

## 7ci fgY<sup>·</sup>Cj Yfj ]Yk

## GhJZZ 7 cbhJWh 8 YhJ] `g

7cbj Ybcfg

B Ua Y	9a U]`		

## 7ci fgY 8YHJ] g

#### $I b h c Z 7 f Y X h^*$

## Gi a a UfmcZh\Y 7ci fgY

♣ 'h\]g'Wei fgYz'ghi XYbhg'k]``[U]b'Vch\'UZ bXUa YbhU``UbX'dfUW]WU`i bXYfghUbX]b['cZh\Y'XYg][b'UbX cdYfUh]cb'cZgc`Uf'WV``g'''H\Y'Wei fgY'k]``YbUV`Y'h\Y'ghi XYbhhc'Yl hYbX'h\Y]f'\_bck `YX[Y'cZgYa]WebXi Wef XYj]W''UbX'dfcj]XY'U'gci bX'VUg]g'Zcf'U'XYYd'i bXYfghUbX]b['cZW'ffYbhgc`Uf'WV``'hYW\bc`c[]Yg'''? Ym dfUW]WU`'dfcWyggYg'gi W\'Ug'gc`]X'ghUhY'X]Zi g]cbz'[YhYf]b['UbX'XYj]W''WebHUW]b['UfY']bhfcXi WYX''5 'fUb[Y cZ'UVcfUhcfm\VUgYX'UbX'Wea a YfW]U`'gc'Uf'W\``'hYW\bc`c[]Yg'UfY'fyj]Yk YX'hc[Yh\Yf'k]h\'fYW\bh hYW\bc`c[]WU``UXj UbWyg']b'h\Y'Z]Y'X'''H\Y'Wei fgY'a U\_Yg'i gY'cZg]a i `Uh]cb'hcc`g'hc'fY]bZcfW''Ub i bXYfghUbX]b['cZXYj]W''d\mg]Wg'UbX'h\Y'X]ZZYfYbhgc`Uf'W\``'hYW\bc`c[]Yg'''H\Y'g]a i `Uh]cb'hcc`g'UfY'U`gc i gYX'hc'XYg][b'UbX'cdh]a]nY'UXj UbW'X'gc`Uf'W\``g'WcbW\dhg'''H\Y'Wei fgY']bhfcXi W'g'U'gi]hY'cZfY`Yj Ubh W\UfUWhYf]gUh]cb'hYW\b]ei Yg'h\UhUfY'i gYX'hc'i bXYfghUbX'h\Y'W\UfUWhYf]gh]Wg'cZgc`Uf'W\``g']bWi X]b[ gdYWfU`'fYgdcbgYz'hYa dYfUhi fY'gYbg]hj] |hmz'fYg]ghjj Y'`cggYgz'W' ffYbh[YbYfUh]cb'UbX'cdYb!WjfW]hj c'hU[Yg''

## 7 ci fgY 5]a g

- 8Yj Y`cd'k ]h\]b'gh XYbhg'U'Z bXUa YbhU`h\YcfYhWU`i bXYfghUbX]b['cZh\Y'cdYfUh]cb'cZgc`Uf'WY``g/
- 9I dcgY ghi XY bhg hc 'U'k ]XY fUb[Y cZgc 'Uf 'WY "' hY VX bc 'c[]Ygz'k \]WX 'UfY 'dfUWlgYX']b "UVcfUhcfmUbX Wa a YfWJU Ybj]fcba Ybhg/UbX
- HYUWX 'ghi XYbhg 'hc 'i gY 'Uj U] 'UV Y 'hcc `g 'UbX 'hY VX b]ei Yg 'hc 'WX UfUWHY f]gY 'gc `Uf 'WY ``g

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

52hYfigi WWYggZ ``miWca d`Yh]b[ 'h\]giWci fgYžmci ig\ci `X'VY'UV'Y'hc.

@YUfb]b[ 'Ci hWca Y	95 GHJ[Y %7ca dYhYbW]Yg
%":8YgWf]VY`gc`Uf`WY```cdYfUh]cbg'i g]b[ 'd\mg]WU``UbX'Y`YWYf]WU` a cXY`g	D9%"%žD9%"&žD9%" žD9' "&
&"'G]a i `UhY'gc`Uf'WY```XYj ]WYg'i g]b[ 'bi a Yf]WU`a cXY`g	D9%"&ž'D9%"' ž'D9&"%ž'D9&"'
' "'8 Yg][ b'gc`Uf'WY``g'Vmcdh]a ]g]b[ 'dUfUa YhYfg'Zcf'a Ul ]a i a YZ]W]YbWn	D9&"%*D9&"
("'5bU'mgY'a YUgi fYX'W\UfUWNf]gh]Wg'cZgc'Uf'WY``g'hc'XYhYfa ]bY gci fWYg'cZ`cgg	D9&"%ŽD9&"'

HYUW ]b[ 'GhfUhY[ ]Yg'

## 5ggYgga Ybh

5ggYgga YbhhUg_	K Y][ \h	8iY'8UhY	7 ci fgY`@YUfb]b[ Ci hWca Yg`5ggYggYX
%" <sup>-</sup> 91 YfW]gYg	' \$I	K YY_'' ž'+	%ž &ž'' ž'(
&"'Ei]n	%) ।	K YY_'% %\$	%ž'&ž''
' "'Dfc YWh	&) ı	K YY_"%\$	%ž'&ž''
(": ]bU``91 Ua	' \$1	Bch5dd`]WUV`Y	&ž¨'

## 5ggYgga Ybh'% '9l YfW]gYg'

8i Y"XUhY."K YY\_" ž"+

 $5\,b\,U^*mg]g\check{z}^*9j\,\,U^*i\,\,Uh]c\,b^*Ub\,X^*8\,Yg][\,\,b^*c\,Zgc^*Uf^*WY^*g$ 

5ggYgga Ybh'& Ei]n

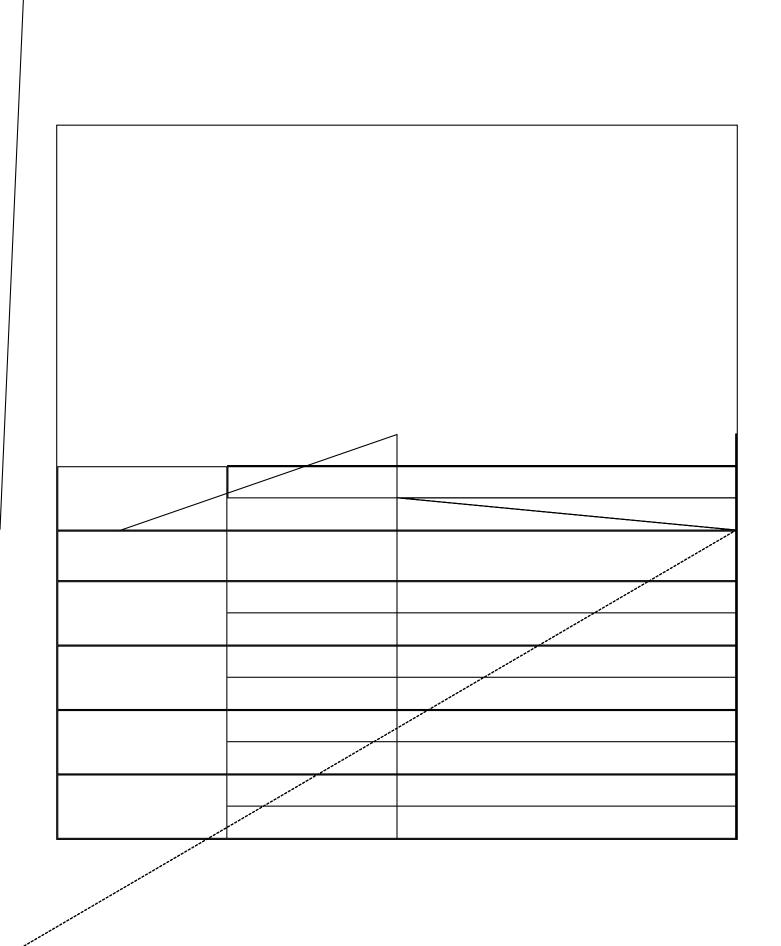
8i Y'XUhY.'K YY\_'%%

@YWhifY'a UhYf]U``Zfca 'fYgdYWhjjY'kYY\_"

5ggYgga Ybh' Dfc YWh

8i Y'XUhY.'K YY\_'%\$

5bU'mg]gž'9jU'iUh]cb'UbX'8Yg][b'cZgc'Uf'WY'`g



## FYgci fW/g

#### DfYgWf]VYX F Ygci fWYg

A "'5"; fYYb'f%, &Ł'"Gc`Uf'7Y``g""FYX'Vcc\_"

\hdg.#kkk"djYXiWUhjcb"cf[#

#### FYWca a YbXYX FYgci fW/g

@YUfb]b[ fYgci fW/g Zcf'h\]g Wti fgY ]bWi XY.

- 'H\Y'D7 %8 'gcZk UfY'dUW\_U[Y']g']bWi XYX'cb'U``'f\Y'Wca di hYfg']b'( %\* 'UbX'())
- `A " `5" ; fYYb `f% , &Ł"Gc`Uf `7 Y``g"" F YX 'Vcc\_"
- >YbbmBY`gcbž"H\Y`D\mg]Wg`cZGc`Uf`7Y``g"
- 'D\chcjc'\U]WGc'\Uf'9bYf[m': fca ': i bXUa YbHJ'g'hc'5dd']\Wh]cbg
- $\bullet$  DYHYf'K i fZY` $\check{z}$ 'D\mg]Wg'cZGc`Uf'7Y``g

5XX]h]cbU``fYZYfYbW'`a UhYf]U``a UXY`Uj U]`UV`Y`hc`gh XYbhg`j ]U`A ccX`Y

I BGK "@]VfUfmik YVg]hY. \hdg.#k k k "`]VfUfm'i bgk "YXi "Ui #

 $A \ ccX`Y. `\ hdg. \#a \ ccX`Y"hY`h'i \ bgk "YXi "Ui \ \#c[\ ]b\#bXYI "d\ d$ 

## Gi Va ]gg]cb cZ5ggYgga YbhHUg\_g

K cf\_'gi Va ]hhYX``UhY`k ]h\ci hUb`Uddfcj YX`YI hYbg]cb`Vmh\Y`Wci fgY`WccfX]bUhcf`cf`XY`Y[ UhYX`Ui h\cf]hm]g gi VYWihc`U``UhY`dYbU`hmcZ)ı 'a Uf\_'fYXi Wf]cb`dYf`XUmz`Wcbg]ghYbhk ]h\`ch\Yf`GDF 99`Wci fgYgz`UbX WUddYX`Uh) `XUmg`f%&\$`\ci fgŁz`UZhYf`k\]W\`U`gh XYbhWUbbchgi Va ]h\Ub`UggYgga Ybh'

 $\label{thm:condition} $$HY^`UhY`dYbU`hm]g`Udd`]YX`dYf`WU`YbXUf`XUmif]bWi X]b[`k YY_YbXg`UbX`di V`]W\c`]XUmgŁ'h\Uhih\Y UggYgga Ybh]g`cj YfXi Y''`H\YfY`]g`bc`dfc!fUhU`cZh\Y``UhY`dYbU`hm`Zcf`gi Va ]gg]cbg`a UXY`dUfhk Umih\fci [\'UXUm'$ 

K cf\_'gi Va ]hhYX'UZhYf'h\Y''XYUX`]bY'Zcf'UVgc`i hY'ZU]''']g'bchUWWdhYX'UbX'U'a Uf\_'cZnYfc'k]``'VY'Uk UfXYX Zcf'h\Uh'UggYgga Ybh']hYa "

cf'gca Y'UggYgga Ybh']hYa gž'U'``UhY'dYbU`hma Umbch'VY'Uddfcdf]UhY"'H\YgY'UfY'WYUf'm']bX]\WUhYX']b'h\Y Wci fgY'ci h']bYz'UbX'gi W\'UggYgga Ybhg'fYWY]j Y'U'a Uf\_'cZnYfc']Zbch'Wca d`YhYX'Vmh\Y'gdY\\JZ]YX'XUhY" 91 Ua d'Yg']bWi XY.

U"''K YY\_`mcb`]bY`hYghg`cf``UVcfUhcfmk cf\_`k cfh\`U`ga U```dfcdcfh]cb`cZh\Y`gi VYWha Uf\_žcf

V"''C b`]bY ei ]nnYg k \YfY Ubgk Yfg UfY fY`YUgYX hc gh XYbhg cb Wca d`Yhlcbžcf

····cf

X""DUgg# U]"UggYgga YbhHJg\_g"

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

 $\label{thm:continuous} IBGK ``Ug`Ub`cb[c]b[`Wcaa]haYbhhc`ZcghYf]b[``U`W``hifY`cZ`YUfb]b[`]bZcfaYX`VmUWUXYa]W]bHY[f]hm'`5``IBGK `ghiXYbhg`\UjY`U`fYgdcbg]V]`]hmhc`UX\YfY`hc`h\]g`df]bW]d`Y`cZUWUXYa]W]bHY[f]hm'D`U[]Uf]gaibXYfa]bYg`UWUXYa]W]bHY[f]hmUbX`]g`bchhc`YfUhYX`UhIBGK "`B'SY[Sde_SfG@EI[eVW{`WSege[YfZW_aXSekagdai`ž$ 

Mci 'UfY'U'gc'fYa ]bXYX'h\UhWUfYZ ``h]a Y'a UbU[ Ya Ybh]g'Ub']a dcftUbhdUfhcZgh XmUbX'cbY'cZh\Y ]XYbh]Z]YX'WUi gYg'cZd`U[ ]Uf]ga ']g'dccf'h]a Y'a UbU[ Ya Ybh'Gh XYbhg'g\ci `X'U``ck 'gi Z]W]Ybh'h]a Y'Zcf fYgYUfW\žXfUZ\]b[ 'UbX'h\Y'dfcdYf'fYZYfYbW]b[ 'cZgci fWYg']b'dfYdUf]b[ 'U``'UggYgga Ybh'lUg\_g''

₹d`U[]Uf]ga i]gʻZci bXi]bimci fik cf\_ik \Ybimci 'UfYi]bʻZ[fghmYUfžimci fi`YWi fYfik]``cZYfimci 'Ugg]ghUbWYihc
]a dfcj Yimci fi'UWUXYa]Wg\_]``g'''H\Yma UmUg\_imci ihci`cc\_'Uhigca Yicb`]bYifYgci fWygžiUhhYbXih\Yi@YUfb]b[
7 YbhfYžcfigca Yh]a YgifYgi Va]himci fik cf\_ik]h\h\YidfcV`Ya iZ[l YX'''< ck Yj Yfia cfYigYf]ci gi]bghUbWygi]biZ[fgh
mYUfžigi W\ugighYU`]b[iUbch\Yfighi XYbhgik cf\_icfidUm]b[igca YcbYihciXcimci fik cf\_žia UmVYi]bj Ygh][UhYX
i bXYfih\YiGhi XYbhA]gWcbXi WhDfcWYXi fYg''

FYdYUHYX'd`U[]Uf]ga 'fYj Yb']b'Z|fghmYUfłź'd`U[]Uf]ga 'UZHYf'Z|fghmYUfźcf'gYf]ci g']bghUbWYgža Um'U`gc'VY ]bj Ygh][UhYX'i bXYf'h\Y'Gh XYbhA ]gWcbXi WhDfcWYXi fYg"'H\Y'dYbU'h]Yg'i bXYf'h\Y'dfcWYXi fYg'WUb']bWi XY U'fYXi Whcb']b'a Uf\_gž'ZU]`]b['U'Wci fgY'cf'Zcf'h\Y'a cghgYf]ci g'a UhHYfg'fi]\_Y'd`U[]Uf]ga ']b'Ub'\cbci fg h\Yg]gŁYj Yb'gi gdYbg]cb'Zfca 'h\Y'i b]j Yfg]mm''H\Y'Gh XYbhA ]gWcbXi WhDfcWYXi fYg'UfY'Uj U]`UV'Y'\YfY.

kkk"[g"i bgk"YXi"Ui #dc]Wn#XcWa Ybhg#ghi XYbha ]gWcbXi WhdfcWYXi fYg"dXZ

## 5 WUXYa ]W = DZcfa Uhjcb

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

: YYXVUW\_cb'h\Y'Wci fgY']g'[Uh\YfYX'dYf]cX]WU``mi g]b['j Uf]ci g'a YUbgž]bWi X]b['h\Y'I BGK a m9I dYf]YbW''dfcWYggž]bZcfa U``X]gW gg]cb']b'h\Y'Z]bU``WUgg'Zcf'h\Y'Wci fgYž'UbX'h\Y'GW\cc''g Gh XYbh#GHJZZa YYh]b[g"'Mci f'ZYYXVUW\_']g'HU\_Yb'gYf]ci g`mž'UbX'Wcbh]bi U``]a dfcj Ya Ybhg'UfY'a UXY'hc'h\Y Wci fqY'VUqYXž']b'dUfhž'cb'qi W\'ZYYXVUW"

 $5 ```ghi XYbhg`UfY`YI dYWhYX`hc`fYUX`UbX`VY`ZJa ]`]Uf`k ]h\`I BGK `[i]XY`]bYg`UbX`dc`]WYg''` \pm 0`dUfh]Wi`Ufž ghi XYbhg`g\ci`X`VY`ZJa ]`]Uf`k ]h\`h\Y`Zc``ck ]b[.$ 

(E5 HY b X Ub W)

OH BGK '9a U] '5XXfYgg

(FGdYW)U`7cbg]XYfUh]cb

(191 Uag

(E) ddfci YX 7 U'W 'Uhcfa

(E5WUXYa ]W<cbYghmUbX D`U[ ]Uf]ga

(Bei ]hUV'Y'@YUfb]b['GYfj]WYa

7F = 7CG

7F = 7CG Dfcj ]XYf 7cXY. \$\$\$-,;

5W\_bck `YX[ Ya YbhcZ7ci blfm

 $K Y : UW\underline{b} ck `YX[Y : h, Y : 6YXY[U : dY cd `Y : k \ c : UfY : h, Y : hfUX]h\underline{b} cb : `W : ghcX]Ubg : cZh, Y ``UbXg : cb : k \ ]WX : I BGK ? Ybg]b[hcb : WUa di g : ]g ``cWUhYX"$ 

# 5ddYbX]l. '9b[]bYYfg'5i glfU`]U'f95Ł'DfcZYgg]cbU`'9b[]bYYf'7ca dYhYbWm GHJbXUfX

Dfc[fUa '±ohYbXYX'@YUfb]b['CihWca Yg				
?bck `YX[ Y`UbX`g_]```VUgY				
D9%"%7cadfY\Ybg]jYžh\YcfmVUgYX`ibXYfghUbX]b[`cZh\Y`ibXYfd]bb]b[`bUhifU``UbXd\mg]\W'`g\\Yb\W`g`UbX`h\Y`Yb[]bYYf]b[`ZbXUaYbhU`g'Udd`]\WV`Y`hc'h\Y`Yb[]bYYf]b[`X]g\\]d`]bY				
D9%"&"7cbWYdhi U``i bXYfgHJbX]b[ 'cZh\Y'a Uh\Ya Uh]Wgž'bi a Yf]WJ``UbU`mg]gž'gHJh]gh]Wgž'UbX Wca di hYf'UbX']bZcfa Uh]cb'gW]YbWYg'k\]W\`i bXYfd]b'h\Y'Yb[ ]bYYf]b[ 'X]gW]d`]bY				
D9%" '±0!XYdh\'i bXYfghUbX]b[ 'cZgdYW]U']ghVcX]Yg'cZ_bck 'YX[ Y'k ]h\]b'h\Y'Yb[ ]bYYf]b[ X]gW]d`]bY				