[fYggʻhc fYj]gYʻdc`]WJYgʻgdYWJZJWJ``mZcfʻhYbi fYX#hYbi fYʻhfUW_žZJ```h]aYʻbcb!hYbi fYʻhfUW_žUbX`dUfhh]aYʻZUWV`hmdfcach]cbʻhc Ybgi fYʻU ZI```UbX`ZUJfʻfYj]Yk ʻUbX`UggYggaYbhcZZUWV`hmgWkc`Uf`mk cf_h\Uhi gYgʻWtaai b]hmYb[U[YX`UddfcUWkYgʻUbX`aYh\cXg"

H\Y]bgh]hi h]cbU`dc`]W]YgcZh\Y1 b]j Yfg]hmcZGci h\:`cf]XU]bWi XY`Ub[i U[Yk\]W gi ddcfhg'h\YfYj]Yk 'UbXYj U'i Uh]cb'cZ Wta a i b]hmlYb[U[YX'hYUW]b[žfYgYUfW\žUbX'gYfj]WY"5``h\YWt``Y[Yg]bWi XY'h\]g``Ub[i U[Y'Ug'k Y``"H\Y'dfcWrgg'hc'Zl``m]bhY[fUhY'UbX]a d`Ya Ybh'h\YgY'dc`]W[Yg]b'U``XYdUfha Ybhq]qcb[c]b["

) "(

 $G]bW'mcifdfYj]cigWUgg]Z]WUh]cbz``UjYh`YfYVYYbUbmW`Ub[Yg]bh`Y]bgh]hih]cb!k]XYXYZ]b]h]cbczZUW`hmgW`c`Uf`mkcf_h`UhigYgWcaaib]mYb[U[YXUddfcUWXYgUbXaYh`cXg3$

Myg

) "("U

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

hfu]b]b[cb Z]bUbW]U fYdcfh]b[ždfcV`Ya !gc`j]b[žUbX ¥ 6 dfcWfXi fYgžk]h\]bX]j]Xi U Wbgi `hUh]cb UbX gYfj]Wf! YUfb]b[k cf_g\cdg" < ck Yj Yfž]b &\$%* žXYZ]b]b[ZUW `hmgW\c`Uf`mk cf_VYWa Ya cfY Zcfa U`]nYX k]h\ h\Y]a d`Ya YbhUh]cb cZh\Y 7 ca a i b]hm9b[U[YX @YUfb]b['5 WUXYa mcZZYfYX h\fci [\ h\Y C ZZ]Wf cZ7 ca a i b]hm9b[U[Ya YbhUbX DUfhbYfg\]dg" 5 gdUfhcZ h\Y Wff]W `i a žVYghdfUWj]Wfg]b Wa a i b]hmYb[U[YX UddfcUWXYgUbX a Yh\cXgk YfY]bhY[fUhYX hc YXi WhY ZUW `hmZcf k cf_]b[k]h\ Wa a i b]hmdUfhbYfg]b Ua i hi U`mVYbYZ]W]U UddfcUWX"C 7 9D dfcj]XYg[i]XUbWf Zcf XYZ]b]b[ZUW `hmgW\c`Uf`m k cf_h\Uhi gYgWa a i b]hmYb[U[YX UddfcUWXYgUbX a Yh\cXgcb h\Y]f k YVg]hYžh\fci [\ Wbgi `hUh]cbžUbX]b h\Y 7 ca a i b]hm

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

i bXYf[fUXi UhY UbX [fUXi UhY ghi XYbhfYgYUfWk"9j U`i Uh]cb`cZhYUWk]b[YZZYWh]j YbYgg`]b`Zcfa Uhg`UbX`gYhh]b[g`ci hg]XY`h\Y WUggfcca 'g\ci `X`]bWi XY Wcbg]XYfUh]cb`cZh\Y`]a dUWhcZghi XYbh`YUfb]b[cb`dfUWh]WržUdd`]WUh]cbžUbX`dc`]Whi 'D"'\hhdg.##k k k "i gZ"YXi #dfcj cgh#XcW a Ybhg#ZUW\`hm!Uk UfXg#h!UbX!d![i]XY`]bYg!&\$%("dXZ

 $FY! 7 `Ugg]Z]WUh]cb. `H\Y '7 UfbY[]Y : ci bXUh]cb `Zcf'h\Y '5 Xj UbWYa Ybh'cZ HYUW\]b[$

FY!7`Ugg]Z]WUh]cb. H\Y'7 UfbY[]Y: ci bXUh]cb Zcf'h\Y'5 Xj UbWa Ybh'cZ HYUW\]b[

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

VYhk YYb]bgh]hi h]cbgcZ\][\YfYXi WUh]cbUbXh\Y]f``Uf[YfWta a i b]h]YgflcWJ`žfY[]cbU'#ghUhYžUbXbUh]cbU`ž]bhYfbUh]cbU`ž [`cVU`ŁZcfa i hi U`VYbYZ|h"5bmcZh\Yh\fYYWUhY[cf]YgcZZJW\`hmUWh]j]hmWti `XYbhU]` Wta a i b]hmYb[U[Ya Ybh" d"'("

7c``Y[YcZ6Y\Uj]cfU`UbX7caaib]mGWJYbWrgghUhYg'h\Uh GW\c`Ufg\]dhu_YgaUbmZcfagž]bWiX]b[]bXYdYbXYbh'm WbXiWhYXUg'k Y``UgWc``UVcfUh]j Y`ml [YbYfUhYXfYgYUfW\UbXgW\c`Uf`mdfcYWrgžWbhf]Vih]cbg'hc'bYk_bck `YX[Yž Waaib]m]adfcj YaYbhzUbX WbgYbgiglXf]j Yb'cfYj]XYbWr!VUgYXdfUWhJWr"H\YgY UWhJj]hJYg]b'h\YaUbmX]ZZYfYbh X]gWJd`]bYg]b'767GfUb[YZfcafYgYUfW\fWfYUh]cb'UbXUhhUJbaYbhcZbYk_bck `YX[Yžk\Yh\YfVUg]Wcf'Udd`]YXbhc'h\YXYjY`cdaYbh#Jad`YaYbhUh]cb'cZWaaib]mYb[U[YaYbhUWhJj]hJYg#dfc[fUag'UbX]adfcjYXghUbXUfXgcZdfUWhJWr"H\YdifdcgYcZfYgYUfW\UbXgW\c`Uf`mkcf_]gh\YgiVghUbhJjYUXjUbWraYbhcZUZJYXcZ]bei]fmcfdfUWhJWrzk\Yh\YfVmh\Y[YbYfUh]cb'cZbYk_bck `YX[YUbX'hYW\bc`c[]Yg'cf'WbgYbgiglXf]jYb'UbXYj]XYbWr!VUgYXdfUWhJWrg'k]h\]b'h\YXJgWJd`]bY"H\YfYWfXcZUWhJj]hJYg`YUX]b['hc'hYbifY'UbX'dfcach]cb'aighdfcj]XYYj]XYbWrcZY!Wr`YbWr]b'cbY'cf'acf'ycZh\YgYZcfag"

A i a Uʻ7 c``Y[YʻcZʻ6i g]bYggʻghUhYgʻh\YʻZc``ck]b[ZcfʻhYbi fYʻUbXʻdfca ch]cb. =h]gʻbchYX'h\Uh]bʻgca YʻUfYUgʻcZʻgW\c`Ufg\]dž di V`]WUh]cbgʻcfʻch\YfʻdfcXi Wfgʻa UmUddYUfʻcb`mUZhYfʻ'Yb[h\mcfYl hYbg]j YYZZcfh'UbXʻa UmUddYUfʻ]bʻUk]XYfʻfUb[YʻcZj Ybi Ygž Vch\cZk\]W\WbVY`dUfh]W`\$ ZcfZcfhW\fa UmUd fZcYZZž

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

 $\label{thm:linear} $$ WbX]XUhYg'Zcf'DfcZYggcf'UfY'g][b]Z]Wbh'm'\][\Yf'h\Ub'h\cgY'Zcf'UhhU]b]b['h\Y'5ggcW]UhY'fUb_'Ug'gdYW]Z]YX']b']bX]j']Xi'U'g XYdUfha Ybh'hYbi fY'UbX'dfca ch]cb'[i]XY']bY'' D'')$

H\Y7c``Y[YcZBifg]b['dc`]W]Yg'UbX'dfcW'XifYg'Zcf'5ddc]bhaYbhžDfcach]cb'UbX'HYbifY'gdYW]ZmWcaaib]mgYfj]W'fYei]fYaYbhg'Zcf'U``ZUW`hmž]bWiX]b[']bghfiWhcg'UbX'fUb_YX'ZuW`hm*H\YfYei]fYaYbhg'UfYXY`]bYUhYX VmhYbifYXžhYbifYYUfb]b['zcf'bcb!hYbifYYUfb]b['fUb_g"GYfj]W']g'fYei]fYX'Zcf'U``ZUW`hm*GYfj]W'hc'h\YWcaaib]mg\gdUfh]W``Uf`mYjU'iUhYXZcf'ZuW`hmgYY_]b['hYbifY'UbX#cf'dfcach]cb"H\Ybcb!hYbifY'hfuW_[i]XY`]bYg'gdYW]ZWU`m]bWiXYWcaaib]mmyb[U[YX

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z[YX cb (#%) #&\$% "

ZcW gYXk cf_g\cdgžUbXa Ybhcf]b[UWh]j]h]Yg D"%

8 YdUfha YbhcZA YbhU`< YU`h\`@Uk`UbX`Dc`]\whiz`5 bmcZh\Y`h\fYY \whY[cf]\ycZZUW`hmU\wh]j]hmfg\\kc`Ufg\]dzhYU\w]b[žUbX gYfj]\w\text{Lwci `X`]b\wi XY`\wa a i b]hmYb[U[Ya YbhzUXXfYgg\f]h]\w\ gc\\YhU`]ggi Yg`UbX \wcbhf]\vi hY`hc`h\Y`di V`]\w[ccX"6i h\\wa a i b]hmYb[U[Ya Ybhih\Uh]gi bXYfhU_Yb`\mzU\w\ hmhc Yb\Ub\w` \wff]\w\`i a zhYU\w]b[`UbX`YUfb]b[`UbX`dfYdUfY YXi \whYxz Yb[U[YX \w]h]nYbga UmVY]b\wi XYX`UbX`Yj U`i UhYX`Ug`dUfhcZhYU\w]b[žUbX`\wa a i b]hmYb[U[Ya Ybhi bXYfhU_Yb`hc Ybf]\w\ g\wc`Ufg\]dzfYgYUf\w\zUbX`\w\y\Uh]j Y`\w\h]j \ma UmVY]b\wi XYX`UbX`Yj U`i UhYX`Ug`dUfhcZ'\y\y\\]b'h\Y`Udd`]\w\h]cb`]b`h\Y`gY\w]cb`a cghfY`Yj Ubhhc`h\Y\\da a i b]hmYb[U[Ya Ybhiy fYgYUf\w\zhY\w]b[\zeta\x\x\y\x\y\y\\y\\]b'\\\"\`D"`+

H\Y'GWkcc`cZDi V`]W5ZZU]fgž`cWlhYX]b h\Y'7c``Y[YcZ5fhg'UbX'GV]YbWfg`\Ug']a d`Ya YbhYXh\Y'Zc``ck]b[Wf]hYf]UZcf
Udd`]Wlbhg'ZcfhYbi fY'UbX'dfca ch]cb. HYUW]b[cWW fg]b'Uj Uf]YhmcZgYhh]b[g'UbX'Uj Uf]YhmcZk Umg''K \]'YhYUW\]b[XcYg
cWW f]b'h\Y'hfUX]h]cbU`WUggfcca ž]h'U'gc'cWW fg]b'U'bi a VYfcZch\Yf``Ygg'hfUX]h]cbU`j Ybi Yg'gi Wk'Ug'cb`]bY'gYhh]b[g''
; fUXi UhY'hYUW\]b['U'gc'cWW fg]b'h\Y WbhYl hcZfYgYUfW\ dfc'YWgzUbX]b'dfUWh]W'gYhh]b[g#gYfj]W'! `YUfb]b[#Wa a i b]hm
Yb[U[Ya Ybh''HYUW\]b['U'gc'cWW fg'k \Yb'ZUW `hmgi dYfj]gY'ch\Yf'Zcfa g'cZghi XYbhX]fYWhYX'fYgYUfW\ZUbX'Z]Y`X'hfU]b]b[
UWh]j]h]Yg'': UW`hma i ghXYa cbghfUhY' 9j]XYbW'cZ]a dUWhcZU``Zcfa g'cZhYUW\]b['fY''["WUggfcca 'UbX'cb`]bY'hYUW\]b[z
gi dYfj]g]b['ghi XYbhg']b'fYgYUfW\UbX'wa a i b]hmYb[U[Ya Ybh#gYfj]W'! `YUfb]b[#Udd`]YX'fYgYUfW\Zgi W\ 'Ug'dfUWh]h]cbYf
UXcdh]cb'cZghi XYbhgfifYWa a YbXUh]cbg'Zfca 'WUgg'dfc'Ywfg D''*

\hdg.##k k k "i gZ"YXi #Ufhg!gW]YbWrg#XcW a Ybhg#ZUW `hmlghUZZ#h!UbX!d#XYdUfha YbhU`!hYbi fY#gW.cc`!di V`]WUZZU]fg"dXZ\hhdg.##k k k "i gZ"YXi #Ufhg!gW]YbWrg#XcW a Ybhg#ZUW `hmlghUZZ#h!UbX!d#XYdUfha YbhU`!hYbi fY#Ubh\fcdc`c[m'dXZ\hhd.##]bhfU"WWvg"i gZ"YXi #Wca a cb#Z]`Y#DfcdcgYX; i]XY`]bYg#DfcdcgYX; i]XY`]bYg!GGK "dXZ\hhd.##]bhfU"WWvg"i gZ"YXi #Wca a cb#Z]`Y#DfcdcgYX; i]XY`]bYg#DfcdcgYX; i]XY`]bYg!A < @D"dXZ\hhd.##]bhfU"WWvg"i gZ"YXi #Wca a cb#Z]`Y#DfcdcgYX; i]XY`]bYg#DfcdcgYX; i]XY`]bYg!G5G"dXZ

)")" V7ca a i b]hmYb[U[Ya Ybh]gfYk UfXYXUgUZcfa cZfYgYUfVk MYg

) ") " V

Dfcj]XY^]b_cfXYgWf]dh]j YhYlh

GWkcc`cZDiV`]W5ZZU]fg

H\Y`Udd`]WUh]cb`cZfYgYUfW\`UbX`gW\c`Ufg\]d`[i]XY`]bYgZcf`Udd`]YX`fYgYUfW\`UbX`Waaib]hmYb[U[YaYbhhc`h\Y`X]gW]d`]bYg]bh\Y`GW\cc``cZDiV`]W5ZZU]fg]g`]adcfhUbh`UbX`Wad`YI": cf`h\]g`fYUgcb`h\Y`GW\cc``cZDiV`]W5ZZU]fg`WfYUhYX`gdYW]Z]W
[i]XY`]bYg.

5 Xcdh]cb cZh\Y ZUW `hma Ya VYfftjia cXY`g Zcf dfcV`Ya fYgc`i h]cbž]bhYfj Ybh]cb dfc[fUa gž]bghfi a Ybhgžcf dfcWfggYgVm ch\Yfgk\c gYY_gc`i h]cbghc g]a]`Uf dfcV`Ya g/

7 cbhf]Vi h]cb cZUdd`]YX fYgYUfW UWh]j]hmk]``Wtbhf]Vi hY hc h\Y]a dfcj Ya YbhcZWta a i b]hm#U[YbW]Yg/H\Y UV]`]hmhc]bWtfdcfUhY bYk XYj Y`cda Ybhq]b h\Y X]qWd`]bY UbX Udd`m bck `YX[Y hc W ffYbhdfcV`Ya q/

8 cW a YbhUh]cb h\Uhh\Y dfUWh]Wr Webhf]Vi h]cbg`\Uj Y`\UX`]a dcfhUbhYZZYWhgcb dc`]WhžUbX#cf`cb`UWea a i b]hmžU[YbWhžcf dfc[fUa /

H\Y^]_Y`]\ccXh\Uhh\Y`dfUWh]WY`UWh]j]h]Ygik]```]bj c`j Y`cffYgi `h`]b'h\Y`WfYUh]cb'cfXYj Y`cda YbhcZbYk 'gYfj]WYXY`]j Yfm gmghYa g'cf'g]a]`Uf'gmghYa g'Zcf'h\Y`]a dfcj Ya YbhcZ'UWca a i b]hm#U[YbWh"

 $\label{thm:linear_continuity} $$ HY^*]_Y^* \cdot XYf]_y^* = hYWUbX]XUhYfiggWXc^Ufg\] d\#dfUWh]WYhVUhYUjYX]ZZ_qYX_hc^hYfWca_a_i_b]_hYg\#U[YbWYg/"$

=XYbh]Z]Wbh]cbcZbYk UfYUgcfUdd`]Wbh]cbcZbYk a Yh\cXgcfUddfcUWXYg]bdfUVb]Wrgh\UhUgg]ghWcaaib]hmU[YbW]Yg/

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

8 YdUfha YbhcZDgm\\\c`c[m`GYfj]\\\']b\Wi XYg'gYfj]\\\'hc`h\Y XYdUfha Ybhž\\c``Y[Y'UbX\\\Ua di g/]hU`gc]b\Wi XYg'gYfj]\\\'hc`h\Y g\\\Ybh]Z]\\\Ua hc`h\Y \\\da a i b]hm'\UbXz]b`UfYUg'\k\YfY]h]g'Uddfcdf]UhYz]h]b\Wi XYg'gYfj]\\\'hc`h\Y \\\da a i b]hm'\\k\Y \\\da a i b]hm'\k\Y \\\da a i b]hm'\\\da a i b]hm'\\\da a i b]hm'\\\da a i b]hm'\\\da a i b]hm

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

@]gh'h\YWc``Y[Yg#gWkcc`g'UbX#cf'XYdUfhaYbhg"

%"7c``Y[YcZH\Y'5fhg
&"7c``Y[YcZ5fhg'UbX'GV]YbW'g

' "7c``Y[YcZ6Y\Uj]cfU'/ '7caaib]hmGV]YbW'g

("AiaU7c``Y[YcZ6ig]bYgg
) "7c``Y[YcZ9Xi WUh]cb

*"7c``Y[YcZ9b[]bYYf]b[
+"DUhY``7c``Y[YcZ; `cVU'GighU]bUV]`]hm
, "7c``Y[YcZDiV']W<YU'h\
- "AcfgUb]'7c``Y[YcZAYX]W]bY

%\$"7c``Y[YcZAUf]bYGV]YbW'

%%"7c``Y[YcZBifg]b[.

%&"7c``Y[YcZD\UfaUVm
%" "<cbcfg7c``Y[Y

) ",

 $\label{eq:continuity} K $$ \hd^{y}bhcZhchU^{w}^{y}[Yg\#gWkcc^{y}UbX\#cf^{y}dUfha Ybhg^{u}hh^{y}]bgh]hi h]cb^{y}g^{y}bhyX^{m}h^{y}^{g}dh^{y}X^{m}h^{y}^{y}h^{y}^{y}h^{y}^{y}h^{y}X^{m}h^{y}^{y}h^{y}^$

%\$\$1

) "_

D`YUgY WjhY h\fYY YI Ua d`Yg`cZWc``Y[Y#gWkcc``UbX#cf`XYdUfha Ybh!`Yj Y``dc`]WjYgžhU_Yb`X]fYWn`mZfca `dc`]WhXcW a Ybhgžh\Uh gdYWjZJWU``mfYk UfX`ZUW'`hmgWkc`Uf`mk cf_'i g]b[Wca a i b]hm!Yb[U[YX`UddfcUWkYg`UbX`a Yh\cXg/]Zh\YfY`UfY`dc`]WjYg gdYWjZJWU``mZcf`hYbi fYX#hYbi fY`hfUW_žZJ```h]a Y`bcb!hYbi fY`hfUW_žUbX`dUfhh]a Y`ZUW``hmžd`YUgY WjhY`cbYYI Ua d`Y"

%"A i a U7c``Y[YcZ6i g]bYgg: cfhYbi fYXZUW`hmž]h]gʻbchYXh\Uh]bʻgca YʻUfYUgʻcZgWkc`Ufg\]dždi V`]WWh]cbgʻcfch\Yf dfcXi Whgʻa UmUddYUfʻcb`mUZhYfʻYb[h\mcfYl hYbg]j Y`YZZcfh'UbXa UmUddYUfʻ]bʻUk]XYfʻfUb[YcZj Ybi YgžVch\cZk\]Wk WUb VY dUfh]W `Uf`mhfi Y`cZWca a i b]hm!Yb[U[YX`UbX#cf]bhYfX]gWd`]bUfmk cf_'Uhh\Y`cWb`zbUh]cbU``UbX#cf]bhYfbUh]cbU``Yj Y`g" 7 ca a i b]hm!Yb[U[YX`gWkc`Ufg\]d a UmVY`XYa cbghfUhYX`Vm\][\!dfcZ]`Y`dfcXi Whgʻgi Wk`UgʻfYdcfhgʻZcf``cWb`zbUh]cbU`zcf]bhYfbUh]cbU`U[YbW]YgʻUbX`Zcfa U`dfYgYbhUh]cbgzcfVmch\Yf`dfcXi WhgʻUgXYg][bUhYX`Vmh\Y`i b]hz`Ugʻk Y``Ug`VmdYYffYj]Yk"

&"H\Y7c``Y[YcZDiV`]W<YUh\`\UgʻgdYWJZ]W`dfUWh]WY`dUh\k UmgʻZcfZUW`hmi]b`bcb! hYbi fYYUfb]b['dcg]h]cbg"F Ub_YX`ZUW`hm Zfca h\YdiV`]W\YUh\`cf\YUh\WbfY'dfcZYgg]cbg'k]h\`bcb'hYbi fYYUfb]b['Uddc]bha Ybhg'k \c 'UfY'df]a Uf]`mYb[U[YX]b dfUWh]WY fY`Yj Ubh'hYUW\]b[#k cf_ZcfWY`XYj Y`cda Ybh'UbX Wta a i b]hmYb[U[Ya Ybh'UWh]j]h]YgžUfY`Uʻgc Yl dYWhYX hc Yb[U[Y]b gca Y'dfUWh]WY fY`Yj Ubh'fYgYUfW\#gW\c`Ufg\]d`UWh]j]h]Yg"H\]gdUh\k Um]g']bhYbXYX`Zcfdi V`]W\YU'h\`cf\YU'h\WbfY dfcZYgg]cbUʻg']b UWUXYa]WUgg][ba Ybh'cf`Zcf'U`]YX`fUZZ]`]UhYEdfcZYgg]cbUʻg']b Wta a i b]hmgYhh]b[g" D"+

5ga Ya VYfgcZh\Ydi V`]W\YU'h\ ZUW`hmž]h]gYl dYWYX'h\UhZUW`hmYb[U[Y`k]h\ h\Y Wta a i b]hm]b`U``UgdYWgcZh\Y]f`k cf_"
9b[U[Ya Ybhik]h\ h\Y Wta a i b]hm]g`XYZ]bYX Ug Wt``UVcfUh]cb VYhk YYb U`ZUW`hma Ya VYf`UbX'h\Y]f``Uf[Yf Wta a i b]h]Yg`flcWU`Z
fY[]cbU`#ghUhYžbUh]cbU`ž]bhYfbUh]cbU`tZcf`h\Ya i hi U``mVYbYZ]WJU`Yl W\Ub[Y`cZ_bck `YX[Y`UbX`fYgci fW'g`hc]a dfcj Y`di V`]W
\YU'h\`dfUWh]W'`UbX`h\Y`cj YfU``\YU'h\`cZh\cgY Wta a i b]h]Yg"9b[U[Ya Ybhik]h\`h\Y Wta a i b]hm]g`]bhY[fU`hc h\Y`hYUW\]b[ž
fYgYUfW\`UbX`gYfj]W'`a]gg]cbg`cZh\Y`7 c``Y[Y`UbX`l b]j Yfg]hmUbX`]g`U`ghfUhY[]W[cu`Zcf`Vch\" D"%* / `&'

""GVW.cc`cZGcWJU`K cf_.: cfidfca ch]cb`Zfca '5 ggcWJUhY`DfcZYggcfhc: i ```DfcZYggcfž]h`]g` YI dYWfYX'h\Uh'U`ZUWI`hma Ya VYf`]g U`fYUXmU``YUX]b['gW\c`Uf`]b h\Y]f`UfYUfgEcZgdYWJU`]nUh]cb`Uh'h\Y`bUh]cbU``cf`]bhYfbUh]cbU```Yj Y`žh\Uh'\Y`cf`g\Y`\UgYghUV`]g\YX U`fYWcfX`cZYI WY``YbWY`]b Vch\`hYUW\]b['UbX`gV\\c`Uf`mfYgYUfW\žUbX`h\Uh'\Y`cf`g\Y`\Ug'U`fYWcfX`cZgi VghUbh]U``Wcbhf]Vi h]cbg`]b gYfj]WY`hc`h\Y`dfcZYgg]cbži b]j Yfg]hmžUbX`Wca a i b]hmžk \YfY`Uddfcdf]UhY"H\Y`]bX]WUhcfg`cZYI WY``YbWY`i gYX`hc`UggYgg`h\Y

FY!7`Ugg]Z]WUh]cb. H\Y'7 UfbY[]Y: ci bXUh]cb Zcf'h\Y'5 Xj UbWa Ybh'cZ HYUWX]b[

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

⊋h\YfY]g'U'dfcWfgg'Zcf]XYbh]Zm]b['cf'Uddfcj]b['U'Wtaaib]hmYb[U[YX'WtifgY'Ug'dUfhcZ'U'Wladig'W'ff]W'iažYld`U]b'h\Y'dfcWfgg/]Zh\YfY`\UjY'VYbW\Ub[Yg']bh\UhdfcWfgg'g]bW'h\Y`Ugh'Udd`]Wlh]cbžd`YUgY'Yld`U]b'h\Y'W\Ub[Yg''

Df]cf'hc &\$%* žk \Yb ZJW\ 'hmk UbhYX'hc XYg][bUhY'U Wei fgY'Ug'gYfj]WY! 'YUfb]b['fG@łźh\Ymbch]Z]YX'h\Y XYdUfha Ybhg'gW\YXi 'Yfž k\c fYdcfhYX'hc h\Y C ZZ]W\ cZh\Y FY[]ghfUfZUbX Wei fgYg'k YfY[]j Yb h\Y G@Uhhf]Vi hY'UbX']ghYX']b '6UbbYf"H\]g']bWi XYX Wea a i b]hmVUgYX']bhYfbg\]dg"K\]'Y ZUW\ 'hmfYWY]j YX'[i]XUbW\ 'UbX'gi ddcfh'Zfca 'C 7 9Džbc Zcfa U'fYj]Yk 'dfcW'gg'k Ug']b d'UW\ 'Zcf' Wei fgYg"Hk c']a dcfhUbhW\Ub[Yg\Uj Y'hU_Yb'd'UW\ ']b h\Y']XYbh]Z]WUh]cb 'UbX'Uddfcj U'cZWea a i b]hm\Yb[U[YX Wei fgYg'g]bW\ 'h\Y'Ugh'Udd`]Wh]cb ']b '&\$\%\$"H\YgY W\Ub[Yg'k]'`dfcj]XY'[i]XUbW\ 'Zcf'i bXYfghUbX]b['h\Y'XUhU'dfcj]XYX'Zcf'h\Y bi a VYf'cZWei fgYg']ghYX']b 'h\Y'hUV'YVY`ck "

%"5 ~Uf[Ybia VYfcZWtifgYgʻUWfcggh\YWladigk YfYfYdcfhYXhcVYG@df]cfhc&\$%"5acb[h\YaUbmWtifgYgXYg][bUhYXUgG@]bh\YdfYj]cigWtifgYYXg][bUh]cbdfcWfggk YfY%\$\$5WJXYa]W.cibXUh]cbWtifgYgʻ'=b&\$%*žh\YbYk X]fYWfcfcZC79DibXYfk YbhUfYj]Yk cZU`WtifgYgʻUbX]bgh]hihYXgdYWJZJW\][\!eiU`]hmWf]hYf]UhcVYigYXVmghUZZUbXZUW`hm]bcfXYfZcfUWtifgYhcVYXYg][bUhYXUgGYfj]Wf!YUfb]b[fG@Z'H\]gY`]a]bUhYXaUbmUWJXYa]WZcibXUh]cbWtifgYgdfYj]cig`mfYdcfhYXUgG@'Cb`mWtifgYgk\]W.Zi`Zj`YXh\Y79@Wf]hYf]UfYaU]bYXfbYYdUfhUZ':fca&\$%*hc&\$% žbYk WtifgYggiVa]hh]b[Zcfh\YG@XYg][bUh]cbWJaYh\fci[\C79D"AcghcZh\YgYWtifgYgUfYXYjY`cdYXk]h\ZUW`hmk\c\UjYUUhYbXYXh\YGYfj]Wf!YUfb]b[5WJXYam'H\YUWJXYamigYgWff]W`iah]hYX`9b[U[YX:UW`hm=bgh]hihY7iff]W`iažXYjY`cdYXVmGY]ZYf/7cbbcfgžUbX`UgVYYbUXUdhYXhcZ]hk]h\]bh\Yib]eiY1G:WtbhYlh':UW`hmWtbh]biYhcXYjY`cdUbXhYUW;h\YgYWtifgYgXVY`ck"

&"=b`&\$% zh\Y1 G:; YbYfU`9Xi Wh]cb7ci bW] fi 97 Egi bgYhhYX h\Y; YbYfU`9Xi Wh]cbfYei]fYa Ybhgz: ci bXUh]cbgcZ ? bck `YX[Y`UbX`@YUfb]b[fi? @zZcf]bWta]b[ghi XYbhgUbX`UxcdhYX`H\Y9b\UbWXX; YbYfU`9Xi Wh]cbfP; 9E'9; 9 W ff]W`i a gX]gh]bWh]cb Zfca h\Y:? @dYfhU]b]b[hc Wta a i b]mmYb[U[Ya Ybh]g`UfYei]fYa YbhcZhk c <][\`=a dUWhDfUWh]Wf fk =DtWti fgYg"7 ca a i b]mm9b[U[YX`@YUfb]b[ff7 9@tWti fgYg]gcbYcZh\Y < =DgcZZYfYXi bXYfh\Y9; 9""=ZUZUW`hma Ya VYf k]g\Yghc Wffh]ZmUWti fgY Ug'U[YbYfU`YXi WUh]cb'7 9@Wti fgYzh\Yma i ghZcfa U`mdfcdcgY`h\Y Wti fgYj]Uh\Y`cb`]bY dfcdcgU'gmghYa "H\]g]bj c'j YgUbgk Yf]b[ghUbXUfX]nYX'ei Ygh]cbg'Uvci hh\Y Wti fgYz]bWi X]b[\ck UbX`k \m]hk Ug WfYUhYX"C bW'h\Y Wti fgY]ggi Va]hhYXz]ha i ghVY`Uddfcj YX`Z]fghVmh\Y`ZUW`hmg XYdUfha Ybhf]ZfY`Yj UbhEUbX`h\Yb`h\Y`ZUW`hma Ya VYf g Wt`Y[Y"Df]cfhc h\Y'9; 9Zh\Yi b]j Yfg]mg Wta a i b]lmYb[U[YX Wti fgYg\UX Ub]bZcfa U`UbX`cdh]cbU`fYj]Yk zWtbgi `hUh]cbz UbX`Uhhf]Vi hY`XYg][bUh]cb dfcWrgg"K]h\`h\Y'9; 9UXcdh]cbzh\YgY Wti fgYgi bXYf[c`Ub`UXX]h]cbU`Zcfa U`Uddfcj U`Vmh\Y C`ZZ]Wf`cZ7 ca a i b]lm9b[U[Ya YbhUbX`DUfhbYfg\]dgfC 7 9Dt"DfcdcgYX Wti fgYgUfY h\Yb`Zcfk UfXYX`Zcf`U`Z]bU`ZUW`hm Uddfcj U`Vmh\Y; 97 "5 hUbmcZh\YgY`ghYdgzh\Ywti fgY WUb VY fYhi fbYX hc h\Y`ZUW`hma Ya VYf hc a U_Y fYj]g]cbgzUg fYWta a YbXYX VmC 7 9D UbX*cf h\Y; 97 "C bWf h\Y; 97 Uddfcj Ygh\Ywti fgYz]ha cj YgZcfk UfX`Zcf`UXa]b]ghfUh]j Y`UbX`ghUhY fYj]Yk g`UbX`h\Yb Z]bU``mVYwta Yg`Ub`cZZ]WJU` wti fgY"

5 "%"

:]```]b`h\Y`hUV`Yg`VY`ck ii g]b[.

- XUhu Zfca h\Ya cghfYVYbhUWUXYa]WmYUff&\$%+!% Ł
- XUhUVUqYXcbibXYf[fUXiUhY: H9
- DYFWbhU[Y1k\YbUg_YXigYXYW]a U`]bdi hžY"["žXcbfhi gY"-cf"&ži gY]bghYUX-\$i cf&\$i

FY!7`Ugg]Z]WUh]cb. H\Y'7 UfbY[]Y: ci bXUh]cb Zcf'h\Y'5 Xj UbWa Ybh'cZ HYUW\]b[

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

Bifg]b[žDiV`]W< YU`h\žA YX]WjbYžD\Ufa UWnžUbX'h\Y`DUhY``7c``Y[Y`cZ; `cVU``GighU]bUV]`]hmbc``cb[Yf`\UjY`]bX]j]XiU`XYdUfha Ybhg`cf`gW.cc`g";]jYb`h\]gW.Ub[YžWcaaib]hmYb[U[YX``YUfb]b[WcifgYg`fYdcfhYX]b`eiYgh]cb`%" 'UfY`Uh`h\YWc``Y[Y`YjY`"

H\]gXUhU]gU`gc`i gYXVmh\Y`C 79D`UbX`7@79i b]hg`hc`]XYbh]ZmZUW`hmUbXWtaai b]hmdUfhbYfg`Zcf`Uk UfXg`cb`Ub`cZZWJadi g" H\YfY`UfY`gYj YfU`YghUV`]g\YXWtaai b]hmYb[U[YaYbhUk UfXg`Uh`h\Y1 b]j Yfg]hmcZGci h\:`cf]XUZZcfYl Uad`YžH\Y`Dfcj cghg 7caai b]hm9b[U[YaYbh'5k UfXžH\Y`C ZZ]Wf`cZGhi XYbh'Gi WWfgg. 6Ygh'7c``UVcfUhcf'5k UfX/7YbhYf`Zcf`@YUXYfg\]d`UbX`7]j]W 9b[U[YaYbh`7caai b]hmDUfhbYf`cZh\Y`MYUfž7caai b]hmDUfhbYf'l `h]aUhY`6i```5k UfXžUbX`h\Y; ccX`BY][\Vcf`DUfhbYf 5k UfX"C 79D`U`gc`Uk UfXg`ZUW`hmk]h\`h\Y`7caai b]hm9b[U[YX`9Xi WJhcf'5k UfX`UbX`Wtaai b]hmdUfhbYfg`k]h\`h\Y 7caai b]hm9b[U[YX`7c!9Xi WJhcf'5k UfX"

6UgYX cb h\Y]bZcfa Uh]cb UVci hWt``Y[YYZZcfhgfY`UhYX hc Wff]W`Uf Wta a i b]hmYb[U[Ya YbhWtbZ]fa YX Zcfh\Y`DD5 zC 7 9D d`Ubg'UbX]a d`Ya Ybhg'ghfUhY[]Yg'hc Vi]X79@WddUVJhmk]h\]b Wt``Y[Yg"H\]g]bZcfa Uh]cb U'gc `YUXg'hc a Udd]b[Wta a i b]hm dUfhbYf'UbX i b]j Yfg]lmWtbhUWidc]bhg'Zcfi bXYfghUbX]b[Wta a i b]hmYb[U[Ya Ybhzci hfYUW UbX dUfhbYfg\]dgYZZcfhg"

%")

5gYj]XYbWYfYeiYghYXZcfmcifYUf`]YfWUgg]ZJWUh]cbžmcik YfYUg_YXk \Yh\Yfmci\UjY]bgh]hih]cbU`fWUadig!k]XYŁYUfb]b[cihWtaYgZcfghiXYbhgWYff]WYUfYb[U[YaYbhk]h\Wtaaib]hm"

: cffY!WUgg]ZJWUh]cbžXYgWf]VYk\Uh\UgWkUb[YXž]ZUbmh\]b[žfY[UfX]b['UggYgga YbhcZ]bgh]hi h]cbU``YUfb]b['ci hWta YgUggCWJUhYXk]h\Wff]W`UfYb[U[Ya Ybh"K\Uh'UfYh\Y'ci hWta Ygž\ck 'UfYh\YgY'ci hWta Yg'UggYggYXžUbXk\Uh'UfYh\Y'fYgi `hg cZh\Y'UggYgga Ybh3'Dfcj]XYfY`y Ubh`]b_g"

: cf h\Y &\$%\$ 7`Ugg]Z]WUh]cbži G: fYdcfhYX bc]bgh]hi h]cbU``YUfb]b[ci hWca YgfG@C gŁZcf W ff]W``Uf Yb[U[Ya Ybh"±b`&\$% žU``X]gW]d`]bYgžWca a i b]hm!Yb[U[YX Wci fgYgftlfYj]ci g`mfYZYffYX hc UgʻgYfj]Wf! YUfb]b[ŁUk UfXYX h\Y 7 9@Uhhf]Vi hY a i gh\Uj Y G@C g'UggcW]UhYX k]h\ W ff]W``Uf Yb[U[Ya Ybh"K]h\ h\Y'UXcdh]cb`cZh\Y'bYk '9; 9žZJWi`hm`YUXYfg\]d]b Wc``UVcfUh]cb`k]h\ h\Y 8]fYWhcfg'Zfca 'h\Y'C ZZ]WfgcZi bXYf[fUXi UhY FYgYUfW.ž9Xi WUh]cb`5 VfcUXžUbX ±bhYfbg\]dg/5 WUXYa mcZHYUW]b['UbX @YUfb]b[/UbX'C ZZ]WfcZ7 ca a i b]hm'9b[U[Ya Ybh'UbX DUfhbYfg\]dg'XYj Y`cdYX [YbYfU G@C g'Zcf'U``< ±D Wci fgYgž]bWi X]b[

dUfh]W]dUh]b[`]b`h\YW&i fgY	"'H\Y'XUhU'gi [[Ygh'h\Uh'79@]bWfYUgYX'ghi XYbh`YUfb]b['UZhYf'dUfh]W]dUh]b[']b'h\Y'Wti fgY"'H\Y'XUhU

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

=g:7 ca a i b]tm 9b[U[Ya Ybh]bhY[fUhYX]bhch\]g UfYU3	MYg
K \Uh'\Ug'VXUb[YX g]bWY'h\Y`'Ugh WUgg]Z]WUh]cb3	#b in Y & \$%\$ Udd] Wuhjcbzh\Y1 G: 7 YbhYf Zcf@YUXYfg\]d UbX 7]j] W9b[U[Ya Ybhfiv@ 9\czZYfYX ghi XYbhg\cddcfhi b]h]Yg Zcf\YUXYfg\]d h\fci [\h\fYYa U]b\dfc[fua g\cddcfhi b]h]Yg Zcf\YUXYfg\]d h\fci [\h\fYYa U]b\dfc[fua g\cddcfhi b]h]Yg h\fci [\uparture Uh\fYY]wfYX]hi bXYf[fUXi UhY Wci fgY"HcXUmzi G: \ugyi dUbXYX\YUXYfg\]d cddcfhi b]h]Ygh\fci [\uparture U] Uf]YhmcZgYfj] Widfc[fua g\uparture X\times ff] [ghyfYXghi XYbhcf[Ub]nUh]cbg\uparture Y0XYfg\]d Gni X]Yg\uparture fua g\uparture X\times ff] [ghyfYXghi XYbhcf[Ub]nUh]cbg\uparture Y0XYfg\]d Gni X]Yg\uparture fua g\uparture fiyag\uparture fiyag\upartu
K YV`@b_f]Z'Uj U]`UV`YŁ	\hhdg.##kkkk"i gZ"YXi #ghi XYbh!UZZU]fg#YUXYfg\]d!WJj]WYb[U[Ya Ybh#YUXYfg\]d! XYjY`cdaYbh#YUXYfg\]d!ghi X]Yg!a]bcf"Ugdl

7i ff]W/`Uf'5Wh]j]hm'("%=bhYfbg\]dg#7c!cdg

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

=g7caaib]mm 9b[U[YaYbh]bhY[fUhYX]bhch\]g UfYU3	MYg
K \Uh`\Ug`W.Ub[YX g]bWf`h\Y``Ugh WUgg]Z]WUh]cb3	** ightlg XYgwlyYX b &\$\%\$zl G: \wbh bi Yghc a \text{U_YYI hYbg } Yi gYcZ]bhYfbg\\dgubX \wcdYfth j Y \text{YUfb}b G "HYFici [\ h\Yc Z]wrcZ-bhYfbg\\dgubX z UfYYF YUJbYggzuddfcl]a UhYm&\$\sqn i XYbhg dYfmYuFhU_Yh\Y YbYF]wlbhYfbg\\dgubX c Yf (\gamma\) \\$\$1 G: \text{gri XYbhgdi fgl Y]bhYfbg\\dgubY wa a i b]mwUhbcbdfcZ h cf[\Ub]nUh]cbg]b gi ddcfhicZvch\ h\Ygh ghYfbg\\dguFY\wa a iYhYX]b\h\Ywa a i b]mwUhbcbdfcZ h cf[\Ub]nUh]cbg]b gi ddcfhicZvch\ h\Ygh ghYfbg\\dguFY\wa a iYhYX]b\h\Ywa a i b]mwUhbcbdfcZ h cf[\Ub]nUh]cbg]b gi ddcfhicZvch\ h\Ygh ghVfbg\\dguFY\wa a iYhYX]b\h\Ywa 2]glg]cb"-b\UXX]h]cbz a Ubm\W* Y YgcZYf]bhYfbg\\dguFU\Xi b\Ygh ghVfbg\\dguFY\wa a iYh\Yf]b\XcYfg\Ub bhYfbg\\dguFY\xc\\dguFY\\cdot ghVffbg\\dguFY\xc\\dguFY\\cdot h\YghY\cdot h\YghX\czYfg\Ub bhYfbg\\dguFY\xc\\dguF\\dguFY\xc\\dguF\\dguFY\xc\\gamma\cdot h\YghY\cdot h\YghX\czYfg\Ub bhYfbg\\dguFY\xc\\dguF\\dg
	VUgYX`cb`h\Y]f`]bhYfYghg`f7@D`(-(%L": cf`h\Y`: U``cZ&\$%, žh\YfY`k YfY`)&`Wcaaib]hm`U[YbW]Yg \cgh]b[`cbY`cf`acfY`ibXYf[fUXiUhY`dgm\Wc`c[m]bhYfbg"
K YV@b_f]ZUj U]`UV`YŁ	\hhdg.##kkkligZ"YXi#WWadig!`]ZY#JbhYfbg\]dg!ghiXYbh!Yad`cmaYbh"Ugdl

7 i ff] W `Uf 5 Wij]hm) "%Ghi Xm5 VfcUX

=g:7 ca a i b]hm 9b[U[Ya Ybh]bhY[fUhYX]bhc h\]g UfYU3	Myg
K \Uh'\Ug\W\Ub[YX g]b\W'h\Y`Ugh WUgg]Z]\Wh]cb3	

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

=g7ca a i b]hm 9b[U[Ya Ybh]bhY[fUhYX]bhch\]g UfYU3	Myg
K \Uh`\Ug\W.Ub[YX g]b\W^h\Y^Ugh WUgg]Z]\Wh]cb3	5 g d f Y j] c i g m X] g W g g Y X h \ Y f Y \ \ \ U g \ V Y Y b \ U a \ U \ c f g \] Z h] b h \ Y \ W f f] W i a f Y e i] f Y a Y b h g U h i G c " + b & \$ % + ž h \ Y i b] j Y f g] h m c Z G c i h \ : `c f] X U Z U W ` h m f Y j] Y k Y X ž X f U Z h Y X ž U b X U X c d h Y X h \ Y 9 b \ U b W Y X ; Y b Y f U ' 9 X i \ W h h c b f 9; 9 k ž k \] W \ Y b W a d U g g Y g Z c i f m Y U f g c Z W f f] W i a k] h \ U <] [\ = a d U W h D f U W h] W V w i f g Y " H \ Y X Y j Y ` c d a Y b h U ` a c X Y ` Z c W g Y g h \ Y Z] f g h h c m Y U f g c Z W g c b D Y f g c b U / ` G c W J U ` F Y g d c b g] Y] m U b X = b h Y ` Y W i U / ` D f U W h] W U G _] ` g ž k \] Y h \ Y ` U g h h c m Y U f g Z c W g c b D Y f g c b U / ` G c W J U ` F Y g d c b g] Y] m u b X = b h Y ` Y U b X 5 d d `] Y X @ Y U f b] b [" H \ Y 9; 9 W f f] W ` i a] g U b] b g h] h i h] c b U ! Y Y Y Y Y Y F Y e i] f Y a Y b h] b U ` a U c f g " 5 ` ` i G g h i X Y b h g a i g h h \ Y] f g Y b] c f m Y U f ` U b X <] [\ = a d U W h D f U M] W \ w i f g Y] b h \ Y] f g Y b] c f m Y U f " H \] g b Y k W f f] W ` i a g h] ` ` U ` c k g Z c f Z J W ` h m c h Y U W \ 7 9@ U b X W j] W b [U [Y a Y b h W i f g Y g c i h g] X Y h \ Y <] [\ = a d U W h D f U M j] W f Y b W t i f U [Y X h c d U f h] W d U h Y] b W a a i b] m Y b [U [Y X] b h Y f b g \] d g ž k c f _ g h X m ž U b X 7 9@ W t i f g Y g] b h \ Y] f Z f Y g \ a U b U b X g c d \ c a c f Y m Y U f "
K YV@b_f]ZUj U]`UV`YŁ	\hhdg.##kkkk"igZ"YXi#ibXYf[fUX#[YbYfU`!YXiWUh]cb!WcibWj`#[YbYX!fYj]g]cb#dfcdcgYX!dfc[fUa"Ugdl

7iff]Wi`ia." "%; YbYfU`9XiWWh]cb

=g:7 ca a i b]hm 9b[U[Ya Ybh]bhY[fUhYX]bhc h\]g UfYU3	Myg
K \Uh`\UgVXUb[YX g]bWfh\Y``Ugh WUgg]Z]WUh]cb3	5gXYgWf]VYX]bdfYj]ciggYWf]cbgcZh\]gUdd`]Wlh]cbžh\YfY\UgVYYbUaUcfg\]Zh]bh\Y Wff]W`iafYei]fYaYbhgUhl G: "=b&\$%+žh\Ylb]jYfg]lmcZGcih\:cf]XUZJW`hmfYj]YkYXž XfUZhYXžUbXUXcdhYXh\Y9b\UbWX; YbYfU`9XiWlh]cb"H\YWff]W`iakUg]adYaYbhYX]b:U`&\$%, "H\YbYk9; 9fYei]fYgU<][\=adUWhDfUWf]WYVtifgYUgUb]bgh]hih]cbU`YjY`fYei]fYaYbh]bU``aUcfg]bh\YgYb]cfmYUf"H\]gbYkWff]W`iagh]``U``ckgZcfZJW`hmhchYUW.79@UbXWj]W Yb[U[YaYbhVtifgYgcihg]XYh\Y<][\=adUWhDfUWf]WYfYei]fYaYbhgUgkY``" <ckyjyfžh\ybyk]bwixyxvihbchfyei]fyx"="bUXX]h]cbžghiXYbhg]bU`X]gWd\]bYgUfYfYei]fYXhchU_YUb9h\]WU" fyugcb]b[ubx7]j]w9b[u[yaybhf9f79łwtifgy]bh\y]f^b]cfmyuf"h\]gwtifgy]bwixygu<][\="adUWhDfUWf]WYUgkY``"AUbmghiXYbhghU_YacfYh\UbcbYcZh\YgYWtifgYg'</td" wff]w`iaugcfyei]fygghixybhghchu_ycby<="DWtifgYk]h\]bh\Y]fX]gWd\]bYzcZk\]W\79@]g"></ckyjyfžh\ybyk>
K YV@b_f]ZUj U]`UV`YŁ	\hhdg.##kkkk"igZ"YXi#ibXYf[fUX#[YbYfU'!YXiWUh]cb!WcibW]*#[YbYX!fYj]g]cb#dfcdcgYX!dfc[fUa"UgdI

7i ff]WV`i a .'('%:]fghiMYUf'9l dYf]YbWV'7ci fgYg

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

=g7caaib]mm 9b[U[YaYbh]bhY[fUhYX]bhch\]g UfYU3	Mrg
K \Uh`\Ug`VX.Ub[YX g]bWY`h\Y``Ugh WUgg]Z]WUh]cb3	=b h\Y dfYj]ci g'Udd`]\Wh]cbžh\Y:]fgh\M'Uf`9I dYf]\Yb\W' 7 ci fgYg']b\Wi XYX UgYfj]\W'!`YUfb]b[dfc Y\M'cf YI dYf]\Yb\W'/\ck Yj \fz]\b\&\\$\%* \z\Uf\j]\Yk c\Z\U``\g\fj]\W'!`YUfb]\b[\wti fg\Yg\k \Ug i b\X\fh\U_\Yb\g]\ai \h\b\Yci g\mk]\h\ h\Yf\j]g]\cb c\Z\h\Y\W \ff]\W`i a \z\cf h\Y:]fgh\M\Uf\f\g\g\k \Ug i b\X\fh\U_\Yb\g]\ai \h\b\Yci g\mk]\h\ h\Yf\j]g]\cb c\Zh\Y\W\ff]\W`i a \z\cf h\Y:]fgh\M\Uf\f\g\g\g\k \Ug i b\X\f\h\Y g\Yfj]\W'!`YUfb]\b[\times\g\g\g\f\g\m\Y\m\X]\times\g\g\g\g\h\Y\g\g\g\g\g\g\h\Y\m\X]\times\g\g\g\g\g\g\g\g\g\g\g\g\g\g\g\g\g\g\g
K YV@b_f]ZUj U]`UV`YŁ	

7i ff]W/`i a .') "%7 UdghcbY`fGYb]cf`@Yj Y``Dfc YVWL

$FY! \ 7 \ Ugg]Z]WUh]cb. \ H\ Y \ 7 \ UfbY[\]Y: ci bXUh]cb. \ Zcfh\ Y \ 5 \ Xj \ UbW a \ YbhcZ$ HYUW]b[

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$%- "@Ugha cX]Z]YX cb (#%) #&\$%- "

FY!7`Ugg]Z]WUh]cb. H\Y'7 UfbY[]Y: ci bXUh]cb Zcf'h\Y'5 Xj UbWa Ybh'cZ HYUW\]b[

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

7 i ff]WV`i a .`- "%C h\Yf"'fD`YUgY'gdYV}Zm]b'h\Y% ei ch\K\Uh`\Ug\W\Ub[YX""% ei ch\hYl h\Vcl 'hc'h\Y f][\h'\\

=g7caaib]hm 9b[U[YaYbh]bhY[fUhYX]bhch\]g UfYU3	MYg
K \Uh`\UgVXUb[YXg]bWYh\Y^Ugh WUgg]Z]WUh]cb3	7 c``UVcfUh]j Y`5gg][ba Ybhg`UbX`Dfc YWrg`\UgVYYb`Uddfcj YX`Vmh\Y`l G.; YbYfU`9Xi WUh]cb 7 ci bWj`Ug'U <][\ =a dUWrDfUVrJ)W'Zcfi gY]b h\Y`9b\UbWrX; YbYfU`9Xi WUh]cb]a d`Ya YbhYX]b &\$%, "B chU``Wc``UVcfUh]j Y`Ugg][ba Ybhg`\Uj Y`U`7 9 Wa dcbYbhVi ha UbmcZh\YgY Wci fgY dfc YWrgXc`UXXfYggfYU`k cf`X`dfcV`Ya g'dfYgYbhYX`VmUWca a i b]hmdUfhbYf`]b h\Y`WUggfcca " : cf Wci fgYg'k]h\``Uf[Y`WUggg]nYgžh\]gUddfcUW. VYWca Yga UbU[YUV`Y`UbX`dfca chYg`Wca a i b]hm Yb[U[Ya Ybh": cf Yl Ua d`Yž]b`U@UbX`l gY`D`Ubb]b[Wci fgYžghi XYbhg`k fchY`dc`]Wn fYWca a YbXUh]cbg`Zcf`U``cWU``a i b]WjdU`]hm'H\]gk UgbchU`ZYUg]V`Y`hUg_]bX]j]Xi U``mžVi hk cf_]b[Ug'UhYUa h\Ymk YfY`UV`Y`hc Wca d`YhY`h\Y`dfc YWrUbX`dfYgYbhh\Y]f`Z]bX]b[ghch\Y`dUfhbYf" H\Y; YbYfU`9Xi WUh]cb`7 ci bWj``XYZ]bYg`Wc``UVcfUh]j Y``YUfb]b[Ug`Zc``ck g.'''7 c``UVcfUh]j Y 'YUfb]b[Wca V]bYg`nk c`_Ym[cU`g.``YUfb]b[hc k cf_UbX`gc`j Y`dfcV`Ya g`]b`h\Y`Wca dUbmcZch\Yfgž UbX`g\UfdYb]b[cbY g'ck b`i bXYfghUbX]b[Vm`]ghYb]b[gYf]ci g`mhc h\Y`]bg][\hgcZch\Yfgž YgdYWjU``mh\cgY`k]h\`X]ZZYfYbhVUW_[fci bXg`UbX``]ZYYl dYf]YbWrg''5ddfcUW.Yg`fUb[Y`Zfca ghi Xm [fci dg`k]h\]b`Uvci fgYžhc hYUa!VUgYX`Ugg][ba Ybhg`UbX`k f]h]b[žhc WccdYfUh]j Y`dfc YVWg`UbX fYgYUfW.""
K YV'@b_f]Z'Uj U]`UV`YŁ	\hhdg.##kkkk"igZ"YXi#Uh`Y#hYUW\]b[#\]dg"Ugdl

&"&"

Dfcj]XY'U'gi a a UfmbUffUh]j Y'XYgWf]V]b['cj YfU``W\Ub[Yg'UbX'hfYbXg'h\Uh\Uj Y'hU_Yb'd`UW'fY`UhYX'hc W'ff]W'`UfYb[U[Ya Ybhcb'mci f'bUffUh]j YžUXXfYgg'h\Y'hfUYWhcfmcZW'ff]W'`UfYb[U[Ya Ybhcb'mci f'WUa di g'ÿ k\YfY\Uj Y'mci VYYbžk\YfY'UfY'mci bck žk\YfY'UfY'mci 'ghfUhY[]WU``md`Ubb]b['cb'[c]b[3Dfcj]XY'fY`Yj Ubh`]b_q"

=0 fYj]Yk]b[h\Y`&\$\$) #&\$%\$ 7 UfbY[]Y 5 dd`]WUh]cb Zcf 9b[U[Ya Ybhž]h]g'UddUfYbhh\UhW ff]W `Uf Yb[U[Ya Ybh'Uh'h\Y I b]j Yfg]hmcZGci h\: `cf]XU`\Ug'YYYb cb Ub'i dk UfX hfUYWhcfmh\Uh'gi VghUbh]UhYg'i G: g'Wa a]ha Ybh'hc Vch\ 'ghi XYbhg YXi WUh]cb UbX Wa a i b]hmk Y``!VY]b["

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

 $\label{thm:condition} \mbox{Wei fgYgbcf']bWi XYX']b'h\Y'fYdcfh]b['cZ7'9@Wei fgYg']b'h\]g'Udd']WUh]cb''$

#i]g]a dcfhUbhhc bchY h\UhUgW ff]W`UfYb[U[Ya YbhUg[fck bžgc\UgfYWc[b]h]cb ZcfhYUW]b[79@Wci fgYg"H\]g]g
Yj]XYbWYX]b h\Y fYWfi]ha YbhcZZUW`hmk]h\ 79 Yl dYf]YbWY/Uk UfXgZcf79 hYUW\]b['Uhh\Y]bgh]hi h]cbUʻžWc``Y[YžUbX
XYdUfha YbhU``Yj Y`g/UbX]b h\Y fYj]g]cb cZhYbi fY UbX dfca ch]cb [i]XY`]bYg]b &\$%("'H\YgY W\Ub[YgYbWci fU[YZUW`hm
WfYUh]j]hmUbX k]``]b[bYgghc XYj Y`cd UbX hYUW\ Wca a i b]hmYb[U[YX Wci fgYg"

6Y[]bb]b[]b&\$%+žI G: ZUW`hmWUff]YX`ci h'UmYUf!`cb[fYj]Yk cZh\Y1 G: ; YbYfU`9Xi WUh]cb7i ff]W`i a "H\YfYgi `hcZh\]g YZZcfhk Ugh\YXYj Y`cda YbhcZUb 9b\UbWX; YbYfU`9Xi WUh]cb f9; 9Łgi ddcfhYX`VmVch\1 G: ZUW`hmUbX``YUXYfg\]d"H\Y fYj]gYX W ff]W`i a `\][\`][\hgh\Yg][b]Z]WUbW' cZWj]WfYgdcbg]V]`]hm]b h\YYXi WUh]cb cZgh XYbhg'Ugk Y``'Ugh\Y]a dcfhUbW' cZ Wta a i b]hmYb[U[Ya Ybh'UbX ch\Yf`\][\!]a dUWidfUWi]Wrgh\UhYb\UbW' ghi XYbh'YUfb]b["H\Y W ff]W`i a k Ug]a d`Ya YbhYX]b`&\$%!&\$% "H\]g'bYk W ff]W`i a k]``Ybgi fYh\Uh1 G: ghi XYbhg']b U``Wt``Y[Ygk]``\Uj YUWWgghc`\][\!ei U`]hmWta a i b]hm

		WYVUHY'a i hi U`mVYbYZJWJU`fY`Uh]cbg\]dgh\Uhk]``U`ck Vch\dUfh]Yghc'UXj UbW'h\Y]f'[cu'g" JFYbYk UV`Yg]gXYj Y`cd]b['UghfYYh`][\hh\UhcdYfUhYgcb'fYbYk UV`YYbYf[mzgi W.'Uggc`Uf UbXk]bX'dck Yfzh\Uhk ci `X'bch'fYei]fY'U'dck Yf'[f]X WbbYWh]cb"'Bc': `ccX: `cf]XU']g'U gYfj]W'h\Uhdfcj]XYg'Wbgi a Yfgk]h\h\h\Y'UV]`]hmhc fYWY]j Y'U'fYdcfh\WbhU]b]b[ZccX'f]g_Zcfh\Y]f'dfcdYfhm'Gi [Uf'G]hYfg]g'U'dfc[fUa']a dUWh]b['h\Y']j Yg'cZ'dYcd'Y'UZZYWhYX Vm W\fcb]WX]gYUgY'UbX'X]gUV]`]h]Yg" \hhdg.##k k k "i gZ"YXi #YbhfYdfYbYi fg\]d#]b]h]Uh]j Yg#]bW\VUhcf"Ugdl\hhdg.##k k k "i gZ"YXi #Vi g]bYgg#bYk g#Ufh]WYg#% \$(\$(!gdch)][\h!dcdcj]WU'Y_gUbXUf"Ugdl
7 ca a i b]hm gYfj]WYdfc YWhg ! ci hg]XYcZh\Y WUa di g	M/g	G. cZYfgUflb[YcZgYf]]W fcYwgci hglXYcZWlad ig cwlmzfY[cbUmzlbX] cvUmf H\Y7@9\cggv]W fcYzgyf]]W fcYmgYf] W fcJdgrc h\YHlad dU6lm\da a i b]mfUfrbYfgUfYUY hc LX] Yfn]gy gyf] W cddcfh b]h]Ygcb 6i "GrbWH\Y7@9\Ugc \deccept fx]buhygrk c Ubbi U"XUmg czgyf]]W cddcfh b]h]Ygcb 6i "GrbWH\Y7@9\Ugc \deccept fx]buhygrk c Ubbi U"XUmg czgyf]]W n\Y7@9\Cgg Ycfy]W h\Y7@9\Cgg Ycfy]W h\Y7@9\Cgg Ycfy fy \gamma fy fy gyfb] \gamma fc fcfdcflibcb zcf B Uhlcbu TubX 7ca a i b]mmGYf] JW frib 7c5F. 9. : F56 G9FJ -796MH< 9 < C FB Gf69DH9A 69Ft]gUb Ubbi U"_JW_cZhrc h\Ywa a i b]mm gyf] JW mYUfzcwlf f[b[Uhh\Y gitfhc 7c7c4 fw] y a Yghyff v i bXfYxgcZbYk gh XYbrgwa a Ych hy fc i htc j c'i bhYf fc [Yh\Yf] b h\Y Hua dU6UmUfYU-H\]gbYk lgh XybrfuXhjcb czgyf] JW wbbYywggh XYbrgw ha a i b]mm gyf] JW mYUfzcwlf f[b[Uhh\Y gitfhc 7c7c4 fw] y a Yghyff v i bXfYxgcZbYk gh XYbrgwa a Ych by bywggh XYbrgw h\ h\Yf y Ubb Wc i hyf [Uhy Y bbbyWggh Ya k] jh\ 1 G
7 ca a i b]hm gYfj]WYdfcYWng	Mrg	H\YfY`UfY`Ubi a VYf`cZWca a i b]hmgYfj]WY`UbX`Yb[U[Ya Ybh'dfc`YWfg'k]h\]b`h\Y`WJa di g h\UhVYbYZ]hh\Y`cb!WJa di g`UbX`cZZ!WJa di g`Wca a i b]h]Yg"

]bhYfUWn]jYX]gWigg]cbigYgg]cbik]h\UidUbY`cZdfUWn]h]cbYfg'UbXYXiWUhcfg'Zfcaih\YfY[]cb hciibXYfghUbXh\Yai`h]d`Y]ggiYgigiffcibX]b[`\iaUbhfUZZ]W_]b["
	±b`Gdf]b[`&\$%, žh\Y`7@79`UbX`7UadigFYWfYUh]cb`dUfhbYfYX`hcWfYUhY`h\Y`DiYfhc`F]Wt

	UbX bcb!dfcZ]hgʻgi Wk ʻUgʻA cfhʻ9`Ya YbhUfmGWkcc``cfʻh\YʻI b]j Yfg]hm5fYUʻ7ca a i b]hm 8Yj Y`cda Ybhʻ7cfdcfUh]cbžk \YfYʻghi XYbhgʻhi hcfžXYj Y`cdžUbX`]a d`Ya Ybhʻdfc[fUa gʻUbX

Ghi XYbh hYUW]b[Ugg]ghUbhg	Mg	I G: XcYgʻbch\Uj Yʻghi XYbhhYUW\]b['Ugg]ghUbhgʻUgg][bYX Zcf Wt!W ff]W `Uf Yb[U[Ya Ybh UWn]j]hmžVi hXcYgʻ\Uj Yʻ[fUXi UhY Ugg]ghUbhgʻh\UhYbUV`YʻghUZzhc ZUWJ`]hUhY Wt!W ff]W `Uf Yb[U[Ya Ybhdfc[fUa gždfc YWngžhYUW\]b['UbX fYgYUfV\'"H\Y`C ZZ]WY`cZ7 ca a i b]hm 9b[U[Ya Ybh'UbX DUfhbYfg\]dgž7 YbhYf Zcf @YUXYfg\]d UbX 7]j]W9b[U[Ya YbhžUbX j Uf]ci g ch\Yfi b]ngʻcb WUa di gʻYb[U[Y; fUXi UhY 5 gg]ghUbhgʻ]b h\]gʻa UbbYf"; fUXi UhY 5 gg]ghUbhg cj YfgYY dfc YWngʻUbX WUb gYfj Y`Ugʻ]U]gcbgʻhc XYdUfha Ybhg
5 h\`Yh]Vg	Mg	#D h\Y Uh\`Yh]WXYdUfha Ybhzghi XYbhl Uh\`YhYg'dUfh]WdUhY]b U j Uf]YhmcZcZZl Wa di g Wa a i b]hmgYfj]WY dfc YWgYUWk mYUf"H\Y1 G: 5h\`Yh]WXYdUfha Ybhk cf_gk]h\ gYj YfU` Wa a i b]hmdUfhbYfg _]bWi X]b[DUfU`ma d]WGdcfhiHUa dU'6Umz`cWU`6cmg'UbX;]f`g'7`i Vgz K \YfY @cj Y; fck gz; ' zA Yhfcdc`]hUb A]b]ghf]YgzUbX ch\Yfg _ hc \c`X'gYfj]WY Yj Ybhg'Zcf ghi XYbhl Uh\`YhYg'UbX ghUZZh\fci [\ci hh\Y'mYUf" #b UXX]h]cbzh\Y A Yb g'UbX K ca Yb g 6Ug_YhVU`HYUa g'k cf_k]h\ Ub cf[Ub]nUh]cb hc fU]gY a cbYmUbX Uk UfYbYgg'Uvci h'UgcWJU`]ggi Y'cf'dfcV'Ya ZUWJb[ZJa]`]Ygzgi W. Ug'5i h]ga "H\Y hYUa gXYX]WUhY dfcWYYXg'Zfca h\Y [Ua Yg'nc h\Y'cf[Ub]nUh]cbg'k cf_]b[hc WfYUhY Uk UfYbYgg" #b YUWk cZh\YgY UWh]j]h]Ygz Uh\`YhYg\Uj Y'h\Y'cddcfhi b]hmhc fYZYWh'cb h\Y]fYI dYf]YbWf"
		Ghi XYbh! Uh\ `YhYg'U'gc dUfh]WduhY]b Wa a i b]hmgYfj]W' Xi f]b[hk c bchUV'Y Wa di g Yj Ybhg"=b`>Ubi Ufm&\$%, ža cfY'h\Ub (\$'ghi XYbh! Uh\ `YhYg'dUfh]WdUhYX]b GhUa dYXY'cZ GYfj]W' UbX \Y'dYX hc WYUb UbX VYUi h]ZmU'dUf_]b h\Y'HUa dU'6UmUfYU"=b 5df]` &\$%, žh\Y XYdUfha Ybh\Y'X 58 Um]b; fYYb'UbX; c`X žk \YfY'Uddfcl]a UhY`m% \$Y`Ya YbhUfmgWkcc`ghi XYbhg'Zfca "cWU'6cmg'UbX;]f`g'Wi Vg'Wla Y'hc Wla di g'hc dUfh]W]dUhY]b'U'"XUm]b!h\Y! `]ZY" Yj Ybh']b'Uh\`Yh]Wg"=b]hg'h\]fX'mYUfzghi XYbh! Uh\`YhYg'gYfj Y'Ugj c`i bhYYfg'UbX'hYUa a UbU[Yfg'U']_Yz\Y'd]b['hc WfYUhY'U; Ua Y'8 UmYbj]fcba Ybh'Zcf'h\Y'_]Xg"
; fYY_@ZY	Mg	H\Y1 b]j Yfg]hmcZGci h\: `cf]XUfYWt[b]nYg'(- ZfUhYfb]h]Yg'UbXgcfcf]h]Ygk]h\]b h\YZc``ck]b[[cj Yfb]b[Wti bW]'g. \(\delta\)hYfZfUhYfb]hm7ci bW]'zA i `h]W `hi fU`; fYY_7ci bW]'z B Uh]cbU` DUb! < Y``Yb]W7 ci bW]'zUbX h\Y DUb\Y``Yb]W5 ggcW]Uh]cb"'9UW cZh\Y`cf[Ub]nUh]cbg gi ddcfh`cWI`zfY[]cbU`zUbX bUh]cbU` Wta a i b]hmdUfhbYfg\]dg'UbX'd\]`Ubh\fcd]WWii gYg" Dfc[fUa gcZZYfYX Vmh\Y W\UdhYfg]bWi XY Uk UfYbYgg! VUgYXzYXi WUh]cbU` dfc[fUa a]b[Wtj Yf]b[gi W\: hcd]Wg'UgXca Ygh]Wj]c`YbWf'UbX'\i a Ub hfUZZ]W_]b[\(zUg\)k Y``UgYmghUbXYf]bhYfj Ybh]cb YXi WUh]cb"A UbmW\UdhYfg'gi ddcfh`cWI` Wta a i b]hmk U_gzgi W\: Ugh\Y 5`n\Y]a Yf g'K U_z6fYUgh'7 UbWff K U_z5fh\f]h]g'>]b[`Y'>Ua zUbXA ch\Yfg'5[U]bgh8fi b_ 8f]j]b[K U_z7Ug'k Y``Ug`cWI`U[YbW]Yg]bWi X]b[A Yhfcdc`]hUb A]b]ghf]Ygz? YYd]b[HUa dU 6Um6YUi h]Z\: `zG\f]bYfg'< cgd]hU`zHf]b]hm7 UZAzUbX ch\Yfg"5 bi a VYfcZch\Yfg'U`gc dUfh]W]dUhY]b h\Y5Xcdh\5!FcUX'dfc[fUa `cWI``m"
		Gca Y cZh\Y W.UdhYfgk cf_k]h\ h\Y 7 YbhYf Zcf @YUXYfg\]d UbX 7]j]W9b[U[Ya Ybhhc]XYbh]Zma YUb]b[Z `dUfhbYfg\]dg'UbX [Yh]bj c`j YX]b dfc[fUa gcZZYfYX h\fci [\ 7 @7 9ž gi W. Ug'GhUa dYXY cZGYfj]Wfz6i ``g'Zcf?]XgžUbX 6i ``g'GYfj]Wf 6fYU_g'K \]`Y Ua cgh'U`` 6i ``g'GYfj]Wf 6fYU_gk]``Z]bX a Ya VYfg'cZh\Y ZfUhYfb]hm#gcfcf]hmWta a i b]hmUg'U'dUfhcZ h\Y]f YZZcfhg'cf'gYfj]b['Ug'U'ghi XYbh'g]hY "YUXYfžh\YfY]g'U'gc 'Ub'Ubbi U``6i ``g'GYfj]Wf 6fYU_cdYb hc cb`mZfUhYfb]hm#gcfcf]hma Ya VYfg"
		Gca Y cf[Ub]nUh]cbg\Uj Y fY[i `Uf gYfj]W cfd\]`Ubh\fcd]Wdfc[fUa gh\UhcWW f Ubbi U`mcf Uha i `h]d`Y h]a Ygh\fci [\ci hh\Y mYUfžgca Yh]a YgYj Yb V]!a cbh\`m'H\YgY]bWi XY 5`d\U 8 Y`hUD]`Gcfcf]mubX h\Y]fV]!k YY_`mj c`i bhYYf]b[Uhh\Y F cbU`X A W8 cbU`X < ci gY"C bY cZ h\Y Ubbi U`dfc YWfg]gh\Y Dfc YWfG\cdžcf[Ub]nYX Vm=chUD\]`H\YhU: fUhYfb]m½+bWžUbX]bWi g]j Y cZch\Yf ZfUhYfb]h]Yg#gcfcf]h]YgZfca U``Wti bW]`g"A cfY h\Ub` * \$\$\$\\UgVYYb fU]gYX cj Yf Ubi a VYf cZmYUfghc dfcj]XY []Znghc W.]`XfYb Zfca `HUa dUg; fUbhDUf_ Wa a i b]hmXi f]b[h\Y\c`]XUmgYUgcb UbX WYUhY UgWxc`Ufg\]d dfc[fUa `Zcf h\Y; fUbh DUf_ 7 ca a i b]hm7 YbhYf"G][a U8 Y`hU`HUi g'5bbi U`Di hh]b `C b H\Y <]hgdfc[fUa `VYbYZ]hg DfYj Ybh7\]`X 5Vi gY 5a Yf]WUUbX`\Ug`fU]gYX`Ub`Uj YfU[Y`cZ``) \$\$\$\$Ubbi U`m'
		Cf[Ub]nUh]cbg'U`gcfU]gY'acbYmZcfWUigYgVUgYX`cb'dUfhbYfg\]dg\\#YUhYX\Vmh\Y`bUh]cbU`

	cf[Ub]nUh]cbg"Gca YcZh\cgY]bWi XYdUfhbYfg\]dgk]h\Gh">i XYžGYfj]WYZcfG][\hžh\YA U]bYGYUWcUghA]gg]cbžUbXh\YFUmcZ <cdyku_"5``czh\ygydufhbyfg\]dgfydfygybhhfi th="" ywaaib]hmyb[u[yaybh]bk\]w;uaihiu`mvybyz]w]u`yiwkub[ycwwfgvyhkyybh\ccf[ub]nuh]cb'ubxdufhbyf"<=""></cdyku_"5``czh\ygydufhbyfg\]dgfydfygybhhfi>
	5 XX]h]cbu``mzh\Y ZfUhYfb]hm#gcfcf]hmWta a i b]hmWtbg]ghYbh`ma cj Yg'ei]W_`mhc gi ddcfh X]gUghYffY`]YZ'dfc^YWfgzUbX a cV]`]nYgWch\]b['UbX ZccX'Xf]j Yg'Ug'k Y``'Ug'Wt``YWf]cbg'cZ ch\Yf]hYa g'cZ]a a YX]UhY bYYX"
	HkccZh\Ydf]aUfm]XYU`gcZh\YZfUhYfb]hm#gcfcf]hmWtaaib]hm]ggYfj]WfUbXd\]`Ubh\fcdm";]j]b[VUW_hcWtaaib]h]Yg]gUb]bhY[fU`dUfhcZh\YZcibXUh]cbcZh\Y]fcf[Ub]nUh]cbg"=bh\Y&\$%+!&\$% UWWXYa]WhYUfžh\YZfUhYfb]hm#gcfcf]hmWtaaib]hmdfcj]XYXcjYf"+\$\$\$\$gYfj]Wf\cifgUbXfU]gYXcjYf"%\$\$\$\$\$]bd\]`Ubh\fcd]WXc``Ufg"
Ch\YfifdiYUgY MYg ydYW]ZnŁ	H\YfY UfY Ubi a VYfcZghi XYbhcf[Ub]nUh]cbgZcW gYX cb UXXfYgg]b[gcWYhU`W.U`Yb[Yg i g]b[U79 UddfcUW." Hf]i a d\Cj YfHfUZJW_]b[Wc``UVcfUhYX k]h\C79D UbX ZUW`hm Zfca j Uf]ci gx]gWd`]bYgz]bWi X]b[gcWjc`c[mzdi V`]W\YU`h\zUbX gcWJU`k cf_zZcfh\YdUgh hk c mYUfghc Vf]b[Uk UfYbYgghc `UVcfUbX gYI hfUZZJW_]b["5 Zcfi a Ybh]hYX; `cVU` \ddot bbcj Uh]cb hc 8]gfi dh <i a="" b]hma="" cb<="" czwkuf[y"h\]g]gh\yzci="" fh\ubx`uf[yghyj="" ghi="" gyx="" hc="" hfuzzjw_]b[="" i="" k="" td="" ub="" ugcdyb="" vyfgzfyy="" wa="" xybhgzzjwi`hmzghuzzzubx="" ya="" ybhzcw=""></i>

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

6"&" ±0X] WUHY k \YH\Yfighi XYbhg`\Uj Y`UWWYgg`hc`U W¢! Wiff] Wi`Uf Yb[U[Ya Ybh`hfUW]b[gmghYa h\Uh WUbgYfj Y`Ug`U W¢! Wiff] Wi`Uf hfUbgWf]dh`cf`fYW¢fX`cZWcaaib]hmYb[U[Ya YbhžUbX]Zgi Wi`U`gmghYa YI]ghgž XYgWf] VY`h\Y`gmghYaigYX`UbX`\ck`]h`]giigYX"

G: Ghi XYbhg\Uj Y'UWWgghc 6i ``Gmb\WiUgnghYa h\UhYbUV`Ygh\Ya hc \wbbY\Wik]h\ j Uf]ci gghi XYbh cf[Ub]nUh]cbg"6i ``Gmb\Wi fb]g\Ygghi XYbhgk]h\ U'gnghYa h\Uhdi V`]g\Yg]bZcfa Uh]cb cb h\Y cf[Ub]nUh]cbz]b\Wi X]b[h\Y\Wbgh]hi h]cbzYj YbhgzUbX [YbYfU'ghi XYbhVcXma YYh]b[g"6mdfcj]X]b[ghi XYbhgk]h\ U\wbj Yb]Ybhd`UhZcfa zh\Yi b]j Yfg]hmdfca chYgYb[U[Ya Ybhbchcb`mk]h\]b h\Y\WJa di gz Vi hk]h\ h\Y\Wa a i b]hmh\fci [\YU\W.]bX]j]Xi U`cf[Ub]nUh]cb g[cU'g"6i ``Gmb\U'ck gghi XYbhghc dfcXi \W\U\wb!\Wff]\W\Uf hfUbg\Mi]dhcfYDcfhZc`]c hc Ugg]ghh\Ya]b dcgh![fUXi Uh]cb dfYdUfUh]cb"I G: \WffYbh`m\Ugd`Ubghc a cj Yhc h\Y'dfc[fUa \9b[U[Y]b Gi a a Yf &\%" "H\]gbYk dfc[fUa k]``gi ddcfh UbX \ZU\W]h\hY cf[Ub]nUh]cb a UbU[Ya YbhzYj Ybhd`Ubb]b[z]bj c`j Ya YbhhfU\W_]b[zdfcj]XY\W!\Wff]\W\`Uf [i]XYX\dUh\k UmgzZJ\W]\]h\hY ghi XYbhY`Y\M]cbgzUbX`Yb\Ub\W`X\Uh\!]b\Zcfa YX]bg][\hg"K]h\U;]j Y Di `gY a cXi Y'UXX!]bzghi XYbhgk]``VY UV`Yhc hf\U\W\UghX\U\W\gq\\chi a a i b]hmqYfj]\W'cddcfhi b]h]Yg"

Ghi XYbhg`Wb`U`gc`YUfb`a]\fc!\fYXYbh]U`g`Zcf`h\Y`WbfYYf`fYUX]bYgg`\&a dYhYb\]\Yg`h\Ym\Uj`Y`Vi]`h
h\fci [\h\Y]f`YI dYf]Yb\Yf`]b`I G: fg`7UfYYf`FYUX]bYgg`6UX[]b[`Dfc[fUa "'7ca dYhYb\]\Yg`]b\Vi XY
@YUXYfg\]džHYUa k cf_ž7ca a i b]\Wb]cbž7f]h]\W``H\]b_]b[ž; `cVU``7]h]nYbg\]džHY\Wbc`c[mžUbX'7UfYYf
A UbU[Ya Ybh": cf`YU\W \%a dYhYb\\mžghi XYbhg`fYZY\\mi dcb`h\Y]f`U\WXYa]\WbX\\&a a i b]hmYb[U[YX
YI dYf]Yb\Yg"

\hdg.##kkk"igZ"YXi#WUfYYf!gYfj]WYg#WUfYYf!fYUXm#]bXYI"UgdI

6" "±bX]WWhYk \Yh\Yf We!W ff]W `Uf dfc[fUa a]b[dfcj]XYgghi XYbhgk]h\ WYUf XYj Y`cda YbhU`dUh\k Umgh\fci[\k\]W\h\YmWWbdfc[fYgghc]bWfYUg]b[`mWta d`Yl Zcfa gcZWta a i b]hm Yb[U[Ya Ybhcj Yf h]a Y"D`YUgY XYgWf]VY h\YdUh\k Umg'UbX\ck ghi XYbhg_bck UVci hh\Ya "Ghi XYbhg'UfY dfcj]XYXk]h\ WYUf XYj Y`cda YbhU`dUh\k Umg'h\Uh\Wb`YUX hc Wta d`Yl Zcfa gcZ Wta a i b]hmYb[U[Ya Ybhcj Yf h]a Yh\fci [\Ubi a VYf cZgci fWfg"

Ghi XYbhgdfc[fYggh\fci[\h\Y7YbhYfZcf@YUXYfg\]d UbX7]j]W9b[U[Ya Ybh]b]h]Uh]j YgʻU`cb[h\Y dUh\k Umci h]bYX Vmh\Y5Wh]j Y7]h]nYbgʻ7 cbh]bi i a "H\]gʻa cXY`gi ddcfhgʻh\Y WcbWrdhh\Uhʻghi XYbhg VY[]b k]h\`]hhY WcbWrdhh\Uhʻghi Zcfh\Y]fʻfc`Y`]b gcWJU`dfcV`Ya gʻʻH\fci [\j c`i bhYYf]ga žghi XYbhgʻVY[]b h\Y]f YXi WUh]cb UbX`a cj Ya Ybhhck UfXgʻX]gWcj Yf]b[h\YfcchWUi gYgʻcZgcWJYhU`dfcV`Ya gʻʻH\YmVYWca Y WcbgWJYbh]ci g\Wh]nYbgžZ]bU`ma cj]b[hck UfXgʻU\Mj] Y\Wh]nYbg\]d`k\YfYh\Y Wca a i b]hmVYWca Y gygʻb YI d`]WJh`m]b j U`i YgʻUbX`]ZY Wc]WrgʻʻH\]gʻa cXY`WUb VYʻgYYb YI d`]WJh`m]b j Qʻa gʻi Wk Ug GhUa dYXY`cZGYfj]Wrž5`hYfbUh]j Yʻ6fYU_gʻzUbX`h\Y@YUXYfg\]d`A]bcf''; YbYfU`mžh\Yj q@ 9 gwU`Yg dfc[fUa gʻU`cb[h\fYYX]a Ybg]cbg.; `cVU`GWcdYž5i X]YbWr j UdUWJhmžUbX`@cb[]hi X]bU`H]a Y: fUa Y'' 7@ 9 k cf_gʻhc YI d`]WJh`mWcbbYWhic YI hYfbU`VUfca YhYfgʻf]"Y'' j UfbY[]YYI dYWhUh]cbgʻzB 5 7 9 Wca dYhYbWJYgž5Wh]j Yj h]nYbgjjcbh]bi i a ž@YUXYfg\]d`=XYbh]hm8Yj Y`cda YbhžYhWk

A i `h]d`Y`k Umg`cZ'Wca a i b]\WUh]b['7@79']b]h]Uh]j Yg`UbX`gYfj]\W`g`UfY`dfcj]XYX`Zcf`ghi XYbhg`h\fci [\`h\Y I G: 'k YVg]hYždi V`]\WUh]cbgžUbX`bYk g`YhhYfg/gc\\JU`a YX]U/a i `h]d`Y`g][bUhi fY`Yj Ybhg/k YY_`m6i `` A Uf_Yh'dfYgYb\\Y'/DYYf!hc!DYYfci hfYU\\/UbX`gdY\\JU`hmYj Ybhg'gi \\X `Ug`h\Y`9I dYf]Ybh]U`@YUfb]b['9L DC ž UbX`J c`i bhYYf: U]f"

Ghi XYbh! Uh\`YhYg`WUb`UWWgg`fYgci fWgk]h\]b`h\Y`C ZZ]WY`cZ`Ghi XYbh!5h\`YhY9b\UbWYa Ybh'UbX`h\Y

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

Ybh]fY Uh\`Yh]WXYdUfha Ybhhc Yb[U[Yk]h\ h\YWa a i b]hmcb UfY[i `Uf VUg]g"7ca a i b]hmgYfj]W WUYbXUfg UfY `c WhYX]b h\YUh\`Yh]WgVi]`X]b[žUbX ghi XYbh! Uh\`YhYg UfY UV`Y hc g][b i d hc j c`i bhYYf Zcf Yj Ybhg VUgYX Ufci bX h\Y]f Uh\`Yh]WUbX UWUXYa]WgW\YXi `Yg"H\YGY`a cb`A Ybhcf]b[`=bgh]hi hY UbX 9b\UbW]b[I fig WUfYYf XYj Y`cda Ybhdfc[fUa a]b[cZZYf cddcfhi b]h]Yg Zcf`ghi XYbh! Uh\`YhYg`hc bYhk cf_UbX [U]b dfc ZYgg]cbU`Yl dYf]YbWf]b h\Y]f WUfYYf Z]Y`Xg`cZ]bhYfYghUbX hc [fck]b h\Y]f `YUXYfg\]d cddcfhi b]h]Yg"H\YGhi XYbh! 5h\`YhY 5Xj]gcfm7 ca a]hhYY UbX h\YGhi XYbh! 5h\`YhY @YUXYfg\]d 5 WUXYa m dfcj]XY`dUfh]WdUh]b[ghi XYbh! Uh\`YhYg`k]h\`h\Ycddcfhi b]hmhc Yb[U[Yk]h\`cbY`Ubch\Yf`UbX`k]h\`h\Y

H\fci [\9Xi Wh]cb5VfcUXzj Uf]ci g]bhYfbUh]cbU`cddcfhi b]h]Yg'UfY dfcj]XYX Zcfghi XYbhghc Yb[U[Y k]h\`cWU`Wca a i b]h]Yg'UbX`\cghWi`hi fYg"H\Y1 b]j Yfg]hmk cf_gcb'Uj Uf]YhmcZWca a i b]hmlWfbhYfYX dfc YWg'UVfcUXzXYg][bYX hc Vf]b[1 G: ghi XYbhghc[Yh\Yfk]h\`cWU`Wcbgh]hi Ybhg']b'a YUb]b[Zi`k Umg" K\]Ybch`]a]hYX hc gYfj]WYdfc YWgzh\YgY UfY Ua cb[h\Ya cgh]b!XYdh\ cddcfhi b]h]Ygz'Ug'h\YmUZZcfX`cWU`Wca a i b]h]Yg'Ub cddcfhi b]hmhc]XYbh]ZmU'bYYX cf'dfc YWh'UbX a UhWk h\Ya k]h\ ghi XYbhgfg_]``gYhg" K\]YbchU'dUh\k Um]b cZh\Ya gY`j Ygz]bhYfbUh]cbU`Wca a i b]hmYb[U[Ya Ybh]g'UghYd]b'Ughi XYbhg dUh\k Um'H\Y'UXj Yfh]gY'dUh\k Umg'h\fci [\UWUXYa]WXYdUfha Ybhg'i g]b[h\Y; `cVU`FcUXa Udgz'Ub ci h`]bY`cZ'Ughi XYbhg'Zci f!mYUf'dUh\k Umh\fci [\h\Ya U'cf]gYa VYXXYX'k]h\'9Xi WUh]cb'5VfcUX Yl dYf]YbWrg": cfghi XYbhga U'cf]b[]bdfc[fUa gh\Uh\Uj'YbchmYhWca d`YhYX'U; `cVU`FcUXa Udz'ghi XYbhg`YUfb'UVci h'h\YgY'cddcfhi b]h]Yg'h\fci [\UWca V]bUh]cb'cZWUggfcca 'dfYgYbhUh]cbz'ZU]fgz' Yj YbhgzVfcWi fYgz'UbX'h\Y'9Xi WUh]cb'5VfcUX'k YVg]hY"

\hhd.##U`hYfbUh]j YVfYU_g"cf[#k d!WbhYbh#i d`cUXg#&\$%(#\$*#5Wh]j Y!7]h]nYb!7cbh]biia!&\$%("dXZ

6"("Dfcj]XYUbUffUh]jYh\UhgdYU_gVfcUX`mhc]bjc`jYaYbhcZghiXYbhg]bWcaaib]hmYb[U[YaYbhzgiWXUgh\YkUmgghiXYbhg\UjY`YUXYfg\]dfc`Yg]bWcaaib]hmYb[U[YaYbhf[]jYYlUad`Yg½cfXYW]g]cb!aU_]b[fc`YgghiXYbhg\UjYcbWUadigfY`UhYXhcWcaaib]hmYb[U[YaYbhfdl`Ubb]b[ž]ad`YaYbhUh]cbžUggYggaYbhzcfch\Yf½"<ck\UgghiXYbh`YUXYfg\]d]bWcaaib]hmYb[U[YaYbhWUgg]Z]WUh]cb3<ck]gghiXYbh`YUXYfg\]d]bWcaaib]hmYb[U[YaYbhfdl`UbWUgg]Z]WUh]cb3<ck]gghiXYbh`YUXYfg\]d]bWcaaib]hmYb[U[YaYbhfdl`UbWcabhfdl)cbcbhfUbgWf]dhžYhWc3Dfcj]XYfYYjUbh`]b_g"

I G. ghi XYbhgʻUfYʻUWnji Y`m]bj c`j YX`]b Wca a i b]hmYb[U[Ya YbhdfcYWngʻUbX`dfc[fUa g`]b`Uj Uf]YhmcZ`YUXYfg\]d fc`Ygʻh\fci [\ai`h]d`Y`gci fWrgžgi W. Ugʻh\Y`7@79ž5h\`Yh]WgžGhi XYbhCf[Ub]nUh]cbgž; fYY_@]ZYž7c``Y[Ygž: K G`=bhYfbg\]dgžUbX`ghi XYbh``YX`W]b]WgʻʻH\Ym\Uj Y`k cf_YX`]b`U`k]XY`fUb[Y`cZbcb!dfcZ|hg`UbX`Wca a i b]hmcf[Ub]nUh]cbg`]bWi X]b[h\Y`GhUhY`cZ: `cf]XU`9a Yf[YbWnA UbU[Ya Ybh'7YbhYfž

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

h\YFYX7fcggžAYhfcdc`]hUbA]b]ghf]Ygfl\caY`YggʻgYfj]WYglz:Ufa&GW\cc`fgW\cc`[UfXYbglzUbX@h\YfUbA]b]ghf]Ygʻfla][fUbhgYfj]WYglz"H\Ym\UjYcf[Ub]nYXWcaaib]hmZcfiagcbWf]h]WU`]ggiYg]bWiX]b[`\iaUbhfUZZ]W_]b[zZccX]bgYWif]hmzUbX`\caY`YggbYgg"GhiXYbhgk\ckcf_]bWcaaib]hm

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

 $\label{thm:local-condition} \mbox{h' in $$ f'' hfuw_5 ^c $ZYgWf]VY \c k h'g'gW.c `ufg']d' ug vyyb 'gi ddcfhyx'g]bW'mci f'`ugh wugg]Z]Wuh]cb''}$

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

7 ca a i b]hm9b[U[Ya Ybh =bj Ybh]j Y DUfhbYfg\]dg 6Yhk YYb A i gYi a g'UbX =bgh]hi h]cbg cZ <][\Yf 9Xi WUh]cb"\hhdg ##X]gWcj Yfm']bXghUhY"YXi #WY\Y#JbXYI "d\d#cWr#Ufh]WY#,]Yk #(&'

7"&"

< ck \Uj Y ZUW `hmcZUbmYa d`cma YbhghUhi g`fhYbi fYX#hYbi fY`hfUW_žZI ```h]a Y`bcb! hYbi fY`hfUW_žUbX`dUfhh]a Y ZUW `hmt Wt``UVcfUhYX`k]h\ Wta a i b]hmdUfhbYfghc dfcXi WfgWkc`Uf`mdfcXi WfgcZVYbYZ]hhc h\Y Wta a i b]hmh\UhUfY`fYdfYgYbhUh]j Y cZWt! WfYUhYX_bck `YX[YVYhk YYb`UWUXYa] Wg`UbX Wta a i b]hmdUfhbYfg`fYgi `h]b[Zfca ci hfYUWk`UbX`dUfhbYfg\]dg`fY"["ž hYWkb])WJ`fYdcfhgžW ff]WJ`i a zffYgYUfWk fYdcfhgzdc`]WhifYdcfhgzdi V`]WUh]cbgzYhWt3Dfcj]XY Z]j Y YI Ua d`YgcZZUW `hm gWkc`Ufg\]d WtbXi WhYX`k]h\ dUfhbYfgZcf Wta a i b]hmVYbYZ]hcf hc]a dfcj YzWf]h]ei Yzdfca chYzcf fYZYWhcb dUfhbYfg\]dg" 5`gczXYgWf]VY\ck h\]ggWkc`Ufg\]d\UgVYYb gi ddcfhYX g]bWf mci f``UghWUgg]Z]WUh]cb"

%"FcVYfhU'6UYfžDfcZYggcfž5bh\fcdc`c[m8YdUfhaYbhžVd!WfYUhYX'Ufh]WYg'UbXVcc_g'k]h\ Wtaaib]mmdUfhbYfg'cbVY\U'ZcZh\YfYZ[YY Wtaaib]mm'K]h\ \YfdUfhbYfž75F=69žU'ZYXYfU`mZbXYX'9b[`]g\!`Ub[iU[Y'dfc[fUažg\Y Wt!WfYUhYX'5aYf]WUbGhcf]Yg žUb'Ubh\c`c[mcZ'cfU`\]ghcf]Yg'Zfca'6ifaYgYfYZ[YYg'k\]W\]gigYX'hc\Y`d'fYZ[YYg`YUfb'9b[`]g\"H\YVcc_df]bh]b['UbX'h\Y'hfUbgWf]dh]cb'cZ]bhYfj]Ykg'kYfYaUXY'dcgg]V`YVmUa]b]![fUbhZfca'C79D"\hd.##bYkg'iqZ'YXi#Ufh]W#AYad`UhYg#3U1+,,'/n1&&\$

&"FYVYVWVGi fbgz5ggcVjUhYDfcZYggcfz9Xi WUh]cbzWc!WfYUhYXdi V`]WUh]cbg'UbXdfYgYbhUh]cbg'k]h\ h\Ydf]bVjdU`cZA cfh 9`Ya YbhUfmGWcc`"8f"Gi fbgWccfX]bUhYg'h\YHYUW\Yf@YUXYf5WXYa mzUWc``UVcfUh]cb VYhk YYb <]``gVcfci [\`7ci bhm Di V`]WGW.cc`g'UbX1 G: '7c``Y[YcZ9Xi WUh]cb hc Ya dck Yf'hYUW\Yfgž]a dfcj Yghi XYbh'UW\]Yj Ya YbhzXYj Y`cd`YUXYfg\]džUbX ZUVj\]hUhYgW.cc`fYbYk U`"H\fci [\ h\]gdUfhbYfg\]džh\Y7C9'a U]bhU]bg'UWh]j Y]bj c'j Ya Ybh]b'h\Y Wa a i b]hmgW.cc`'a cXY`z dUfh|WdUh]b[]b]hg'XYj Y`cda Ybh'UbXdfcj]X]b['qhfUhY[]Wd`Ubb]b['qi ddcfh"

6i fbgžF"K "ž×c\bgcbžK "K "==\vec{1}\texts{Z} / < UfX]b!FcVYfbgžG"ł f&\$%+Ł"H\YA cfhHYUW\Yf@YUXYf5WUXYa m 8 Yj Y`cd]b[hYUW\Yf YUXYfgZcfi fVUb gW\cc`g'hc[Yh\Yf"=\vec{1}\texts{B} "MYbXc`!< cddYmž8"5"G\Ub`Ymž8"7"8 Y`UbYž/ 8 "< cddYmf9Xg"\texts{Z} K cf_]b[hc[Yh\Yf. 9b\UbW]b[i fVUb YXi WUhcfei U`]hmh\fci [\gW\cc`!i b]j Yfg]hmdUfhbYfg\]dg fdd"\%- y\%(, \texts{Z} \texts{V} \texts{U} \texts{ChhY\EB 7}.

=\vec{1}\texts{D}Zcfa Uh]cb 5 [Y Di V`]g\]b["\hhdg.##k k k "i gZ"YXi #YXi WUh]cb#ZJW\`hm#ZJW\`hm#ZJW\`hm#ZJW\`hm#ZJW\`hm#ZJW\]

"8]bcfu\A Ufh]bYn! Hmgcbž5 gg]ghUbhDfcZYggcfžDi V`]W< YUʻh\ŽWt!WfYUhYX 7 Ua dUa Ybhc 5 Y[f]UʻUbX UʻfY`UhYX di V`]WUh]cb" H\]gZfYY dfc[fUa Ya Yf[YX Zfca 8f"A Ufh]bYn! Hmgcb g Wt``UVcfUh]cb k]h\ Wta a i b]hmdUfhbYfg @Uh]bcgi b]Xcgidcfi b B i Yj c 5 a UbYWffž±bWf@ B 5 ±bWtZA cfhcb D`UbhA YUgY < YUʻh\ 7 UfY UbX A cZZ]hhHUa dUʻ6Um7 UbWf 7 ca a i b]hmB Yhk cf_" 7 Ua d 5 Y[f]Uʻdfcj]XYgʻgi ddcfhžYXi WUh]cbžUbX ci hfYUW. Zcf <]gdUb]WfYUghWUbWffgi fj]j cfg"±n]gʻh\Y`Z]fghcbVt`c[mWUa dž dfcj]X]b['UWh]j]h]Ygʻ]b GdUb]g\žhU]`cfYX hc h\Y @Uh]bUVta a i b]hm" \hhdg.##]b_"gdf]b[Yf'Wta #VtbhYbh#dXZ#%\$'%\$, \$1 & \$x\$, ,) , % \$+\$% % & ("dXZ

("8f"GhYj Yb A YmYfgff \]YZGW]Ybh]ghŁUbX8f"A Uf_9"@ h\Yfźf5ggcW]UhY DfcZYggcfŁZ7YbhYf ZcfA Uf]h]a Y UbX DcfhGhi X]Yg UhI G: 7c`Y[YcZA Uf]bYGW]YbW""H\YmgYY_hc]bWfYUgY UbX Udd`mZ bXUa YbhU`_bck `YX[YcZ[`cVU`cW'Ub gmghYa g'UbX \i a Ub!cWfUb]bhYfUWf]cbgh\fci [\fYgYUfW.žYXi Wh]cbžUbX Wca a i b]hmYb[U[Ya Ybh"H\YmdUfhbYfYXk]h\ fYdfYgYbhUh]j Yg Zfca h\YDcfhcZHUa dU'6Umžh\YHUa dU'6Um9ghi UfmDfc[fUa žUbX1 G:]g\ UbXK]`X`]ZY`GYfj]WfhcfYgYUfW.ždi V`]g\žUbX dfYgYbhUVci hh\YYZYWWgcZk U_Ygcbh\Yg\cfY`]bYYbj]fcba YbhcZHUa dU'6Um" A YmYfgžG"8"žA "9"@ h\YfžG"F]b[i Yhž; "F Ui `Yfgcbž9"G\Yfk ccXž?"7cbfUXUbX; "6Ug]`]ž&\$%, "K U_YgZfca @Uf[YJ YggY`g UbXh\YF]g_hch\YG\cfY`]bY'9bj]fcba Ybh]b`HUa dU'6Um" b DfcWYYX]b[gžA HG#-999'C WYUbg%, 7cbZYfYbWf žC Wh"&' ž&\$%, ž 7\Uf`YqhcbžG7"

) "8 f"@cf]Y: f]XY``ž5 ggcWUhY DfcZYggcfž7 c``Y[YcZ6Y\Uj]cfU`UbX.7 ca a i b]hmGWJYbWrg Wc!WfYUhYXk Jh\ h\Y HUa dU'6Um Dc`]WrUhfU]b]b[h]h`YX`: U]f UbX =a dUfh]U`Dc`]W[b[" G\YXYj Y`cdYX UbX XY`]j YfYX h\Y dfc[fUa k]h\ UW ff]W `i a XYg][b hYUa Wcbg]gh]b[cZdc`]WrYl YW h]j Ygžgi dYfj]gcfgžcZZ]WrfgžWca a i b]hmghU_Y\c`XYfgžUwXYa]WYl dYfhgžUbX hcd gcWJU`

FY!7`Ugg]Z]WUh]cb. H\Y'7 UfbY[]Y: ci bXUh]cb Zcf'h\Y'5 Xj UbWa Ybh'cZ HYUW\]b[

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

dgmWkc`c[]ghg`Zfca `Ufci bX`h\Y`bUh]cb"`H\]g`dfc[fUa `]g`bck VY]b[]a d`Ya YbhYXVmh\Y1 "G"8YdUfha YbhcZ'>i gh]Wf`UbX`dc`]WfXYdUfha Ybhg`Ufci bX`h\Y`Wci bhfm"\hhdg.##Z]dc`]Wfb["Wca #h\Y!hYUa #

7""

< ck `\Uj Y`dfcZYgg]cbU`ghUZZWcbhf]Vi hYX hc h\Y gW\c`Ufg\]d cZWca a i b]hmYb[U[Ya Ybhfh\fci [\ WcbZYfYbW'dfYgYbhUh]cbz
di V`]\WUh]cbzWcbgi `h]b[zUk UfXgzYh\WzUggc\yUhYX k]h\ h\Y]f Wc!W ff]W\`UfYb[U[Ya YbhU\X]Yj Ya Ybhg'fY"['zghi XYbhdfc[fUa
XYj Y`cda YbhzhfU]b]b[W ff]W\`Uz`YUXYfg\]d dfc[fUa]b[zYhW\z3Dfcj]XY Z]j YYl Ua d`YgcZdfcZYgg]cbU`ghUZzgW\c`Ufg\]d
fY`UhYX hc Wca a i b]hmYb[U[Ya YbhUbX XYgWf]VY\ck h\]ggW\c`Ufg\]d\UgVYYb gi ddcfhYX g]bW\mci f`UghWUgg]Z]WUh]cb"</pre>

G]bWrh\Y&\$%\$ WUgg]Z]WUh]cbzgi ddcfhZcfdfcZYgg]cbU`XYj Y`cda Ybh'UbX'gWkc`Ufg\]d\UgYl dUbXYX hc YbWti fU[YghUZZhc dUfh]W]dUhY]b Wta a i b]hmYb[U[Ya YbhYZZcfhgh\fci [\gWkc`Uf`mk cf_"DfcZYgg]cbU`ghUZZUfY'gi ddcfhYX]b dfYgYbh]b[UbX Wtbhf]Vi h]b[hc'h\YgWkc`Ufg\]d'cZYb[U[Ya Ybh]b'a i `h]d`Y k Umgzgi Wk'Ug'dfYgYbhUh]cbgzWtbgi `h]b[zdfc[fUa XYj Y`cda Ybhz UbX'di V`]WUh]cbg"H\YmUfY'U'gc]bj]hYX'hc'hU_Y'dUfh]b gma dcg]i a gzUk UfX WfYa cb]YgzUbX WtbZYfYbWfg]b'UfYUg'cZ]bhYfYgh UbXYl dYfh]qY"FYWfbhqi ddcfh]bWi XYq'fY[]qhfUh]cb'UbX'hfUj Y`qi ddcfhZfca 'dfcZYqq]cbU`XYj Y`cda YbhZ bXq"

>i gh]b:]lm[YfU'XZA "5"z5gg]ghUbh'8]fYWfcfz7YbhYf'Zcf@YUXYfg\]d: 7]j]W9b[U[Ya Ybhz7cbZYfYbWf'DfYgYbhUh]cbz
HfUbgZcfa]b['h\Y'Gh'XYbh'J c'i bhYYf'9| dYf]YbWf.'H\Y'K]b!K]b'cZ'DfcZYgg]cbU'8Yj Y'cda Ybh'C ddcfhi b]h]Yg']b'ci f
DYfZcfa UbWY!6UgYX'9fUz &\$% zGYfj]WYI b]hYgzDc]bhg'cZ'@[\hg'7cbZYfYbWf'cb'J c'i bhYYf]b['UbX'GYfj]Wfz5h'UbhUz; 5

? UfU: i `hcbžD\"8 "7ccfX]bUhcfžl G: ; `cVU`7]h]nYbg'Dfc'YWffE 9DŁUbX'Gca a Yf'A]hW\Y``D\8 ž7c``Y[YcZ'\bhYfX]gWjd`]bUfm Ghi X]Ygž Gi ddcfh]b[: UW\`hmžGhUZZZ/ Ghi XYbhg'H\fci [\; `cVU`9b[U[Ya Ybh'Dfc[fUa a]b[" 'DfYgYbhYX'Uh'&\$%+'557/ I 7cbZYfYbWf.; `cVU`9b[U[Ya Ybh'UbX'GcWjU'FYgdcbg]V]`]hm'<][\Yf'9Xi WUh]cb g'Fc'Y]b'5XXfYgg]b[; `cVU`7f]gYgžBYk Cf'YUbgž@5

8 YVcfU\; fUI Uz; fUXi UhY 5 gg]ghUbhz7 YbhYf Zcf@YUXYfg\]d/7]i]W9b[U[Ya Ybhz7 cbZYfYbW DfYgYbhUh]cbzGh"@Yc

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

DfYgYbhUh]cbž&\$% B5GD57cbZYfYbWYž@cg5b[Y`Ygž75

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

* "&"

±0X]WUHY`\ck Weaaib]mmYb[U[YaYbh]gWebbYWHYXhcYZZcffmgU]aYXUHn**ghiXYbhfYhYbh]cbUlaxn**igi**d**WWsgwyizUbxexexeysWf]Waxinduhdescrib \UgWkUb[YX:g]bWrh\Y`UghWUgg]Z]WUh]cb"Dfcj]XYfY`YjUbh`]b_g`]ZUjU]`UV`Y"

I G. X]fYWnmUbX]bX]fYWnmWcbbYWgh\Y]f ghi XYbhfYhYbh]cb UbX ghi XYbhgi WWggYZZcfhgh\fci [\ Wa a i b]hmYb[U[Ya Ybh' Cj Yf h\Y "UghhYb mYUfgžl G: \Ugg][b]Z]Wbhm]a dfcj YX]hgg]l!mYUf[fUXi Uh]cb fUhY Zfca (+i hc +\$i UbX:]fghiH]a Y]b 7c``Y[Yfl H=7 Eghi XYbhfYhYbh]cb fUhYgZfca , % hc cj Yf - \$i]b h\Y gUa Yh]a Y dYf]cX UfUhY cZ[fck h\ h\UhZYk]bgh]hi h]cbgWba UhW\"H\YgY[U]bg'UfYh\YfYgi `hc ZU'h\ci [\hZ `UbX XY`]VYfUhY W`hi fY W\Ub[YžUg'h\Yi b]j Yfg]hm hfUbgZcfa YX h\Yk Um]hUddfcUW\Yg'h\Yghi XYbhYl dYf]YbW'UbX]g Wa a]hYX hc]a dfcj Y[fUXi Uh]cb UbX Z[fghl mYUf fYhYbh]cb fUhYg"l G: \Ug\YYYb fYWc[b]nYX Vm H\Y9Xi WUh]cb Hfi gh f&\$%+EUg\YY]b[;*]b h\YbUh]cb Zcf Y`]a]bUh]b[h\Y Wa d`Yh]cb [Ud VYhk YYb V`UW_UbX k \]hY ghi XYbhgž (]b h\Y bUh]cb Zcf @Uh]bc ghi XYbhgi WWggžUbX; %]b h\Y ghUhY cZ: `cf]XUZcf Vch\"

CjYf'(% cZh\YibXYf[fUXiUhYghiXYbhg'Uh1G: HUadUfYWY]jYDY``; fUbhgžUbXh\YgYghiXYbhg\UjY'U*,ı'[fUXiUh]cb'fUhYžk\]W\]g%ı\][\Yfh\Ubh\YbUh]cbU'UjYfU[Y'UbX\][\Yfh\Ubbcb!DY``[fUbhfYW]d]Ybhg"H\YgYcihWcaYg'UfY'UW\]YYcg]bg Vr

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z[YX cb (#%) #&\$% "

 $dfcWXi fYg[cjYfb]b[h\YIG: < i \ a \ UbFYgYUfW. DfchYVh]cbgfk FDDL:Dfc[fUa"+bUXX]h]cbzh\YE5#E =Dfc[fUa dfcj]XYghfU]bb[UbXYXi Wh]cb hc fYgYUfW. YfgUbXh\Y]fghi XmhYUagUbXdfcj]XYgh\Yak]h\ hcc`ghc ZUWj]hUhYh\Y WcbXi WhcZh\Y]fghi XmhYUagUbXgfj YgUgU_YmWca dcbYbhcZh\Y55< FDD! UWWfYX]hYX < i \ a UbFYgYUfW. DfchYVh]cb Dfc[fUa"+\YE5#E =Dfc[fUa fYdcfhghc h\Y5ggcW]UhY8]fYWhcfZcfFY[i `Uhcfm5ZZU]fgk]h\]b FYgYUfW. <math>\Rightarrow hY[f]hm/ 7cad$ d`]UbW"

 $\label{thm:control_bound} $$H_Y^9Xi_Wh_cb_b_b_E_Df_ful g_W^bXi_WhYX_mYUf!fci_bX_VmI_G: < FDD_Zcf_I_G: ZUW_mzghuZzzghi_XYbhgzUbX_ci_fuZ]_JuhY_cf_Ub_nuh_cbg_bWi_XY_cb_]bY_hfu]b]b[g_cb_ck_hc_gi_Va_]hfYgYUfW.Udd_JWh]cbg_fgYj_YfU_h]a_Yg_UmYUfza_cbh_mZUWY!hc!_ZUWY_hfU]b]b[g_XYhU]_jb[_df_cdYf_fYgYUfW.Yh_]Wg_UbX_dc_JWhfYei_]fYa_Ybhg_fUhj_Uf]ci_g_Yj_Ybhg_tzV]!Ubbi_U_ghi_XYbhfYgYUfW.Yh_JWg_UbX_dc_JWhfYei_]fYa_Ybhg_fUhX_ghUZZfYhfYUhgz_UbX_a_cbh_mW_ghca_]nYX_WUggfcca_dfYgYbhUh]cbg_cb_=6!fY_UhYX_Jggi_Yg_UbX_fYgYUfW.hcd_JWg_UbX_ghuZZfYhfYUhgz_UbX_a_cbh_mW_ghca_lnYX_WUggfcca_dfYgYbhUh]cbg_cb_=6!fY_UhYX_Jggi_Yg_UbX_fYgYUfW.hcd_JWg_UbX_ghuZZfYhfYUhgz_UbX_a_cbh_mZ_ghuX_fYgYUfW.hcd_JWg_UbX_fYgYUfW.hcd_JWg_UbX_ghuZZfYhfYUhgz_UbX_a_cbh_mZ_ghuX_fYgYUfW.hcd_JWg_UbX_fYgYUfW.hcd_JWg_UbX_fYgYUfW.hcd_JWg_UbX_ghuX_fYgYUfW.hcd_JWg_UbX_fYgYUf$

CbYcZh\Y[cU`gcZh\Y<FDD`]ghcdfcj]XYžWbXi WhžUbX`UhhYbX`Waaib]mncihfYUWX`UbX`YXi WUh]cb`Yj Ybhg"±b`UXX]h]cb hch\YWUfY`hU_Yb`hc`UggifY`h\YYh\]Wg`UbX`eiU`]mncZh\YfYgYUfWXYf`UbX`h\YfYgYUfWXžh\]g[cu`\Y`dgUXXfYgg'UbX`]bZcfa`h\Y

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z[YX cb (#%) #&\$% "

@ 6HEŹf[\hgžW]a UhY W.Ub[YžUbX ch\Yf hcd]Wg"H\YgY]ggi Yg'UfY cZhYb h]YX hc Wt! Wiff]Wi`Uf`cddcfhi b]h]Yg Vch\`cb`UbX`cZZ WUa di g": cfYl Ua d`Yžghi XYbhgYbfc``YX]b U Wti fgY h\UhYl d`cfYX]a a][fUh]cb`UbX`fYZ [YY'dc`]W]Yg'dUfh]W]dUhYX]b Ub Yl dYf]Ybh]U`Yj YbhcZZYfYX Vmh\Y`7 cbhYa dcfUfm5fhg`A i gYi a fl/5 A ŁZX]fYWf`mU`][bYX k]h\`h\Y X]gWi gg]cb`cb`Vi]`X]b[' U VcfXYf`k U``"5 7 9 Ubh\fcdc`c[mWti fgY cZZYfYX ghi XYbhgh\Y`cddcfhi b]hmhc]bhYfj]Yk fYZ [YYg'UbX`k f]hY h\Y]f`ghcfmhc Wta d`Ya Ybhh\Y X]gWi gg]cb"

±0:&\$%+žh\Y'6`UW_Di`d*dfcj]XYX'ghiXYbhgik]h\h\Y'cddcfhib]hmhcYlUa]bYYjc`j]b['dYfgdYVh]jYgcZ'6`UW_]XYbh]hm]b5aYf]WUbW`hifY'UbX`\]ghcfmZfca%-%&hc'&\$%*h\fci[\fUfY\]ghcf]WU'df]bhYX'aYX]U'g\ckb']bX]U'c[iYk]h\WbhYadcfUfmkcf_gcZ'Ufh"

8 i f]b['h\Y': U``&\$% 'gYa YghYfž75A 'dUfhbYfYX'k]h\ h\Y'ghi XYbhg'Zfca 1 G: g'< cbcfg'7c``Y[Y'UbX'9b[`]g\ 'UbX'< i a Ub]h]Yg 8 YdUfha Ybhg'hc \cgh'Ub YXi WUh]cbU' hk c!dUfh'gma dcg]i a 'Yb[U[]b['ghi XYbhg']b 'Ub Ubh]!dUfh]gUbžbUh]cbU' d`UhZcfa WU``YX: fYYXca g) \$ GhUhY'=b]h]Uh]j Y"Ghi XYbhg'Wci 'X'g\UfY'h\Y]f"j]g]cb'cZZfYYXca 'Zcf'h\Y Wca a i b]hm"

±5 &\$%, žH\Y1 G: 7c``Y[YcZ5fhg`UbXGV]YbWrg\cghYX`UVcc__`Ui bWX#gYa]bUf`h]h`YX`8 YWc`cb]nUh]cb]b`H\ci[\h/ DfUWh]Wr. 9i fcdY`UbX`h\Y'5a Yf]WUg`C h\Yfk]gY" H\YVcc__žYbh]h`YX`7 ca dUfUh]j Y`FUVJU`Dc`]h]Wg`]b`@Uh]b`5a Yf]WUz`]bj Ygh][UhYg`h\Y]bhYfgYWh]cb`cZgcW]U`dck Yf`UbX`fUVJU`dc`]h]Wg`UbX`h\Y]f`]a dUWhcb`h\Y`fY[]cb`g`\]ghcf]Ygždc`]h]Wgz]XYbh]h]Yg`UbX`W`hi fYg"

I b8 cW U`mhfU]b]b[]gUj U]`UV`Y hc U``I G: ghi XYbhg"A cXY`YX`UZhYf I bXcW U`mhfU]b]b[Uhch\Yf]bgh]hi h]cbgžh\]ghfU]b]b[YXi WbhYgh\Y I G: Wta a i b]hmcb h\Y\]qhcfmžfY`Yj Ubh"Y[]q`Uh]cbžUbX W ffYbhfYU`]h]Yg`cZh\Y i bXcW a YbhYX Wta a i b]hm'

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z[YX cb (#%) #&\$% "

VmZcghYf]b[gcW]UʻžYVcbca]WžUbX Ybj]fcba YbhUʻgi ghU]bUV]`]hm'H\YmUWca d`]g\ h\]ga]gg]cb h\fci [\hYUW\]b[žfYgYUfW\ž ghi XYbha Ybhcf]b[žUbX Wca a i b]hmci hfYUW\žUgk Y``UgVm[YbYfUh]b[dfUWh]WU`_bck `YX[YUbX XYj Y`cd]b[]bbcj Uh]j Y hYW\bc`c[]Ygžg_]``g'UbX dc`]WYg"C bY cZh\Y dfc[fUa gh\YmcZYf]g'Ub YbhfYdfYbYi fg\]d WcbWfbhfUh]cb"H\Y A "5"]b; `cVU` Gi ghU]bUV]`]hmWcbWfbhfUh]cb]b 9bhfYdfYbYi fg\]d dfcj]XYgghi XYbhgk]h\ UWca dfY\Ybg]j Y i bXYfghUbX]b[cZWcbWfdhgžhcc`gž UbX g_]``gcZgi ghU]bUV]`]hmUbX [fYYb hYW\bc`c[m": cW g'UfYUg']bWi XY [fYYb hYW\bc`c[mžXYj Y`cda YbhžhfUbgdcfhUh]cbž YbYf[mžUbX gi ghU]bUV`Y YbhYfdf]gY"H\Y dfc[fUa 'hYUW\Ygghi XYbhg'h\Y Udd`]WUV`Y YbhfYdfYbYi f]U`g_]``g'h\YmbYYX hc gc`j Y dfcV`Ya g'fY`UhYX hc gi ghU]bUV]`]hmUbX dfcj]XYgghi XYbhg'k]h\ fYU`!k cf`Xž\UbXg!cb``YUfb]b[Yl dYf]YbWf hc``YUfb \ck hc gi WWYggZ ``mhfUbgZYf`_bck `YX[Y]bhc dfcXi WfgUbX dfcWrggYg'h\UhVYbYZ]hgcW]YhmUbX h\Y YbhfYdfYbYi f"

H\Y1 G: 7YbhYfZcf9bhfYdfYbYi fg\]dž]gʻUʻbUh]cbU`mfUb_YXžWIa di glk]XY]bhYfX]gVIjd`]bUfmWfbhYf`cWIbhXj lb h\YA i a U 7c``Y[YcZ6i g]bYgg"H\YWfbhYfcZZYfgi bXYf[fUXi UhY Wti fgYgʻUbX`dfc[fUa gʻZcf'U``1 G: ghi XYbhgʻfVi g]bYggʻUbX`bcb! Vi g]bYgg½"K \Yh\Yf`ghi XYbhgʻk ci `X`]_Yhc]bWfYUgYh\Y]f YbhfYdfYbYi f]U``vi g]bYggʻg_]``gždi fgi Yh\Y]f`ck b`Vi g]bYggʻ]XYUgžcf `YUfbk Umgʻhc Vf]b[]bbcj Uh]cb UbX YbhfYdfYbYi f]U``YUXYfg\]d]bhc YI]gh]b[dcg]h]cbgʻUbX Vi g]bYggYgžUb YbhfYdfYbYi fg\]d a]bcf`cf WtbWfbhfUh]cb hYUWXYgj U`i UV`Yg_]``gʻh\UhWta d`Ya YbhUbmXY[fYY`dfc[fUa "Ghi XYbhgʻXc bchbYYX`hc XYWUfY`U a]bcf`cf WtbWfbhfUh]cb hc`hU_YYbhfYdfYbYi fg\]d Wti fgYg"A UbmWti fgYgʻUfY`cZZYfYX`cb`]bY`a U_]b[h\Ya a cfY`UWWfg]V`Y`hc h\YVta a i b]hm'

H\YI G: Ghi XYbh =bbcj Uh]cb =bW VUhcf \UgcdYfUhYX Ug'UdUfhbYfg\]d VYhk YYb h\YI G: 7YbhYf Zcf 9bhfYdfYbYi fg\]d UbX I G: C ZZ]W cZF YgYUfW / =bbcj Uh]cb g]bW &\$\&\\"H\Y7 YbhYffg\ZUW\"hm\\\"ghUZZ\"UbX U'i a b] gi ddcfhUbX a Ybhcf ghi XYbh Wa dUb]Ygh\fci [\YXi Wuh]cb\\"hU]b]b[\"\"zUbX WbbYVM]cb hc h\Y Vi g]bYgg\\"da a i b]hm\"G]bW\"]bW\"dh]cb\\"a cfY h\Ub\\\\\$\$ ghi XYbh Wa dUb]Yg\\"uj Y\YYb bi fhi fYX\"zUW\"YfUhYX\"zUbX\"Ui bW\YX\"H\YgY bYk j Ybhi fYg\\"YV\"Yb bi fhi fYX\"zUW\"YfUhYX\"zUbX\"Ui bW\YX\"H\YgY bYk j Ybhi fYg\\"YV\"Yb bi fhi b]h]Yg\"Zcf ghi XYbhg\UbX fY\\"bhU'i a b] hc \\\U\\"ufhh\Y]f ck b\\"WfYYfg\"H\Y bYk \\ Vi g]bYgg\"g\\"Y\UhY Ya d`cma Ybhcddcfhi b]h]Yg\"Zcf h\Y ghi XYbh\Zci bXYfg\"Ug k\"Y\"Ug'ch\Yfg]b h\Y\\"a a i b]hm\"K\]Y bch\U\"c\"c\"h\Y ghi XYbh\\"a d\"b]\"Yi gYX\"U\\"a a i b]hm\Yb[\U[\YX\"Uddfc\UW\"\"zgca Y ghi XYbh\\"a d\"b]\"Yb\"a i b\"Y\Yb\"Zci b\XYX\"Zcf h\Y\"di fdcg\"c\"z\"UXXf\Ygg]b[\\"a a i b]hm\\U\"Yb[\Yg\"

\hdg.##k k k "i gZ"YXi #dW[g#a U!dfc[fUa #YbhfYdfYbYi fg\]d!WcbWfbhfUh]cb"Ugdl

\hdg.##k k k "i gZ"YXi #YbhfYdfYbYi fg\]d#

\hhdg.##kkkk"i gZ"YXi #YbhfYdfYbYi fg\]d#dfc[fUa g#i bXYf[fUXi UhY#

\hhdg.##kkkk"i gZ"YXi #YbhfYdfYbYi fg\]d#]b]h]Uh]j Yg#]bWVUhcf"Ugdl

9"Ci hfYUVX UbX DUfhbYfg\]dg

CihfYUWX UbX DUfhbYfg\]dg\Ug'VYYb i gYX hc XYgWf]VY hk c X]ZZYfYbhVi hfY`UhYX UddfcUWXYghc Wea a i b]hmYb[U[Ya Ybh'' CihfYUWX \Ug'hfUX]h]cbU`mZcW gYX cb h\Y Udd`]Wbh]cb UbX dfcj]g]cb cZ]bgh]hi h]cbU`fYgci fWgZcf Wea a i b]hmi gY" DUfhbYfg\]dg ZcWi gcb We``UVcfUh]j Y]bhYfUWh]cbgk]h\ Wea a i b]hmUbX fY`UhYX gWxc`Ufg\]d Zcf h\Ya i hi U`mVYbYZ]WJU`YI WXUb[YžYl d`cfUh]cbžUbX Udd`]WUh]cb cZ_bck `YX[Yž]bZcfa Uh]cbžUbX fYgci fWgffYgYUfWX žWdUWJmWi] X]b[žYWebca]W XYj Y`cda YbhžYhWZ"H\YX]gh]bWh]cb VYhk YYb h\YgY hk c]g [fci bXYX]b h\Y WebWidhgcZfYWJdfcWJmmUbX a i hi U`VYbYZ]hžk \]WXUfY YI d`]WJhmYl d`cfYX UbX UXXfYggYX]b dUfhbYfg\]d UWh]j]h]Yg"7 ca a i b]hmYb[U[YX]bgh]hi h]cbg\Uj Y VYYb]bhYbh]cbU`UVci hfYZfUa]b[h\Y]f ci hfYUWX dfc[fUa g'UbX Zi bWh]cbg]bhc UWea a i b]hmYb[U[Ya YbhZfUa Yk cf_h\Uh]ga cfY Webg]ghYbh k]h\ UdUfhbYfg\]d UddfcUWX"

%"CihfYUW

%'%

K \UhW\Ub[Yg'nc'ci hfYUW\dfc[fUa g'UbX'\overline{z} bWh]cbg'fYl hYbg]cb'dfc[fUa gzhfU]b]b[dfc[fUa gzbcb!\WfYX]h\Wci fgYgzYj U'i Uh]cb gi ddcfhzYh\Wch\Uh'fYZY\Wh'U\Wca a i b]hmYb[U[Ya Ybh'dUfhbYfg\]d'UddfcU\\\\\Uj Y'hU_Yb'd'U\W'g]b\W'mci f''Ugh\WUgg]Z]\Wh]cb3 8 Yg\Wf]VY'h\fYYYI Ua d'Yg'cZ'fYdfYgYbhUh]j Y'ci hfYU\\\dfc[fUa g.

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

I G: Webh]bi Yghc cZZYf dfc[fUa gXcW a YbhYX]b h\Y &\$\$) #&\$%\$ Udd`]WUh]cbžk \]`Y YI dUbX]b[ci hfYUW. YZZcfhghc a YYhh\Y\Uh\žYXi WUh]cbžUbX;gi ghU]bUV]`]hmW.U``Yb[Yg;ZUWYX Vm: `cf]XUWca a i b]h]Yg;UbX;h\Y;HUa dUfY[]cb"

%"I G: A cfglb];7c``Y[YcZA YX]WJbYdfcj]XYg\YU'h\ ci hfYUW hc h\YfY[]cb ga cghj i `bYfUV`Ydcdi `Uh]cbgzgYfj]b[
]bX]j]Xi U'g'UWfcgg'h\Y^]ZYgdUb"8 Yj Y`cdYX'k]h\ WJmm`YUXYfgzHUa dU'6UmGhfYYhA YX]WJbY]g'Ughi XYbhl fi b'cf[Ub]nUh]cb
dfcj]X]b[a YX]WJ WUfY hc \ca Y`Ygg']bX]j]Xi U'g'UbX ZUa]`]Yg'h\fci [\ghfYYhfi bgzW]b]WgzUbX Uj Ub'h\UhcZYfgVUg]Wa YX]WJ
WUfY"6F=8; 9'< YU'h\WUfY;7`]b]WJg'Ughi XYbhl fi b'ZfYY W]b]WZcfi b]bgi fYX]bX]j]Xi U'g"H\Y W]b]WJg'Ua i `h]!X]gWJd`]bUfmYZZcfh
k]h\ a YX]WJbYzgcVJU'k cf_zd\mg]WJ'h\YfUdmzd\Ufa UWhzUbX'di V`]W\YU'h\ hc]a dfcj Y'dUh]Ybhk Y``!VY]b["H\Y'MVcf'Mci h\
7`]b]WgYfj Yg'mci h\ U[Yg'%'!&(ždfcj]X]b[gYI i U'#fYdfcXi Wh]j Y\YU'h\ WUfYz<=J 'UbX'GH=hYgh]b['UbX'hfYUha YbhzdfYj Ybh]cb
Wti bgY`]b[zUbX'fYZYffU'g"K cf_]b[k]h\ WJmmUbX Wti bmm[cj Yfba Ybhgzbcb!dfcZ|hcf[Ub]nUh]cbgzUbX'ch\Yf\YU'h\ dfcj]XYfgz
h\YmcZZYf'a YbhU`\YU'h\ gYfj]WYgUbX wti bgY`cfg'g_]``YX]b'hfUi a U'UbX'@ 6HE Z]ggi Yg"DYX]Uhf]Wg'C i hfYUW\ GYfj]WYg
Dfc[fUa fC GDEgYfj Yg\][\!f]g_ UbX'i bXYfgYfj YX W\]`XfYbzUXc`YgWbhgzUbX W\]`Xj]Wh]a g'cZXca Ygh]Wj]c`YbWf"GYfj]WYg
]bWi XY'df]a UfmWUfYzhfYUha YbhZcf W\fcb]WUbX'UW hY]``bYggYgz\YU'h\ UbX'cfU'\m[]YbY YXi WUh]cbzhfYUha YbhIbX'gY`Zl
a UbU[Ya YbhYXi WUh]cb Zcf Ugh\a Užbi hf]h]cb Wti bgY`]b[zW\]`X\ccX\YU'h\ dfca ch]cbzUbX']b'\f fmdfYj Ybh]cb YXi WUh]cb"

&"H\Y1 G: 7 ca a i b]hmGi ghU]bUV]`]hmDUfhbYfg\]d Dfc[fUa f7 GDD&U`ck gWa a i b]h]Yghc dfcj]XY`YUXYfg\]d h\fci [\gi ghU]bUV]`]hmUbX`]j UV]`]hm'7 GDD \UfbYggYg1 G: fYgci fWrgžZUW`hmYl dYfh]gYžUbX'ghi XYbh]bbcj Uh]cb hc WfYUhY W\Ub[Y h\fci [\ Wa a i b]hm]XYbh]Z]YX'dfc YWg"H\YgY Wc``UVcfUh]cbg'UfY'Uhh\Y'ZcfYZfcbhcZgc'j]b[Wa d'Yl 'gcW]U`zYWbbca]WzUbX Ybj]fcba YbhU`W\U`Yb[Yghc ghfYb[h\Yb: `cf]XUWa a i b]h]Yg"H\Ydfc[fUa Yb[U[YgZUW`hmUbX'ghi XYbhg]b'7 9@Wti fgYg UWfcggX]gW]d`]bYggi W\Ug'UfW\]hYWfi fYžVi g]bYggžWf]a]bU`'r gh]WYžYb[]bYYf]b[z[`cVU`gi ghU]bUV]`]hmzUbX'i fVUb'd`Ubb]b[" 7 GDD]gWa dcgYX'cZa i `h]dY'dfc YWfgk \]W\ hU_Y'd`UW'cj Yf'Ub'UWXYa]WmYUf hc UXj UbW'h\YbYYXgcZUWta a i b]hmzk \]'Y YXi WUh]b[h\YbYI h[YbYfUh]cb gk cf_ZcfW'"G]bW' &\$%+zcj Yf') \$\$ i bXYf[fUXi UhY'UbX'[fUXi UhY'ghi XYbhg\Uj Yk cf_YX'cb &' `Uf[Y!gWUY'ghi X]Yg"H\YgY'ghi X]Yg]bWi XY\]ghcf]WdfYgYfj Uh]cbzgYU'Yj Y`f]gYzhfUbgdcfhUh]cb Wtff]Xcfgzk UghYk UhYf a UbU[Ya YbhzUzZcfXUV'Y\ci g]b[z; -Ga Udd]b[zUbX'k U`_UV]`]hmghi X]Yg"Ghi XYbhg'dfYgYbhh\Yz]bX]b[g'hc Wjhmczz]WJU'g'UbX fYg]XYbhg/UbX'a cghfYWbhmfYwta a YbXUh]cbg'Zfca ghi XYbhg'cb'UdYff]`cZZccX'ghi Xmk YfY]bhY[fUhYX']bhc'UWJmmgghfUhY[]Wd'Ub"H\]g]g'Ug'hfcb[`a i hi U`mVYbYz]WJU`ci hfYUW\ dUfhbYfg\]d"

' "H\Y`C g\Yf`@]ZY`cb[@YUfb]b[=bgh]hi hY`fC @@!I G. Ł]g`U`YUfb]b[Wta a i b]hmZcf`c`XYf`UXi `hg`f) \$ŽŁcZZYf]b[WUggYg`]b`h\Y Ufhg`UbX`gW]YbWrgžWta di hYf`hfU]b]b[žUbX`hYW\bc`c[mYXi WUh]cb"H\Y`=bgh]hi hY`g`a]gg]cb`]g`hc`dfcj]XY`]bhY``YWhi U`gh]a i `Uh]cbž gc W]U`]bhYfUWh]cbžgYfj]Wr`cddcfhi b]h]YgžUbX`ci hfYUW\hc h\Y`I b]j Yfg]hmUbX`h\Y`[fYUhYf`Wta a i b]hm`C @@!I G. fg`fcchg`[c VUW_hc %--' k \Yb`]hk Ug`h\Y`I G. 8]j]g]cb`cZGYb]cf`Dfc[fUa g`f8 GDŁk]h\`]hg\Wtbgh]hi Ybhdfc[fUa gžGYb]cfB Yh'UbX`@YUfb]b[]b`F Yh]fYa Ybh"=b`: YVfi UfmcZ`&\$\$) žI G. 8 GD VYWJa Y`C @@!I G. UZhYf`fYWY]j]b['h\Y`Z]fghcZgYj YfU`[]Zhg`Zfca 'H\Y`6YfbUfX C g\Yf`: ci bXUh]cb"F Yj]Yk `cZh\Y`&\$%)!&\$%* Ubbi U`fYdcfh]bX]WUhYg`C @@!I G. Yb[U[YX`k]h\`%{(-+a Ya VYfg`UbX`cZZYfYX &+\$ Wti fgYg"C @@!j c`i bhYYfg\Wtbhf]Vi hYX`UhchU`cZ%(z) (+\cifg]b`&\$%)"

\hhdg.##\YU`h\"i gZ"YXi #a YX]W]bY#ghi XYbhcf[g#hVga

 $\hdg.##\YU`h\"i gZ"YXi #Vf]X[Y#$

\hhdq.##\YU`h\"i qZ"YXi #WUfY#dYX]Uhf]Wq#qYfj]WYq!qdYWU`h]Yq#UX!a YX#mVcf!mci h\!W]b]W

\hdg.##\YU`h\"i gZ"YXi #a YX]WJbY#dYX]Uhf]Wg#dYX]Uhf]Wg!ci hfYUWX!gYfj]WYg!dfc[fUa "

\hdg.##\gWk YV' "\gWi gZ"YXi #V`c[#&\$% #\$&#&\$#XY`]j Yf]b[!\YU`h\!WUfY!gYUZUfYf#

\hhdg.##kkkk"igZ"YXi#Yb[U[YaYbh#Mgdd#\hhdg.##kkk"igZ"YXi#Mcbh]bi]b[!YXiWUh]cb#c``]#UVcihlig#JbXYI"Ugdl

%"&

K \UhW\Ub[Yg\UjYhU_Ybd`UWYfY[UfX]b[]bgh]hi h]cbU`fYgci fWrgfWt!Wff]W`Uf`ghi XYbhgYfj]Wržk cf_#ghi Xmghi XYbh d`UWra Ybhgž`]VfUfmgYfj]WrgžUh\`Yh]WcZZYf]b[gžYhWLh\Uh'UfYdfcj]XYX'Ug'ci hfYUW\ hc'h\Ywta a i b]hmBDfcj]XYYI Ua d`Yg'cZ\ck h\YgY]bgh]hi h]cbU`fYgci fWrg'UfY Wcbg]ghYbhk]h\ UWta a i b]hmYb[U[Ya YbhdUfhbYfg\]d'UddfcUW\"

Dfc^YW#7c``UVcfUh]cb H]h`Y	DfcWfYa Ybh7UgYGhi Xm5bUmg]g&\$%
Cf[Ub]nUh]cbBUaY	< UV]hUh'Zcf' <i [\'7ci=""]``gvcfci="" a="" bhm<="" td="" ub]hmcz'<=""></i>
Dc]bhcZ7cbhUVM	F cb 'Gdccfž7 C C
9a U]`	fgdccf4\UV]hUh\]``gVcfci [\"cf[
D\cbY	, % !&' -!&&(&žYl h%\$+
±bgh]hi h]cbU`DUfhbYf	IG: AiaU7c`Y[YcZ6ig]bYgg27YffmKUg\ž8]fYWhcfz6ig]bYgg <cbcfgdfc[fua< td=""></cbcfgdfc[fua<>
Di fdcgY'cZ'h\]g Wt``UVcfUh]cb	

±bgh]hi h]cbU`DUfhbYf	I G: '< cbcfg'7 c``Y[Yž@]bXm8 Uj]Xgcb'D\"8
Di fdcgY'cZh\]g Wc``UVcfUh]cb	GYfj]WY'hf]d#gYfj]WY!`YUfb]b[WtifgYhc'giddcfhh\Ykcf_'cZh\Y?Yfc``Y'±b]h]Uh]jYfgWtaaib]hm\YU'h\YZcfhg'h\fci[\jc`ibhYYf]b[']b'acV]`YW]b]WgžWtaaib]hmcihfYUW.žUbX'Ugg]gh]b['8f"?Yfc``Y'k]h\`\]gYZZcfhg'Zcf']adfcj

Di fdcgY`cZh\]g Wt``UVcfUh]cb	8. W. JY MY 1996 [Joyyf Jb [k k dwy yw labwy my laby a fice [\ dfc Yw gicb [fyyb v i] X Jb [g \ UbX fUlbk UmY f \ Jb k [mY f \ Jb k k l h i l G \ gir XY brg "H\ Y gw cc 'V cughg UbY k cf _ c Zw ghy f bg ubX d Jd y ghc with f i b c Zu UbX f Y i gy [h i y by f y h i y gw cc 'V cughg UbY k cf _ c Zw ghy f bg ubX d Jd y ghc with f i b c Zu UbX f y i gy [h i y by f y i y gw cc 'g hc] 'Y fy "8 f" m i ubX \ Jg gir XY brg "g c i] 'h ub y by gh X y gw cc 'g hc] 'Y fy "8 f" m i ubX \ Jg gir XY brg "g c i] 'h ub y bj gh X y w "Y X G f 5 H G Z c f 6 [c 9 b Y f [m i 6 [c Y w w y b f] c 'v w y bl b f h i y by gh X y w "Y X W "Y b Y [f ubh z c X k Ugh Y d f c Y w k k] h i d f c Y w g cb [c v u g ub] hull j c b f i b X X X w h i i Y 6 [" ubX A Y] b X U . W Y f i c i b X Uh j c b t b X U f W y c i y " Y b Y W W 'Y b Y [f ubh z c X k Ugh Y d f c Y w k b c c f m u hh f f y b w f c 'y b X W f f i c f j X U 7 y b W f Z c i b X b I j k W b C g m y b W i c i b X b h j c b t m X x X m h i Y 6 [" ubX A Y] b X U . W Y f i c f y x Y Y b Y f Z c f -b g f i w b W h i X c y w y b W i C i b X b h j c b W i X c Z M [f uh f f c f y x y x b w f z c c x Z y b Y f m z k uh f z u b y c w y c c m x b w y c c i b X b h j c b W i X c z w y b W i X l g d x c c z z y b V f X c z w y b W i X l g d x c c z z y b V f X c z w y b y b W i X c z m x b w y c c i b X b y b y w i X l g d x c c z z y b X y x z w y b y b y w i X l g d x c c g m x y b y b y w i X l g d x c z z y b X y x z z b x z z w y c b g x y b x y b y x x z b y x z z b x z z b y x z z b x z z z y x z b x x z b y x z z b x x z b y x z z b x x z x z b y x z z b x x z z z z y x z b x x z z z z y x z b x y x z z b x x z z z z y x z b x y z z z z x x u y x z z b x x x x z z z z y x z b x x z z z z z x x u y x z z z z x x u y x z z z z x x u y x z z z x x u y x z z z x x u y x z z z x x u y x x z z z z x x u y x z z z x x u y x x z z z z x x u y x x z z z z x x u y x x z z z z x x u y x x x x x x x x x x x x x x x x

Dc]bhcZ7cbhUWh	7\f]gh]bU'A]hVXY``
9a U]`	7\f]gh]bU"A]hWkY``4 a Yhfca]b"cf[
D\cbY	, % !&\$-!%\$*+
⇒bgh]hi h]cbU`DUfhbYf	I b]j Yfg]hmcZGci h\`: `cf]XUža i `h]d`Y`i b]hgžWt``Y[Ygžghi XYbh'cf[Ub]nUh]cbg'UbX'Uh\`Yh]Vtj
Di fdcgY'cZh\]g We``UVcfUh]cb	HcYb[U[Y1 G: 'ghi XYbhg'UbX'ghUZZ]b'a YUb]b[Z `dfcYWfg'h\Uh'gi ddcfh'A Yhfcdc`]hUb'A]b]ghf]Yg a]gg]cb'cZWUf]b['Zcf'h\Y\ca Y`Ygg'UbX'h\cgY'Uhf]g_'cZVYWta]b['\ca Y`Ygg'h\fci [\'gYfj]Wfg'h\UhU``Yj]UhY'gi ZZYf]b['ždfca chY'X][b]hmžUbX]bgh]``gY`Zgi ZZJW]YbWff
@Yb[h\cZDUfhbYfg\]d	G]bW*%-) 'UbX'cb[c]b[
Bia VYfcZZUW`hm]bj c`j YX	++: UWV`hm\UbX`ghUZZk\cjc`ibhYYf`cf`cjYfgYY`ghiXYbhjc`ibhYYfg`UbXWcifgY`kcf_
Bia VYfcZghUZZ]bjcjYX	GYY'UVcj Y
Bi a VYf c Zghi XYbhg]bj c`j YX	: fca '&\$%*!&\$%
; fUbhZ bX]b[ž]Z fY`Yj Ubh	b#U
a dUWhichih\Y]bgh]hi h]cb	&\$%+:ccX8f]j Ygk # G:5h\Yh]WgGdf]b[:cchVU`; Ua YUbX:U``7UbbYX:ccX8f]j Y/UbX&\$% B 755 HfUW_Z:]YXHci fbUa Ybh7`ch\]b[8f]j Y"I G:< YUfngZcfh\Y'< ca Y`Yggighi XYbh[fci d j c`i bhYYfgik]W'dYfk YY_Xi f]b[h\Y:U`Y Gdf]b[igYa YghYfgiXc]b[V`ccXdfYggi fYZidi gY gWfYYb]b[gZcfh\Y W]Ybhgk YigYfj Y]bCi hfYUWX UbX Zcfh\Y%\$\$\ca Y`YggZJa]]Ygk \c^i]j Yicbci f Wa di g"H\YmU'gc WfYUhY UbX dfcj]XY\YU'h\ "]hYfUhi fY": YXYfU`K cf_Gh Xmi=bhYfbg\Uj Yh\Y cddcfh b]lmhc "YUfb UbX'gYfj Y]b Yj YfmXYdUfha Ybhcb Wa di g"A Ufg\Ui`7YbhYfZ 7@79% C 79D ghUZZj c`i bhYYf]bci f' <c`]xum7ybhyfz\y'd]b[i "a="]g'U'gYfj" \$\ca="" &\$%+zi="" '&\$%)="" 'h\y'dyx]uhf]w8="" 6fyu_g'zcf="" <c`]xumhybh'i="" [u]b'uyhhyf'dyfgdywf]j="" \c^i]j=""]`]yg]b=""]b]ghf]yg"5wuxya]w:=""]b]ghf]ygifug'ub=""]h\h\y]f=""]wf!=""]wrgubx=""]x="" a="" b[yf"i="" b]hm'k="" b]hyx'a="" b]lmdufhbyfgfk="" bhyyf]b[`uha="" bhyyfg]b="" bhyyfh]a="" bxuh]cbg'ghi="" bxuh]cbj="" byyx":="" c`i="" cb'h\y'hcd]wg'cz\ca="" cb[`ch\yfcf[ub]nuh]cbgłhc="" cdh]cb="" cgdy`7\c]f\ug'dyfzcfa="" ci="" du="" dyf]ybwf="" f'a="" f]b[h\y]f`zfghgya="" fca="" fgxi="" fwk!"<="" fyg\a="" g7`]b]wzfca="" g:="" g:;="" g:?="" ggyfj="" ghi="" gwfyyb]b[gzcfh\y'&)="" gyx="" h\y'7@795'hyfbuh]j="" h\y'<c`]xumhybhy="" h\y]f'dfczygg]cbu`gyfj="" hc="" hyua="" i="" k="" mxy'duf_i="" td="" ua="" ubł="" wbxi="" wca="" wh\yuh\="" wuggyg'g'gdybx'&\c^i="" wx]`xfybk="" xybh"yuxyfg\]d="" xybhgfu``:="" xybhgzghuzzzubx="" xybhj="" y="" y'&\$z\$\$\$\za="" y'cb'h\y'byxgczh\y'hua="" y'cbw'dyfk="" y'gdf]b[="" y'uha="" y\cghyx'h\yghi="" y\uj="" y`ygg="" y`yggbyggzdcj="" ybh[uj="" ydufha="" yfg]cb'dfc[fua="" yfhmžubx\i="" yfmmyuf'k="" yg'ym:="" yghyfj="" yh\cx]gh7\i="" yhfc'="a" yhfcdc`]hub'a="" yufb]b[zh\fyy!xumyl="" yx]b'h\y="" yy_hc="" zcw="" zfca=""></c`]xum7ybhyfz\y'd]b[i>
=a dUWhicbih\Y Wcaaib]hm	5``Yj]UhY`Gi ZZYf]b[! %z (*z\$' (a Yu`g`gYfj YX`hc`\i b[fmbY][\Vcfg`h\fci [\ci h`HUa dU'6Um`y`U% i]bWfYUgY`cj Yf``Ugh`mYUf"! %+(z*' - b)[\hg`cZ`gUZY`g\Y`hYf`ZcfW\]`XfYb`UbX`h\Y]f`dUfYbhg`y`U`&&i]bWfYUgY`cj Yf``Ugh`mYUf"! % z(\$&`ZJa]`]Yg`fYWf]j YX` <c`]xumugg]ghubwf"! %="" %\$`zja="" %z)="" *+z%\$,="" [\ci=""]`]yg`k=""]h\=""]wfg=""]xyx`h\fci="" `gyfj="" b`hh="" dfcj="" g<="" hcmg"!="" hfyuw\="" td="" uhyf="" y`u%'="" y`ywff]wjhmv]``g"!="" yf*zygk="" yfy`ug`i="" yfy`ugg]ghyx`k="" yggybh]u``k="" yx="" z(+\$w\]`xfyb`fywf]j=""></c`]xumugg]ghubwf"!>

ı		
	_	

=a dUWhicbih\Y Waaib]hm	H\Y`a cghg][b]Z]WUbh]a dUWh`\UgVYYb]bXYjY`cd]b[``YUXYfg\]dWUdUWjhmk]h\hYUVXYfgh\fci[\`U7ighca]nYXHYUWXYf@YUXYf5WXYa m'`5`_YmWca dcbYbhcZh\Y`dUfhbYfg\]dkUghcYghUv`]g\UWXfY`cZhYUWXYf`YUXYfgk]h\h\Yg_]``ghc fllcgmghYa Uh]WU``mghi Xmh\Y]f`ck b`dfUWj]WY`VmXYjY`cd]b[Wf]h]WU`XUhU^]hYfUWmUbX`hYUWXYffYgYUfWXYf`g_]``gžf&ŁYZZYVMjjY`mVcUVX`hYUVXYfWbXjYJVYgUbX`]b!gYfj]WYhYUWXYfghc]a dfcjY`dfUWh]WYžUbX`fl Eg_]``Zi``mZUVYjhUhY`cV!Ya VYXXYXžXjYZYWJMXdfijDMZXdfijDMZXdfYgYcbMjjWYb;CjjaYyWXXjCjjjxXjNWXXMjXXXdfiyXUWXjCjjjxXXjVYgXXUMJjMJjWXMdfijDMZXdfijDMZXdfiyYgYcbMjjWbb;CjjaYyWXXjCjjjxXjNWXXMjXXXdfiyXUWXjCjjjxXXjVYgXXUMJjMjJWXMdfijDMXXMdfiyJMjJWXMdfiyMdfiyJMjJWXMdfiyMjJWJMjJWJMjJWJMjJWJMjJWJMjJWJMjJWJMjJW

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

Bi a VYf'cZ'ZJW'`hm]bj c`j YX	%%
Bia VYfcZghUZZ & & bjcjYX	
Bia VYfcZghi XYbhg 7`cgYhc'*\$\$`ghi XYbhg'cj Yf'h\Y'dUgh%*`mYUfg"]bjc`j YX	
; fUbhZ bX]b[ž]Z fY`Yj Ubh	b#U
a dUWhicbih\Y]bgh]hi h]cb	Ghi XYbhYXi WJh]cb`]b`di V`]W\YU`h\žgcV]JU`k cf_žUdd`]YX`Ubh\fcdc`c[mždgmWkc`c[mžYb[]bYYf]b[`hcdfYdUfY`Zcfk cf_]b`h\Y`Wtaaib]hmUbX`hc]bWfYUgY`_bck`YX[Y`UVcihX]j Yfg]hm
=a dUWhicbih\Y Waaib]hm]bih\YiHUadUfY[]cb" Waaib]hm	

DUfhbYf', %%

Dfc^YVV#7c``UVcfUh]cb H]h`Y	H\Y`G_]``g`7YbhYf% 1 G: `DUfhbYfg\]dg	
Cf[Ub]nUh]cbBUaY	H\Y'G_]``g'7YbhYf	
Dc]bhcZ7cbhUVh	7 Y`YghY`FcVYfhgž: ci bXYf#8]fYVMcf	
9a U]`	₩cVYfhg4 h\Yg_]``g\#bhYf"cf[
D\cbY	, % !+\$' !% &('9I h'%\$(
±ogh]hi h]cbU`DUfhbYf	I G: F][\hdUh\FYgYUfW\UbX:=bbcjUh]cb:7YbhYfžCZZ]WrcZWcaaib]hm9b[U[YaYbhUbXDUfhbYfg\]dgz7mVYfgYWrf]hm8YdUfhaYbh	
Di fdcgY`cZh\]g Wt``UVcfUh]cb Hk c`di fdcgYg. Hc Vf]b[`]b`UXX]h]cbU``UWUXYa]W`Ub[i U[Y`gi ddcfh'Zcf Y`Ya YbhUfmghi cddcfhi b]lmihc Yb[U[Y`. K G`ghi XYbhg'8 f"B Uh\Ub:]g_`ÿ`7 m\YfgYW f]hm`Gi a a Yf 7 Ua hc YI dcgY`ghi XYbhg'hc 7 m\YfgYW f]hm`UbX`>cVg`]b`h\Y`Z]Y`X`5 bch\Yf`7`Ugg`k cf_]b[`cb 8 UhUVUgY		
@Yb[h\cZDUfhbYfg\]d	%"mYUf"UbX"cb[c]b[
Bia VYfcZZUW`hm]bj c`j YX		
Bi a VYfcZghUZZ]bj c`j YX		
Bia VYf c Zghi XYbhg %% lbj c j YX		
; fUbh'Z bX]b[ž]Z fY`Yj Ubh	b#U	
⇒a dUWhicbih\Y]bgh]hi h]cb	: YXYfU`K cf_Ghi Xmghi XYbhgʻUfYʻUV`Y hc [U]bʻUi h\Ybh]WbcbdfcZ]hʻUbX Wca a i b]hmYl dYf]YbWf k cf_]b[k]h\ mci h\ hc \Y`d h\Ya XYj Y`cd h\Y]f`]hYfUWng_]``gʻh\fci [\ 8 f"Hf]bUʻGdYbWf g Yj]XYbWf!VUgYX fYUX]b[Wiff]Wi`i a "5XX]h]cbU`: K Gʻghi XYbhfgŁ[U]b YI dYf]YbWf`]b UXa]b]ghfUh]j Y#c[]gh]WgʻhUg_gʻ]bʻbcbdfcZ]ha UbU[Ya Ybh'UbXa Uf_Yh]b["	

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

&"&

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

H\YfY\UjYVYYb`U'bi a VYf`cZ`UWh]cbg`hU_Yb`hc`]b]h]UhY`UbX`gi ghU]b`dUfhbYfg\]dg"CjYf`h\Y`dUghZ]jY`mYUfgžC79D`\Ug`]b]h]UhYX Wta a i b]hmdUfhbYf`A UhW.!i dYjYbhg"7ca a i b]hma Ya VYfg`UfY]bj]hYX`hc`a YYhZUW`hmUbX`ghUZZZfca 'UWfcggTG. hc`hU`_UVci hdUfhbYf]b["FYdfYgYbhUh]jYg`Zfca '79`i b]hg`gdYU_hc`dUfh]W]dUbhg`UVci hcddcfhi b]h]YgžYl dYfh]gYžUbX`gYfj]WYg Uj`UV`Y`h\fci [\`h\Y]f`fYgdYVW]jY`i b]hg"H\YgY`dUfhbYfg\]dgfUb[Y`Zfca 'g\cfh\hYfa j`c`i bhYYf]ga hc`a cfY`cb[!hYfa

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

]bZcfa Uh]cb]gg\UfYX]b Ubbi U fYdcfighc h\Y Wa a i b]lmžghUhY Ugk Y``Ug`cW'`UXj]gcfmVcUfXg'UbX'ch\Yf'gci fW'g"C bY i b]ei Y YZZcfh]gh\Y K 9! 75 F 9 dfc[fUa žU Wfcgg! Wc``UVcfUh]cb cZa i `h]d`Y ghU_Y\c`XYfgk cf_]b[hc Vi]`X hfi ghVYhk YYb Wa a i b]lmiUbX fYgYUfW.Yfghc UXXfYggh\Y [Ud]b\YU'h\ Yei]lmi'K 9! 75 F 9 i gYg'U' *\$!XY[fYY Wa a i b]lmYb[U[Ya Ybh a cXY`"A U'cf Wa dcbYbhg]bWi XY Ub 5 Xj]gcfm6cUfXž7 ca a i b]lmi YX F YgYUfW. F Yj]Yk 7 ca a]hhYYž7 ca a i b]lmiB Yhk cf_ž F YgYUfW.Yf B Yhk cf_UbX 7 ca a i b]lm9b[U[Ya Ybh''K 9! 75 F 9 ZUW]hUhYg Wa a i b]lmiZcfi a g'Ufci bX \YU'h\ WUfY dUfh]W `Uf`m h\Y dUfh]WdUh]cb UbX dfca ch]cb cZWa a i b]lmck bYfg\]d cZfYgYUfW. ghi X]Ygh\Uha UI]a]nY\YU'h\ Yei]lmi'H\Ymi gY h\Y]bZcfa Uh]cb hc]a dfcj Y dfc[fUa g'UbX'gYfj]W'g"

Cb[c]b['UggYgga Ybh\Ug'U`ck YX'bYk 'dfc[fUa gždfc'YWlg'UbX'Wc``UVcfUh]j YYZZcflg'hc Ya Yf[Y'Zcf'h\Y'cb[c]b[VYbYZ]hcZ Vch\'h\Y Wca a i b]hm'UbX'h\Y'i b]j Yfg]hm'\hdg.##\YU'h\"i gZ'YXi #d\Ufa UWn*#k Y!WUfY

&")

Dfcj]XY'UgiaaaUfmbUffUh]jY'XYgWf]V]b[cjYfU``WkUb[Yg'h\Uh\UjY'hU_Yb'd`UWY'fY`UhYX'hccihfYUWk'UbX'dUfhbYfg\]dg'cb Waadig'g]bWf'h\Y``UghWUgg]Z]WUh]cb""=bmcif'bUffUh]jYžUXXfYgg'h\Y'hfUYWMcfmcZcihfYUWk'UbX'dUfhbYfg\]dg'cbmcif Waadig'ÿ k\YfY\UjY'mciVYYbžk\YfY'UfY'mcibckžk\YfY'UfY'mcighfUhY[]WU``md`Ubb]b[cb'[c]b[3Dfcj]XY'fY`YjUbh`]b_g"

H\YfY'UfY'a UbmZUWrcfg'h\Uh\Uj Y]bZi YbWrX'h\Y'hfUYWrcfmcZci hfYUW\UbX'dUfhbYfg\]dg'Uhl G: cj Yf'h\Y'dUgh'%\$ mYUfg"H\Y YghU']g\a YbhcZzH\Y'DUhY`7c``Y[YcZ; `cVU'`Gi ghU]bUV]]mzh\Y'C ZZJWr'cZ7ca a i b]hm9b[U[Ya Ybh'UbX'DUfhbYfg\]dgzC ZZJWr cZ7cfdcfUhY'DUfhbYfg\]dgzUbX'h\Y'7YbhYf Zcf'@YUXYfg\]d UbX'7]j]W9b[U[Ya Ybh"5XX]h]cbU``mzcj Yf'h\Y'dUgh'%\$ mYUfg'l G: \Ug'hfUbg]h]cbYX']bhc U'a U'cffYgYUfW\]bgh]hi h]cb'UbX'hcXUm]g'cbY'cZU'ga U``bi a VYf'cZdi V']WfYgYUfW\i b]j Yfg]h]Yg bUh]cbk]XY'k]h\'J Yfm<][\FYgYUfW\5Wh]j]hmh\Uh]g'U'gc XYg][bUhYX'Ug'7ca a i b]hm9b[U[YX'Vmh\Y'7UfbY[]Y': ci bXUh]cb Zcf'h\Y'5Xj UbWra Ybh'cZHYUW\]b["

!H\Y`YghUV`]g\a YbhcZh\Y`DUhY``7 c``Y[YcZ; `cVU``Gi ghU]bUV]`]hm\Ug``YX`hc`dUfhbYfg\]dg'k \]W\UXXfYgg`Ybj]fcba YbhU` W\U``Yb[Yg`gi W\fYX`h]XY`cf`gYU``Yj Y`f]gY"

!H\YWYUh]cb`UbX`ZibX]b[`cZ'C 7 9D`\Ug``YX`hc`]bWYYUgYX`Uk UfYbYgg`Ua cb[`ZUW`hm`UVci hh\YVYbYZ]hg`cZWca a i b]hmYb[U[YXh\YW]b[`Z`YUfb]b[`UbX`gW.c`Ufg\]d"H\]g`\Ug`cdYbYX`h\Y`Xccf`hc`bYk `dUfhbYfg\]dg`UbX`ci hfYUW.YZZcfhg`UbX`h\Y`YI dUbg]cb`cZWci fgY`cZZYf]b[g"

!H\Y'UXcdh]cb'cZh\Y'9b\UbWYX; YbYfU''9Xi Wh]cb'k]``]bWfYUgY'ghi XYbh'UbX Wa a i b]hmdUfhbYfg\]d XYj Y`cda Ybh'Yj Yb Zi fh\Yf'Ug'ZUW'`hm]b'U``X]gWJd`]bYg'U`][b'h\Y'9; 9 W ff]W``i a k]h\ Wa a i b]hmbYYXg'UbX'ghi XYbh``YUfb]b[ci hWa Yg''Ghi XYbhg k]```\Uj Y'UVfcUXYf'fUb[Y'cZ`YUfb]b[cddcfhi b]h]Yg''H\]g]g'Ub']bgh]hi h]cbU`'df]cf]hm''

!H\YYghUV`]g\a YbhcZh\Y`C ZZ]WY`cZ7cfdcfUhY`DUfhbYfg\]dg`\Ug`YX`hc`h\Y`XYj Y`cda YbhcZbYk`dUfhbYfg\]dg`UbX cddcfhi b]h]Yg`Zcf`fYgYUfW. UbX Vi g]bYgg"H\Y`C 7 D`dfcj]XYg`U'bYk `Xccf`]bhc`l G: hc VYhhYf`WcbbYWfYgYUfW.Yfgž]bhYfbg`UbX ch\Yf`i b]j Yfg]hmUggYhg`hc`cWU`Vi g]bYggYg`VmfYXi WJb[h\Y Wca d`Yl]hmcZk cf_]b[k]h\]b`U`Uf[Y`gmghYa "

!9I dUbXYX dfc[fUa a]b['UbX']bhYbh]cbU Yb[U[Ya Ybhh\fci [\'7@79'U`ck g'Zcf'bYk dUfhbYfg\]dg'bUh]cbU``mUbX'UVfcUX Zcf ghi XYbh`YUXYfg\]d XYj Y`cda Ybh'

7fYUhYXVm=bgh]hi h]cbcb%#&, #&\$% "@UghacX]Z]YXcb(#%)#&\$% "

!H\YYI dUbg]cbcZh\Y7c``Y[YgcZBifg]b[žA YX]WjbYžDiV`]W< YU`h\`UbX'D\Ufa UWncjYfh\Y'dUgh'%\$ mYUfg\Ug\UX'Ug][b]Z]WUbh]a dUWncbdUfhbYfg\]d`XYjY`cda Ybh'UbX'ghi XYbh`YUfb]b[hcUXXfYggfY[]cbU`\YU`h\ W\U``Yb[YgZcfdYcd`YcZ'U``U[Ygž]bWca Yg'UbX'gcW]YhU`bYYXg"BYk W]b]Wgzdfc[fUag'UbX'WYbhYfg`\UjYVYYbcdYbYX]bWc``UVcfUh]cbk]h\ WjmrzghUhY'UbXfY`][cig'cf[Ub]nUh]cbg"

!H\YfY`c\Wh]cb`cZh\Y`A cfgUb]'7c``Y[Y`cZA YX]\\\bYhc`Xck bhck b`HUa dU`k]``Vf]b[bYk `dUfhbYfg\]dg'h\Uh\\\b']a dfcj Y`h\Y\YU`h\`cZh\Y\\can a i b]hmhc`Zcfa 'U`K Y``bYqg'8]qhf]\\\"

!H\Y`fUd]X`XYj Y`cda YbhcZfYgYUfW\`Uhi G: `\Ug``YX`hc`h\Y`WfYUh]cb`cZdUfhbYfg\]dg`hc`UXXfYgg`Xfi ['UXX]Wh]cbžGH9A YXi WUh]cbžW]a UhY`W\Ub[YžX]UVYhYqžUi h]qa ža YbhU``\YU`h\`UbX`hYW\bc`c[mhc'bUa Y`1 qh'U`ZYk "

9UW. cZh\YgY ZJWcfg'UbX Yj Ybhg`\Uj Y]bZi YbWrX h\Y [fck h\ cZbYk 'UbX]bbcj Uh]j YdUfhbYfg\]dg'Zcf'ghi XYbhgžZJWi `hm'UbX Wta a i b]hm'5g Dfcj cghK]`Wtl ghUhYX]b\]gUXXfYgg'hc ZJWi `hm]b`&\$%+ž 5Vcj Y`U``žUhl G: žk Y`fYa U]b XYYd`mWta a]hhYX hc di fgi]b[h\Y hfi h\ h\fci [\f][cfci g'gW]YbWr UbX gWkc`Ufg\]džUg'hc[Yh\Yfk Y`ghf]j Y`hc]a dfcj Y`h\Y`\YU'h\ UbX`k Y`` VY]b[cZ h\Y Wta a i b]h]Yg'k Y`gYfj Y '5g'l G: a cj Yg'hc Wtbgc`]XUhY h\Y h\Y h\fyY Wla di gYgžci hfYUW\ UbX`dUfhbYfg\]d XYj Y`cda Ybhk]`` Wtbh]bi Y`hc [fck 'UbX ZcW g'cb hYUW\]b[žfYgYUfW\ UbX'gYfj]Wr Zcf'h\Y Z hi fY`k Y``VY]b[cZci f Wta a i b]h]Yg'UbX`U``l G: ghi XYbhg''

FYZYVMjcbUbX5XXjhjcbU` ±bZcfa Uhjcb

fCdhlcbU'Ł

FY!7`Ugg]Z]WUh]cb. H\Y'7 UfbY[]Y: ci bXUh]cb Zcf'h\Y'5 Xj UbWa Ybh'cZ HYUW\]b[

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

fCdh|cbU'Ł

D`YUgYi gYh\]ggdUWrhc XYgWf]VY UbmUXX]h]cbU`WXUb[Ygg]bWrmci f`UghWUgg]ZJWUh]cb bchWUdhi fYX]b dfYj]ci gei Ygh]cbg"

7 ca a i b]hmYb[U[Ya Ybh\ UgʻU'k UmgʻVYYb Uhh\ Y ZcfYZfcbhcZh\ Ya]gg]cb cZh\ Y1 b]j Yfg]hmcZGci h\ : `cf]XU"H\ Y XUhU fYdcfhYX gYYa]bUXYei UhY hc hfi `mWcbj Ymh\ Y Wca a]ha Ybh'UbX h\ Y WcbghUbh]bbcj Uh]cb h\ UhhU_Ygʻd`UWY YUW. XUmhc]a dfcj Y ci fʻghi XYbhg i bXYfghUbX]b[cZh\ Y]f d`UWY]b h\ Y k cf`X UbX h\ Y]f UV]`]hmhc a U_Y UX]ZZYfYbWY]b h\ Y "]j YgʻcZch\ Yfg" K \] Y1 G: `\Ugʻ[fck b]b fYgYUfW. YZZcfhgžh\ Y1 b]j Yfg]hmWcbh]bi Ygʻnc Yb[U[Ya YUb]b[Zi ``mhc UXXfYggʻgcWJYhU` W.U``Yb[Yg` `cWU``mžfY[]cbU``mžbUh]cbU``mžUbX [`cVU``mʻ5gʻDfYg]XYbh; Ybg\ UZhghUhYX]b \Yf``YhhYf hc h\ Y7 UfbY[]Y: ci bXUh]cb]b `&\$\$*ž K]h\ UWca a]ha Ybh'nc hYUW.]b['UbX "YUfb]b[/U`cb[k]h\ X]gWcj Yfmž]bbcj Uh]cbžUbX h\ Y WfYUh]cb cZbYk _bck `YX[Y/ Wca a i b]hmYb[U[Ya Ybh\ UgʻfYdfYgYbhYX Ub]a dcfhUbh'UbX]bhY[fU`dUfhcZ^]ZYUh1 G: g]bWfci f`Zci bX]b[" H\]g]gʻUgʻhfi Y

FY!7`Ugg]Z]WUh]cb. H\Y'7 UfbY[]Y: ci bXUh]cb Zcf'h\Y'5 Xj UbWa Ybh'cZ HYUW\]b[

7 fYUhYX Vm=bgh]hi h]cb cb %#&, #&\$% "@Ugha cX]Z]YX cb (#%) #&\$% "

FYei YghZcfDYfa]gg]cb hci gY 5 dd`]WUh]cb ZcfFYgYUfW.

⇒ cfXYfhc VYhhYfi bXYfghUbXh\Y]bgh]hi h]cbU]nUh]cb cZWta a i b]hmYb[U[Ya Ybh]b\][\YfYXi WUh]cbžk Yk ci `X`]_Yhc a U_Yh\YfYgdcbgYg]bh\YUdd`]WUh]cbgUj U]`UV`YZcffYgYUfWk di fdcgYgZcfVch\h\Y7UfbY[]Y: ci bXUh]cb UbX]hg'5Xa]b]ghfUh]j YDUfhbYfZcfh\Y7ca a i b]hm9b[U[Ya Ybh7`Ugg]Z]WUh]cbžh\YGk YUfYf7YbhYfZcfDi V`]WGYfj]WYUh6fck b'l b]j Yfg]hmžUbXZcfch\Yf\][\YfYXi WUh]cbfYgYUfWkYfq'Uq'k Y``"

GifjYmfYqdcbqYqk]``VYa UXYUjU]`UV`Y ZcffYqYUfW difdcqYqcb`m]Zh\Y Waaib]mdUfhbYfdfcj]XYqWabqYbh"

 $\pm b b c W U g Y k] ``f Y g d c b g Y g V Y g V f Y X h V h] Z m h V W a a i b] h m d U f h b Y f c f h V W b a d i g ! U ``f Y g Y U f W k k] `` \ c b c f U b c b m a] h m ' b b c W U g Y k] `` \ c b c f U b c b m a] h m ' b b c W U g Y k] `` \ f Y g Y U f W k k] `` \ c b c f U b c b m a] h m ' b b c W U g Y k] `` \ f Y g Y U f W k k] `` \ c b c f U b c b m a] h m ' b b c W U g Y k] `` \ f Y g Y U f W k k] `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ c b c f U b c b m a | h m ' b b c W U g Y k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` \ f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k k | `` f Y g Y U f W k k | `` f Y g Y U f W k k k | `` f Y g Y U f W k k k | `` f Y g Y U f W k k k | `` f Y$

D'YUgY fYgdcbX hc 5 cf 6 VY ck.

5"=WebgYbhhc\Uj]b[h\Y]bZcfa Uh]cbdfcj]XYX]bh\YUdd`]WUh]cbZcfh\YdifdcgYgcZfYgYUfW\"=bdfcj]X]b[h\Y]bh\Y]bh\YUdd`]WUh]cbZcfh\YdifdcgYgcZfYgYUfW\"=bdfcj]X]b[h\]gWebgYbhžbY]h\Yf=bcfa mWea a i b]hmdUfhbYfcf[Ub]nUh]cbbcfh\YWUa di g=dUfhbYfk]h\k]``VYX]gWegYX"!!Ya dhm!

6"=WebgYbhhc`\Uj]b[h\Y]bZcfaUh]cbdfcj]XYX]bh\YUdd`]WUh]cbZcfh\YdifdcgYgcZfYgYUfW\"=bdfcj]X]b[h\]gWebgYbhž=U`gcU[fYYam]XYbh]hmcfh\Y]XYbh]hmcZamWeaaib]hmdUfhbYfcf[Ub]nUh]cbaUmVYfYjYU`YX"