

7 ci fgY Cj Yfj]Yk

GHJZZ:7cbHJWh:8YHJ]`g

7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`]m	@cWUhjcb	D\cbY
5`]gcb'K UbbUb	U"k UbbUb4 i bgk "YXi "Ui	6mUddc]bha Ybh VYZcfY'cf'UZHYf gYa]bUfg'cf'Uh ch\Yf'h]a Yg	A cfj Yb 6fck b'% ('# C b`]bY	-',) % \$+

GWXcc`7cbHJWhi±bZcfa Uhjcb

GWXcc``cZGcWJU``GWJYbWYg

Fcca '%) -

A cfj Yb 6fck b 7 &\$

Ya U]`. 'gcgg4 i bgk "YXi "Ui

d\cbY. '\$&'-',) '% \$+

5W_bck `YX[Ya YbhcZ7ci bhfm

I BGK '5frgž8Yg][b'UbX'5fW,]hYWi fY'? Ybg]b[hcb'UbX'DUXX]b[hcb'Wa di gYg'UfY'Vi]'hcb'5Vcf][]bU`@UbXg"'K Y'dUmci f'fYgdYWg'hc'h,Y'6]X'][U''UbX'; UX][U''dYcd'Yg'k \c'UfY'h,Y'7 i ghcX]Ubg'cZh,YgY'`UbXg" K Y'UW_bck `YX[Y'h,Y'5Vcf][]bU`'UbX'HcffYg'GhfU]h=g`UbXYf'dYcd'Ygž'h,Y':]fghi5i ghfU`]Ubgžk \cgY'`UbXgž k]bXg'UbX'k UhYfg'k Y'U``'bck 'g\UfYž'UbX'dUmfYgdYWhc'h,Y]f'i b]ei Y'j U'i Ygž'UbX'h,Y]f'Wbh]bi]b['UbX YbXi f]b['W' h fYg'k \]W. XYYYdYb'UbX'Ybf]W. h,Y'`]ZY'cZci f'bUh]cb'UbX'Wca a i b]h]Yg"''

 $\label{eq:continuous} \text{$\overset{\cdot\cdot}{=}$ U[Y'WciftY'gmcZhY'CZhY'Dfc'J]WY!7\twww.$``cf'$$ bX][Ybcig']$ $$BGK_{$^{\circ}}$$ bX][Ybcig'ghfUhY[m]$$ $$$

5ggYgga Ybh

7 ci fgY XYg][b UbX YUfb]b[UWhjj]h]Yg

H\]g`Wci fgY`\Ug`VYYb`XYg][bYX`rc`ZJW]`]rUhY`X]fYWYX`fYgYUfW."`Ghi XYbhg`WJb`i bXYfhU_Y`[fci d`k cf_'UbX dYYf`fYj]Yk 'rh\fci [\ci hrh\Y`Wci fgYž\ck Yj Yfžrh\Y`Z]bU``YggUmcf`fYgYUfW.`dfc`YWhk]```VY`Ub`]bX]j]Xi U`d]YWY`cZk cf_"`Ghi XYbhg`WcbXi Wh'U'd]YWY`cZXYg_!VUgYX`fYgYUfW.`cb`U'rcd]WcZh\Y]f`W\ccg]b["`H\Y`Wci fgY []j Yg`ghi XYbhg`h\Y`cddcfhi b]hmhc`WcbXi Wh'fYgYUfW.`]b`Ub`UfYU`cZ]bhYfYghk]h\]b`h\Y`X]gWJd`]bYg`cZ]bhYfbUhjcbU``fY`UhjcbgžXYj Y`cda Ybhighi X]Yg`cf`di V`]Wdc`]WmUbX`[cj YfbUbWY"`5g`h\Y`Wca d`Yhjcb`cZ GF 5D) %\$%]g`U'dfYfYei]g]hYž`]h`]g`YI dYWYX`h\Uhghi XYbhg`k]```Vi]`X`cb`h\Y`_bck`YX[Y`UWei]fYX`]b`h\UhWci fgY`Zcf`h\Y]f`fYgYUfW.`hcd]WfU`h\ci [\`]Zghi XYbhg`k\]W\W`rcYI d`cfY`U'bYk 'rcd]Wzh\]g`Wb`VY`bY[ch]UhYXŁ"

- 5b YI hYbXYX YggUmftg]a] `Uf 'hc 'U 'ci fbU``Uff]WY ! 'Ub 'Uf[i a YbhVi] `hcb Yj]XYbWYŁ
- HYVXb]WU``cf`UWUXYa]WfYgYUfWX`fYdcfhg
- 5Xi cWUWmfYdcffg h\Uh`cVVmZcf W\Ub[Yi g]b[Ub Yj]XYbW VUgYX UddfcUW\
- @]hYfUhi fY`fYj]Yk g`Yj U`i Uh]b['Ya Yf[]b[']ggi Yg`]b`U`[]j Yb`Z]Y`X"

 $\label{thm:conditional} Dfc \Upsilon Whited] Wg ``UfY `bY[ch] UhYX ``VYhk YYb ``h\Y ``gh` XYbhUbX ``h\Y ``Wti fgY ``Wtbj Ybcf'' ``Gh` XYbhg ``UfY `]bj]hYX ``hc dfcdcgY `hcd] Wg ``Ug `a i W\` `Ug ``dcgg] V ``Y ž `UbX `h\Y ``UWUXYa] Wgi dYfj]gcf ``WUb `\Y `d `gh` XYbhg `]XYbh] ZmU ``gi]hUV ``Yhcd] Wf$

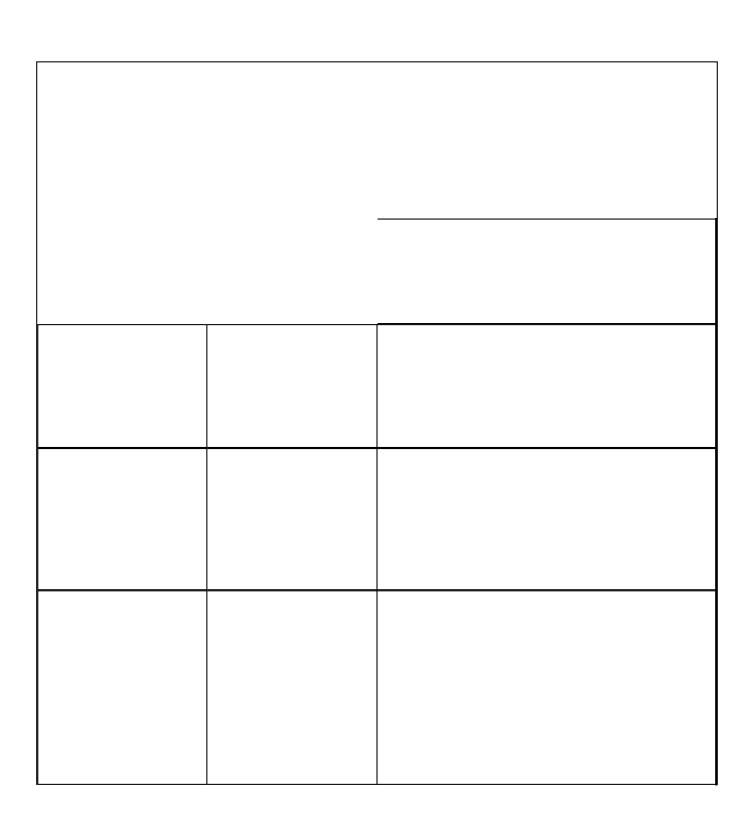
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5ggYgga Ybh'tUg_	K Y][\h	8i Y [.] 8UhY	7 ci fgY @YUfb]b[Ci hWca Yg 5ggYggYX
%"·F Yj]gYX·fYgYUfVX dfcdcgU`	(\$1	% #\$' #&\$&&`%%\$\$`DA	%ž &
&"`:]bU``F Ydcfh	*\$1	' \$ <i>#</i> \$(#&\$&&`%% \$\$`DA	&ž''

5ggYgga Ybh% F Yj]gYX fYgYUfW dfcdcgU

5ggYgga Ybh``Yb[h\. '%') \$\$ 'k cfXg 8i Y'XUhY. '% #\$' #&\$&&'%\\$\$*DA

‰



K YY_'*.'&%'A UfVX'!'&) A UfVX	<ca cf_<="" th="" yk=""><th>±bX]j]XiU`Wcbgi`HJh]cbg'cf']bXYdYbXYbh fYgYUfWX</th></ca>	±bX]j]XiU`Wcbgi`HJh]cbg'cf']bXYdYbXYbh fYgYUfWX
		7 cbgi `HUHjcb'k]h\ 'U'fYgYUfVX '`]VfUf]Ub'hc'X]gW gg cf'fYj]gY'mci f'gYUfVX 'gHfUHY[mž''FYj]Yk 'mci f'XUHU UbX'gHJfhhc'UbU`mgY'mci f'Z bX]b[g"
K YY_`+.`&, `A UfW\`!`% 5df]`	GYa]bUf	@]b_]b[i d ! 5bU`mg]b[mci f XUHJ UbX dfYgYbh]b[mci f Z]bX]b[g
		8]gW gg]b['mci f'UbU'mg]g'UbX'k \Uh'mci f'Z]bX]b[g a YUb"'@]b_]b['mci f'Z]bX]b[g'k]h\ 'mci f'fYgYUfW\ ei Ygh]cbfgŁ'UbX'h\Y']ggi Yg'mci ']XYbh]Z]YX']b'h\Y]b]h]U''VUW_[fci bX'f1]hYfUhi fY'fYj]Yk gŁ'hc'a U_Y'U ghfcb['Uf[i a Ybh'
K YY_', . '('5df]`!', '5df]`	<ca cf_<="" td="" yk=""><td>±oX]j]XiU`Wcbgi`hUh]cbg'cf']bXYdYbXYbh fYgYUfWX</td></ca>	±oX]j]XiU`Wcbgi`hUh]cbg'cf']bXYdYbXYbh fYgYUfWX
		8]gW gg'mci f'gY`YWqcb'cZXUHJ'UbX'mci f']b]hjU` ZbX]b[g"'6cc_YX'hja Yg'k]h\'Wci fgY'Wcbj Ybcf"'
K YY_''%'5df]`'!'%) 5df]`	GYa]bUf	⇒XYbh]Zm]b[ˈh\Yˈ]a d`]WUh]cbgˈcZˈmci fˈfYgYUfW\dfc^YWh'UbXˈk f]h]b[ˈUˈWcbWi g]cb
		I bXYfgHJbX]b['k \mmci f'Z]bX]b[g'a UHYf']b'HYfa g cZmci f'fYgYUfWX 'hcd]WUbX']XYbHJZmH\Y]a d']WUHJcbg'cZmci f'fYgYUfWX 'Zcf'dc']Whž dfUWHJWY'cf'UXj cWUWH' 6cc_'U'HJa Y'hc'a YYhk]h\ h\Y'Wci fgY'WccfX]bUhcf']b'k YY_'%\$'hc'X]gW gg'mci f Z]bU`'fYdcfh'UbX'H\Y'gHfYb[h\'cZmci f'Uf[i a YbH'
K YY_'%\$.'% '5df]`'!'&& 5df]`	<ca cf_<="" td="" yk=""><td>±bX]j]XiU``Wcbgi`hUh]cbgʻcfʻ]bXYdYbXYbh fYgYUfW</td></ca>	±bX]j]XiU``Wcbgi`hUh]cbgʻcfʻ]bXYdYbXYbh fYgYUfW
		: cW g'cb'Wca d'Yhjb[ž'YX]hjb['UbX'dc']g\]b['mci f fYdcfh'6cc_YX'hja Yg'k]h\'Wci fgY'Wcbj Ybcf''3 TYR_TV e` ^ VVeR_U UZdTfdd j`fccVdVRcTY cVa`æSVWcV j`f dfS^Ze3ddVdd^V_e\$ž'

FYgci fWyg

DfYgWf]VYX F Ygci fWYg

 $5 \cdot gY \cdot Y \cdot W_{l} cb \cdot cZfY \cdot UX] b[g \cdot]g \cdot dfcj] XYX \cdot cb \cdot A \cdot ccX \cdot Y \cdot i \cdot bXYf \cdot h \cdot Y \cdot @Y[Ubhc \cdot \cdot]b _ " \cdot H \cdot]g \cdot k] \cdot [Jj \cdot Y \cdot mci \cdot X] fY \cdot Wh \cdot UWW \cdot gg \cdot hc \cdot h \cdot Y \cdot Ufh] WY \cdot g"$

FYWca a YbXYX FYgci fWyg

FYWca a YbXYX fYgci fWYg

 $\label{eq:continuity} $$H\caUg\check{z}; "`f\&\$\%+\&": `h e` U` j` fc VdVRcTY c` [VTe, 3.9 f ZJV Wc ef UV_ed`fl fX`YX\&" @cbXcb.`G5; 9 Di V`]WJh]cbg"`$

Df]bh'

\htdq.#k k k "Vcc a\cd"i bak "YXi "Ui #XYhJ]a"W]3+H9A B C 1 - +, %(+' - (, , ++

8][]W`.'

@Uf[Ubž7":UbX'A cff]gžH":f&\$%-Ł' fR]ZReZgV VT`_URg' VdVRcTY, 3 eVaSj eVa9fZUVž@cbXcb.'G5; 9 DiV`]WUf]cbg"

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7 ci fgY 9j U`i Uhcb UbX 8Yj Y`cda Ybh

5 XX]hJcbU``fYZYfYbWrg`UVci hih\Y`X]ZZYfYbhfei U`]hUhJj Y`UbX`ei U`]hUhJj YE'UddfcUW\Yg`hc`WcbXi WfJb[gYWcbXUfmfYgYUfW\`\Uj Y`VYYb`]bWi XYX`cb`A ccX`Y"

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

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

Image: Ybwci bhYf'U'dfcV'Ya k \Yb'UhYa dhjb['hc'gi Va]hmci f'Ugg][ba Ybhh\fci [\'Hi fb]h]bz'd'YUgY

HY'Yd\cbY'9| hYfbU''Gi ddcfhcb'-',) "''' %cf'Ya U]''h\Ya 'cb'Y! hYfbU'hY'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'mYUft'''=\mathred{Image: Wa Jhmci f'Ugg][ba YbhXi Y'hc'U'ZJi 'hk]h\'Hi fb]h]b'mci 'a UmUdd'm\mathred{Image: Wa Jhmci f'Ugg][ba YbhXi Y'hc'U'ZJi 'hk]h\'Hi fb]h]b'mci 'a UmUdd'm\mathred{Image: Wa Jhmci f'Ugg][ba YbhXi Y'hc'U'ZJi 'hk]h\'Hi fb]h]b'mci 'a UmUdd'm\mathred{Image: Wa Jhmci f'Ub'Y! hYbg]cb\mathred{Image: Wa Jhmci h\Yf'f'Y'j UbhXcW a Ybhg\mathred{Image: Wa Uj''9! hYfbU''Gi ddcfhmci 'k]'`

JbWi XY'Ug'Yj]XYbW' hc'gi ddcfhmci f'Y! hYbg]cb'Udd']\wUh]cb"'\mathred{Image: Wa Uj''9! hYfbU''Gi ddcfhmci 'k]'`

Ui hca Uh]\wU'`mfYW']j Y'U'h]\w_Yhbi a VYf\mathred{Image: hY'Yd\cbY'mci 'k]\tag{Y}\wu''mug_'\mathred{Image: Wa'\mathred{Image: hY}\wu''mug_'\mathred{Image: hY'Yd\cbY''mci 'k]\tag{Y}\wu''mug_'\mathred{Image: hY'Yd\cbY'''mci 'k]\tag{Y}\wu'''mug_'\mathred{Image: hY'Yd\cbY''''' | h'Yf'''' |

Hi fb]h]b'U'gc'dfcj]XYg'i dXUhYg'cb'h\Y]f'gmghYa 'ghUh' g'cb'H\Y]f''''

; YbYfU`mž'UggYgga YbhiHug_g'a i ghVY'gi Va]hhYX'Y`YVWfcb]\WJ``mij]U'Y]h\Yf'Hi fb]h]b'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`hYfbUh]j Y'gi Va]gg]cb'XYHJ]`g"

cfi]bZcfa Uhjcbicbi\ckihcigi Va]hUgg][ba Ybhgicbi]bYij]UiA ccXiY.i\hdg.#gh XYbhi bgk "YXi "Ui #\ck! gi Va]hUgg][ba Ybha ccXiY

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

D`U[]Uf]ga i]gii g]b[ih\Yik cfXgicfi]XYUgicZch\YfgiUbXidfYgYbh]b[ih\Ya iUgimci fick b"i=iWUbihU_Yia Ubm Zcfa gžZfca iXYi]VYfUhYiWXYUh]b[ihciUWW]XYbhU`mWcdm]b[iZfca iUigci fWYik]h\ci hiUW_bck iYX[Ya Ybh'i

5WUXYa]W±bZcfa Uh]cb

8 i Y'hc'Yj c'j]b['UXj]WY'VmBGK '<YU'h\ž'ghi XYbhg'a i gh\W\Y_'Zcf'i dXUh\Y\']bZcfa Uh\cb'fY[UfX]b['cb`]bY 'YUfb]b['Zcf'U``'5fhgž'8Yg][b'UbX'5f\W]h\Y\Mi fY'\\chi fgYg'h\]g'h\fa 'fJ]U'A ccX'Y'cf'\\chi fgY']bZcfa Uh\cb dfcj]XYX"Ł

: 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/
- YI Ua]bUhcb dfcWXi fYg/
- gdYWJU``Wcbg]XYfUhjcb`]b`h\Y`Yj YbhcZ]``bYgg`cf`a]gUXj Ybh fY/
- gh XYbhYei]lmUbX X]gUV]`]lm/

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