







9h,]\vg`UbX`FYZY\vh]jY`DfU\vh]\vy

7 cifgY`8YHJ]`g 7 fYX]hDc]bhg`*` GiaaUfmcZh\Y`7 cifgY

GiVYWM5fYU.EaU[S^I ad]

5ggYgga Ybh

D`YUgY`bchY`h\Uhh\Y`cb!`]bY`YIYfW]gY`]g`U`fYei]fYaYbhUg`dUfhcZUhhYbXUbWY#dUfh]W]dUh]cb`!`]b`ch\Yf k cfXgž`]hfYd`UWYg`%`\cif`cZ`YWhifY`dYf'kYY_"`=h`]g`bchU`[fUXYX`UggYggaYbh/\ckYjYfžmci`aighaU_Y`U fYUgcbUV`Y`UhhYadhUhU```h\fYY`dUfhg`cZh\Y`YIYfW]gY`hc`aU]bhU]b`mcif`UhhYbXUbWY#dUfh]W]dUh]cb`fYWcfX" =bZcfaUh]cb`UVcihh\Y`cb!`]bY`YIYfW]gY`WUb`VY`ZcibX`cb`h\Y`AccX`Y`g]hY"``H\Y`cb!`]bY`YIYfW]gY`k]``U`gc`VY UXXfYggYX`]b`h\Y`KYY_`%`YWhifYžUbX`]b`h\Y`Z]fghihicf]U`"

: i fh\Yf`XYHJ]`g`cZUggYgga Ybhgž`]bWi X]b[`XYgWf]dh]cbg`cZh\Y`HJg_g`UbX`fY`UhYX`Wci fgY`cV^YWf]j Ygž'UfY dfcj]XYX`]b`Xck b`cUXg`Uj U]`UV`Y`cb`h\Y`A ccX`Y`g]hY"

±0`U```UggYgga Ybhgžmci `g\ci`X`i gY`h\Y`GW\cc`fg`dfYZYffYX`fYZYfYbW]b[`gmghYa "`H\]g`]g`U`gc`XYhU]`YX`]b`h\Y Xck b`cUXUV`Y`\UbXci hUj U]`UV`Y`cb`h\Y`A ccX`Y`g]hY"

8iY'XUHYg'Zcf'kcf_'fYei]fYX']b'GC7K'\$\$-`9h\]Wg'UbX'FYZYWhjjY'DfUWhjWYž']bWiX]b[`h\Y'cb`]bY'YIYfWjgYž

5ggYgga Ybh& 7UgY gh Xm

GHUfh'XUHY.

@Yb[h\.`&\$\$\$`kcXg

8YHJ]`g. @Yb[h. &\$\$\$`k cfXg"Ghi XYbhg`gY`YWicbY`WUgY`Zfca `h.Y]f`dfUWjWY`fk \]WX`a UmVY`Ub`]bX]j]Xi U` dYfgcbž'U`ZJa]`mž'U`[fci d`cf`U`Wca a i b]hmdfc YWHz"`H\Ym]XYbhjZmUbX`YI d`U]b`h.Y`Yh.]WU``UgdYWhg`cZ dfUWhJWY`k]h.`h.]g`WUgY`UbX`Udd`mh\Y`_bck `YX[Y`Zfca `h.]g`Wci fgY`VmWf]hJWU``mfYZYWhJb[`cb`h.Y]f dfUWhJWY`K f]hYb`ZYYXVUW_`UbX`U`bi a Yf]WU``a Uf_`UfY`dfcj]XYX`fk c`k YY_g`UZfYf`h.Y`gi Va]gg]cb`Xi Y`XUhY" 7 f]hYf]U`UfY`Uj U]`UV`Y`hc`ghi XYbhg`Uhih.Y`ghUfficZfk.Y`Wci fgY`gc`h.Uhih.YmWUb`k cf_`hck UfXg`gdYWjZjYX ghUbXUfXg"

Hi fb]h]b`gYh]b[.`H\]g`Ugg][ba Ybh]g`gi Va]hhYX`h\fci [\`Hi fb]h]b`UbX`gh XYbhg`WUb`gYY`Hi fb]h]b`g]a]`Uf]hm fYdcfng"

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<pre>X YY_`(`A UfWX '! '%</pre>	@YWnifY	GcWJU``↑ghJVW"	
A UFVX	Hihcf]U`	; fci dg'5 UbX'6	
		@cc_]b[`Uhih\Y`Zci bXUh]cbU``WcbW/dhg.`\i a Ub	
		X][b]miUbXikcfth:UbXigcWjUiifgf]W¥" 9IYfWjgY.iickiXcijUiiYgiUZYWidfUWjWY3	
	Cb`]bY`5W f]j]hm	H\Y`h\]fX`dcghhc`h\Y`cb!`]bY``YUfb]b[`UWhjj]hmi]g`Xi` Vmi-da`cb`GibXUm`%)`AUfVX"`H\]g`]g`Ub	
		UthYbXUbW/#dUfhjWjdUhjcbfYei]fYa Ybh	
		·9IYfW]gY.`∖ck Xcij YWnifY	

		9 YfWjgY`&.`gY`ZifYZYWjcb`UbX`Yh\]WU```YUfb]b[DfYdUf]b[`Zcf`h\Y`WUgY`ghiXm"
K_YY_`%%`&+`5df]``!`&,	@YWhifY	factu: Zi YbWnfiUbX'h\Y'dc`]hjWg'cZdfUWijWY
5df]	Hi hcf]U`	; fci dg'5 UbX'6
		@cc_]b[`XYYdYf`Uhk \Uhk Y`Vf]b[`hc`gcW]U``k cf dYfgcbU``UbX`W``h fU``j U`i Yg" 9I YfW]gY`%`YI Ua`]b]b[`Wfcgg!W``h fU``WUgY YI Ua`d`Yg 9I YfW]gY`&.`gY`ZfYZYW]cb`UbX`Yh\]WU```YUfb]b["
	5ggYgga Ybh	DfYdUf]b[`Zcf`h\Y`WUgY`gh`Xm" H\Y`WUgY`gh`Xm`]g`Xi Y`Uh'\$\$`da`cb`Gi bXUm %\$`A Um"

F Ygci fWg

DfYgWf]VYX F Ygci fWfg

6Ub_gžG"'f&\$%&E7fZ[Ue S`VHS'gWe [`EaU[S^I ad] ž(^{h.}9X]h]cb"'6Ug]b[ghc_Y.DU`[fUj Y'A UWa]``Ub"

; UfXbYfž: "'f&\$%(Ł'4W[Y 5d[f[US^k DWKWUf[hW'6Ug]b[ghc_Y. DU`[fUj Y A UWa]``Ub"

<i [a Ubž F "'f&\$%(Ł 3 ŽL B da XWee[a` S^7 fZ [Ue"'@cbXcb. DU`[fUj Y A UWa]``Ub"

FYWca a YbXYX FYgci fWYg

6Ub_gžG"f&\$\$(± 7 fZ[Ueł 3UUag` fST[[fk S` V fZWE aU[S^Bda Wee[a` e" 6Ug]b[ghc_Y. DU`[fUj Y! A UVa]``Ub"

 $\label{eq:started} \begin{array}{l} 6 \mbox{Ub}_g \ddot{z} \mbox{G}"/~; \mbox{U} \mbox{U} \mbox{I} \mbox{S} \mbox{FZ} \mbox{S} \mbox{V} \mbox{E} \mbox{a} \mbox{U} \mbox{E} \mbox{I} \mbox{I} \mbox{I} \mbox{I} \mbox{S} \mbox{FZ} \mbox{S} \mbox{V} \mbox{E} \mbox{a} \mbox{U} \mbox{I} \mbox{$

6ck `YgžK "ž7c``]b[f]X[YžA "ž7iffmžG"/`JU`Ybh]bYž6"`f&\$\$*Ł7fZ[US^BdSUf[UW[`EaU[S^Lad], 3`3bb?[WW] 3bbdaSUZž7fck g`BYgh'5``Yb'/`Lbk]]b"

7\Ybck Yth,ž'@''/ 'A W5i`]ZYž'8"'f&\$%) EFZWDaSV fa EaU[S^I ad] `: g_ S` EWdh[UWBdSUf[UW2'(th, 'YX]h]cb" Gcith, 'A Y'Vci fbY. '7 Yb[U[Y`@YUfb]b["'O'gdYW]U``mi7 \UdhYfg`&z'' z'(z'- /' %\$Q

7`]ZcfXž8"%'6if_Yž6"'f&\$\$-E3`f[ŽAbbdWee[hW7fZ[UeS`VHS'gWe[`EaU[S^I ad] ž6Ug]b[ghc_Y. DU`[fUjY!'AUWa]``Ub"

; fUmžA "/ K YVVžG" 5" fYXgŁf&\$%\$Ł7fZ[Ue S`V HS⁄gWBWdebWUf[hWe [`EaU[S^I ad] ž6Ug]b[ghc_Y. DU`[fUj Y!A UWa]``Ub"

<]ba Ubž`@'`A "`f&\$% Ł`7fZ[Ue, S B 'gcS'[ef[U 3bbdaSUZ fa ? acS^FZWackž) h\`9X]h]cb"`6cghcbžA 5 . K UXgk cfh\ž`7Yb[U[Y`@YUfb]b["

<i[a UbžF"`f&\$\$) &@W 3bbdaSUZWe fa 7fZ[Ue [`fZW5Sd[`YBdaXWee[a`ež6Ug]b[ghc_Y.`DU`[fUjY! A UWa]``Ub"

<i[a UbžF"'f&\$% Ł'5g/fgdW/HS/gWeS`V 7fZ[Ue[`EaU[S^I ad], 7_TdSU[`Y 6 [hWde[fkž@cbXcb.'F ci hYX[Y"]

<i[a UbžF "/ 7 UfhYfz">"fYXgEf&\$%*EDWfZ[][Y HS'gWe S`V 7 fZ[Ue [`EaU[S^I ad] "@cbXcb.`DU`[fUj Y"]

DUmbYžA "f&\$%* E? aVWd EaU[S^I ad] FZWack" (h\ 9X]h]cb" CIZcfX. CIZcfXI b]j Yfg]hmDfYgg"

DUk UfžA "/ '5bgWca VYž5" K "'f&\$%(ŁDWXWUf[hWBcSUf[UW[` EaU[S^I ad] , FZ[`] [` Ył 6a[` Y S` V 4 W[` Yž DcfhA Y`Vci fbY. '7 Ua Vf]X[Y`I b]j Yfg]mDfYgg"

DUk UfžA "ž<i [a UbžF "ž5`YI UbXfUž5"7 5bgWca VYž5"K "`fYXgŁf&\$%+Ł7_bai Wd(` Y EaU[S^I ad] Wde, H[dfgage BcSUf[f[a` WdežG]b[UdcfY. Gdf]b[Yf`B Uhi fY"

=b`UXX]h]cbžfY`Yj Ubh'ci fbU``Ufh]WYg`UbX`ch\Yf``]VfUfmia UhYf]U`g`UfY`dfcj]XYX`]b`h\Y`@Y[Ubhc``]b_`cb A ccX`Y"`Nci `UfY`U`gc`YbWci fU[YX`hc`i bXYfhU_Y`mci f`ck b``]hYfUhi fY`gYUfW\Yg"`; ccX`d`UWYg`hc`ghUfhUfY 5i ghfU`]Ub`GcW]U``K cf_ž'6f]h]g\`>ci fbU``cZGcW]U``K cf_ž'9h\]Wg'Z `GcW]U``K Y`ZJfY`fU```Uj U]`UV`Y`j]U`h\Y IBGK `@]VfUfmŁUbX`h\Y`cb!`]bY`>cifbU``cZGcWJU``K cf_`JU`iYg'Z`9h\]Wg`fZcf`k\]W\`U`\ch]b_`]g`dfcj]XYX`cb h\Y`AccX`Y`dU[YŁ"`f5bmt\]b[`VmGUfU\`6Ub_g`]g``]_Y`mhc`VY`fY`YjUbhž`UbX`g\Y`XcYg`U`gc`cWWJg]cbU``m kf]hY`UVcihWcaaib]mikcf_"Ł

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

H\]gʻWci fgYʻ]gʻYj Uʻi UHYXʻi g]b[ʻghi XYbhʻYUfb]b[ʻfYj]Yk gžWUggʻZYYXVUW_ʻUbXʻH\Yʻa m9I dYf]YbWYʻgi fj Ym fYgi `hg"`Ghi XYbhZYYXVUW_ʻ]gʻj Uʻi YXʻUgʻdUfhcZh\Yʻcb[c]b[`Wci fgYʻfYj]Yk `UbXʻXYj Y`cda YbH' GdYWJZ]WZYYXVUW_ʻ\UgʻVYYbʻi gYXʻhcʻa U_YʻW\Ub[Ygʻk \]W\`\Uj Y`]bWi XYXžVUgYXʻcbʻdfYj]ci gʻYj Uʻi Uh]cbgʻ !`W\Ub[Ygʻ\Uj Y`VYYbʻa UXYʻhcʻUggYgga Ybh'HUg_gʻUbXʻZ]bY!hi b]b[`cZWUggʻYI YfW]gYg"``H\Ub_`mci `]b UXj UbWYʻZcf`mci f`dUfh]W]dUh]cb`]bʻh\]gʻdfcWYgg"

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

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

Zmci YbWci bhYf'U'dfcV'Ya 'k \Yb'UhYa dhjb['hc'gi Va]hmci f'Ugg][ba Ybhih\fci [\ 'Hi fb]hjbž'd'YUgY hY'Yd\cbY'9I hYfbU''Gi ddcfhicb'- ',) '' ' %cf'Ya U]`'h\Ya 'cb'YI 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'mYUfŁ"'Zmci UfY'i bUV'Y'hc'gi Va]hmci f'Ugg][ba YbhXi Y'hc'U'ZJi `hk]h\ 'Hi fb]hjb'mci 'a UmUdd`m'Zcf'Ub'YI hYbg]cbž'Vi hmci a i ghfYhU]b'mci f'hjW_Yhbi a VYf'Zfca '9I hYfbU''Gi ddcfhfU'cb['k]h\ 'Ubmch\Yf'fY'Yj UbhXcW a YbhgEhc]bWi XY'Ug'Yj]XYbWY hc'gi ddcfhimci f'YI hYbg]cb'Udd`]WUh]cb"'Zmci 'Ya U]`'9I hYfbU''Gi ddcfhimci 'k]`` Ui hca UhjWU'`mfYWY]j Y'U'hjW_Yhbi a VYfž'Vi h]Zmci 'hY'Yd\cbY'mci 'k]``bYYX'hc'gdYWJZWU``mUg_'Zcf'cbY" Hi fb]hjb'U`gc'dfcj]XYg'i dXUhYg'cb'h\Y]f'gmghYa 'gfUhi g'cb'Hk]hYf"

; YbYfU`mžUggYgga YbhHUg_gʻa i ghVYʻgi Va]hhYXʻY`YWfcb]WU``mj]U`Y]h\Yf`Hi fb]h]b`cf`U`A ccX`Y Ugg][ba Ybh"`=b`]bgHUbWfg`k \YfY`h\]g`]g`bchdcgg]V`Yž`]hk]```VY`gHUhYX`cb`mci f`Wci fgY'g`A ccX`Y`g]hY`k]h\ U`hYfbUh]j Y`gi Va]gg]cb`XYHU]`g"

: cf`]bZcfa Uh]cb`cb`\ck 'hc`gi Va]hUgg][ba Ybhg`cb`]bY`j]U`A ccX`Y.`\hhdg.##ghi XYbh'i bgk "YXi "Ui #\ck! gi Va]hUgg][ba Ybha ccX`Y

5WUXYa]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"`=hWUb`hU_Y`a Ubm Zcfa gžZca `XY`]VYfUhY`W\YUh]b[`hc`UWW]XYbhU``mWcdm]b[`Zca `U`gci fWY`k]h\ci hUW_bck `YX[Ya Ybh'

I BGK '[fci dg'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 Yfmig]a]`Uf`k cfXg`hc`h\Y`cf][]bU``hYI h`cf`]XYU`k]h\ci hUW_bck `YX[]b['h\Y gci fWY`cf`i g]b['ei chUh]cb`a Uf_g"`H\]g`U`gc`Udd`]Yg`hc`]a U[Ygž`Ufh`UbX`XYg][b`dfc`YWngž`Ug`k Y```Ug dfYgYbhUh]cbg`k \YfY`gca YcbY`dfYgYbhg`Ubch\Yf`g`]XYUg`cf`k cfXg`k]h\ci hWfYX]h"

=ðUddfcdf]UhY`dUfUd\fUg]b[..7\Ub[]b[`U`ZYk`k cfXg`UbX`d\fUgYg`k \]`Y`a cghmfYhU]b]b[`h\Y`cf][]bU` ghfi Whi fY`UbX#cf`dfc[fYgg]cb`cZ]XYUg`cZh\Y`cf][]bU`ž`UbX`]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_]b['k]h 'ch Yfg'Vi hdUgg]b['cZh 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'gh XYbhVYZcfY'h Y'Xi Y'XUHYžcf'Zcf'h Y'di fdcgY'cZh Ya d`U[]Uf]g]b['UhUbmh]a Yž'dUm]b['Ubch Yf'dYfgcb'hc'dYfZcfa 'Ub'UWUXYa]WhUg_žghYU`]b['cf'UVei]f]b[Ubch Yf'dYfgcb'g'UWUXYa]Wk cf_'UbX'Wcdm]b[']hž'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[`gcifWYg`k\]W\`\UjY`bchVYYb`fYUXžk]h\cihUW_bck`YX[]b[`h\Y`~gYWcbXUfm~ gcifWY`Zfca`k\]W\`_bck`YX[YcZh\Ya`\Ug`VYYb`cVhU]bYX"

8id`]WUhjcbffgY`Zd`U[]Uf]ga "Łigi Va]hhjb[imcifickbikcf_ž]bik\c`Yicfi]bidUfhžk\YfYi]h\UgidfYj]cig`m VYYbidfYdUfYXicfigi Va]hhYXiZcfiUbch\YfiUggYggaYbhicfiWcifgYiUhi BGK icfiUbch\Yfib]jYfg]hm"

7 cffYWhfYZYfYbWjb[dfUWfjWYg.

- 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 Uhf]Vi h]cb Zcf U fUb[Y cZa UhYf]U g]b\$

%o U,

5WUXYa]W=bZcfaUh]cb[.]

: cf[·]YggYbhJU^{··}gh XYbh[·]]bZcfa UhJcb[·]fY[·]UhJb[^{··}hc.

- fYei Ygłg Zcf Yl łYbg]cb/
 `UłY gi Va]gg]cbg [i]XY]bYg/