

7ci fgY[.]Cj Yfj]Yk

5WUXYa]W±bZcfaUh]cb

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

7ci fgY 8YHJ] g

7 fYX]hDc]bhg * *

Gi a a UfmcZh\Y 7ci fgY

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

- % 5dd`m`]bhYfdYfgcbU``Wcaaib]Wuh]cb``WcbWYdhg`UbX`dfcWYggYg`hc`cf[Ub]gUh]cbU``WcbhYl hg`UbX dfcV`Yag
- &" 8Ya cbgffUhY _bck `YX[Y`cZcf[Ub]qUhcbU``Wca a i b]\WUhcb `Wcb\Wdhq
- ' " 5dd`mbY[ch]Uh]cb'UbX'dYfgi Ug]cb'g_]``gž'UbX'h\Ycf]Yg'cZa UbU[]b['W\Ub[Y
- ("91Ua]bY'h\Y']adcfrUbWY'cZjU'i]b['X]jYfg]mžYh\]WU`XYWJg]cb'aU_]b['UbX'WcbZ]WifYgc'ih]cb

HYUWX]b['GhfUhY[]Yq'

HYUW]b[GhfUhY[]Yg.

7 cfdcfUhY 'UbX' ±bhYfdYfgcbU` '7 ca a i b]\Wbh]cb']g'XYg][bYX' hc'YbWti fU[Y'UbX'WkU``Yb[Y'mci 'hc'fYZYWhcbUbX']a dfcj Y'mci f'ck b'Wta a i b]\Wbh]cb'dfU\W}\W'"

H\Y`Wci fgY`]g`XY`]j YfYX`]b`U`gYa]bUf`Zcfa ž`k\YfY`X]gW gg]cbgž`UbU`mg]g`UbX`Udd`]WUh]cb`cZ_Ym'WcbWYdhg UbX`fYWYbhfYgYUfW\`Z]bX]b[g`UfY`i gYX`hc`XYj Y`cd`U`XYYdYf`i bXYfghUbX]b[cZghfUhY[]WWca a i b]\WUh]cb" H\Y`gi V^YWfi]g`XYg][bYX`Ufci bX`U`a]l`cZUWhj]h]Yg`hc`Vi]`X`dUfh]\W]dUbhg¾33`]bhYfYghUbX``YUfb]b["`H\Y`hk c\ci f`WUgg`dYf]cX`YUW\`k YY_`k]```]bWi XY.

33 ······U 'gYWgcb 'cb '_Ymdf]bWg'Ygž'k \]W\ 'k]```]bffcXi WY 'h\Y 'fY`Yj Ubh'WcbWYdfg 'UbX'h\YcfmcZWcfdcfUhY UbX']bhYfdYfgcbU``Wca a i b]WUf]cb"

3/83.....U'qYf]Yq'cZX]qWiqq]cbq'UbX'UWij]hJYq'U]a YX'UhUdd`m]b['h\Y' Ymdf]bWjd`Yq"

Hc cVHJ]b h\ Y Z ``VYbYZ]hg Zca h\]g Wci fgYzgh XYbhg UfY YbWci fU[YX hc YI hYbX mci fgY`ZVYmcbX h\ Y]f Wca ZcfnncbY"'H\ Uha YUbg UWlj Y`mdUfl]W]dUl]b[']b h\ Y Wcbj YfgUl]cbg UbX X]gW gg]cbg ']b 'WUgg Ug Vch\ 'U `]ghYbYf 'UbX 'gdYU_Yfz VY]b['cdYb 'hc 'UbX k]``]b['hc 'WcbhYa d`UhY 'U'fUb[Y 'cZdYfgdYWlj Yg 'UbX'hfmbYk 'k Umg

 $Ghi XYbhg`UfY`Ug_YX`hc`fYZYWhcb`h\Y`gYhfYUX]b[g`VYZcfY`YUW\`WUggž`UbX`Vf]b[`h\Y]f`ei Ygh]cbg`UbX`]XYUgUVci hh\Y`fYUX]b[g`VUgYX`cb`h\Y]f`ck b`i b]ei Y`YI dYf]YbWfg`hc`YUW\`WUgg"`$

GHJfhXUhY. Bch5dd`]WUV`Y

@Yb[h\.'&ž)\$\$Ž'kcfXg

 $8YHU]^g. ^8) $$^k cfXg^Zcf^k f]HYb^fYZYWIjcb''^H\]g^]g^H\Y^Z]bU^^UggYgga Ybh'HUg_''K f]HYb^ZYYXVUW_dfcj]XYX j]U^Hi fb]h]b''$

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

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

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

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

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

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

GdYWJU`7cbq]XYfUhcb55dd`]WUhcbq

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

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

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

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

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

ł G][b]ZJWUbhmiUZZYWimci fidYfZcfa UbWY]biUggYggUVYkcf_žVYjhUiZcfa U`YbX!cZgYa YghYfiYl Ua]bUhjcbžU WUggihYghžU`UVcfUhcfmhYghžU`gYa]bUfidfYgYbhUhjcbicfUbmch\YfiZcfa icZUggYgga Ybh'

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

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

D`U[]Uf]ga `]g`i g]b['h\Y`k cfXg`cf`]XYUg`cZch\Yfg`UbX`dfYgYbh]b['h\Ya `Ug`mci f`ck b"'\lefi\Wb'hU_Y`a Ubm Zcfa gžZfca `XY`]VYfUhY`W\YUh]b['hc`UVW]XYbhU`mWcdm]b['Zfca `U`gci f\W' k]h\ci hUW_bck `YX[Ya Ybh'

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

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

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

 $7c^{i}$ g]cb. 'k cf_]b['k]th. 'cth. Yfg'Vi h'dUgg]b['c\Zth. Y'k cf_'Ug'U'dYfgcb'g']bX]j]Xi U''k cf_"'7c''i g]cb'U'gc

I	

1	HYI N/cc_'W.UdhYf'%\$
	GYa]bUf [.] 7cbhYbh
I	

I		
K YY_''%+'GYdhYa VYf'! &' 'GYdhYa VYf	GYa]bUf	XYbhjhmUbX:7 ca a i bj\WJhjcb']b'; `cVU``UbX A i `hj\W`hi fU`'7 cbhYl hg' HYl h\vcc_'\W.\Udh\yfg') `UbX'\% GYa]bUf'7 cbh\ybh • K \Uhjg'[`cVU`]nUhjcb'\UbX'\ck 'XcYg']h
		 < ck 'UfY' h\Y'X]g\theta ifg\g'cZX]j \text{Yfg]hmUbX}
6fYU^&('GYdhYa VYf'! ' \$'GYdhYa VYf	GYa]bUf	Dck Yf'UbX'Wcblfc``]b'cf[Ub]gUlf]cbg'
φ OTUINA VII		HYI Wcc_'WXUdHYf'-
		GYa]bUf WebHybh

	GYa]bUf	9h\]Wg'UbX'jU'iYg']b'cf[Ub]gUh]cbg'
C ₩cVYf		HYI hvcc_'W.Udhyf'%(
		GYa]bUf WcbHybh
		 K \mixc Yth]Wg'a UthYf3 K \UhWcbghh HYg'Yth]WU'XYWJg]cb'a U_]b[UbX'Yth]WU'VY\Uj]ci f3 K \Uh']g'thY'']b_'tc'j U'i Yg'UbX'\ck'a Um gtUbXUfXg'j Ufm3 K \UhYth]WU''UWJcb'thYgtg'WUb'VY'Udd']YX3 @Y[U']mz'ZU]fbYggz'j]g]V]']tmz'[YbYfU']mz' 'Y[UWh

F Ygci fWYg DfYgWf]VYX F Ygci fWYg

7\YbYmž'; ž'7\f]ghYbgYbž'g'

H\Y`ghi XYbh`YUfb]b[`YI dYf]YbW']g`]a dcffUbhirc`h\Y`: UW`hmž'Wcbj Ybcfg`UbX``YWhi fYfg`]b`h\]g`Wchi fgY" H\fci [\ci hih\Y`Xi fUh]cb`cZ7cfdcfUhY`UbX`±bhYfdYfgcbU``7caai b]WUh]cb`ghi XYbhg`UfY`YbWchi fU[YX`hcdfcj]XY`Y]h\Yf`ZcfaU``UbX#cf`]bZcfaU``ZYXXVUW_cb`h\Y]f`YI dYf]YbWrg`cZh\Y`Wchi fgY"`H\]g`k]```VY`UbU`mgYX VmghUZZUbX`]bWcfdcfUhYX`]bhc`h\Y`gYaYghYf`dfc[fUa`k\YfY`dcgg]V`Y"`5hih\Y`WcbWi g]cb`cZh\Y`gYaYghYf`UZcfaU``ghi XYbhYj U`i Uh]cb`]g`dfcj]XYX`hc`YbUV`Y`ZYYXVUW_cb`h\Y`Wchi fgY`WcbhYbhUbX`hYUW\]b[`ghUZ'`H\]g U``ck g`Zcf``cb[Yf`hYfa`ghi XYbh]bdi h]bhc`Wchi fgY`XYg][b"`

•

⇒a U[Y'7fYX]h

6cX]Yg/ =bHYfZJWYg &\$%*

7F = 7CG

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