

EDST5032

9h\bc[fUd\]WF YgYUfW\`A Yh\cXc`c[m

GYa YghYf'Hk c''#'&\$%

7ci fgY⁻Cj Yfj]Yk

'GhUZZ'7cbhUWh'8YhU]`g'

'7cbj Ybcfg'

B Ua Y	9a U]`	5j U]`UV]`] m	@cWUh]cb	D\cbY
?U`Yfj c'; i `gcb	_"[i`gcb4 i bgk "YXi "Ui		; ccXgY``Fa %\$+	

GWkcc`7cbhJWhi ≠bZcfa Uh]cb

GW.cc`cZ9Xi WUhcb 5fhg'UbX'GcWJU`GWJYbWYg

@Yj Y``%z̈>c\b'; ccXgY```6i]`X]b['fl &\$Ł

H. 'Ž * %'f&Ł'-',) '%-++

9. YXi WUhcb4 i bgk "YXi "Ui

K . YXi WUhjcb"Ufhg"i bgk "YXi "Ui

5 htyb X Ub WY F Yei] fYa Yb hg

5XX]h]cbU``GVX.cc``cZ'9Xi WUh]cb`UhhYbXUbWY`fYei]fYa Ybhg

 $\pm i]g'Yl \ dYWYX'h Uh'Ubmgh XYbh'Ybfc``YX']b'Ub'98GH'Wci fgY'k]h 'h Y'GW cc``cZ9Xi WUhcb'k]```a U_Y'U Wca a]ha Ybh'hc'h Y]f'`YUfb]b['UbX'Uh'YbX'U```WUggYg']b'Z ```k \YfY'WcbhYbh']g'XY`]j YfYX']b'U'ZUWY!hc!ZUWY a cXY'Yl WYdh']b'WffU]b'WffW a ghUbWYg'k \YfY'UVgYbWY']g'Xi Y'hc']``bYggž'a]gUXj Y`]$

XX.IH

7ci fgY 8YW] g

7 fYX]hDc]bhg * *

K cf_`cUX

%) \$`\ci fg`]bWi X]b[`WUgg`WcbHUWh\ci fgž`fYUX]b[gž`WUgg`dfYdUfUh]cbž'UggYgga Ybhž'Zc``ck 'i d`UWh]j]h]Ygž YhW

Gi a a UfmcZh\Y 7ci fgY

H\]g`Wci fgY`dfcj]XYg`ghi XYbhg`k]h\`Ub`cj Yfj]Yk `cZh\Y`d\]`cgcd\]WJ`ždfUWJWJ`žUbX`Yh\]WJ``]ggi Yg`—`h\Uh]g]ggi Yg`cZa Yh\cXc`c[mUbX`a Yh\cXg`!`]bj c`j YX`]b`XYg][b]b[`UbX`WcbXi Wfjb[`Yh\bc[fUd\]WfYgYUfW\`]b YXi WUfjcb"`H\Y`Wci fgY`k]```U`gc ZcW g`cb`XUhU`Wc``YWfjcb`UbX`UbU`mg]gžYl Ua]b]b[`]ggi Yg`]bj c`j YX`]b`YUW\cZh\Y`cj YfUfW\]b[`glfUhY[]Yg`cZcVgYfj Uh]cbgž]bhYfj]Yk `UbX`a i `h]!a cXU``UddfcUW\Yg"`H\fci [\ci hh\Y Wci fgYžei Ygh]cbg`WcbWfb]b[`h\Y`bUhi fY`cZ_bck `YX[Yž'hi h\ž'UbX``Ub[i U[Yž'Ug`k Y```Ug`]ggi Yg`cZdck Yfž fYgdcbg]V]`]hmUbX`Yh\]Wg`k]```VY`ZcfY[fci bXYX"

5 hh Y WcbWi g]cb cZh]g Wci fgY h Y gh XYbhk]``VY UV`Y hc

- % 8 Ya cbghfUhY 'h\Y 'UV]`]hmhc 'XYgWf]VYžYI d`U]b 'UbX'X]gW gg'_YmXYVUhYg'UbX']ggi Yg']b 'WcbhYa dcfUfm Yh\bc[fUd\m
- &" 8 Ya cbghfUhY 'h\Y 'UV]]mihc]XYbhjZmžYl Ua]bY 'UbX'Yl d`U]b 'h\Y 'fY`Uhjcbg\]dg 'VYhk YYb 'fYgYUfV\\ ei Yghjcbgž'h\Ycfm'UbX'a Yh\cXc`c[m
- ' " 8 Ya cbglfUlY 'h\Y 'UV]`]lmihc 'XYgWf]VYž'X]gW gg 'UbX 'UbU'ngY 'h\Y 'fY`Ulr]cbg\]d 'cZYh\bc[fUd\mihc Yd]glYa c`c[mUbX'h\Y'dcg]llcbU`]lmicZh\Y'fYgYUfW\Yf
- ("8 YacbglfUllY'll\Y'UV]`]lmlrc'i bXYftU_Y'UbU`mg]g'UbX'fYdfYgYblUll\cb'cZVUg]WYl\bc[fUd\]WfYgYUfW

HYUW]b['GlfUhY[]Ya'

± cfXYf'rc'XYj Y`cd'Vch\ 'U'r\YcfYh]WU``UbX'U'dfUWf]WU``i bXYfgrUbX]b['cZ]ggi Yg']b'WcbhYa dcfUfmei U`]rUh]j Y fYgYUfW\ '! 'gdYWJZ]WU``mYh\bc[fUd\m!'h\Y'Wci fgY'k]`bj c`j Y'gY`YWhYX'fYUX]b[gž'hYUW\Yf']bdi hž'dYYf X]gW gg]cbgž'ghfi Wfi fYX'fYgYUfW\ 'UWh]j]h]Yg'UbX']bX]j]Xi U``fYZYWh]cbž'rc'dfcj]XY'ghi XYbhg'k]h\ 'cddcfhi b]h]Yg rc'Yb[U[Y'XYYd`mž'X]U`c[]WU``mž'UbX'fYZYI]j Y`mk]h\ ']XYUg'UVci hYh\bc[fUd\]WdfcW*ggYg'UbX'dfUWh]Wfg"

5i ghfu`]Ub'DfcZYgg]cbU`; fUXi UhY'HYUWX]b['GhJbXUfXg

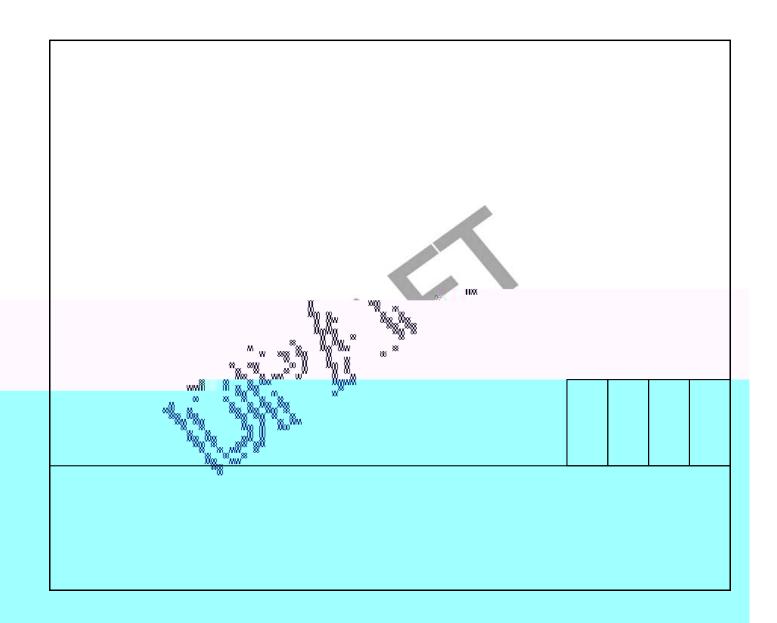
GHJbXUfX	8YgWf]dh]cb
, ,	K cf_'k]h\`Wc``YU[iYg'hc'igY`XUhU'Zfca']bhYfbU``UbX'YIhYfbU`'ghiXYbh'UggYggaYbhg'Zcf YjU`iUh]b['`YUfb]b['UbX'hYUW\]b[ž']XYbh]Zm]b[']bhYfjYbh]cbg'UbX'acX]Zm]b['hYUW\]b[dfUWf]WY"

5ggYgga Ybh

 $\label{eq:Karlowski} K\ cfX\ ``Yb[\ h\ 'Zcf'Ugg][\ ba\ Ybh'hc\ 'VY\ 'X]gW\ ggYX\ 'Z\ fh\ Yf']b\ 'WUgg''$

5ggYgga Ybh'HUg_g'

5ggYgga Ybh'hUg_	K Y][\h		



I BGK G7 < CC@C: 981 75H€B F1 6F = 7 # 998657? G < 99H

98GH) \$' &

5ggYgga YbhHUg_. 5bU`mg]g cZYh\bc[fUd\]WXUhU

GdYW]ZJW7 f]hYf]U	∵flŁ—		 2fŽŁ
I bXYfgHJbX'cZh\Y'ei Ygh]cb'cf']ggi Y'UbX'h\Y'_Ym'WcbWYdhg]bj c`j YX			
8Ydh\cZUbUmg]g'UbX#cf'Wf]heiY']b'fYgdcbgY'hc'h\Y'hUg_			
: Ua]`]Uf]hmk]h\ 'UbX'fY`Yj bWY'cZ'dfcZYgg]cbU`'UbX#cf'fYgYUfVX `]hYfUhi fY'i gYX'hc'gi ddcfhifYgdcbgY			
GHTi Whi fY'UbX'cf[Ub]nUh]cb'cZfYgdcband ************************************			
DfYgYbHJhjcbicZifYgdcbgy twocfxjb[ihcityddfcdf]UhYiUWUXYa]WUbX `]b[i]ghjWWcbjYbhjobg			
; YbYfU`Wca a Ybhg#YWca a YbXUhjcbgʻZcfʻbYl h'hja Y.ʻ			

@YWhi fYf

F YWca a YbXYX. ' '''#&\$'fl @'DG'7F'8B'<8Ł' k Y][\h]b['.'&\$i

"B6. h\]g'h\Wg']b'h\Y'j Uf]ci g'Vcl Yg'UbX'XYg][bYX'rc'dfcj]XY'ZYYXVUW_'rc'ghi XYbrg/h\YmUfY'bch[]j Yb
Yei U`k Y][\h]b'XYhYfa]b]b['h\Y'fYWca a YbXYX'[fUXY"8YdYbX]b['cb'h\Y'bUhi fY'cZh\Y'UggYgga YbhiUg_ž
'YWhi fYfg'a Um'U`gc'WcbhYl hi U`]nY'UbX#cf'Ua YbX'h\YgY'gdYV]Z]WWf]hYf]U"''H\Y'fYWca a YbXYX'[fUXY']g
hYbhUh]j Y'cb`mžgi Va 'YWh'rc'ghUbXUfX]gUh]cb'dfcWyggYg'UbX'Uddfcj U`'Vmh\Y'GW\cc`'cZ'9Xi WUh]cb
@YUfb]b['UbX'HYUW\]b['7ca a]hhYY"

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

 $Gh\ XYbhg\ 'UfY\ 'YI\ dYWhYX\ 'hc\ 'di\ hh\ Y]f\ 'bUa\ Yg\ 'UbX\ 'gh\ XYbhbi\ a\ VYfg\ 'cb\ 'Yj\ YfmdU[\ Y\ 'cZh\ Y]f\ 'Ugg][\ ba\ Ybhg\ ''$

Hi fb]h]b Gi Va]gg]cb

 $\bullet \ \ \, \text{K cf_'gi Va]} \\ \text{lh} \\ \text{X '\%' hc '\% 'XUmg 'UZhYf' h\ Y 'gh]} \\ \text{di ``UhYX 'XYUX`]} \\ \text{bY } \\$

- i bXYfgfUbX mci f'f][\hg'UbX'fYgdcbg]V]`]hJYg'Ug'U'gh XYbhUhl BGK
- VY`Uk UfY`cZd`U[]Uf]ga ž`Wcdmf][\hz'l BGK `Gh XYbh7cXY`cZ7cbXi WhUbX`5VWWdhUV`Y`l gY`cZ I BGK `=\forall H`F Ygci f\W\g`Dc`]\m\m
- VY 'Uk UfY 'cZh\Y 'ghUbXUfXg 'cZVY\Uj]ci f'Yl dYWYX 'cZYj YfmcbY ']b 'h\Y 'l BGK 'Wca a i b]hm
- `cWUHY 'gYfj]WYg'UbX ']bZcfa UH]cb'UVci hI BGK 'UbX'I BGK '@]VfUfm

Gca Y'cZh\YgY'UfYUg'k]``VY'ZJa]`]Uf'hc'mci ž'ch\Yfg'k]``VY'bYk"'; U]b]b['U'gc`]X'i bXYfgHJbX]b['cZU``h\YfY`UhYX'UgdYWfg'cZ9@ ${\mathfrak G}$ 9'k]``\Y`d'mci 'a U_Y'h\Y'a cghicZmci f'ghi X]Yg'UhI BGK "f\hd.#gi V\YWfi \\X\yg''\YfUfm'i bgk\\"YXi\\"Ui\#\`\]qY\#JVci \\Y\\]qY\\

7ci fgY GWXYXi `Y

J]Yk 'WUgg'ha YHUV'Y

H]a YtUV`Y

8UHY	HmdY	7 cbhYbh
K YY_'%\$.'%'CWhcVYf'!'+ CWhcVYf		Hi YgXUmC WcVYf'&bX'!': f]XUmC WcVYf') h
		GYa]bUf."%\$Ua"!"(""\$da"YUWX"XUm

Fygci fWyg

DfYgWf]VYX F Ygci fWYg

Bch'Uj U]`UV`Y

FYWca a YbXYX FYgci fWYg

Bch'Uj U]`UV`Y

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

∍a U[Y'7fYX]h

GmbYf[]Yg^]b^GcibX^&\$%*

7F = 7CG

7F = 7 C G 'Dfcj]XYf'7cXY. '\$\$\$-,;