

### 7ci fgY 8YW] g

#### 7 fYX]hDc]bhg \* \*

### Gi a a UfmcZh\Y 7ci fgY

Gi VYWh5fYU. EbS` [eZ S` V >Sf[` 3\_ Wd[US` EfgV[We H\]g'Wci fgY'Wbb'U`gc'VY'ghi X]YX']b'h\Y'Zc``ck ]b[ 'gdYW]U`]gUh]cb. 7 gdabWS` EfgV[We

K \Uha U\_Yg`WcbMa dcfUfmGdU]b`gi W\`U`ZJgW]bUljb[`d`UWY`]g`l\Y`]a a YbgY`UbX`ZYbYljWW\Ub[Y`]h\Ug i bXYf[cbY`UbX'h\Uh\Ugža UbmUf[i YždfcXi WYX`U`bYk `Wci blfm' \dangle ``Ygg'l\Ub`\U`ZU`WYbh fmž'U dfYXca ]bUbhmfi fU`žU[f]W`li fU`gcW]Ymm\Ug`VYYb'lfUbgZcfa YX`]blc`U`a U]b`mi fVUb`UbX`lYW\bc`c[]WU`cbY"`5`(\$!mYUf`X]\WUlcfg\]d`\Ug`VYWca Y`U`XYa c\WUWh'cbY`cZh\Y`k cf`Xfg`a cgh\WblfU`]gYX`glUlhYg`\Ug VYYb`a UXY`]blc`cbY`cZh\Y`a cghXYWYblfU`]gYX"`5`gcW]Ymm\Uhk Ug`]bhYbgY`mgYl i U``mfYdfYggYX`\Ug VYWca Y`U`bclUV`mdYfa ]gg]j Y`cbY"`H\YfY`\Ug`VYYb`U`fYj c`i ljcb`]b'l\Y`fc`Yg`cZa Yb`UbX`k ca Yb"`5bXž GdU]b`\Ug`Yl dYf]YbWXX`U`gi f[Y`]b`]a a ][fUljcb'l\Uh\Ug`hi fbYX`]lb`jb'l\Y`gdUWY`cZ^\ghU\ZYk 'mYUfgž]blc`U a i `h]!Yh\b]WgcW]Ymd'\dotY]gwbhYl hcZW\Ub[Yž'h\Y`hcd]Wg`Yl d`cfYX`]b'l\Y`Wci fgY`]bwl XY`bUljcbU`]ga `UbX bUljcbU`]XYbhJmž`]hYfUfmdfcXi Wljcbž'h\Y`Uffgža YX]Už[YbXYf`UbX`gYl i U`]lmž'9i fcdYUb]gUljcbž`Ub[i U[Yg UbX`fY[]cbU`]ga žfY`][]cbž'UbX`Z]YglUg"

 $H\g^Wc_i fgY^g = Wc_i fgY^g =$ 

### 7 ci fgY @YUfb]b[ 'Ci hWca Yg

% X]gW gg'h\Y`X]ZZYfYbhhmdYg'cZW`hi fU`dfUW]WYgž'hYbXg'UbX']ggi Yg']b'a cXYfb'GdU]b &" UddfU]gY'h\Y']a dcfrUbW'cZW`hi fU`dfUW]WYgž'hYbXg'UbX']ggi Yg']b'a cXYfb'GdU]b ' " ]bj Ygh][ UhY'U'dUfh]W``Uf'W\`hi fU`dfUW]WYZ'hYbX'UbX#cf']ggi Y']b'h\Y'WcbhYl hcZWcbhYa dcfUfmGdU]b

### HYUWX]b[ 'GhfUhY[]Yg'

H\]g``Yj Y`` 'Wci fgY`]g`WcbXi WhYX`h\fci [\``YWi fYg`UbX`hi hcf]U`g`]b`k\]Wk\UWhj Y`dfYdUfUhjcbždUffjWjdUhjcbUbX`Yb[U[Ya Ybh]g`Yl dYWhYX"'9UWk`k YY\_'U`gdYWjZJWhcd]Wk]```VY`h\Y`ZcW g`cZh\Y`Wci fgY`a YYhjb[g"`H\Y ZUWY`hc`ZuWY`\ci fg`UfY`gi dd`Ya YbhYX`k]h\`cb`]bY`UWhj ]hjYg`fY`UhYX`hc`h\Y`fYUX]b[g"`H\Y`Wci fgY`]g cf[Ub]nYX`Ufci bX`WcfY`UbX`gi dd`Ya YbhUfmfYUX]b[g"`Ghi XYbhg`UfY`Yl dYWhYX`hc`\Uj Y`fYUX`h\Y`WcfY fYUX]b[g"`Ghi XYbhg`UfY`Yl dYWhYX`hc`\Uj Y`fYUX`h\Y`WcfY fYUX]b[g`fYei ]fY`ghi XYbhg`hc`UhfU]b`U`bYWYggUfm`Yj Y``cZ\_bck`YX[Y`Ug`fYei ]fYX`Zcf`W``hi fU``Wca dYhYbWY`UbX`Z fh\Yf`ghi Xm''H\Y`gi dd`Ya YbhUfmfYUX]b[g`gYfj Y dUfhmUg`Ub`U]X`hc`\Y`d`ghi XYbhg`[YhghUfhYX`k]h\`]XYbhjZmjb[`ch\Yf`gci fWyg`Zcf`h\Y`fYgYUfW\`YggUm'

 $H\Y'fYUX]b[g'dfcj]XY'h\Y'VUg]g'Zcf'X]gW'gg]cb'''H\fci[\X]gW'gg]cb''k Y'k]^``Yb[U[Y'h\Y'gWkc`Ufg\]d'cZh\Y'ZY'''$ 

: fca 'h\Y'; i ]XY`]bYg'cb'@YUfb]b[ 'h\Uh\Dcfa 'HYUW\]b[ 'ghi XYbhg'Wca a i b]WUhY']bZcfa Uh]cbz']XYUg'UbX Uf[ i a Ybhg'Vch\ 'cfU``m'UbX']b'k f]h]b[ "'H\Ym[ Uh\Yf'UbX'dfcW/gg']bZcfa Uh]cb'Zfca 'U'j Uf]YhmcZdUdYfz'Ui X]c! j ]gi U``UbX'Y`YWfcb]Wgci fW/g"'H\Ymi gY'+H'YZY

# 5ggYgga Ybh

5gg][ ba Ybhgʻa i gh'\Uj Y'UʻdfcdYfmWca dʻYhYXʻGW\cc``5ggYgga Ybhʻ7cj Yfg\YYhž'k ]h\`h\Y`XYWUfUhjcb g][ bYX`UbX`XUhYX`Vm\UbX"`H\Y`7cj Yfg\YYhWUb`VY`Xck b`cUXYX`Zfca `\hhdg.##\U`"Ufhg"i bgk "YXi "Ui #gh XYbhg#Mci fgYg#Mci fgY!ci h]bYg#

### 5ggYgga Ybh'HUg\_g'

5ggYgga Ybh'tUg_	K Y][\h	8i Y <sup>.</sup> 8UhY	Gh XYbh@YUfb]b[ Ci hWca Yg 5ggYggYX
: ]bU``9ggUmi	()।	&*#\$(#&\$% `\$(.\$\$`DA	% <u>ž&amp;</u> Ž
Hi hcf]U``Dcfh7c`]c'	&) ı	Bch5dd`]WUV`Y	&
7`UggʻDfYgYbHJhjcbʻUbX 5bbcHJhYX`6]V`]c[fUd\mi	' \$1	Bch5dd`]WUV`Y	&Ž

#### 5ggYgga Ybh8YHJ]`g

5ggYgga Ybh%: ]bU`9ggUm

GhUfhXUhY. Bch5dd`]WUV`Y

@Yb[ h\. &) \$\$ k cfXg ]bWi X]b[ V]V ]c[ fUd\m

8YHJ]`g. Mci 'bYYX'hc'k f]hY'U'&) \$\$!k cfX'YggUmcb'U'hcd]WUbX']bWi XY'U'V]V`]c[fUd\mcZUh`YUghhYb
UWUXYa ]Wgci fWrg'Wcbgi `hYX']b'XYj Y`cd]b['h\Y'YggUmi g]b['<5FJ5F8'fYZYfYbW]b['ghmY"'H\Y'Z]bU``YggUm
bYYXg'hc'VY'i d`cUXYX'h\fci [\'HIFB+H-B'UbX']g']bX]j ]Xi U`"Mci 'k ]``fYWY]j Y'k f]hYb'ZYYXVUW\_"'=ik ]``VY
[]j Yb']b'fi Vf]Wg'k ]h\']bX]j ]Xi U`'Wca a Ybhg"

#### 5XX]h]cbU`XYhU]`g.

± 'Zcfa i `Uhjb[ 'U'hcd]Wž'mci 'a i gh'dcgY'h\Y'hjh`Y'Ug'U'ei Yghjcb"'H\fci [\'h\Y'YggUmž'mci 'k]``'Ubgk Yf'h\Y ei Yghjcb"

Mci 'bYYX'rc'fYgYUfW.'U'rcd]WfY'Yj Ubhirc'GdUb]g\'dcdi `Uf'W'`hi fY'Vi hiX]ZYfYbhiZca 'h\Y'cbY'W\cgYb'Zcf h\Y'[fci d'dfYgYbhUf]cb"'Mci 'bYYX'rc']bWi XY'U'V]V']c[fUd\mi g]b['<5FJ5F8'fYZYfYbW]b[
ghmY"\htdg.##ah XYbh'i bqk "YXi "Ui #\Ufi UfX!fYZYfYbW]b[

±bʻZcfa i `Uhjb[ 'U'hcd]Wžmci 'a i ghidcgY'h\Y'hjhìY'Ug'U'ei Yghjcb"'H\fci [\'h\Y'YggUmžmci 'k]``'Ubgk Yf'h\Y ei Yghjcb"'

8UhY gi Va ]gg]cb K YY\_ %\$ž&\*#(#% Uh(da

.

 $\begin{tabular}{ll} \textbf{Gi Va } ] \textbf{gg]} \textbf{cb'bch'g}. \begin{tabular}{ll} \textbf{bYX'hc'i gY' < 5FJ 5F 8'fYZ'fYbW]} \textbf{b['ghm'Y'' \htdg. \#ghi XYbh'i bgk "YXi "Ui #\Ufj UfX! fYZ'fYbW]} \textbf{b[} \end{tabular} \label{tabular}$ 

 $\label{thm:continuous} \begin{tabular}{ll} Hi fb]h]b "gYhh]b" . "H\]g"Ugg][ ba Ybh]g"gi Va ]hhYX"h\fci [ \ 'Hi fb]h]b "UbX"gh XYbhg"Xc "bchgYY"Hi fb]h]b g]a ]`Uf]hmfYdcfhg" \\ \end{tabular}$ 

5ggYgga Ybh'& 'Hi hcf]U` 'DcfhZc`]c

GHJfhXUhY. Bch5dd`]WUV`Y

@Yb[ h\. '%) \$\$

8YHJ]`g.

5 ``]ghcZhcd]WghcWXccgYiZfcak]```VY'[]jYbVmh\Y``YWhifYcfh\Y'[fcidWUbWXcgYh\Y]fickb"

## 5 h Yb X Ub WY F Yei ] f Ya Yb hg

5 thY b X U b WY 'c Z `Y Whi f Y g 'U b X 'hi hc f]U `g ']g 'a U b X U hc fmi]b 'th \]g 'W c i fg Y " I b Y I W g Y X 'U V g Y b WY 'Z fca 'a c f Y 'th U b &\$ i 'c Z hi hc f]U `g 'k ]`` f Y g i 'h ]b 'th Y 'U k U f X 'c Z U 'Z U]` [ f U X Y "

\$\times \times \

# 7ci fgY'GWXYXi `Y

### J]Yk 'WUgg'ha YHUV'Y

### H]a YHJV`Y

8 UhY	Hmd Y	7 cbh/bh
K YY_'%'%': YVfi Ufm!'&( : YVfi Ufm	@YWi fY	GdUb]g\`BUh]cbU``]XYbh]hmžU`a mh\3
K YY_'&.'&) ': YVfi Ufm!'' A UfWX	@YWi fY	: fUbWcž' * 'mYUfg'cZX]WWhcfg\]d"'9`; iYfb]WU"
K YY_" . ( "A UfVX "! "%\$ A UfVX	@YWi fY	A cbUfW\mUbX`XYa cWfUWm\``5`' fX`F Ydi V`]W\\\
K YY_^(.^%%`A UfVX^!^%+ A UfVX	@YWi fY	BYk 'ZJa]`mj U`i Yg'UbX'[YbXYf'fYdfYgYbfUf]cbg"'H\Y WJgY'cZ5`a cXi j Uf"'
K YY_")."% "A UfVX"!"&( A UfVX	@YWi fY	6Ugei YgʻUbXʻ7 UHJʻUbgžk \cʻUfYʻH\YmUbXʻk \UhXc H\Ymk UbH3
K YY**.*&) ^A UfVX ^! '' % A UfVX		Hci f]ga 'UbX'ghYfYchmdYg"'H\Y'V]fh\'cZ Hci f]ga d\cV]U"
K YY_"+."%"5df]`"!"+"5df]`	@YWhifY	EiYgh]cbg'cb'A][fUh]cb'UbX'h\Y'bYYX'hc'VY`cb["
K YY_', .', '5df]`'!'%( '5df]`	@YWhifY	; ]bUbWJU``7 f]g]g'UbX'Dc`]rJWU``7 cffi dh]cb"
K_YY_''%)	@YWi fY	GdUb]g\`gYbgY`cZ\i a ci f"

## FYgci fW/g

DfYgWf]VYX F Ygci fWYg

H]hY'H\Y'BYk'GdUb]UfXg

5i h\cf'>c\b'<ccdYf

Di V`]g\Yf'DYb[i]b'5Xi `hž'&\$\$\*

€6B'\$%( %\$%\*\$-(Ž-+,\$%( %\$%\*\$-&

@Yb[h\'(), dU[Yg

 $GY^YWHYX^WXUdhYfg^k]^YVY^]bX]WUhYX^kYY_m'$ 

FYWca a YbXYX FYgci fW/g

 $5XX]h]cbU`gWkc`Uf`m`Ufh]WYg`k]``VY`dcghYX`cb`AccX`Y`kYY_`m'$ 

: -@AGF9EI + F98 : CF H<- G7CIFG9

H\Y`g\_]b =`]j Y`]b VmDYXfc 5`a cXcj Uf

<c`m7Ua d Vm>"5a Vfcg]UbX 7Ujc

CZZ7cifgY VmBUWkc; "JY`]``U"

5```Z|`a q'U| U|`UV`Y'B9H: @=L

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

7 ci fgYgʻUfYʻdYf]cX]WJ``mfYj ]Yk YXžʻUbXʻghi XYbhgʻʻZYYXVUW\_`]gʻi gYXʻhcʻ]a dfcj Yʻh\Ya ":: YYXVUW\_`]g [ Uh\YfYXʻi g]b[ 'j Uf]ci gʻa YUbgʻ]bWl X]b[ 'I BGK 'gʻ7 ci fgY`UbXʻHYUW\]b[ '9j Uʻi Uh]cbʻUbXʻ=a dfcj Ya Ybh fl⁄ 5 H9 ±'dfcWfgg"

Gi Va ]gg]cb cZ5ggYgga YbhHUg\_g

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 Ybht\fci [ \ 'Hi fb]hJbž'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'mYUfŁ" Image:

UfY'i bUV'Y'hc'gi Va ]hmci f'Ugg][ ba YbhXi Y'hc'U'ZJi 'hk ]h\ 'Hi fb]hJb'mci 'a UmUdd'mZcf'Ub'Y! hYbg]cbž'Vi hmci
a i ghfYhJ]b'mci f'hJW\_Yhbi a VYf'Zfca '9! hYfbU''Gi ddcfhfU'cb[ 'k ]h\ 'Ubmch\Yf'fY'Yj UbhXcW a YbhgŁ'hc
]bWi XY'Ug'Yj ]XYbW' 'hc'gi ddcfhmci f'Y! hYbg]cb'Udd']WUh]cb" Image: Ya U]''9! hYfbU''Gi ddcfhmci 'k ]''

Ui hca UhJWJ''mfYW'] Y'U'hJW\_Yhbi a VYfž'Vi h]Zmci 'hY'Yd\cbY'mci 'k ]'''bYYX'hc'gdYWJZWJ''mUg\_'Zcf'cbY"

Hi fb]hJb'U'gc'dfcj ]XYg'i dXUhYg'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 i]gii g]b[ih\Yik cfXgicfi]XYUgicZch\YfgiUbXidfYgYbh]b[ih\Ya iUgimci fick b"i±iWUbihU\_Yia Ubm Zcfa qžZfca iXYi]VYfUhYiW\YUh|b[ihciUVW]XYbhU`mWcdm]b[iZfca iUigci fWYik]h\ci hUW\_bck iYX[Ya Ybh'i

IBGK '[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 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\_]b[ 'k ]th 'cth Yfg'Vi hidUgg]b[ 'cZZth 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\_'thc'Ubcth Yf'ghi XYbh'VYZcfY'th Y'Xi Y'XUHYZcf'Zcf'th Y'di fdcgY'cZth Ya

- i bXYfglUbX`mci f`f][\hg`UbX`fYgdcbg]V]`]h]Yg`Ug`U`gh XYbh'Uhi BGK
- VY'Uk UfY'cZd`U[]Uf]ga ž'Wcdmf][\hzil BGK 'Gh XYbh7cXY'cZ7cbXi WhUbX'5WWdhUV`Y'I gY'cZ I BGK '= H'F Ygci fWfg'Dc`]Wh
- VY 'Uk UfY 'cZh\Y 'ghUbXUfXg 'cZVY\Uj ]ci f'Yl dYWhYX 'cZYj YfmcbY ']b 'h\Y 'l BGK 'Wcaaib]hm
- `cWUHY 'gYfj ]WYg'UbX `]bZcfa UH]cb'UVci hI BGK 'UbX'I BGK '@]VfUfm

### 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 ]bUh]cb dfcWYXi fYg/
- gdYWJU``Wcbg]XYfUhjcb`]b`h\Y`Yj YbhcZ]``bYgg`cf`a ]gUXj Ybhi fY/
- gh XYbhYei ]mUbX X]gUV]`]m/
- UbX'ch\Yf'YggYbhU`'UWUXYa ]W]bZcfa Uhcbz'gYY

\hdg.#k k k "Uffig"i bgk "YXi "Ui #W ffYbhgh XYbhg#UWUXYa ]W]bZcfa Ufjcb#dfchcWc`g![i]XY`]bYg#

=a U[ Y 7 fYX]h

| 'BUhU`]U'C fh]n

7F = 7CG