MECH3110

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7ci fgY 8YhU]`g

I b]hg cZ 7fYX]h *

Gi a a Ufm cZ h\Y 7ci fgY

H\]g Wci fgY k]`` Wcbh]bi Y h\Y XYj Y`cda YbhcZ U gmghYa UhWU UddfcUW\ hc dfcV`Ya gc`j ]b[ UbX XYg][b h\Uh Wca a YbWYX ]b YUf`]Yf Wci fgYg" h\ k]`` Zc`Wi g cb a Uh\Ya Uh]WU` a cXY``]b[ cZ XYg][b Udd`]WUh]cbg/ZcfVW Zck h\fci [ \ Wca dcbYbhg UbX UggYa V`]Yg/VY` h\ ]WU]b UbX [ YUf Xf]j Y XYg][b/Wc``]b[Y`Ya YbhVYUf]b[ gY`YWh]cb/XmbUa]WU` mc`UXYX hc h\Y Wcbb YWh]cbg/g\UhXYg][b UbX U]dcfY h\ YgY]XYUg]b h\Yfm g cZ dfUWh]WU` Udd`]WUh]cbg"

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H\]g Wci fgY k]`` Wcbh]bi Y h\Y XYj Y`cda YbhcZ U gmghYa UhWU UddfcUW\ hc dfcV`Ya gc`j ]b[ UbX XYg][b h\Uh Wca a YbWYX ]b YUf`]Yf Wci fgYg" H\Y Wci fgY Zc``ck g cb Zfca h\Y]bhfcXi Wh]cb dfcj]XYX Vm 9B; ; %\$\$\$ž YghUV`]g\g h\Y a UW\]bY Y`Ya YbhXYg][b UddfcUW\ UbX dfcj]XYg Ub cddcfhi b]mhc Udd`mh\Y a YW\Ub]WU` _bck `YX[Y UbX hYW\b]ei Yg [U]bYX Zfca A A 5B&(\$\$ UbX A A 5B' (\$\$" Ghi XYbhg k]`` ]bhYfUWh Ug dUfhcZ U XYg][b hYUa ž k\]`Y XYj Y`cd]b[ XYg][b gc`i h]cbg Zcf U fYU`]gh]W dfcV`Ya cZfYUgcbUV`Y g]nY UbX Wca d`YI]mh' H\Y YWi fY hcd]Wg fY`UhY Wc gmhc Ugg][ba YbhfYei ]fYa Ybhg k]h\ U `UV`UbWY VYhk YYb h\Y YcfmUbX dfUWh]WY" 5ggYgga Ybhk]`` \Uj Y U ghfcb[Ya d\Ug]g cb dfUWh]WU` XYg][b _bck `YX[Y UbX g_]``g Ug k Y``Ug U \][\ ghUbXUfX cZdfcZYgg]cbU` k f]hhYb UbX [ fUd\]WU` Wca a i b]WUh]cb" H\]g k]`` ]bWVi XY fYgYUfW\]b[ ]bZcfa Uh]cb Zcf XYg][b Ugg][ba YbhUbX gYUfW\]b[ Zcf gc`i h]cbg Ug Ug_]gdfYž VWUh]cbg VYWca Y `Ygg Wca d`YhY UbX a cfY fYU`]gh]W UbX 5 dfcc Zcf WVcbW dhdfchchmdY k]``VY a Ui fZWUhi fYXžUggYa V`YX UbX hYghYX hc Ybgi fY h\Y XYg][b ]g Z Ug V`Y UbX Zi bWh]cbg Ug WU]a YX"

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5ZhYf gi WWYggZ``mWca d`Yh]b[ h\]g Wci fgYžmci g\ci `X VY UV`Y hc.

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&" A UbU[Y U XYg][b dfcWYWUbX VY UV`Y hc d`UžgWXYXi Y UbX XcW a Ybhk cf_UWh]j]h]Yg]b UWW cfXUbW k]h\ ghUbXUfX dfUWh]W"	D9%"' žD9%"* žD9&"%žD9&"' ž D9&"(žD9' "&žD9' "' žD9' "*
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@YWhifYg]b `h\]g `Wci fgY `UfY `XYg][b YX `hc `Wcj Yf `h\Y `hYfa]bc`c[ mž `WcfY `WcbWY dhg `UbX `hYW\b]ei Yg ]b `h\Y XYg][b `cZa UW\]bYg" H\Y mg\ck `\ck `h\Y jUf]ci g `hYW\b]ei Yg `UfY `Udd`]YX `]b `dfUWh]WY `UbX `h\Y `XYh U]`g `cZ k \Yb ž k \YfYž UbX `\ck `h\Ymg\ci `X `VY `Udd`]YX"

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&": UghYbYf 5gg][ba Ybh	&$1	: f]XUm K YY_ , ž&' .))	%ž' ž(
' "; YUfVcl Dfchchmd]b[Dfc YWh	($1	; fci d VcbhfUWhi Y : f]XUm K YY_ &Vmˇ&' .)) ž 9b[bYYf]b[XfUk]b[g Xi Y A cbXUm K YY_ ') Vmˇ$-.$$ž : YUg]V]]hm ghi Xm XcW a Ybh]b[Yb[]bYYf]b[UbU mg]g cZ XYg][b Xi Y : f]XUm K YY_ ') Vmˇ&' .)) ž 7ca d UbWY hYgh]b[k]` VY \Y X Xi f]b[Yl Ua dYf]cX"	%ž&ž' ž(

5ggYgga Ybh % HfUbga]gg]cb 5gg][ba Ybh

Gi Va]gg]cb bchYg. F Ydcfh hc VY gi Va]hhYX hc Hi fb]h]cb h\Y Wci fgY A ccX Y dU Y.
8i Y XUhY. : f]XUm K YY_ %$ž& .))
8YUX]bY Zcf UVgc i hY ZU]. ') XUmg UZhYf h\Y Xi Y XUhY.
A Uf gfYhi fbYX. A Uf g hc VY fYhi fbYX i dcb fY YUgY cZ]bU a Uf gfUZhYf Yl Ua dYf]cXÐ".

8Yg][b cZ U hfUbga]gg]cb gmghYa hc dfcj]XY a YW\Ub]WU dck Yf Zcf U [ ]j Yb dfcWYgg.

H\]g Ugg][ba Ybh]g gi Va]hhYX h\fci [\ Hi fb]h]b UbX ghi XYbhg WUb gYY Hi fb]h]b g a Uf]hm fYdcfhg.

5XX]h]cbU XYhU]g

Ghi XYbhg k]` k cf_]b [fci dg hc XYg][b U hfUbga]gg]cb gmghYa . D YUgY fYZYf hc Ugg][ba Ybh [i]XY]bYg k]h\ ]b HYUa g Zcf Zi fh\Yf]bZcfa Uh]cb.

5ggYgga Ybh & : UghYbYf 5gg][ba Ybh

Gi Va]gg]cb bchYg. F Ydcfh hc VY gi Va]hhYX hc Hi fb]h]cb h\Y Wci fgY A ccX Y dU Y.
8i Y XUhY. : f]XUm K YY_ , ž&' .))
8YUX]bY Zcf UVgc i hY ZU]. ') XUmg UZhYf h\Y Xi Y XUhY.
A Uf gfYhi fbYX. Hk c k YY_g UZhYf gi Va]gg]cb

8Yg][b cZ U gmghYa h\Uh]gYg Vc h ZUghYbYfg hc gi dddcfhjUf]ci g ghfi Wh fYg.

H\]g Ugg][ba Ybh]g gi Va]hhYX h\fci [\ Hi fb]h]b UbX ghi XYbhg WUb gYY Hi fb]h]b g a Uf]hm fYdcfhg.

5XX]h]cbU XYhU]g

ÐbX]j]Xi U Ugg][ba Ybh Ghi XYbhg k]` XYg][b UbX UbU mgY U ghfi Wh fY h\Uh]gYg Vc hYX ℅]bhg. D YUgY fYZYf hc Ugg][ba Ybh [i]XY]bYg k]h\ ]b HYUa g Zcf Zi fh\Yr]bZcfa Uh]cb.

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8i Y XUhY. ; fci d WcbhfUWhiXi Y: f]XUmK YY_ '& Vm '& '.))ž 9b[]bYYf]b['XfUk]b[g Xi Y A cbXUmK YY_ ') Vm $-.$$ž: YUg]V]]hm ghi Xm XcW a Ybh]b['Yb[]bYYf]b['UbU mg g cZ XYg][b Xi Y: f]XUmK YY_ ') Vm '& '.))ž
7ca d]UbWY hYgh]b[k]`VY \Y X Xi f]b['Y] Ua 'dYf]cX"
A Uf g fYh fbYX. '5`'UggYgga Ybh a Uf g fYh fbYX k]h\]b hk c k YY g cZ gi Va]gg]cb cZ h\Y fYgdYWh]j Y XY j YfUV Y"

8Yg][b UbX UbU mg g cZ U[YUfYX ffUbga]gg]cb gmghYa ":]bU XYg][b k]`VY dfchchmdYX UbX hYghYX Zcf Wca d]UbW"

5XX]h]cbU XYhU]`g

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%". ; fci d WcbhfUWhf$ı Ł" 8i Y: f]XUmK YY_ '& ž '& '.))"

&". 9b[]bYYf]b['XfUk]b[g f%$ı Ł" 8i Y A cbXUmK YY_ ') ž $-.$$"

'". : YUg]V]]hm ghi Xm XcW a Ybh]b['Yb[]bYYf]b['UbU mg g cZ XYg][b f%$ı Ł" 8i Y: f]XUmK YY_ ') ž '& '.))"

(". 7ca d]UbWY hYgh]b['cZ a Ui ZUWhi fYX [YUfYX ffUbga]gg]cb dfchchmdY f&$ı Ł" 7ca d]UbWY hYgh]b[k]` VY \Y X Xi f]b['K YY_ '%%"

D YUgY fYZYf hc UggYgga Ybh[i]XY]bYg k]h\]b HYUa g Zcf Zi fh\Yf]bZcfa Uh]cb"

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	K cf_g\cd	%g‑h‑gYgg]cb‑hcd]W‑C dYb‑VVcbgi `HUh]cb
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K YY_‑%$.‑%, ‑5df]‑!‑&&‑5df]`	@YWh‑i fY	A cbXUm‑%).$$‑!‑%+.$$‑Di V`]W< c`]XUm
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	K cf_g\cd	%g‑h‑gYgg]cb‑hcd]W‑C dYb‑VVcbgi `HUh]cb
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7ci fgY 9jU`i Uh]cb UbX 8YjY`cda Ybh

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a m9i dYf]YbW\Y dfcWYggž]bZ cfa U X]g W i gg]cb]b h\Y ZbU WUgg Zcf h\Y Wci fgYž UbX h\Y]b UbX h\Y Yž U   ‰

Gi Va]gg]cb ˙cZ˙5ggYgga Ybh˙HUg_g

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YI Ua gž d`YUgY` gYY `h\Y `9I Ua g` k YVdU[Y"

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Gi dd`Ya Ybh`Ufm UggYgga Ybh	Ghi XYbh`dfcj]XYX`Ub U`hYfbUhY`UggYgga Ybh`Uh`U `UhYf`XUhY#]a Y	Y"["`U`gi dd`Ya YbhUfmYI Ua `]g`gWXYXi ``X`Xui f]b[ `h\Y gi dd`Ya YbhUfmYI Ua `dYf]cX`cZ`h\Y`hYfa
Gi Vgh]hi hY`]hYa	H\Y`a Uf_`cf`h\Y a ]ggYX UggYgga Ybh`g`gi Vgh]hi hYX k ]h`h\Y`a Uf_`cZ`Ubch\Yf UggYgga Ybh	Y"["`a Uf_`cf`E i ]n`%`Udd`]YX`U`gc`Udd`]YX`Ug`a Uf_`cf E i ]n`&ž`a YUb]b[ `]ZU`ghi XYbh`UVX]YvYX`U`a Uf_`cZ &$# $`Zcf`E i ]n`%`UbX`k Ug`[ fUbhYX`GdYW]U` 7cbg]XYfUh]cb`Zcf`E i ]n`&žU`a Uf_`cZ&$# $`k ci `X`VY Udd`]YX`Zcf`E i]n`&žYhW
9I Ya dh]cb	5``Wci fgY`a Uf_g`UfY fYWU`W`UhYX`YI W`i X]b[`h\]g UggYgga Ybh`UbX]hg k Y][\h]b[	Y"["`H\Y`Wci fgY`\Ug`Ub`UggYgga Ybh`ghfi Wh\ fY`cZ ! `5gg][ba Ybhg`' `$ı ž ! `@UV`fYdcfh`' `$ı ž ! `:]bU``9I Ua `( `$ı " =Zh\Y`@UV`fYdcfh]`g`a ]ggYX`UbX`ghi XYbh]g`[ fUbhYX GdYW]U``7cbg]XYfUh]cbžh\Yb`h\Y`UggYgga Ybh ghfi Wh\ fY`a UmVY`fYk Y][\hYX`Ug`Zc``ck g. ! `5gg][ ba Ybhg`) `$ı ! `: ]bU``9I Ua `) `$ı Ug`h\ci [ \`h\Y`@UV`fYdcfh]X]X`bch YI]gh
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I BGK `\Ug`Ub`cb[c]b[ `Wca a]ha Ybh`hc`ZcghYf]b[`U`W``h`fY`cZ`YUfb]b[ `]b`Zcfa YX`Vm`UWUXYa ]W]bhY[f]hm`5``
I BGK `ghi XYbhg`\Uj Y`U`fYgdcbg]V]`]hm`hc`UX\YfY`hc`h\]g`df]bW]d`Y`cZUWUXYa]W]bhY[f]hm`D`U[ ]Uf]ga
i bXYfa]bYg`UWUXYa ]W]bhY[f]hm`UbX`]g`bch`hc`YfUhYX`Uh`I BGK `"'B/SY[Sd[e_ SfG@EI  [e VWX[`WW Se ge[`Y
fZWi adVe ad[VWSe aXafZWde S` V bSee[`Y fZW_ aXXSe kagdai `ž

D`U[ ]Uf]ga `]g`U`hmdY`cZ]bhY``YWhi U`h\YZh`=h`WUb`hU_Y`a Ubm`Zcfa gžZfca `XY`]VYfUhY`W\YUh]b[ `hc`UWW]XYbhU``m
Wcdm]b[`Zfca `U`gci fVW`k]h\ci h`UWbck `YX[Ya Ybh`I BGK `\Ug`dfcXi WYX`U`k YVg]hY`k]h\`U`k YU`h\`cZ
fYgci fWYg`hc`gi ddcfh`ghi XYbhg`hc`i bXYfghUbX`UbX`Uj c]X`d`U[ ]Uf]ga žj ]g]h `ghi XYbh`i bgk "YXi "Ui #d`U[ ]Uf]ga `"
H\Y`@YUfb]b[ `7YbhfY`Ugg]ghg`ghi XYbhg`k ]h\`i bXYfghUbX]b[`UWUXYa ]W]bhY[f]hm`UbX`\ck `bch`hc`d`U[ ]Uf]gY"
H\YmU`gc`\c`X`k cf_g\cdg`UbX`WUb`\Y`d`ghi XYbhg`cbY!cb!cbY"

Mci `UfY`U`gc`fYa]bXYX`h\Uh`WUfYZ `]ha Y`a UbU[Ya Ybh`g`Ub`]a dcfhUbh`dUfh`cZghi XmUbX`cbY`cZh\Y
]XYbh]ZYX`WUi gYg`cZd`U[ ]Uf]ga `]g`dccf`h]a Y`a UbU[ Ya Ybh`Ghi XYbhg`g\ci `X`U`ck `gi ZZ]W]Ybh]a Y`Zcf

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7ci fgY`WfYX]h]g`WU`W``UhYX`]b`I b]hg!CZ`7fYX]hf`I C 7 Ł``H\Y`bcfa U`k cf`\cUX`Y`dYWhUh]cb`Zcf`cbY`I C 7]g`UddfcI ]a UhY`m&) `\ci fg`dYf`hYfa "`H\]g`]bWi XYg`WUgg`WcbhUWh\ci fg`dfj UhY`ghi Xmž`chYf`YUfb]b[ UWj]h]hYgž`dfYdUfUh]cb`UbX`h]a Y`gdYbh`cb`U``UggYggUV`Y`k cf_"

A cghWci fgYk cf_`Wci fgYg`Uh`I BGK `UfY`*`I C 7 `UbX`]bjcj Y`Ub`Ygh]a UhYX`%) $`\ci fg`hc`Wca d`YhYžZcf`Vch\ fY[i `Uf`UbX`]bhYbg]jY`hYfa g"`9UWX`\ci fgY`]bWi XYg`U`dfYgWf]VYX`bi a VYf`cZ`\ci fg`dYf`k YY_`fcf#k Ł`cZ gWXYXi `YX`WUgc!ZUWY`!hc!ZUWY`UbX#cf`cb`]bY`WcbhUWh`5bmUXX]h]cbU``ha Y`VYmcbX`h\Y`dfYgWf]VYX`WcbhUWh\ci fg g`\ci `X`VY`gdYbh`]b`a U_]b[ `gi fY`h\Uh`mci `i bXYfghUbX`h\Y``YWhi fY`a UhYf]U`žWca d`YhY`]b``hY`gYh Ugg][ ba YbhgžZ`fh\Yf`fYUX]b[ ž`UbX`fYj ]g]b[ `Zcf`UbmYl Ua]bUh]cbg"

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Di V`]WX]ghUbWb[ `WcbX]h]cbg`a i ghVY`Zc``ck YX`Zcf`U``ZUWY!hc!ZUWY`WUggYg"`Hc`Ybgi fY`h\]gž`cb`mghi dXYbhg Ybfc``YX`]b`h\cgY`WUggYg`k ]``VY`U``ck YX`]b`hY`fcca "`Bc`cj Yf!Ybfc`a Ybh`]g`U``ck YX`]b`ZUWY!hc!ZUWY` WUggYg"`Ghi XYbhg`Ybfc``YX`]b`cb`]bY`WUggYg`WUb`gk Ud`hY`]fYbfc`a Ybh`Zca `cb`]bY`hc`cb!WUa di g`WUggYg VmGi bXUmžK YY_`%`D`YUgY`fYZYf`hc`mci f`Wci fgYf`A ]WfcgcZhHYUa g`UbX`A ccX`Y`g]hYg`Zcf`a cfY ]bZcfa Uh]cb`UVci h`WUgg`UhhYbXUbWY`Zcf`]b!dYfgcb`UbX`cb`]bY`WUgg`gYWh]cbg#UWh]j]h]Yg"

Mci f`\YU`h\`UbX`h\Y`\YU`h\`cZ`h\cgY`]b`mci f`WUgg`]g`Wf]h]WU``mma dcfhUbh"`Mci `a i ghghUm`Uh`\ca Y`]Zmci `UfY g]W_`cf`\Uj Y`VYYb`UXj]gYX`hc`gY`Z!]gc`UhY`Vm[BGK `\YU`h\`cf`[cj Yfba Ybh`Ui h\cf]h]Yg"`7i ffYbh`U`Yfhg`UbX`U `]gh`cZ`\cgd]hU`g`WUb`VY`Zci bX`\YfY"`Mci `k ]``bch`VY`dYbU`]gYX`Zcf`a ]gg]b[ `U`ZUWY!hc!ZUWY`UWh]j]hmXi Y hc`]``bYgg`cf`U`fYei ]fYa Ybh`hc`gY`Z!]gc`UhY"`K Y`k ]``k cf_`k ]h\`mci `hc`Ybgi fY`Wcbh]bi ]bc`cZ`YUfb]b[ `Xi f]b[mci f`]gc`Uh]cb`UbX`\Uj Y`d`Ubg`]b`d`UWY`Zcf`mci `hc`WUhW\`i d`cb`UbmWcbhYbh`cf`YUfb]b[`UWh]j]Yg`mci `a Um a ]gg"`K \YfY`h\]g`a][\h`bch`VY`dcgg]V`Yž`Ub`Udd`]WUh]cb`Zcf`ZYY`fYa]gg]cb`a UmVY`X]gWi ggYX"`: i fh\Yf ]bZcfa Uh]cb`]g`Uj U]`UV`Y`cb`Ubmci fgY`A ccX`Y`cf`HYUa g`g]hY"

≢b`WYffU``b`WUggfcca `UbX`UVcfUhcfmg]hi Uh]cbg`k \YfY`d\mg]WU``X]ghUbWb[`WUbbch`VY`a U]bhU]bYX`cf`h\YfY`]g U`\][ \`f]g_`h\]h`WUbbch`VY`a U]bhU]bYXžWUWY`a Ug_g`k]``VY`Wcbg]XYfYX`a UbXUhcfmDD9 `Zcf`ghi XYbhg`UbX ghUZZ"

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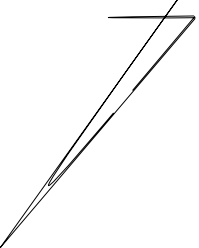
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DfcZYgg]cbU``UbX`dYfgcbU``Uhhf]Vi hYg	
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