

7ci fgY[·]Cj Yfj]Yk

GHJZZ:7cbHJWh:8YHJ]`g`

7cbj Ybcfg

B Ua Y	9a U]`				

7ci fgY 8YW] g

7 fYX]hDc]bhg * *

Gi a a UfmcZh\Y 7ci fgY

± 'h\]g'Wci fgY'mci 'k]```YUfb'\ck 'hc'UbU`mgY'hYI hg'Zcf'h\Y'di fdcgY'cZhfUbg`Uh]cb"'6UgYX'cb'`GmghYa]W
: i bWf]cbU`'@|b[i]gh]WgžU'a cXY``h\UhfY[UfXg``Ub[i U[Y'Ug'U'a YUb]b[!a U_]b['fYgci fWYž'h\Y'Wci fgY
]bhfcXi Wrg'mci 'hc'U'gYhcZhcc`g'h\Uhk]```YbUV`Y'mci 'hc'i bXYfghUbX``]b[i]gh]WwXc]Wrg'a UXY']b'U'hYI hik]h\]b
]hg'WcbhYI higc'h\Uhmci 'WUb'a U_Y']bZcfa YX'XYW[g]cbg'k\Yb'hfUbg`Uh]b["'

7ci fgY @YUfb]b[Ci hWca Yg

- %" 5 bU`mgY`[fUa a Uh]\WU``UbX``YI]\WJ``W\c]\W\g`a UXY`]b`hYI hg`UbX`]bhYfdfYhh\Y`UbU`mg]g`]b`\\cbY\\Jcb'hc\a YUb]b[\UbX`\\cbY\H\h```
- &" 5dd`mihYl hiUbU`mg]g`hc`a U_Y`]bZcfa YX`XYW]g]cbg`]b`lfUbg`Uh]cb```
- ' " >i gh]ZmlfUbg`Uh]cb`W\c]\W\g`]b`dfcZ\gg]cbU``\\cbh\l hg``
- ("FYUX'hYI hg'Wf]hJWU``m'Zcf'h\Y'di fdcgY'cZhfUbg`UhJcb

HYUWX]b['GhfUhY[]Yq'

A C 8 @) %**]blfcXi Wrg`\ck 'hc`UbU`mgY`hYI hg`Zcf`h\Y`di fdcgY`cZhfUbg`UhJcb`UbX`]bhYfdfYhJb['XfUk]b['cb GmghYa]W: i bWrJcbU``@]b[i]ghJWg`fG: @\"`H\]g``]b[i]ghJWh\Ycfm]g`\][\`mfY`Yj Ubh'hc`hfUbg`UhJcb`UbX]bhYfdfYhJb['VYWUi gY`]hdfcj]XYg`i gYZ ``hcc`g`bYYXYX`hc`UbU`mgY`a YUb]b[']b`WcbhYI hžk \]W\`]g`U`WcfY Y`Ya Ybh]b`hfUbg`UhJb['UbX`]bhYfdfYhJb["'

H\]g'Wci fgY'Wcbg]grg'cZU'rk c!\ci f''YWr fY'UbX'U'cbY!\ci f'ri rcf]U''YUW.'k YY_"'=b'rh\Y''YWr fYz'gri XYbrg'k]''
YUfb'rh\YcfYr]WU''WcbWrdrg'UVci ria YUb]b[z'WcbrYl riUbX'[fUa a Uf'''H\Un']g'\ck 'X]ZZYfYbri_]bXg'cZa YUb]b[
UfY'Wcbgrfi YX'rh\fci [\"Yl]Wc![fUa a Ur]WU''Wxc]Wrg'k]h\]b'rh\ring fY'Ur]gcb'rc 'WcbrYl ri'=b'rh\Y'ri rcf]U'z'rh\Ym
k]'''YUfb'rh\fci [\'Urbi a VYf'cZrfUbg`Ur]cb!fY`UrYX'UWr]j]r]Yg'\ck 'rc'UbU'mgY'rhYl rg'rc'i bXYfgrUbX
X]ZZYfYbri_]bXg'cZa YUb]b['UbX'\ck 'rc'bY[cr]UrYX'UWr]j]r]Yg'\ck 'rc'UbU'mgY'rhYl rg'rc'i bXYfgrUbX
X]ZZYfYbri_]bXg'cZa YUb]b['UbX'\ck 'rc'bY[cr]UrY'gi WX'a YUb]b[g']b'rh\Y'dfcWrgg'cZrfUbg`Ur]cb'''=b'rh\]g'rk Urr
gri XYbrg'rk]''''Y' Yei]ddYX'rk]rh\dfuWr]WU''rcc`g'rk]rh\rk\]mwUffmci rij Uf]ci g'rUg_g'Ug'U'rfUbg`Urcf'UbX*cf']brh\fdfYrhf']b'rh\Y'rfYU''rk cf'X'Ug'rk Y`''Ug'rh\YcfYr]WU'
_bck 'YX[Y'rc'XYZ/bX'rh\Y]f'XY`]VYfUrY'XYWJg]cbgz'rk\]W\]g']bWrYUg]b['m]a dcfrUbri]b'rh\Y'dfcZrgg]cbU'
Wca a i b]rm]b'rh\Y'&%griWrbri fm'''

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FYZYW¶jY'YggUm	(\$1	\$*#\$) #&\$% `\$\$\$`5A	&Ž

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GhUfhiXUhY.: cfa U`Yl Ua 'dYf]cX

@Yb[h\. "%") \ci fg

8YHJ]`g. `Ghi XYbhg`Wca d`YhY`Ub`Yl Ua]bUh]cb`hc`XYa cbghfUhY`h\Y]f`UV]`]hmhc`UbU`mgY`Wca d`Yl `[fUa a Uh]WU` ZYUhi fYg`cZhYl hg"Ghi XYbhg`fYWY]j Y`U`gi a a Uh]j Y`[fUXY"

Hi fb]hjb gYhjb[. H\]g]g bchU Hi fb]hjb Ugg][ba Ybh

5ggYgga Ybh& HYI hUbU`mg]g hYghg

GhUfh'XUhY. '&, #\$' #&\$% '\$-.\$\$'5A

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8YHJ]`g. `Ghi XYbhg`Wca d`YhY`hk c`hYghg`hc`XYa cbghfUhY`h\Y]f`UV]`]hmhc`UbU`mgY`VUg]W[fUa a Uh]WU``ZYUhi fYg cZhYl hg"Ghi XYbhg`fYWY]j Y`U'qi a a Uh]j Y`a Uf_`k]h\`]bX]j]Xi U``ZYYXVUW_"`

Hi fb]hb gYhb[. H\]g]g bchU Hi fb]hb Ugg][ba Ybh

5ggYgga Ybh' FYZYWNji Y YggUm

GhUfhiXUhY. '\$-#\$) #&\$% '\$) .\$\$ 'DA

@Yb[h\." \$\$\$"k cfXq

8YHJ]`g. `Gh XYbhg`k f]hY`Ub`YggUmfl ž\$\$\$`k cfXgŁ`hc`XYa cbglfUhY`h\Y]f`UV]`]hmhc`Udd`mhYl hUbU`mg]g _bck `YX[Y`UbX`g_]``g`hc`lfUbg`Uh]cb"Gh XYbhg`fYVW]j Y`]bX]j]Xi U``Wca a Ybhg`UbX`[fUX]b[`i g]b[`U'fi Vf]WH\]g]q`h\Y`Z]bU``UqqYqga YbhZcf`UhYbXUbWY'di fdcqYq"`

 $\label{eq:higher} \begin{tabular}{ll} High \$

5 https://bxubwww.Fyei]fYaYbhg

 $\hbox{Ghi XYbhg'UfY'ghfcb[`m'YbWc'i fU[YX'hc'UhhYbX'U```WUggYg'UbX'fYj]Yk'``YWhfY'fY'WcfX]b[g''' } \\$

7 ci fgY GWX YXi `Y

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H]a YtUV`Y

8 UhY	Hmd Y	7 cbhYbh	
K YY_"%"% ": YVfi Ufm'!"&(@YWhifY	HYI himdYg'UbX'fY[]ghYf	
: YVfi Ufm	Hi hcf]U`	FY[]ghYf'UbU`mg]g	
K YY_"&."&) ": YVfi Ufmi!"	@YWhifY	; fUa a Ufž'A YUb]b['UbX'7 cbhYl h	
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K YY_" ."("A UfWX"!"%\$	@YWhifY	7`UggYg'UbX'ZI bWnjcbg'	
A UfVX	Hi hcf]U`	7 cbghhi YbWnUbU`mg]g	
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K YY_^).^% ^A UfWX^!^&(A UfWX	FYUX]b[
K YY_^*.^&) ^A UfVX^! ^' %	@YWhifY	@c[]WU``a YUb]b['UbX'HYI h5bU`mg]g'HYgh%	
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K YY_'‱'&- '5df]`'!'% A Um	@YWn fY	5dd`]WUIJcb'hc'lfUbg`UIJcbž']bHYfdfYIJb['UbX#cf X]gWci fgY'UbU`mg]g'fHi YgXUm' \$'5df]`'- 'Ua '!'%&'da l	
	Hi hcf]U`	EiYghjcbgʻUVci hh\YʻZjbU``Yl UaʻfHiYgXUm'\$'5dfj` %&!%daž'!('daŁ	

FYgci fWyg

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Image: Ybwb: bh/f'u'dfcv'ya k \yb'uhh/a dh/b['hc'gi va]hmci f'ugg][ba Ybhh\fci [\ 'Hi fb]h/bž'd'YugY

HY'Yd\cbY'9| h/fbu''Gi ddcfhcb'-',) '' ' ' %cf'Ya U] 'h\Ya 'cb'Y! h/fbu'h/hgi ddcfh4 i bgk "YXi "Ui "'Gi ddcfh
\ci fg'UfY', .\$\$Ua '-'%\$.\$\$da 'cb'k YY_XUmg'UbX'-.\$\$Ua '-') .\$\$da 'cb'k YY_YbXg'fl *) 'XUmg'U'mYUfŁ" Image: UfY'i bUV'Y'hc'gi va]hmci f'Ugg][ba YbhXi Y'hc'U'ZJi 'hk]h\ 'Hi fb]h/b'mci 'a UmUdd'mZcf'Ub'Y! h/bg]cbž'Vi hmci
a i ghfYhJ]b'mci f'h/w_Yhbi a VYf'Zfca '9! h/fbu''Gi ddcfhfU'cb['k]h\ 'Ubmch\Yf'YY] UbhXcW a YbhgŁ'hc
]bWi XY'Ug'Yj]XYbW'hc'gi ddcfhmci f'Y! h/bg]cb'Udd']WJh/cb" Image: Ya U]''9! h/fbu''Gi ddcfhmci 'k]'`
Ui hca Uh/WJ'mfYW'] Y'U'h/w_Yhbi a VYfž'Vi h]Zmci 'hY'Yd\cbY'mci 'k]'`'bYYX'hc'gdYW/ZWJ'`mUg_'Zcf'cbY''
Hi fb]h/b'U'gc'dfcj]XYg'i dXUh/g'cb'h\Y]f'gmghYa 'ghUh' g'cb'Hk]hYf"

; YbYfU``mž'UggYgga YbhiHug_g'a i ghVY'gi Va]hhYX'Y`YVWfcb]\W)``mj]U'Y]h\Yf'Hi fb]hjb'cf'U'A ccX`Y Ugg][ba Ybh'' =b']bgHJb\W'g'k \YfY'h\]g']g'bchdcgg]V`Yž']hk]``'VY'gHJhYX'cb'mci f'\\circ i fgY'g'A ccX`Y'g]hY'k]h\ U`hYfbUhj Y'gi Va]gg]cb'XYHJ]`g''

cfi]bZcfa Uh]cbicbi\ckihcigi Va]hUgg][ba Ybhgicbi]bYij]UiA ccXiY.i\hdg.#gh XYbh'i bgk "YXi "Ui #\ck! qi Va]hUgq][ba Ybha ccXiY

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"'=hWJb'hU_Y`a Ubm Zcfa gžZfca `XY`]VYfUhY`W\YUh]b['hc`UWW]XYbhU`mWcdm]b['Zfca `U`gci fWY'k]h\ci hUW_bck `YX[Ya Ybh'

IBGK [fcidg'd'U[]Uf]ga]bhc'h\Y'Zc``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["

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

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

8 i d`]\WUh]cb`ffgY`Zd`U[]\Uf]ga "Ł gi Va]\h]b[`mci f`ck b`k cf_ž]b`k \c`Y`cf`]b`dUfhžk \YfY`]h\Ug`dfYj]ci g`m VYYb`dfYdUfYX`cf`gi Va]\hYX`Zcf`Ubch\Yf`UggYgga Ybhcf\Wci fgY`UhI BGK `cf`Ubch\Yf`i b]j Yfg]\m'

7 cffYWnfYZYfYbWlb['dfUWnWyg.

- DUfUd\fUg]b[žgi a a Uf]g]b[žYggUmk f]h]b['UbX h]a Y a UbU[Ya Ybh
- 5ddfcdf]UhY'i gY'cZUbX'Uhtf]Vi h]cb'Zcf'U'fUb[Y'cZa UhYf]U`g']bWi X]b['hYl hž']a U[Ygž'Zcfa i `UY'UbX WcbWYdhg"

- i bXYfgfUbX mci f'f][\hg'UbX'fYgdcbg]V]`]hJYg'Ug'U'gh XYbhUhl BGK
- VY`Uk UfY`cZd`U[]Uf]ga ž`Wcdmf][\hz'l BGK `Gh XYbh7cXY`cZ7cbXi WhUbX`5VWWdhUV`Y`l gY`cZ I BGK `=\forall H`F Ygci f\W\g`Dc`]\m\m
- VY 'Uk UfY 'cZh\Y 'ghUbXUfXg 'cZVY\Uj]ci f'Yl dYWYX 'cZYj YfmcbY ']b 'h\Y 'l BGK 'Wca a i b]hm
- `cWUHY 'gYfj]WYg'UbX `]bZcfa UH]cb'UVci hI BGK 'UbX'I BGK '@]VfUfm

Gca Y'cZh\YgY'UfYUg'k]``VY'ZJa]`]Uf'hc'mci ž'ch\Yfg'k]``VY'bYk"'; U]b]b['U'gc`]X'i bXYfgHJbX]b['cZU``h\YfY`UhYX'UgdYWng'cZ9@+69'k]``\Y`d'mci 'a U_Y'h\Y'a cghicZmci f'ghi X]Yg'UhI BGK "'\\hd.##qi VYWfi |XYg"`]VfUfm'i bqk "YXi "Ui #\`]qY#JVci hY`]qY

5 WUXYa]W = b Zcfa Uh cb.

: cf`YggYbhJU``gh XYbh`]bZcfa UhJcb`fY`UhJb['hc.

- fYei Yghg Zcf Yl hYbg]cb/
- `UhY`gi Va]gg]cbg`[i]XY`]bYg/
- fYj]Yk 'cZa Uf_g/
- I BGK '< YU`h\ 'UbX'GUZYhm'dc`]W[Yg/
- YI Ua]bUhcb dfcWXi fYg/
- gdYWJU``Wcbg]XYfUHjcb`]b`H\Y`Yj YbhcZ]``bYgg`cf`a]gUXj Ybhi fY/
- gh XYbhYei]mUbX X]gUV]`]m/
- UbX'ch\Yf'YggYbhJU`'UWUXYa]W]bZcfa UhJcbž'gYY

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

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a U[Y'7fYX]h

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