



# ENGG2400

A YWUb]Wg'cZGc`]Xg`%

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

GWcc`cZ7]j]`UbX`9bj]fcbaybU`9b[]bYYf]b[]`#`!BGK`9b[]bYYf]b[]

7ci fgY`Cj Yfj ]Yk

GhJZ`7cbhJW`8YhJ]`g

7cbj Ybcfg

B Ua Y	9a U]	5j U]`UV]]m	@cW]h]cb	D\cbY
8Uj ]X`?Y`Yfa Ubb	X"_Y`Yfa Ubb4 i bgk "YXi "Ui	Dcgh]b`h\Y`HYUa g 7\UbbY`g`Zcf [ YbYfU`ei Ygh]cbgž UbX`Zcf`dYfgcbU` ei Yf]Yg`a YggU[ Y a Y`&(#`cb`HYUa g i g]b[ `7\Uf	Fcca`&\$, >ž 5]bgk cfn`6`X[	-', )`'+&'`

GW`cc`7cbhJW`h]Zcfa Uh]cb



@YUfb]b[ `Ci hMca Y	95 `GHJ[ Y`%7ca dYhYbWYg

# 5ggYgga Ybh

## 5ggYgga YbhHUg\_g

5ggYgga YbhHUg_g	K Y][ \h	8i Y'8UH	Gh XYbh@YUfb]b[ Ci hWta Yg'5ggYggYX
K YY_`mHUg_g`	%-l	K YY_`m	' ž'(ž) ž*
6`cW_`HYghg`	&+l	K YY_g'(ž+ž%\$`H\i fg`*da	&ž' ž'(ž) ž*
@UVg`	% l	K YY_) `UbX`K YY_`-	' ž'(ž) ž*
: ]bU`9l Ua ]bU]cb`	' *l	GYY`9l Ua `H]a YHUV`Y	' ž'(ž) ž*

## 5ggYgga Ybh8YHU]`g

### 5ggYgga Ybh%`K YY\_`mHUg\_g

@Yb[ h. `%k YY\_`

8YHU]`g.

DGG`< UbX!]bg`UbX`k YY\_`mei ]n"

5ggYgga YbhW]hYf]U`Zcf`Z ``a Uf\_g`]b`DGG` \UbX!]bg`]g`cb`mi`h`Uhmci `a U\_Y`U`fYUgcbUV`Y`UH`Ya` dh]b`mci` f`ck`b` \UbX`k`f]h]b[ `Zcf`YUW`c`Z`h`Y`f`k`UbX!]b`f`d`f`c`V`Ya`g"

DGG`f`Y`h`f`b`Y`X`k`]h]b`]k`c`k`YY\_g`"A`cc`X`Y`E`i`]n`]g`]bg`h`b`h`"\$)`#`a`Uf`\_`Zcf`DGG`cb`Y`k`YY\_`UH`ž`\$`#`a`Uf\_g`Zcf`k`c`k`YY\_g`UH`"Gi`Va`]h`Ug`D8: `cf`d` \`c`h`c`g`i`d`c`UX`Y`X`j`]U`HY`Ua`g`5gg][`ba`Y`b`h`g`"H`c`h`U`-`"DGG`<`UbX`]bg`"

A`cc`X`Y`E`i`]n`a`i`gh`V`Y`X`cb`Y`k`]h]b[ `h`Y`cb`Y`k`YY\_`d`Y`f`]c`X`"A`cc`X`Y`e`i`]n`n`Y`g`k`]`V`Y`d`]b`b`Y`X`U`g`h`U`V`g`Zcf`Y`U`W`h`c`d`]W`X`U`b`b`Y`]b`HY`Ua`g`"H`c`h`U`-`"A`cc`X`Y`E`i`]n`n`Y`g`"

Gi`Va`]gg]cb`b`ch`Y`g.`Gi`Va`]h`e`i`]n`j`]U`A`cc`X`Y`E`i`]n`Ub`X`DGG`j`]U`HY`Ua`g`5gg][`ba`Y`b`h`g`"

Hi`fb]h]b`g`Y`h]b[ .`H` \`]g`]g`b`ch`U`Hi`fb]h]b`U`gg][`ba`Y`b`h`

### 5ggYgga Ybh&.`6`cW\_`HYghg`

GhUfhXUH. `K`YY\_g`'(ž+ž%\$`H\i`fg)`da

@Yb[ h. `( )`a`]bi`h`Y`g`ž`%`a`]bg`h`Y`W`Vi`Z`Y`f`ž`%`a`]bi`h`Y`g`W`b`Ub`X`i`d`c`UX`h`a`Y`g`"

8YHU]`g.

H` \`f`Y`Y`6`c`W`\_`H`Y`g`h`W`c`j`Y`f]b[ `h`f`Y`Y`e`i`Y`g`h`c`b`g`Y`U`W`ž`c`b`Y`Zcf`Y`U`W`c`Z`h`Y`k`YY\_`m`h`c`d`]W`ž`h`Y`g`h`U`\_`Y`b`c`b`]b`Y`j`]U`HY`Ua`g`"

5ggYgga YbhW]hYf]U`Zcf`Z ``a Uf\_g`]b`W`i`XY`g`W`c`f`Y`W`h`Ub`X`W`Y`U`f`a`U`h`Y`a`U`h]W`i`k`c`f\_]b[ `ž`f`Y`U`g`c`b]b[ `Ub`X`X`]U`f`U`a`g`h`c`g`i`d`d`c`f`h`h`Y`W`c`f`Y`W`h`b`i`a`Y`f]W`i`Ub`g`k`Y`f`"

6`cW\_`hYghXi fUhc b`lg`(`) `a ]bi hYg`bca ]bU`md`i g`%) `a ]bi hYg`Vi ZYf`Zcf`hYVXb]WU` ]ggi Yg`UbX`hYb`%) `a ]bg  
i d`cUX`hja Y`UZf`Z]bU`Ubkg Yf`fYgdcbgYg`Uj Y`WcgYX" H\YfY`UfY`bc`U`hY`V`cW\_`hYghz`U`hYfbUhj] Y`hja Yg  
UbX`bc`gi dd`Ya YbhUfmV`cW\_`hYghg"GdYW]U`Wcbg]XYfU]cbg`k ]`cb`mcZYf`Zcf`hY`k Y][`h]b[ `hc`VY`UXXYX`hc  
hY`Z]bU`YI Ua "

A Uf\_g`k ]`VY`fYh fbYX`k ]h]b`h`fY`k YY\_g"

5XX]h]cbU`XYHJ]`g.

7 f]h]f]U`

Gi Va ]gg]cb`bchYg.







F Ygci fWg

DfYgWf]VYX`F Ygci fWg`

HYI hWcc\_."A YWUbjWg`cZA UHf]U'g. HYbh`9X]hcb`]b`G=I b]hg"!`F 7`< JVVY`YfZ`DYUfgcb`9Xi WU]hcb"

I BGK `@]VfUfmk YVg]H. `hhdg.## k k "`]VfUfmi bkg "YXi "Ui #

A ccX`Y. `hhdg.##a ccX`Y`h`hi bkg "YXi "Ui #c[ ]b#bXYI "d\`d`

A ]WcgcZiHYUa g. `hhdg.##YUa g"a ]WcgcZiWca `

F YWca a YbXYX`F Ygci fWg

C hYf`fYgci fWg`UfY`dfcj ]XYX`X][ ]U`mi`Mci `a UmVWccgY`hc`[ YhUXX]hcbU`hYI hWcc\_g"

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

H\Y` : UW`hmcZ9b[ ]bYYf]b[ `Yj U`i UH`g`YUW`Wci fgY`YUW`hja Y`]h]g`fi b`h`fci [ `f]E`hY`A m9I dYf]YbW`  
Gi fj YmgZ`UbX`f]]E` : cW`g` ; fci d`A YY]b[ g" `5g`dUfhcZ`hY`A m9I dYf]YbW`dfcW`ggZ`mci f`gh`XYbhYj U`i U]hcbg  
cb]j U]ci g`UgdYWg`cZ`hY`Wci fgY`UfY`[ fUXYX`/h`Y`7ci fgY`7ccfX]bU`cf`dfYdUfYg`U`gi a a UfmfYdcfhiZ`f`hY  
<YUX`cZGW`cc""5bmdfcV`Ya `UfYUg`UfY`]XYbh]ZYX`Z`cf`fYa YX]U`UW]cbZ`UbX`]XYUg`Z`cf`a U\_]b[  
]a`dfcj Ya Ybhg`hc`hY`Wci fgY`UfY`bchYX`Z`cf`UW]cb`hY`bYI h]ja Y`h`U`h`hY`Wci fgY`]g`fi b" : cW`g` ; fci d

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

5 WUXYa ]W=Zcfa Uh]cb

⇒ U[ Y'7 fYX]h

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

5ddYbX|l . '9b[ ]bYYfg'5i ghfU`U'f95Ł'DfcZYgg]cbU`'9b[ ]bYYf'7ca dYhYbWm  
 GHUbXUfX

Dfc[ fUa 'hYbXYX'@YUfb]b[ 'Ci hWta Yg	
? bck `YX[ Y'UbX'g_]`VUgY	
D9%"%7 ca dfY\Ybg]j YžhYcfmVUgYX'i bXYfghUbX]b[ 'cZhY'i bXYfd]bb]b[ 'bUh fU`UbX d\mg]WU`gWYbWg'UbX'hY'Yb[ ]bYYf]b[ 'Z bXUa YbH'g'Udd`]WUV'Y'hc'hY'Yb[ ]bYYf]b[ 'X]gWd`]bY	
D9%"&'7 cbWdh U`i bXYfghUbX]b[ 'cZhY'a UhYa Uh]Wgžbi a Yf]WU`UbU`mg]gžghUhgh]WgžUbX Wta di h'f'UbX' ]bZcfa Uh]cb'gWYbWg'k \]W' i bXYfd]b'hY'Yb[ ]bYYf]b[ 'X]gWd`]bY	
D9%" " 'h!XYdh'i bXYfghUbX]b[ 'cZgdYWU`]ghVcX]Yg'cZ_bck `YX[ Y'k ]h]b'hY'Yb[ ]bYYf]b[ X]gWd`]bY	
D9%"('8]gWfba YbhcZ_bck `YX[ Y'XYj Y`cda YbhUbX'fYgYUfW'X]fYW]cbg'k ]h]b'hY Yb[ ]bYYf]b[ 'X]gWd`]bY	
D9%" ) ? bck `YX[ Y'cZYb[ ]bYYf]b[ 'XYg][ b'dfUW]W'UbX'WcbhYi h U`ZUWc'fg]a dUW]b[ 'hY Yb[ ]bYYf]b[ 'X]gWd`]bY	
D9%"* 'i bXYfghUbX]b[ 'cZhY'gWc'dYždf]bWd`Ygžbcfa gžUW]c' bHUV`]h]Yg'UbX'Vci bXg'cZ gi gh]bUV'Y'Yb[ ]bYYf]b[ 'dfUW]W' ]b'hY'gdYW]ZWX]gWd`]bY	
9b[ ]bYYf]b[ 'Udd`]WU]cb'UV`]jm	
D9%"%5dd`]WU]cb'cZYghUV`]g\YX'Yb[ ]bYYf]b[ 'a Yh'cXg'hc'Wta d'Yi'Yb[ ]bYYf]b[ 'dfcV'Ya gc`]b[	
D9%"&'&'i YbhUdd`]WU]cb'cZYb[ ]bYYf]b[ 'h'W]b]ei Ygžhc'c'g'UbX'fYgci fW'g	
D9%" " '5dd`]WU]cb'cZgmg]Ya Uh]WYb[ ]bYYf]b[ 'gmb'hYg]g'UbX'XYg][ b'dfcW'ggYg	
D9%"('5dd`]WU]cb'cZgmg]Ya Uh]WUddfcUW]Yg'hc'hY'WcbXi W]UbX'a UbU[ Ya YbhcZYb[ ]bYYf]b[ dfc'YW]g	
DfcZYgg]cbU`UbX'dYfgcbU`Uhf]Vi hYg	
D9' "%9h]WU`WcbXi W]UbX'dfcZYgg]cbU`UW]c' bHUV`]jm	
D9' "&'9ZYW]j Y'cfU`UbX'k f]hYb'Wta a i b]WU]cb`]b'dfcZYgg]cbU`UbX`UmXca U]bg	
D9' " '7fYUh]j Yž]bbcj Uh]j Y'UbX'dfc!UW]j Y'XYa YUbc' f	
D9' "( 'DfcZYgg]cbU`i gY'UbX'a UbU[ Ya YbhcZ]bZcfa Uh]cb	
D9' ") 'C'fXYf'ma UbU[ Ya YbhcZgY'Zi'UbX'dfcZYgg]cbU`WcbXi W]	
D9' "*" '9ZYW]j Y'hYUa 'a Ya VYfg\]d'UbX'hYUa ``YUXYfg\]d	