



# MECH4620

7 ca di hUjcbU` : `i ]X`8 mbUa ]Wg

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gdYWZWI`mk ]h`dfUW]WU`g_]`g:`]b`i g]b[ `U`Wca a YfWU`7: 8 dUW_U[ Yž5BGMG`7: L"	
("`H\Y`UV])]mhc`]bYfdFYhWca di fU]cbU`fYgi `rg`UbX`hc`k`f]h`U fYdcfhWcbj Ym]b[ `hY`fYgi `rg`cZ`hY`Wca di fU]cbU`UbU`mg]g"	D9' "%žD9' "" žD9' "**

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dfc YW]c`YbWci fU[ Y`Wc`UVcfU]j Y`YUfb]b[ 'YI dYf]YbWg"5`gcžXYa cbgfU]c'fg'UfY`bck`fYei ]fYX`hc  
dfcj ]XY`a cfY`Wca dfY\Ybg]j Y`ZYXVUW\_]cb`Ugg][ ba YbhUW]j ]hYg`Xi f]b[ ``UV`gYgg]cbg"

Gi Va ]gg]cb'cZ5ggYgga YbhiHUg\_g

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GWkcc'Wcj Yf'g\YYH'

5`gi Va ]gg]cbg'UfY'YI dYVWYX'hc'VY'bYUhiUbX'WYUfmgYhici H'Mci f'fYgi 'hg'UfY'h\Y'd]bbUWY'cZU`mci f'\UfX  
k cf\_'UbX'g\ci 'X'VY'hYUhiX'k ]h'Xi Y'fYgdYVW'DfYgYbh]b[ 'fYgi 'hg'WYUfm[ ]j Yg'h\Y'a Uf\_Yf'h\Y'VYghWUbxW  
cZi bXYfgUbx]b[ 'mci f'a Yh\cX/Yj Yb']Zh\Y'bi a Yf]WU'fYgi 'hg'UfY']bVc'ffYVW'

A Uf\_]b[ '[ i ]XY']bYg'Zcf'Ugg][ ba Ybhgi Va ]gg]cbg'k ]`VY'dfcj ]XYX'Uhih\Y'gUa Y'h]a Y'Ug'Ugg][ ba YbhXYH]g  
hc'Ugg]ghk ]h'a YH]b[ 'UggYggUV'Y'fYei ]fYa Ybhg" Gi Va ]gg]cbg'k ]`VY'a Uf\_YX'UWVc'fX]b[ 'hc'h\Y'a Uf\_]b[  
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K cf\_gi Va ]hYX'`UHY'k ]h\ci hUb'Uddfcj YX'YI hYbg]cb'Vmih\Y'Wci fgY'Wc'fX]bUhc'f'cf'XY'Y[ UHYX'Ui h\cf]hm]g  
gi VYVWihc'U'`UHY'dYbU'hmcZ&\$'dYfW'bhf&\$i 'E'cZh\Y'a U[ ]a i a 'a Uf\_'dcgg]V'Y'Zcf'hUhiUggYgga Ybh]hYa ž  
dYf'WU'YbXUf'XUm'

H\Y'`UHY'dYbU'hmi]g'Udd'YX'dYf'WU'YbXUf'XUmif]bWi X]b[ 'k YY\_YbXg'UbX'di V]W\c'XUmgE'hUhih\Y  
UggYgga Ybh]g'c] YfXi Y'"H\YfY'g]bc'dfc!fUHU'cZh\Y'`UHY'dYbU'hmiZcf'gi Va ]gg]cbg'a UXY'dUfhk Umih\ci [ '\U  
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K cf\_gi Va ]hYX'UZfY'h\Y'XYUX']bY'Zcf'UVgc'i hY'ZU]' ]g'bchUWVW'dhYX'UbX'U'a Uf\_'cZnYfc'k ]`VY'Uk UfXYX  
Zcf'hUhiUggYgga Ybh]hYa "

: cf'gca Y'UggYgga Ybh]hYa gžU'`UHY'dYbU'hmia UmibchVY'Uddfcdf]UHY'"H\YgY'UfY'WYUfm]bX]WUhiX'']b'h\Y  
Wci fgY'ci h]bYž'UbX'gi W'UggYgga Ybhg'fYVW'j Y'U'a Uf\_'cZnYfc']ZbchWca d'YhX'Vmih\Y'gdYVW]ZYX'XUHY"  
9I Ua d'Yg']bWi XY.

% K YY\_'micb']bY'hYghg'cf'UVcfUhc'fmik cf\_'k cffh'U'ga U`dfc'dcf]cb'cZh\Y'gi VYVWia Uf\_ž'cf  
&" C b']bY'ei ]nnYg'k \YfY'Ubgk Yfg'UfY'fY'YUgYX'hc'gfi XYbhg'cb'Wca d'Yh]cbž'cf  
' " DfcZYgg]cbU'UggYgga YbhHUg\_gžk \YfY'h\Y']bhYbh]cb ]g'hc'WYUHY'Ub'Ui h\Ybh]WUggYgga Ybh'hU  
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UggYgga YbhdYfZcfa UbWžmci 'UfY'Y'[ ]V'Y'rc'Udd'mZcf'GdYWU'7 cbg]XYfUhc'b'df]cf'rc'gi Va ]h]b[ 'Ub  
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UggYgga Ybhž'mci 'UfY'XYWUf]b[ 'mci fgY'Z]hYbci [ '\rc'Xc'gc'UbX'W]bbch'Uthf'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 YbhUfm  
UggYgga Ybhž'd'YUg'gYY'hY'j]bZcfa Uhc'b'cb'I BGK 'g'[GdYWU'7 cbg\]XYfUhc'b'dU\]Y"](#)

D'YUgY'bc'hY'hUhighi XYbhg'k ]'bchVY'fYei ]fYX'rc'dfcj ]XY'UbmXcW a YbhUfmYj ]XYbW'rc  
gi ddcfhUVgYbW'g'Zca 'UbmWUggYg'a ]ggYX'

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I BGK `gh`XYbhg`Uj`Y`U`fYgdcbg]V`]hmlc`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` VW`Se ge[`Y`  
fZWi`ad/e`ad[VWSe`aXafZW`S`V`bSee[`Y`fZW\_`aXSe`kagdai` `z`

D`U[ ]Uf]ga` ]g`U`hmdY`cZ]bhY`YW`i`U`h`YZ`i`#iW]b`hU`\_Y`a`UbmiZcfa`gZ`Zca`XY`]VYfUHX`WX`YU]b[ `hc`UWUXYbH`U`m`  
W`dm]b[ `Zca`U`gci`fW`k`]h`ci`hUW`bck`YX[`Ya`Ybh`I`BGK` `Ug`dfcXi`WX`U`k`YVg]h`k`]h`U`k`YU`h`cZ`  
fYgci`fW`g`hc`gi`ddcfghi`XYbhg`hc`i`bXYfgHbX`UbX`Uj`c]X`d`U[ ]Uf]ga`z]`]g]h`[gh`XYbh`i`bgk`"YXi`"Ui`#d`U\[ \]Uf\]ga`"](#)  
H`Y`@YUfb]b[ `7`YbhY`Ugg]ghg`gh`XYbhg`k`]h`i`bXYfgHbX]b[ `UWUXYa ]W]bhY[ f]m]UbX`ck`bchlc`d`U[ ]Uf]gY`  
H`Y`mi`U`gc`lc`X`k`cf\_g`l`cdg`UbX`W]b`Y`d`gh`XYbhg`cbY!`cb!`cbY`"

Mci`U`fY`U`gc`fYa`]bXYX`h`UhWUfYZ`h`a`Y`a`UbU[`Ya`Ybh]g`Ub`ja`dcfHbhdUfHcZghi`XmiUbX`cbY`cZ`h`Y`  
]X`Ybh]Z`Y`X`W]i`gYg`cZ`d`U[ ]Uf]ga` ]g`d`ccf`h`a`Y`a`UbU[`Ya`Ybh`G`h`XYbhg`g`l`ci`X`U`ck`gi`Z`W]Y`bh]h`a`Y`Z`c`f`  
fYgYUfW`Z`X`fU`Z]b[ `UbX`h`Y`dfcdYf`fY`Z`fY`bW]b[ `cZ`gci`fW`g`]b`dfY`dUf]b[ `U`UggYgga`Ybh]Ug\_g`"

Z`d`U[ ]Uf]ga` ]g`Z`ci`bX`]b`mci`f`k`cf`\_`k`Y`b`mci`U`fY`]b`Z`fghmY`Uf`Z`mci`f`Y`W`i`fY`f`k`]`c`Z`Y`f`mci`Ugg]ghU`bW`hc`  
]a`dfcj`Y`mci`f`UWUXYa ]Wg\_]`g`"H`Y`ma`UmUg\_`mci`hc`cc\_`Uhgca`Y`cb`]bY`fYgci`fW`gZ`U`hY`bX`h`Y`@YUfb]b[`  
7`YbhY`Z`cf`gca`Y`h`a`Yg`fYgi`Va`]h`mci`f`k`cf`\_`k`]h`h`Y`dfcV`Ya`Z]`YX`"<ck`Yj`Yf`a`cfY`gYf]ci`g`]bgHbW`g`]b`Z`fgh`  
mY`Uf`Z`gi`W`Ug`gh`U`]b[ `UbchYf`gh`XYbhg`k`cf`\_`cf`dU]b[ `gca`YcbY`hc`Xc`mci`f`k`cf`\_`Z`a`UmVY`]bj`Ygh[`UH`X`  
i`bXYf`h`Y`G`h`XYbhA`]gW`bXi`W`h`DfcW`Xi`fYg`"

F`YdYUH`X`d`U[ ]Uf]ga`fYj`Yb`]b`Z`fghmY`Uf`Z`d`U[ ]Uf]ga`U`Z`Y`f`Z`fghmY`Uf`Z`cf`gYf]ci`g`]bgHbW`gZ`a`UmU`gc`V`Y`  
]bj`Ygh[`UH`X`i`bXYf`h`Y`G`h`XYbhA`]gW`bXi`W`h`DfcW`Xi`fYg`"H`Y`d`Yb`U`h`Y`gi`bXYf`h`Y`dfcW`Xi`fYg`W]b`]bW`i`XY`  
U`fY`Xi`W`h`cb`]b`a`Uf\_g`Z]`]b[ `U`W`i`fgY`cf`Z`c`f`h`Y`a`cghgYf]ci`g`a`UH`Y`fg`f]`\_Y`d`U[ ]Uf]ga` ]b`Ub`l`cbci`fg`  
h`Y`g]g`L`Yj`Yb`gi`gdYbg]cb`Zca`h`Y`i`b]`Yfg]m`H`Y`G`h`XYbhA`]gW`bXi`W`h`DfcW`Xi`fYg`UfY`Uj`U]UV`Y`Y`fY`.

[k`k`k`"\[g`i`bgk`"YXi`"Ui`#d`U\[ \]Uf\]ga`\]W`<`cb`Y`g`m`i`U`b`X``D``U`\[` \]`U`f`\]`g`a`"\]`g`Z`c`i`b`X`\]`b`m`c`i`f`k`c`f`\\_`k`Y`b`m`c`i`U`f`Y`\]`b`Z`f`g`h`m`Y`U`f`Z`m`c`i`f`Y`W`i`f`Y`f`k`\]`c`Z`Y`f`m`c`i`U`g`g`\]`g`h`U`b`W`h`c`\]`a`d`f`c`j`Y`m`c`i`f`U`W`U`X`Y`a`\]`W`g`\\_\]`g`"H`Y`m`a`U`m`U`g`\\_`m`c`i`h`c`c`c`\\_`U`h`g`c`a`Y`c`b`\]`b`Y`f`Y`g`c`i`f`W`g`Z`U`h`Y`b`X`h`Y`@`Y`U`f`b`\]`b`\[`7`Y`b`h`Y`Z`c`f`g`c`a`Y`h`a`Y`g`f`Y`g`i`V`a`\]`h`m`c`i`f`k`c`f`\\_`k`\]`h`h`Y`d`f`c`V`Y`a`Z`\]`Y`X`"<`c`k`Y`j`Y`f`a`c`f`Y`g`Y`f`\]`c`i`g`\]`b`g`H`b`W`g`\]`b`Z`f`g`h`m`Y`U`f`Z`g`i`W`U`g`g`h`U`\]`b`\[ `U`b`c`h`Y`f`g`h`X`Y`b`h`g`k`c`f`\\_`c`f`d`U`\]`b`\[ `g`c`a`Y`c`b`Y`h`c`X`c`m`c`i`f`k`c`f`\\_`Z`a`U`m`V`Y`\]`b`j`Y`g`h`\[`U`H`X`i`b`X`Y`f`h`Y`G`h`X`Y`b`h`A`\]`g`W`b`X`i`W`h`D`f`c`W`X`i`f`Y`g`"](#)

5 WUXYa ]W=Zcfa Uh]cb

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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





