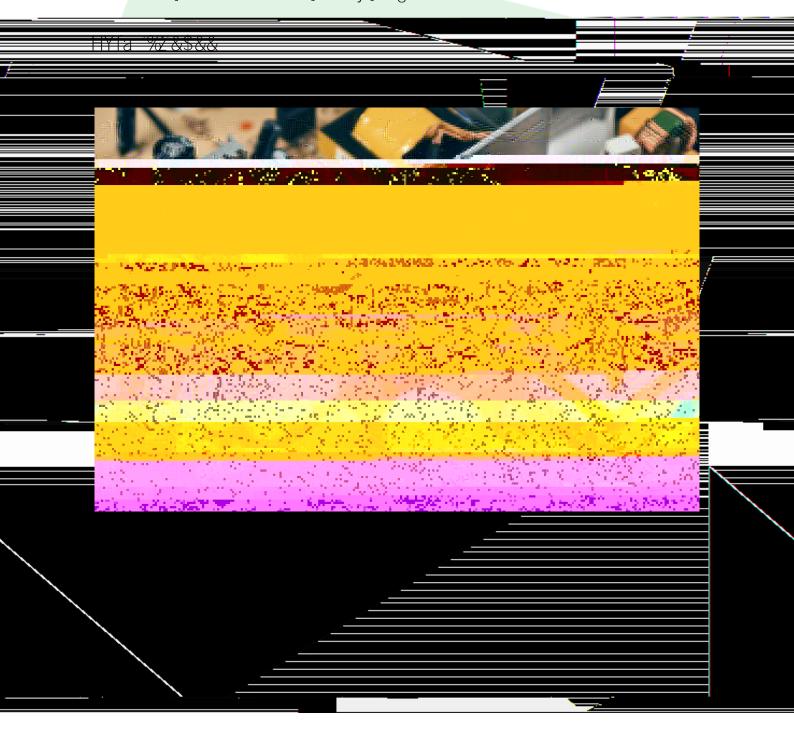


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=blfcXi Wjcb^hc^9`YWfcb]W8Yj]Wfg



7ci fgY[·]Cj Yfj]Yk

GhJZZ 7 cbhJWh 8 YhJ] g

7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`]m	@cWUhjcb	D\cbY
GhYd\Yb [*] 6fYa bYf	gdVfYa bYf4 i bgk "YXi "Ui	Hc 'VY 'UXj]gYX	H9H6 ⁻ &%+) +, -\$

8 Ya cloghfUhcfg

B Ua Y	9a U]`	5j U]`UV]`] ˈm	@cWUh]cb	D\cbY
G\U\f]mUf`GUZJh 8]dHJ				

7ci fgY 8YHJ] g

$I b h c Z 7 f Y X h^*$

Gi a a UfmcZh\Y 7ci fgY

7ci fgY 5 a g

H\]gʻgi VYWfik]``Wcj YfʻUʻVfcUXʻfUb[YʻcZhcd]Wgʻ]bWi X]b[ʻgYa]WcbXi Whcfʻa UhYf]Uʻgžd!bʻf bWh]cbgžX]cXYgžgc`Uf`WY``gžZ]Y`X`YZZYWfilfUbg]ghcfgž``][\hiYa]hh]b[ʻX]cXYgʻUbX`cd!Ua dg"

7]fW]hUdd`]WUrjcbg'k]```]bWi XY'VUg]WWjfW]hhcdc`c[]Yg'h\Uh']``i ghfUhY'_YmcdYfUrjb['W\UfUWhYf]grj\Wg'cZ Y`YWfcb]WXYj]WYg'UbX'WjfW]hdf]bWjd`Yg'Wf]rj\WU`Zcf`fYbYk UV`Y'YbY[fm'Udd`]WUrjcbg"

H\Y`U]a `cZh\]g`Wci fgY`]g`hc`\Y`d`ghi XYbhg`i bXYfghUbX`h\Y`df]bW]d`Yg`UbX`cdYfUh]cb`cZZ bXUa YbhU` Y`YWfcb]WXYj]WYgž]b`dUfh]W\`Ufžh\cgY`fY`Yj Ubhhc`F YbYk UV`Y`9bYf[miUdd`]WUh]cbg"

7 ci fgY @YUfb]b[Ci hWca Yg

5ZHYfigi WWYggZi ``mWca d`YhJb[ih\]giWci fgYžmci ig\ci `X`VY`UV`Yihc.

@YUfb]b['Ci hWca Y	95 GHJ[Y %7ca dYhYbW]Yg
%"`7 U`W``UhY`_YmdUfUa YhYfg`Zcf`gYa]WcbXi Wcfg`UbX`Z bXUa YbhU`ghfi Wi fYg`cZdb`^ bWncbg"	D9%''%Ž'D9%''
&"`9Id`U]b'h\Y`cdYfUh]cb'cZWcaacb'gYa]WcbXiWcf'XYj]Wfg'UbX WU`W`UhY'_YmdUfUaYhYfg'cZh\YgY'XYj]Wfg"	D9%''%Ž'D9%''
' "'6i]`X`UbX`UbU`mgY`W]fW]g'W&bg]gf]b['cZY`YWf6b]WW&a dcbYbfg]bWiX]b['X]cXYg'UbX'ffUbg]gfcfg"	D9%" ž'D9%")

HYUW]b['GhfUhY[]Yg'

5XX]h]cbU`7ci fgY ±bZcfa Uh]cb

Mci 'UfY'YI dYWfYX'hc'UffYbX'U```YWfi fYgž'k cf_g\cdg'UbX``UVg']b'cfXYf'hc'a UI]a]gY``YUfb]b["'Mci 'k]``bYYX hc'Wca d'YfY'dfY!k cf_'Zcf'YUW.'cZmci f'k cf_g\cdg'UbX``UV'WUggYg"'+b'UXX]h]cb'hc'h\Y``YWfi fY'bcfYg'UbX fYWcfX]b[gž'mci 'k]```VY'YI dYWfYX'hc'fYUX'fY'Yj UbhifYI hg'Ug'fYei]fYX"'; fci d``YUfb]b[']g'YbWci fU[YXž'Vi h Ubmgi Va]ffYX'k cf_'a i ghVY'gc'Y`mmci fgž'Ug'UWWcfX]b['hc'Ghi XYbhF Ygdcbg]V]`]h]Yg'UbX'7 cbXi Wf'I BGK Uggi a Yg'h\UngY`ZX]fYWfYX'ghi XmcZh\]g'_]bX']g'i bXYffU_Yb']b'UXX]h]cb'hc'UffYbX]b['ZJWY!hc!ZJWY 'WUggYg h\fci [\ci h'h\Y'Wci fgY"

5ggYgga Ybh

5ggYgga Ybh'tUg_	K Y][\h	8iY'8UHY	7 ci fgY '@YUfb]b[Ci hWca Yg '5 ggYggYX
%"Ei]nnYg	&) ı	K YY_') ž%\$	%ž [*] &
&" F Ydcfhg	&) ı	K YY_`) ž, ž%\$	%ž [*] &
' "':]bU`'9I Ua) \$1	HcʻVYʻW¢b∄fa YX	%ž [*] &

5ggYgga Ybh% Ei]nnYg

#D'WUgg'ei]nnYg'k]``'VY'fi b'Xi f]b['th\Y'thYfa 'tc'UggYgg'i bXYfgtUbX]b['cZa UthYf]U``UbX'U``ck 'gti XYbtg'tc [Ui [Y'th\Y]f'i bXYfgtUbX]b["'th\YfY'k]``'VY'tk c'ei]nnYg'Xi f]b['th\Y'thYfa 'UbX'UfY'k cfth\'&) | 'cZZ]bU``a Uf_']b tctU''"

 $\label{eq:continuity} \textit{Ghi XYbhg'k} \] \text{``Wca d'YhY'U'dfUW} \text{'W'ei} \] \text{'`lb'k} \ YY_' (\ \text{'hc'} [\ \text{Ui } \ [\ Y'ghi \ XYbh'dfc [\ fYgg'' \] \] \text{''lb''} \] \text{''lb''} \]$

5ggYgga Ybh'Wf]hYf]U

 $\label{eq:continuous} D`YUgY`gYY`A\ ccX`Y`G]hY`Zcf`5ggYgga\ Ybh`7f]hYf]U`Xi\ f]b[\ 'hYfa"$

5 http://bxubww.F.Yei]fYa Ybhg

7ci fgY GWX YXi `Y

@YWn fYg'Hi YgXUm'%*!'\"Ua ž'K YXbYgXUm-'!'\"Ua

K cf_g\cdg``Hi YgXUm'%'Ua '!'%'da ž'Hi YgXUm'&'!'('da

J]Yk 'WUgg'h]a YhUV'Y

H]a YHJV`Y

8 UhY	Hmd Y	7 cbh/bh	
K YY_'%'%(': YVfi Ufm! % ': YVfi Ufm	@YWhi fY	±blfcXi Wgcb′hc′GYa]WcbXi Wcfg	
K YY_'&.'&%: YVfi Ufm!	@YWn fY	7 Uff]Yfg`]b`GYa]WbXi Wcfg	
&) : YVfi Ufm	K cf_g\cd	DfcV`Ya 'GYh'%	
K YY_'' . '&, ': YVfi Ufm!	@YWn fY	DB 1 bWjcbg	
('A UfWX	K cf_g\cd	@HGd]WY'G]a i `Uhjcb'5gg][ba Ybh%'#DfcV`Ya 'GYh%	
K YY_'(.'+'A UfW.'!'%%	@YWn fY	CdhcY`YWrfcb]WDB^↑bWnjcb`XYj]WYg	
A UfVX	K cf_g\cd	DfcV`Ya 'GYh'%	
K YY_').'%('A UfVX'!'% A UfVX	@YWn fY	8]cXY 7]fW]h5dd`]WUh]cbg	
	K cf_g\cd	DfcV`Ya 'GYh'&	
	5ggYgga Ybh	±bʻWUggʻE i]nʻ%	
K YY_'*.'&%'A UfW\'!'&)	< ca Yk cf_	FYj]Yk 'K YY_	
A UfVX		fl BGK :: `Yl]V]`]hniK YY_Ł	
K YY_'+. '&, 'A UfWX'! '%	@YWifY	ACG: 9Hg	
[5df]`	K cf_g\cd	@HGd]WY'G]a i `Uhjcb'5gg][ba Ybh'&'#DfcV`Ya 'GYh'&	
K YY_', .'('5df]`!', '5df]`	@YWifY	Cd ⁻ 5a dg	
	K cf_g\cd	DfcV`Ya 'GYh&	
K YY_''%%'5df]`'!'%)	@YWifY	FYbYkUV`Y`9bYf[m5dd`]WUh]cbg	
[5df]`	K cf_g\cd	@HGd]WY'G]a i `Uh]cb'5gg][ba Ybh' '#DfcV`Ya 'GYh'	
K YY_'%\$.'% '5df]`'!'&&	@YWifY	FYbYkUV`Y`9bYf[m5dd`]WUh]cbg	
5df]`			

F Ygci fWYg

DfYgWf]VYX F Ygci fWyg

FYWca a YbXYX HYI hg.

6"; "'GlfYYha Ubž'G"? "'6UbYf'YYž'Gc`]X'GlUhY'9`YWfcb]W8Yj]WYgž'G]I h\'9X]hJcbž'DfYbhJWY'<U``'fJ ccX'Zcf'db \\ bWhJcb'YI d`UbUhJcbg'Ug'k Y```Ug'A CG: 9HgŁ

5"G"`GYXfU`UbX`?"7"`Ga]h\ž`A]\McY`Y\Mfcb]\W7]f\W]\gž`G]I h\`9X]h]cbž`C | ZcfX`I b]j Yfg]\mDfYggž`&\$\%`cf``UhYf" fJ Yfm[ccX`Zcf`a Uh\Ya Uh\\WJ``VUqYX`\Mf\W]\h\Ub\\mq]q\!"

GcZhk UfY

@HGd]WY. 7]fW]hg]a i `Uhcf" 7 Ub`VY`Xck b`cUXYX`Zfca `\hd.#k k k "`]bYUf"Wca #XYq][bhcc`g#gcZk UfY#_@Hgd]WY"'J Yfmi gYZ ``hc``YUfb`\ck 'hc'i gY°

FYWca a YbXYX FYgci fWYg

Ch\YffYWca a YbXYXVcc_q

A "5"; fYYbž'Gc`Uf`7Y``g!'CdYfUhjb['Df]bWjd`Ygž'HYW\bc`c[miUbX'GmghYa'5dd`]WUhjcbgž'H\Y'Ib]j Yfg]lmiBYkGcih\'KU`Yq"fj ccX'Zcf'db'^bWhjcb'UbX'gc`Uf'WY```VUq]WqŁ"

5"F" < Ua V`Ymž'9`YWf]WU``9b[]bYYf]b[.'Df]bW]d`Yg`UbX'5dd`]WUh]cbgž: ci fh\ '9X]h]cbž'DYUfgcb"

<cfck]m UbX <]``ž5fhcZ9`YWfcb]Wgž5bmYX]h]cbž7Ua Vf]X[Y1 b]j Yfg]hmDfYgg"fl ccX`Zcf'i bXYfghUbX]b[Y`YWfcb]WWcbWYdhg`UbX`W]fW]hcdYfUh]cbž`][\hcb'h\Y'a Uh\qŁ

< Y`dZi``ZcfgYa]WcbXiWhcfgUbX'db'\ibWh]cbg

\hdg.#kkk"djYXiWUh]cb"cf[# gcaYb]WYUb]aUh]cbg

H\YfY`UfY`UWi U``m`chg`cZk YVg]hYg`h\Uh[c`h\fci [\`gYa]WcbXi Whcf`XYj]\W'g"

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

: YYXVUW_cb`h\Y`Wci fgY`]g`[Uh\YfYX`dYf]cX]WU``mii g]b[`j Uf]ci g`a YUbgž]bWi X]b[`h\Y`I BGK a m9I dYf]YbW'`dfcW'ggž]bZcfa U``X]gW gg]cb`]b`h\Y`Z]bU``WUgg`Zcf`h\Y`Wci fgYžUbX`h\Y`GW\cc`'g Gh XYbh#GhUZZa YYh]b[g"'Mci f`ZYYXVUW_`]g`hU_Yb`gYf]ci g`mžUbX`Wcbh]bi U``]a dfcj Ya Ybhg`UfY`a UXY`hc`h\Y Wci fgY`VUgYXž]b`dUfhžcb`gi W\`ZYYXVUW_"

± 'h\]g'WtifgYžfYWYbhacX]ZJWUhJcbg'fYgi 'hJb['Zfca 'ghi XYbhZYYXVUW_']bWi XY'Yad\Ug]g]b['h\Y'WJfW]hUbU'mg]g'UgdYWg'UbX'U'[fYUhYf'Yad\Ug]g'cb'Wtbj YfhYf'WJfWi]hg'''

@UVcfUhcfmK cf_g\cd \dd \dzcfa Uhjcb

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

K cf_'gi Va]hhYX``UhY`k]h\ci hUb`Uddfcj YX`YI hYbg]cb`Vmh\Y`Wci fgY`WccfX]bUhcf`cf`XY`Y[UhYX`Ui h\cf]hm]g gi VYWihc`U``UhY`dYbU`hmcZ)ı 'a Uf_'fYXi Wf]cb`dYf`XUmž`Wcbg]ghYbhk]h\`ch\Yf`GDF 99`Wci fgYgž'UbX WUddYX`Uh)``XUmg`f\&\\$`\ci fg\z`UZhYf`k\]W\`U`ghi XYbhWUbbchgi Va]h'Ub`UggYgga Ybh'

 $\label{thm:condition} $$HY^`UhY`dYbU`hm]g`Udd`]YX`dYf`WU`YbXUf`XUmif]bWi X]b[`k YY_YbXg`UbX`di V`]W\c`]XUmgŁ'h\Uhih\Y UggYgga Ybh]g`cj YfXi Y''`H\YfY`]g`bc`dfc!fUhU`cZh\Y``UhY`dYbU`hm`Zcf`gi Va]gg]cbg`a UXY`dUfhk Umih\fci [\'UXUm'$

K cf_'gi Va]hhYX'UZhYf'h\Y''XYUX`]bY'Zcf'UVgc`i hY'ZU]''']g'bchUWWdhYX'UbX'U'a Uf_'cZnYfc'k]``'VY'Uk UfXYX Zcf'h\Uh'UggYgga Ybh']hYa "

cf'gca Y'UggYgga Ybh']hYa gž'U'``UhY'dYbU`hma Umbch'VY'Uddfcdf]UhY"'H\YgY'UfY'WYUf'm']bX]\WUhYX']b'h\Y Wci fgY'ci h']bYz'UbX'gi W\'UggYgga Ybhg'fYWY]j Y'U'a Uf_'cZnYfc']Zbch'Wca d`YhYX'Vmh\Y'gdY\\JZ]YX'XUhY" 91 Ua d'Yg']bWi XY.

U"''K YY_`mcb`]bY`hYghg`cf``UVcfUhcfmk cf_`k cfh\`U`ga U```dfcdcfh]cb`cZh\Y`gi VYWha Uf_žcf

V"''C b`]bY ei]nnYg k \YfY Ubgk Yfg UfY fY`YUgYX hc gh XYbhg cb Wca d`Yhlcbžcf

W"DfcZYgg]cbU`'UggYgga Ybh'hUg_gž'k \YfY'h\Y']bhYbh]cb']g'hc'WfYUhY'Ub'Ui h\Ybh]WUggYgga Ybh'h\Uh\Ug'UbUVgc'i hY'gi Va]gg]cb'XUhY'

····cf

X""DUgg# U]"UggYgga YbhHJg_g"

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

 $\label{thm:continuous} IBGK ``Ug`Ub`cb[c]b[`Wcaa]haYbhhc`ZcghYf]b[`U`W`hifY`cZ`YUfb]b[`]bZcfaYX`VmUWUXYa]W]bHY[f]hm'`5``IBGK ``ghiXYbhg`\UjY`U`fYgdcbg]V]`]hmhc`UX\YfY`hc`h\]g`df]bW]d`Y`cZUWUXYa]W]bHY[f]hm'`D`U[]Uf]gaibXYfa]bYg`UWUXYa]W]bHY[f]hmUbX`]g`bchhc`YfUhYX`UhIBGK "`B'SY[Sde_SfG@EI[eVW{\WSeaXafZWbES`VbSee[YfZW_aX\Sekagdai`ž$

D`U[]Uf]ga `]g`U`hmdY`cZ]bhY``YWi U``h\YZh'`±iWUb`HU_Y`a UbmZcfa gžZfca `XY`]VYfUhY`W\YUh]b[`hc`UWV]XYbHU``m Wcdm]b[`Zfca `U`gci fWYk]h\ci hUW_bck `YX[Ya Ybh'`I BGK `\Ug`dfcXi WYX`U`k YVg]hY`k]h\`U`k YU`h\`cZ fYgci fWg`hc`gi ddcfhighi XYbhg`hc`i bXYfgHUbX`UbX`Uj c]X`d`U[]Uf]ga žij]g]h`ghi XYbh'i bgk "YXi "Ui #d`U[]Uf]ga "H\Y`@YUfb]b[`7 YbhfY`Ugg]ghg`ghi XYbhg`k]h\`i bXYfgHUbX]b[`UWUXYa]W]bhY[f]hmUbX`\ck 'bchhc'd`U[]Uf]gY" H\YmU`gc`\c`X`k cf_g\cdg`UbX`WUb`\Y`d`ghi XYbhg`cbY!cb!cbY"

Mci 'UfY'U'gc'fYa]bXYX'h\Uh'WUfYZ\ ``h]a Y'a UbU[Ya Ybh']g'Ub']a dcfhUbhdUfhcZgh XmUbX'cbY'cZh\Y]XYbh]Z]YX'WUi gYg'cZd'U[]Uf]ga ']g'dccf'h]a Y'a UbU[Ya Ybh'Gh XYbhg'g\ci `X'U``ck 'gi ZZ]W]Ybh'h]a Y'Zcf

5 WUXYa]W = 2cfa Uhlcb

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

: YYXVUW_cb'h\Y'Wci fgY']g'[Uh\YfYX'dYf]cX]WU``mi g]b['j Uf]ci g'a YUbgž]bWi X]b['h\Y'I BGK a m9I dYf]YbW''dfcWYggž]bZcfa U``X]gW gg]cb']b'h\Y'Z]bU``WUgg'Zcf'h\Y'Wci fgYž'UbX'h\Y'GW\cc''g Gh XYbh#GHJZZa YYh]b[g"'Mci f'ZYYXVUW_']g'HU_Yb'gYf]ci g`mž'UbX'Wcbh]bi U``]a dfcj Ya Ybhg'UfY'a UXY'hc'h\Y Wci fqY'VUqYXž']b'dUfhž'cb'qi W\'ZYYXVUW"

 $5 ```ghi XYbhg`UfY`YI dYWhYX`hc`fYUX`UbX`VY`ZJa]`]Uf`k]h\`I BGK `[i]XY`]bYg`UbX`dc`]WYg''` \pm 0`dUfh]Wi`Ufž ghi XYbhg`g\ci`X`VY`ZJa]`]Uf`k]h\`h\Y`Zc``ck]b[.$

(E5 HY b X Ub W)

Œ BGK '9a U]`'5XXfYqq

CEGdYWU`'7cbg]XYfUhcb

(19) Ua q

(Enddfcj YX'7 U'W 'Uhcfg

(E5 WUXYa]W < cbYghmUbX D`U[]Uf]ga

(Bei]hUV`Y`@YUfb]b['GYfj]WYg

a U[Y'7fYX]h

=a U[Y'hU_Yb'Zfca '\hdg.#k k k "dYl Y`g"Wca #gYUfWX#WfrW]h#

7F = 7CG

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

5W_bck `YX[Ya YbhcZ7ci bhfm

 $K Y `UW_bck `YX[Y `h,Y `6YXY[U `dYcd`Y `k \c `UfY `h,Y `hfUX]h]cbU ``W ghcX]Ubg `cZh,Y ``UbXg `cb `k \] W `I BGK ? Ybg]b[hcb `WUa di g `]g ``cWUhYX"$

5ddYbX]l. '9b[]bYYfg'5i glfU`]U'f95Ł'DfcZYgg]cbU`'9b[]bYYf'7ca dYhYbWm GHJbXUfX

Dfc[fUa '±bhYbXYX'@YUfb]b['CihWca Yg	
?bck `YX[Y`UbX`g_]```VUgY	
D9%"%7cadfY\Ybg]j Yž'h\Ycfm'VUgYX'i bXYfgHJbX]b['cZh\Y'i bXYfd]bb]b['bUhi fU`'UbXd\mg]\WJ`'g\JYb\W'g'UbX'h\Y'Yb[]bYYf]b['Z bXUaYbHJ`g'Udd`]\WJV`Y'hc'h\Y'Yb[]bYYf]b['X]g\Jd`]bY	
D9%"&"7 cbWYdh U``i bXYfghJbX]b['cZh\Y'a Uh\Ya Uh]Wgž'bi a Yf]WJ``UbU`mg]gž'ghJh]gh]Wgž'UbX Wca di hYf'UbX']bZcfa Uh]cb'gW]YbWYg'k \]W\'i bXYfd]b'h\Y'Yb[]bYYf]b['X]gW]d`]bY	
D9%" =: #e!XYdh_i bXYfghUbX]b['cZgdYW]U`]ghVcX]Yg`cZ_bck `YX[Y`k]h\]b`h\Y`Yb[]bYYf]b[X]gW]d`]bY	