



# ENGG9744

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HYfa `Hk c` `##`&\$&%

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7 ci fgY`Cj Yfj ]Yk

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B Ua Y	9a Uj`	5j Uj`UVj`]m	@cWjhcb	D\cbY
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K YV

[GWcc`cZA YWUbj\]WU`UbX`A Ubi ZJW` f\]b\[ `9b\[ \]bYYf\]b\[](#)

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[I BGK `Gh`Xm5VfcUX`UbX`9I`WU\]b\[ Y`fZcf`\]bVci bX`ghi`XYb\]g†](#)

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D\cbY

fZ`\*%&Ł`- ' , ) ; ) \$\$`-Bi WYi g`Gh`XYbh<i V

fZ`\*%&Ł`- ' , ) `+\*\*%`-9b[ ]bYYf]b[ `bXi`grf]U`HfU]b]b[

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fZ`\*%&Ł`- ' , ) `(\$`-`+`-GWcc`C`Z]W††

††D`YUgY`bchY`hUh`hY`GWcc`C`Z]W`k`j`bch\_bck`k`Yb#Zmci`f`Wci`fgY`Wcbj`Ybcf`]g`cb`Wla`di`g`cf`Uj`Uj`UV`Y

9a U]

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- Y"[ "Ybfc`a Ybž`dfc[ fYgg]cbžWUg\`fYei YgržWči fgY`]ggi Yg`cf`dfc[ fUa !fY`UhYX`ei Yf]Yg

[9b\[ \]bYYf\]b\[ \]`Xigf\]U`HfU\]b\]b\[ \]`Xigf\]U`HfU\]b\]b\[ \]`ei Ygh\]cbg](#)

[\]BGK`Gh.Xm5VfcUX](#) –`gh XmiUVfcUX`gh XYbhYbei ]f]Yg`fZcf`]bVci bX`gh XYbhgŁ

[\]BGK`9I.WUUb\[ \]Y](#) –`gh XYbhYI WUUb[ ]Y`Ybei ]f]Yg`fZcf`]bVci bX`gh XYbhgŁ

[\]BGK`:\]i`h`fY`Gh.XYbhg](#)



H\]g'Wci fgY'Ugc'dfcj ]XYg'gYj YfU'Wca dYH'bwWmUFYUg'cZkY'595' bH'fbUhc'bu'Bi WYUf'A UbU[ Ya Ybh 5WUXYa mfiBA 5E'YUfb]b[ 'ci hWca Yg'Zcf'a Ugh'fg''Yj Y'Wci fgY' ]b'Bi WYUf'HYWbc'c[ mA UbU[ Ya Ybh

BA 5'7ca dYH'bwWm5fYUf	BA 5'7ca dYH'bwWm @Yj Y'
%&' bH'fbUhc'bu'bi WYUf'cf[ Ub]nUhc'bg	%
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&%'Bi WYUf'dck Yf'd'Ubh'UbX'ch'Yf'ZUW]m]mXYg][ b'df]bW]d'Yg	%
&*&'Bi WYUf'dck Yf'd'Ubh#ZUW]m]mcdYfUhc'bu'gm]hYa g	%
&*" 'Bi WYUf'gUZY'midf]bW]d'Yg'UbX'UbU'm]g]	'
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f; fcgVc]gž>"XYž: "'5XUW]ž'UbX'<"< ]fcgY"'&\$%+" " bH'fbUhc'bu'Bi WYUf'A UbU[ Ya Ybh5WUXYa mA Ugh'fg Dfc[ fUa g']b'Bi WYUf'HYWbc'c[ mA UbU[ Ya Ybh" "595"

HYUW]b[ 'GhfUfY[ ]Yg'

: i 'micb]bY""H\]g'Wci fgY']g'l BGK 'X][ ]H' 'i d']zh'W'bh'bz'k \]W] ]g'hU[ [ \hcb]bY'h'fci [ \h'Y'cb]bY'YUfb]b[ d'Uh'Z'ca "

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H\]g']g'U'dcgh[ fUXi UH' Wci fgY' W'bj YbYX'Vm'h'Y'GW]cc''cZA YW]Ub]W] 'UbX'A Ubi ZUW] f]b[ '9b[ ]bYf]b[ " 4]g'dUfhc'ZkY'A 9b[ GW]Bi WYUf'9b[ ]bYf]b[ 'gdYW]U']nUhc'bu'UbX'W]b'VY'hU\_Yb'Ug'Ub'Y'YW]j Y'Vm' fX'cf ( h'm'Uf'gh'XYbh]Z'ca 'ch'Yf'gW]cc'g'UbX'ZUW] h]Yg'cb'h'Y'Uddfcj U'cZ\ca Y'gW]cc'UbX'h'Y'9B; ; - +( (


Gh XYbng'k cf\_]b'[ fci dg'hc'dfcXi W'U'XYg][ b'VUg]g'hfYUhUggYgga YbhZcf'U'bi WYUf'ZUW']m'i'H\Y  
Ugg][ ba Ybh]g'[ fUXYX'VmU'fi Vf]W': cf'UH'gi Va ]gg]cbgž&\$i' cZa Uf\_g'UFY'XYXi W'X'dYf'XUmž'fYUWX]b[  
nYfc'a Uf\_g'cb'%'&h'>i' mž'&\$&%"A Uf\_g'UFY'fYh'fbYX'Vm%( h'>i' m'

Gi Va ]gg]cb'bchYg. 'Gi Va ]hYX'h'fci [ \ 'Hi fb]h]bž]b'a ccXY"

Hi fb]h]b'gYh]b[ . 'H\]g'Ugg][ ba Ybh]g'gi Va ]hYX'h'fci [ \ 'Hi fb]h]b'UbX'gh XYbng'Xc'bchgYY'Hi fb]h]b  
g]a ]Uf]mifYdcfng"

5ggYgga Ybh' . '9a Yf[ YbWmGWbUf]c

GHUfhXUHY. '%( # \$ \* # & \$ & % \$ - . \$ \$ ' 5A

## 5 H\Y'W'ei fgY'jg'W'ebXi W\Y'X'Z' "mcb'jbY" H\Y'W'ebH'bh]g'YI H'bg]j' Y'UbX'gca Y'hja Yg'W'U''Yb[ ]b[ 'a YUb]b[ 'hUh

UH\Y'bxUbW' U'hk YY\_'m'h h'cf]U'g'k ]h' H\Y'W'ei fgY'W'ebj YbY'f'k '\]Y'cdh'cbU''jg'gh'f'cb[ 'miYbW'ei fU[ YX''G'h XYbhg  
k ]''b'Y'Y'X'h'c'a U\_Y'U'ffU'b[ Ya Ybhg'h'c'W'ebXi W'h[ f'ci d'k c'f\_'h'c[ Y'h'Y'f''G'ca Y'U'gg][ ba Ybhg'z'gi W'U'g'h'Y'g'UZ'Y'm  
W'lgY'd'f'Y'g'Y'bh'U'h'cb'U'f'Y'g'W'Y'X'i 'Y'X' ]b'U'X'j UbW'U'bx'U'h'Y'bxUbW' ]g'a UbX'U'h'c'f'm'h'c'c'V'h'U]b'h'Y' [ f'U'X'Y'g''

## 7 ci fgY'GW'Y'X'i 'Y

[J \]Yk' W'U'gg'h'ja Y'h'U'V'Y](#)

H]a Y'h'U'V'Y'

8 U'h	H'm'd'Y	7 c'bh'Y'bh
C'K'YY_'&)'A'Um!'& A'Um		
K'YY_'%' ' %A'Um!'(' >i bY	Hcd]W	B'i'W'Y'U'f'G'U'Z'Y'[i'U'f'X'g
K'YY_'&'+'>i bY!'%% >i bY	Hcd]W	A'U'h'f]U''5'W'W'ei'bh]b[
K'YY_''. '%(>i bY!'%' >i bY	Hcd]W	F'U'X]U'h'cb'G'U'Z'Y'm
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K'YY_'>)'&'>i bY!'&'>i 'm	Hcd]W	B'i'W'Y'U'f'G'Y'W'f]m
K'YY_'*') '>i 'm!'-'>i 'm	Hcd]W	B'i'W'Y'U'f'g'U'Z'Y'm'Z' b'X'U'a'Y'bh'U'g'
K'YY_'+'%&'>i 'm!'%'>i 'm	Hcd]W	H\Y'g'U'Z'Y'm'W'lg'Y'
K'YY_'.'%&'>i 'm!'&'>i 'm	Hcd]W	G'U'Z'Y'm'5'gg'Y'g'ga'Y'bh''
K'YY_'-'&'>i 'm!' '\$>i 'm	Hcd]W	G'U'Z'Y'm'5'b'U'm'g]g



F Ygci fWg

DfYgWf]VYX`F Ygci fWg`

H\Y`a cgh]a dcfUbhfYgci fWg`UfY`dfcj ]XYX`Ug`dXZxcW a Ybhtg`Ug`dUfhcZhY`Wci fgY"

F YWca a YbXYX`F Ygci fWg

%`Bi WYUf`GUZY [ i UfXgZ`GYW f]mUbX`B cdbfc` ]ZfUhc`b. `5W]Yj ]b[ `GYW f]mk ]h`HYWbc`c [ mUbX`Dc`]Wn  
5i hcf.`>Ua Yg`8cmY  
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( ``K YVg]hYg. `DUfh]W`Ufmi`595`XcW a Ybhtg`f]dfcj ]XYX`]b`hY`Wci fgY`a UHf]U`gE``5`gc. `K B5ž  
5BGžB9žK`BG

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

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A m9i dYf]YbW`dfcW`ggž]bZcfa U`X]gW`gg]cb`]b`hY`Wci fgYžUbX`hY`GVKcc`fj`Gh XYbh`GHUZZa YYh]b[ g``Mci f  
ZYXVUW`\_]g`hU`\_Yb`gYf]ci g`nžUbX`Wcb]bi U`]a dfcj Ya Ybhtg`UfY`a UXY`hc`hY`Wci fgY`VUgYXž]b`dUfř`cb`gi`W  
ZYXVUW`\_"

Gi Va ]gg]cb'cZ'5ggYgga YbhiHUg\_g

5ggYgga Ybhgi Va ]gg]cb'UbX'a Uf\_]b[ 'Wf]hYf]U

G\ci 'X'hY'Wci fgY'\Uj Y'Ubmcbcb!Y'YWfcb]WUggYgga Ybhgi Va ]gg]cbž'hYg'g\ci 'X'\Uj Y'U'ghUbxUfX  
GWcc'Wcj Yf'g\YYH'

5`gi Va ]gg]cbg'UfY'YI dYWYX'hc'VY'bYUhbX'WYUfmgYhici H'Mci f'fYgi 'hg'UfY'hY'd]bbUWY'cZU`mci f'\UfX  
k cf\_'UbX'g\ci 'X'VY'hYUhx'k ]h'Xi Y'fYgdYWf'DfYgYbh]b[ 'fYgi 'hg'WYUfm[ ]j Yg'hY'a Uf\_Yf'hY'VYghWUbw  
cZi bXYfgtUbx]b[ 'mci f'a YhcX/Yj Yb']ZhY'bi a Yf]WU'fYgi 'hg'UfY']bVc'ffYWf'

UggYgga YbhdYfZcfa UbWžmci 'UfY'Y'[ ]V'Y'hc'Udd'mZcf'GdYWU'7 cbg]XYfUhc'b'df]cf'hc'gi Va ]h]b[ 'Ub  
UggYgga Ybhcf'g]h]b[ 'Ub'YI Ua "

I BGK 'bck '\Ug'U': [\]h\]c'G\]h#Gi Va \]h\]f' Yžk \\]W'a YUbg'hUh\]Zmci 'Uhf'a dhUb'YI Ua 'cf'gi Va \]hU'd\]YW'cZ](#)  
UggYgga Ybž'mci 'UfY'XYWUf]b[ 'mci fgY'Z]hYbci [ \ 'hc'Xc'gc'UbX'W]bbch'Uhf'Udd'mZcf'GdYWU'  
7 cbg]XYfUhc'b"

: cf'XYHU]g'cZUdd'm]b[ 'Zcf'GdYWU'7 cbg]XYfUhc'b'UbX'W]bX]h]cbg'Zcf'hY'Uk UfX'cZgi dd'Ya YbUfm  
UggYgga Ybž'd'YUg'gY'Y'hY'j]bZcfa U]cb'cb'I BGK 'g' [GdYWU'7 cbg\]XYfUhc'b'dU\] Y"](#)

D'YUg'Y'bc'h' **hUhg]h'X'Yb]g'k' ]b'chVY'fYei ]fYX'hc'dfcj ]XY'Ubm'XcW'a YbUfmYj ]XYbW'hc**  
gi ddcfhUVgYbW'g'Zca 'UbmWUggYg'a ]ggYX'VYWU'gY'cZ7CJ -8!%- 'di V']W\YU'h'a YUgi fYg'gi W'Ug

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

I BGK `Ug`Ub`cb`c]b[ `Wca a ]ha Ybhlc`ZcghYf]b[ `U`W`hi`fY`cZ`YUfb]b[ `]bZcfa YX`VmiUWUXYa ]W]bhY[ f]m`5`  
I BGK `gh`XYbtg`Uj`Y`U`fYgdcbg]V`]mhc`UX`YfY`hc`h`g`df]bW]d`Y`cZUWUXYa ]W]bhY[ f]m`D`U[ ]Uf]ga  
i bXYfa ]bYg`UWUXYa ]W]bhY[ f]m]UbX`]g`bchlc`YfUHX`Uhl`BGK`"B`SY[Sde\_`SfG@E|`[e VWX`W`Se ge[`Y`  
fZWi`ad/e`ad[VWSe`aXafZWde`S`V`bSee[`Y`fZW\_`aXSe`kagdai`ž

D`U[ ]Uf]ga`]g`U`mdY`cZ]bhY`YWi`U`h`Y`Z`h`h`W]b`hU`\_Y`a`UbmiZcfa`gž`Zca`XY`]VYfUHX`WXYU]b[ `hc`UWUXYbH`m`  
Wcdm]b[ `Zca`U`gci`fW`k`]h`ci`hUW`bck`YX[`Ya`Ybh`I`BGK`Ug`dfcXi`W`X`U`k`YVg]h`k`]h`U`k`YU`h`cZ`  
fYgci`fW`g`hc`gi`ddcfhgh`XYbtg`hc`i`bXYfgH]bX`UbX`Uj`c]X`d`U[ ]Uf]ga`ž`]g]h`[gh`XYbH`i`bgk`"YXi`"Ui`#d`U\[ \]Uf\]ga`"](#)  
H\Y`@YUfb]b[ `7`YbhfY`Ugg]ghg`gh`XYbtg`k`]h`i`bXYfgH]bX]b[ `UWUXYa ]W]bhY[ f]m]UbX`\ck`bchlc`d`U[ ]Uf]gY"

5 WUXYa ]W=Zcfa Uh]cb

7 fYX]hdc]bhg

7 ci fgY`WYX]hg`W`W`UH`X`]b`I` b]hg!C Z 7 fYX]hfl C 7 E`H`Y`bcfa U`k cf`cUX`YI dYWUh]cb`Zf`cbY`I C 7



