

BIOM9420



7ci fgY`Cj Yfj]Yk

GhJZZ`7cbhJW`8YhJ]`g

7cbj Ybcfg

BUa Y	9a U]`	5j U]`UV]`]m	@cW]h]cb	D\cbY
? Ub[`@]Ub[_Ub[``]Ub[4 i bgk "YXi "Ui	9a U]`W`bZ]fa U]h]cb df]cf`Z]WY!`c!Z]WY W`bgi `h]h]cb	G96 `9,	

GW`cc``7cbhJW`h]Z]fa U]h]cb

Gh XYbhGYfj]W]g`W]b`VY`W`b]W]W]X`j]U`[i bgk "h\]c# YVZ\]fa g](#)"

7ci fgY'8YHJ]`g

I b]hg'cZ7 fYX]h*`

Gi a a UfmicZ'h\Y'7ci fgY

6-€A - (&\$'YI d'cfYg'h\Y'gWYbW'VY\]bX'W]b]W'X]U[bcgh]Wg'Wc] Yf]b['UfYUg'cZV]cWYa]ghfñ
\UYa Uhc'c[mž]a a i bc'c[mž]a U[]b['UbX'W]b]W'V]ca YVXUb]Wg'Ug'k Y''Ug'h\Y'fYbU''UbX'W]fX]c] UgW 'Uf
gmghYa g''-b'YUW'cZ'h\Y'UfYUg'h\Y'i bXYf]m]b['df]bW]d'Yg:]b'h\Y'a YUgi fYa YbhcZW'fU]b'd\mg]c'c[]W'
dUfUa YHfg'k]''VY'Wc] YfYX'UbX'\ck 'h\Ym\Uj Y'VYb'i gYX'hc'Yb[]bYf'X]U[bcgh]WYei]da YbH'

7ci fgY'5]a g

7ci fgY'CV'YW]j Yg

6-€A - (&\$'7]b]W' '@UVcfUhc fmGWYbW'\Ug'VYb'XYg][bYX'hc'dfcj]XY'gh XYb]k]h'U'fUgh'cZ
gca Y'cZ'h\Y'a UbmX]ZYfYbhiUgdYWg'cZW]b]W'a YX]W]bY'k \YfY'6]ca YX]W'9b[]bYf'UfY'cZ

5ggYgga Ybh

5gg][ba Ybŕg'a i ghVY'gi Va]hYX'j]U'A ccX'Y VmiŕY'XYg][bUH'X'XUH'UbX'hja Y''H\Y'F Ydcfhia i ghiWĉbŕU]b
 U' [Bcb'D'U\[_Uf\]ga '8YWUfUŕcb'7cj Yf'G\YYh](#)

@UH'gi Va]gg]cbg'k]''VY'dYbU'jgYX') i 'cZŕY'a Uf_'Zcf'YUWŕ'WŕYbXUf'XUm'UH'žWŕddYX'UhZ]j Y'XUmj'fŕ&\$
 \ci fglž'UZŕf'k \]Wŕ'U'gh XYbhWŕbbchgi Va]hUbX'UggYgga Ybhž'UbX'bc'dYfa]hYX'j Uf]Uŕcb''žmci 'ZcfYgYY'U
 dfcV'Ya ']b'a YYh]b['ŕY'bc'a]bUH'X'gi Va]gg]cb'XUH'ž'd'YUgY'WĉbŕUWŕŕY'7ci fgY'7cbj Ybcf'ŕc'X]gW'gg'mci f
 g]ŕi Uŕcb'Ug'gccb'Ug'dcgg]V'Y''

5ggYgga Ybhia Uf_g'k]''VY'Uj U]UV'Y'cb'A ccX'Y'Ug'gccb'Ug'dcgg]V'Y'UZŕf'a Uf_]b[ž'k \]Wŕ'k]''bcfa U''mVY
 k]ŕ]b'&k YY_g'cZgi Va]gg]cb''

5ggYgga YbhUg_	K Y][\h	8i Y'8UH'	7ci fgY'@YUfb]b[Ci hWĉa Yg'5ggYggYX
%'9bnma Y'@UVcfUŕcfm F Ydcfh	%)	Bch5dd']WŕV'Y	%ž'ž' ž(
&'C'b']bY'E i]nnYg	%)	5hŕY'YbX'cZŕi ŕcf]U'cb K YY_'+	%ž'&
' ':]bU'9I Ua	') i	: f]XUmik YY_')	%ž'&
(' @]ŕfUŕi fY'F Yj]Yk	&\$i	: f]XUmik YY_'%\$	%ž'ž' ž(
) "': fci d'j]XYc'dfYgYbhUŕcb	%) i		&ž'
*"F Ud]X'Ubŕ][Yb'ŕYghŕf]d XYg][b'fYdcfh	%)		

:]bU`9I Ua `fC b`]bY:]bU`E i]n`%\$i `Z`H]a Y `]a]hYXžcdYb Vcc_ž`cb[Ubgk Yf`9I Ua `&)i Ł`f1)i Ł

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8i Y`XUHy. : f]XUmk YY_`%\$

@]hYfUhi fY`F Yj]Yk `f&\$i Ł[e Ua_ b`WVW Se S Ydągb fSe] VWe[Y` W fa bđh[VWS` abbadfg` [fk XadfWS_ ž` ad
S` V [VWbW VW f [fWdSfgdWeWsdJZ[Y a` V[XWdW f Ua_ b`W_ W fSck fab[U SdVSe dWWhS` f fa fZW
_ WSegdW_ W faXY`gUaeW[S U[[US`eWff` Yž

5ggYgga Ybh). : fci d j]XYc`dfYgYbhU]cb

; fci d j]XYc`dfYgYbhU]cb`f%)i Ł[e S Ydągb dWbadf VWe[Y` W fa Ua` ea [VSfW`MSd [Y [fZWSeeWee_ W fe
S` V fgfadS`e S` V Td[Y [fS`^faYWfZWd[S fWS_ W h[đ` _ W f fa bđVgUWS UaZW[hWS` V TS`S` UWW eZad
h[VWđ bdWew fSf[a` ž

5ggYgga Ybh*. `F Ud]X`Ubh][Yb`hYghghf]d`XYg][b`fYdcfh

F Ud]X`Ubh][Yb`hYghghf]d`XYg][b`fYdcfh`f%\$i Ł[e S Ydągb fSe] VWe[Y` W fa W ZS` UWefgVW fe
g` VWefS` V[Y [dWWhS` f fab[Ue S` V Sbb`k fZW)` ai` WYW[f_ Wk U[[US`S` V V[SY` aef[U eWff` Yež

5 hYbXUbWV F Yei]fYa Ybhg

Gh XYbfg UfY gfcfb[`mYbWci fU[YX`tc` UHfYbX`U`WUggYg`UbX`fYj`Jk`YWh`fY`fYWcfX]b[g"

7 ci fgY`GVX`YXi`Y`

K YY_	8UHf	@j Y`9j Ybh@YWh`fY`	C b`]bY`F Ygci fWg	Hi`tc`f]U`	5ggYgga Ybh`8i`Y`
%	&`>i`b`	8]U[bcgh]W 9b[]bYYf]b[` % 7 ci fgY]bffcXi W]cb 4[a_`W[US^ 7`Y[`WVd[`Y`S`V 6[SY` aef]Ue	%`A`5H@56]bffcXi W]cb`- C bfUa d Wci fgY %`6UW_[fci bX`tc [fci d`a`U`cf fYdcfh! ;`i`WcgY 6]cgYbgcfg	K cf_g\cd`%- 7 ca d`YHf A`5H@56`C bfUa d Wci fgY	5ddYbX A`5H@56 7 ci fgY 7 ca d`Yh]cb 7Yfh]Z]WUfY`tc hY`9bnma`Y UW]j`]mifYdcfh]b`k`YY_`)
&	-`>i`b`	8]U[bcgh]W 9b[]bYYf]b[`& 4`aaV`6[SY` aef]Ue 3`f[TaVkJTSeW 6[SY` aef]Ue	%`7Y`~/`8B5 VUW_[fci bX Zcf`k`YY_` %`7Y`W`W`W`Y j`]XYc %`9I`Y`F`W`g`Y`cb V`W`W`W`Y %`F`Y`j`]Yk 9bnma`Y ?`]bYh]Vg 5W]j`]mif`]g_ 5ggYgga`Ybh/ E`i`]n &`-`bffcXi`W]cb`tc X]U[bcgh]Wg`! Ybnma`Yg	K cf_g\cd`&`- ;`fci`d`X]gW`gg]cb cb`gci`fWg`cZ gW]Ybh]Z]W]hYfUih`fY` 7 ca dUfY`fYj`]Yk`gZ `ci`fbU`g`/ gW]Ybh]Z]W]fYdcfng K`f]hY`Ub`UVgfhUW`h	
'	%*`>i`b`	8]U[bcgh]W 9b[]bYYf]b[`"	%`D7F`j`]fhi`U` `UV	K cf_g\cd`" ` -	

		6@3† 9 W Wf[Ue ~ B5D 6 [SY` aef[Ue	% 7 \fca cgca U` X]gcfXYfg	9bnma Y`?]bYh]Wg 5Wj]]m!`A ccXY "A UFV`Y" `dfUW]WU`	
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	Hi hfjU`	K cf_g\cd` ('- ; fci d`X]gW gg]cb`cb`\ck `rc`k f]fY`U``]fYfuh fY fYj]Yk
K VWI`),`&`×gbW!`% >i`m	@YWi fY %o	8]U[bcghW9b [fbYf]b [W]eW hf]b[`YI Yf Y 5 SdV[SU? a` [fad` Y
	C b`]bY`5Wj]]m	%`K cf_YX`YI Ua d`Y`!`WUFX]UWci hdi h &`K cf_YX`YI Ua d`Y`!`X]i h]cb '`K cf_YX`YI Ua d`Y`!`97;
	Hi hfjU`	K cf_g\cd`)` - 7 UfX]UWA cb]hf]b[`YI YfW]gY
	5ggYgga Ybh	9bnma Y`?]bYh]Wg`5Wj]]mF Ydcfh 8i Y`: f]XU! %o

		; fci d'X]gW gg]cb'UbX'fYdcfhVUW_'cb'[U]hZ bW]cb YI YfW]gY
K YY_`%\$.`%5i [i gh!') 5i [i gh	@YVh fY	F Yj]Yk `cZW`bhYbh'
	Hi hcf]U`	; fci d'j]XYc'dfYgYbhU]cbg'
	5ggYgga Ybh	A U`cf'; fci d'F Ydcfh 8i Y: f]XUmik YY_`%\$

F Ygci fWg

F YWca a YbXYX'F Ygci fWg

F 9@9J 5BH'F 9GCI F 79G' 'l gYZi ``6cc_g

- 4hfcXi Wjcb'hc'6]ca YX]WJ''9b[]bYYf]b['fi fX'YX]h]cbE'Vm>c\b'9bXYfY'UbX'>cgYd\`6fcbn]bc
Di V]g\Yf.'9`gYj]Yf#5WUXYa]WDFYggž&\$%%ž-66B.'-+, \$%&' +(-+- *

8][]h'Uj U]UV'Y!' \hhdg.## bgk Vcc_g\cd"j]h'Ugci fW"Wca #dfcXi Wg#j -+, \$\$, \$- *%&%+

- 5b'4hfcXi Wjcb'hc'7]b]WJ''@UVcfUhc'fmGW]YbWV'Vm7 cbb]Y'A U\cbž@]bXU'5" Ga]h'UbX'7\Yfm
6i fbg"Di V]g\Yf.'9`gYj]Yf<YU'h'GW]YbWVgž%-, , ž-66B %\$ \$+&%* (-- \$(

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

Gh XYbhZYXVUW\Ug\Y'dYX'hc'g\UdY'UbX'XYj Y`cd'h]g'Wci fgYž]bWi X]b['ZYXVUW'cVHU]bYX'Zca'cb!
]bY'Yj U'i Uh]cbg'Ug'dUfhcZI BGK 'g'a m9l dYf]YbW'dfcW'gg"7\Ub[Yg'hc'hY'Wci fgY'\Uj Y']bWi XYX
fYj]g]cb'hc'hY'Wci fgY'WcbhYbhVmFYZcW'g]b['cb'hY''YWi fY'WcbhYbhUbX'VU'UbW]b['h]g'WcbhYbhUW'cgg'hY
gW]YbW'g'UbX'a Uh'g''H\]g'Wci fgY']g'bck'XYg][bYX'hc'fi b'cb!']bY']b'X]ghUbW'a cXY"

Gi Va]gg]cb 'cZ5ggYgga YbhiHUg_g

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

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7CI FG9'9J5@! 5H€B'5B8'89J9@CDA 9BH

Gh XYbhZYXVUW_ \Ug\YdYX'hc'g\UdY'UbX'XYj Y'cd'h.]g'Wci fgYž]bWi X]b['ZYXVUW_cVHU]bYX'Zca'cb!
]bY'Yj U'i Uh]cbg'Ug'dUfhcZI BGK 'g'Ug'dUfhcZI BGK 'g'a m9I dYf]YbW'dfcW'gg"Mc'i 'UfY'\][\`m
YbWci fU[YX'hc'Wca d'YH'gi W\ 'Ub'cb!]bY'Yj U'i Uh]cb'hc'k UfX'h'Y'YbX'cZHYfa "': YYXVUW_UbX'gi [[Ygh]cbg
dfcj]XYX'k]"VY'ja dcfh]bh]b]ja dfcj]b['h'Y'Wci fgY'Zf'Z hi fY'gh XYbthg"

85H9G'HC'BC H9

FYZf'hc'A m BGK 'Zcf'æ dcfh]bh8UH'gžUj U]UV'Y'Uh
[\hfdg.##a m'i bgk "YXi "Ui #gh XYbh#fYgci fW'g#? Ym8UH'g"\ha`](#)

57589A ⇒ '58J ⇒9

: cf]bZcfa Uh]cb'UVci h

- ""B cH'g'cb'UggYgga Ybth'UbX'd'U[]Uf]ga ž
- ""GdYWU"7 cbg]XYfUh]cbgž
- ""GW'cc" Gh XYbh9h]Vg'C Z]W'fz'UbX
- ""69GG

fYZf'hc'h'Y'GW'cc" k YVg]h'Uj U]UV'Y'Uh
[\hfd.##k k "Yb\[\]bYYf\]b\["i bgk "YXi "Ui #/\]ca YX\]WU'!Yb\[\]bYYf\]b\#

Gi dd`Ya YbhUfm9I Ua]bUh]cbg.

Gi dd`Ya YbhUfm9I Ua]bUh]cbg'Zcf'HYfa '&\$\$&&'k]"VY'\Y'X'cb'fH67E'g\ci 'X'mci 'VY'fYei]fYX'hc'g]hcbY"

H\]g'Wci fgY'ci h]bY'gYth'ci hXYgW]dh]cb'cZUggYg'Uh'h'Y'XUH'h'Y'7ci fgY'Ci h]bY']g'di V']g\YX" H\Y
bUh fY'cZUggYg'a UmVXUb[Y'Xi f]b['h'Y'HYfa 'UZf'f'h'Y'7ci fgY'Ci h]bY']g'di V']g\YX" A ccX'Y'g\ci 'X'VY
W'cbgi 'h'X'Zcf'h'Y'i d'hc'XUH' WUgg'XYgW]dh]cbg" 'Z'h'YfY']g'Ubm]bW'cbg]gh'bWn]b'h'Y'XYgW]dh]cb'cZ
UW]j]h]Yg'VYtk YYb'h'Y'I b]j Yfg]m]h]a YHUV'Y'UbX'h'Y'7ci fgY'Ci h]bY'fUg'i dXUH'X']b'A ccX'Y'Udd']Yg"

⇒a U[Y'7 fYX]h

GmbYf[]Yg']b'Gci bX'&\$%*

7F ⇒CG

7F ⇒CG'Dfcj]XYf'7cXY.'\$\$-\$- ;

5W_bck `YX[Ya YbhcZ'7ci bhfm

K Y'UW_bck `YX[Y'h'Y'6YXY[U'dYcd'Y'k \c'UfY'h'Y'fUX]h]cbU'W'g'hcX]Ubg'cZ'h'Y'UbXg'cb'k \]W'I BGK
? Ybg]b[hc'b'W]a di g']g'c'W]h'YX"