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8f]``]b['A i X'!': cfa i `Uh]cbžGY`YW]cb'UbX'A U]bhYbUbWY

7 ci fgY⁻Cj Yfj]Yk

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B Ua Y	9a U]`	5j U]`UV]`]m	@cWUh]cb	D∖cbY
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GW&cc``cZA]bYfU`g`UbX`9bYf[mFYgcifWfg C`X`AU]b`6i]`X]b[ž`@YjY``%z`%)-`f?%)Ł IBGK`GM8B9MBGK`&\$)&`5IGHF5@=5

H. 'Ž*%f&Ł'-',)')\$\$* 9.'

7ci fgY[·]8YHJ]`g

7 fYX]hDc]bhg***

Gi a a UfmcZhXY7ci fgY

H\Y'Wci fgY'Wcj Yfg'H\Y'Zc``ck]b['UgdYWg.'H\Y'Z bXUa YbHU`'df]bW]d`Ygž'Wca dcg]h]cb'UbX'UXX]h]j Yg'cZ Xf]``]b['Zi]Xg"'7`'UmWXYa]ghfm''Dc`ma Yf'UbX'Udd`]WUh]cbg']b'Xf]``]b['Zi]Xg"'A i X'k Y][\hXYhYfa]bUh]cb'UbX WU'W``Uh]cbg"'A i X'Z]`hfUh]cb'UbX'a i X'WU_]b['dfcWYgg"'5D=a i X'dfcdYfh]Yg"'7 \Ya]WU``UbU`mg]g']bWi X]b[d<ž'U`_U`]b]mž'W\`cf]XY'WcbWYbhfUh]cbž'k UhYf'\UfXbYggž'gUbX'WcbhYbhž'a i X'fYhcfhUbX'a Yh\mYbY'V`i Y h]hfUh]cbg"'A i X'gmghYa 'XYg][b'Zcf'Wcbhfc``cZZcfa Uh]cb'XUa U[Y'UbX'k Y``VcfY'gHUV]`]m"

5gʻdUfhicZh\YʻWcifgYžghiXYbhgʻk]``ghiXmUXX]h]cbU`hcd]Wgʻh\fci[\`UʻdfcYWh``8Yg][bʻaiX`dfc[fUaʻZcfʻUb YIhYbXYX`fYUVX`XYjY`cdaYbhkY``'`+bʻh\Y`dfcYWhžghiXYbhgʻUfY`fYei]fYX'hc`WUffmicih``]hYfUhifY`gifjYmž dYfZcfa`kY``VcfY`ghUV]`]miUbU`mg]gžUbX`XYg][bʻaiX`dfc[fUa`h\fci[\`U`WUgY`ghiXm'`:]bU``dfcYWhfYdcfh UbX`dfYgYbhUh]cb`]gʻfYei]fYX"

7 ci fgY 5]a g

H\]gʻWcifgYʻk]``YbUV`YʻghiXYbhgʻhcʻUWei]fYʻZibXUaYbhU``_bck`YX[YʻcZXf]``]b[ʻZi]XgʻUbXʻhcʻUdd`mih\Y h\Ycfmihcʻh\YʻXYg][bžYjU`iUh]cbʻUbXʻcdh]a]nUh]cbʻcZXf]``]b[ʻZi]Xʻdfc[fUa"

7cifgY@YUfb]b[CiHWcaYg

%" 8 Yg][b`UbX`Yj U`i UHY`Xf]``]b[`Zi]X`dfc[fUa `i bXYf`gdYW]Z]Wk Y```WcbX]h]cbg" &" DfYdUfY`UbX`HYghXf]``]b[`Zi]Xg`UVWcfX]b[`hc`5D=gHUbXUfXg" ' " C dh]a]nY`Xf]``]b[`Zi]Xg`hc`WcbHc``Zcfa Uh]cb`XUa U[Y`UbX`k Y``VcfY`gHUV]`]hm"

HYUW]b[GhfUhy[]Yg

D`YUgY'fYZYf'hc'h\Y']bZcfaUh]cb']b'AccX`Y

Hi fb]h]b`gYh]b[.`H\]g`]g`bchU`Hi fb]h]b`Ugg][ba Ybh

5ggYgga Ybh). Dfc YWh

8YHJ)`g.8Yg][b`a i X`dfc[fUa `Zcf`Ub`YI HYbXYX`fYUW\`XYj Y`cda Ybhk Y``"`H\Y`gdYWJZWUHjcb`cZh\Y`dfc*'*YWhk]```VY`fY`YUgYX`cb`K_YY_`)"

Gi Va]gg]cb bchYg.A ccX`Y`Cb`]bY`Gi Va]gg]cb

Hi fb]h]b`gYh]b[.`H\]g`]g`bchU`Hi fb]h]b`Ugg][ba Ybh

5ggYgga Ybh*.:]bU`9l Ua

8YHJ]`g.

5 'k c`\ci fg`cb`]bY`ei]n`k]``VY`\c`X`k]h`]b`h\Y`YI Ua `dYf]cX"`; i]XY`]bYg`Zcf`\Y`d]b[`h\Y`dfYdUfUh]cb`Zcf`h\Y Z]bU``YI Ua `k]``VY`fY`YUgYX`df]cf`hc`h\Y`YI Ua "

Gi Va]gg]cb bchYg.A ccX`Y ei]n

Hi fb]h]b`gYh]b[.`H\]g`]g`bchU`Hi fb]h]b`Ugg][ba Ybh

5 HHYbXUbWY FYei]fYa Ybhg

Ghi XYbhgʻUfYʻghfcb[`mʻYbWci fU[YX'hcʻUhhYbX'U```WUggYgʻUbX'fYj]Yk ``YWhi fYʻfYWcfX]b[g"

7 ci fgY GWX YXi `Y

J]Yk WUgg ha YHJV Y

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8UhY	Hmd Y	7 c bhYbh	
K YY_`%`%(`GYdhYa VYf'! %`GYdhYa VYf	Hcd]W	7\!%'≢blfcXiWhjcb/7\!&7`Um7\Ya]ghfm	
K YY_`&.`&%`GYdHYa VYf`! &)`GYdHYa VYf	Hcd]W	7\!&7`Umi7\Ya]ghfmy'7\!' Dc`maYf'7\Ya]ghfm	
KYY_'.`&, GYdhYaVYf! &CWfcVYf	Hcd]W	7\!' `Dc`ma Yf`7\Ya]ghfm	
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KYY_`*.`%-`CW/cVYf'!`&' CW/cVYf	Hcd]W	7∖!) '5D≓AiX'DfcdYfh]Yg	
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K_YY_`, .`&Bcj Ya VYf'!`* Bcj Ya VYf	Hcd]W	7∖! *`AiX`GmghYag'∕`HfYUbaYbbg`Zcf`GdYW)Z]W <c`y 7cbX]b]cbg"</c`y 	
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FYgci fWfg

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BchUjU]`UV`Y

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

5 hih Y YbX cZYUW. Wci fgYžU```ghi XYbhg`k]```\Uj Y h\Y`cddcfhi b]hmhc Wca d`YhY`U'Wci fgY`Yj U`i Uh]cb`Zcfa " H\YgY`Ubcbma ci g`gi fj Ymg`\Y`d`i g`i bXYfgHUbX`mci f`j]Yk g`cZh\Y`Wci fgYžmci f``YWhi fYfg`UbX`h\Y`Wci fgY a UhYf]U`g"`K Y`UfY`Wcbh]bi ci g`m`]a dfcj]b[`ci f`Wci fgYg`VUgYX`cb`ghi XYbhZYYXVUW_ž`UbX`mci f`dYfgdYWh]j Y]g`j U`i UV`Y"

: YYXVUW_`]g`[]j Yb`j]U`<u>\hhdg.##gh XYbh'i bgk "YXi "Ui #a mYI dYf]YbWY</u>`UbX`mci `k]``VY`bchjZjYX`k \Yb`h\]g`]g Uj U]`UV`Y`Zcf`mci `hc`Wca d`YhY"

K Y'U'gc'YbWci fU[Y'U```ghi XYbhg'hc'g\UfY'UbmZYYXVUW_'h\Ym\Uj Y'Ubmh]a Y'Xi f]b[''h\Y'Wci fgY'-']Zmci \Uj Y'U'WcbWYfbž'd'YUgY'WcbhUWii g']a a YX]UhY`m'

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

H\Y'GW\cc``\Ug'XYjY`cdYX'U'[i]XY`]bY'hc'\Y`d'mci'k\Yb'giVa]hhjb['U'WcifgY'Ugg][baYbh'

K Y`YbWci fU[Y`mci `hc`fYHJ]b`U`WcdmicZYj YfmUgg][ba Ybhigi Va]HYX`Zcf`UggYgga YbhZcf`mci f`ck b`fYWcfX Y]h\Yf`]b`\UfXWcdmicf`Y`YWfcb]WZcfa "

5```UggYgga Ybhg`a i gh\Uj Y`Ub`UggYgga YbhWcj Yf`g\YYhUhUV&YX"

@UhY Gi Va]gg]cb cZUb 5gg][ba Ybh

: i ```a Uf_g`Zcf`Ub`Ugg][ba YbhUfY`cb`mdcgg]V`Y`k \Yb`Ub`Ugg][ba Ybh`]g`fYWY]j YX`Vmh\Y`Xi Y`XUhY"`

K Y'i bXYfgHUbX'H\Uh'Uh'h]a Yg'mci 'a Umbch'VY'UV`Y'hc'gi Va]h'Ub'Ugg][ba Ybh'cb'h]a Yž'UbX'H\Y'GV\\cc``k]`` UVWca a cXUHY'UbmZU]f'UbX'fYUgcbUV`Y'YI HYbg]cb"'K Y'k ci `X'fYVca a YbX'mci 'fYj]Yk 'H\Y'I BGK 'GdYV]U` 7 cbg]XYfUh]cb'[i]XY`]bYg'-gYVf]cb'VY`ck "

@UhY`gi Va]gg]cb`k]``bchVY`UVWYdhYX`UbX`k]``VY`Wcbg]XYfYX`Ug`bc`gi Va]gg]cb"

GdYWJU`7cbg]XYfUh]cb

Mci 'WUb'Udd`mZcf`gdYWJU`'Wcbg]XYfUh]cb'h\fci [\`<u>H\Y'Bi WYi g'Gh XYbh<i V</u>'k \Yb']``bYgg'cf'ch\Yf WJfW a gHUbWYg']bhYfZYfY'k]h\`mci f'UggYgga Ybh'dYfZcfa UbWY'''G]W_bYggž'a]gUXj Ybhi fY'cf'ch\Yf WJfW a gHUbWYg'VYmcbX'mci f'WcbHfc``a Um

- DfYj Ybhmci 'Zfca 'Wca d'Yhjb['U'Wci fgY fYei]fYa Ybh
- ? YYd mci Zfca UthYbX]b[UbUggYggUVY UVMj]hm
- Ghcdimciigi Va]hh]b[iUggYggUVYkcf_ZcfUVkcifgY
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K Y`Ug_`h\Uhimci `d`YUgY`WebhUWih\Y`7 ci fgY`7 cbj Ybcf`]a a YX]UhY`mcbWY`mci `\Uj Y`Wea d`YhYX`h\Y`gdYWJU` Webg]XYfUh]cb`Udd`]WUh]cbžbc``UhYf`h\Ub`cbY`k YY_`Zca `gi Va]gg]cb"

A cfY`XYfU]`g`cb`gdYWJU``Wcbg]XYfUHjcb`WUb`VY`Zci bX`Uh`<u>k k k "ghi XYbh'i bgk "YXi "Ui #gdYWJU`!Wcbg]XYfUHjcb</u>

Gh XYbhGi ddcfh

H\YʻI b]j Yfg]miUbXʻh\Yʻ: UW `midfcj]XYʻUʻk]XYʻfUb[YʻcZgi ddcfhigYfj]WfgʻZcfʻgh XYbhgž`]bWi X]b[.

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

Mci f``YWi fYf`UbX'h\Y'I b]j Yfg]mik]``YI dYWinci f`gi Va]hYX'Ugg][ba Ybhg`UfY'hfi `minci f`ck b`k cf_''I BGK \Ug`j YfmWYUf`[i]XY`]bYg`cb`k \Uhd`U[]Uf]ga `]g`UbX`\ck `hc`Uj c]X`]h'`D`U[]Uf]ga `]g`i g]b[`h\Y'k cfXg`cf]XYUg`cZch\Yfg`UbX'dfYgYbh]b[`h\Ya `Ug`nci f`ck b''D`U[]Uf]ga `]g`U`mdY`cZ]bhY``YWi U``h\YZh'' #iWUb`hU_Y a UbmZcfa gž'Zīca `XY`]VYfUhY`W\YUh]b[`hc`UVW]XYbhU``mWcdm]b[`Zīca `U`gci fWY`k]h\ci hUW_bck `YX[Ya Ybh' H\Y'I b]j Yfg]mi\Ug`UXcdhYX`Ub`YXi WUh]j Y`UddfcUV\'hc`d`U[]Uf]ga `UbX`\Ug`XYj Y`cdYX`U`fUb[Y`cZ fYgci fWYg`hc`gi ddcfhigh XYbhg''5```h\Y`XYhU]`g`cb`d`U[]Uf]ga ž`]bWi X]b[`gca Y`i gYZ ``fYgci fWYgž'WUb`VY Zci bX`Uhi<u>k k k "gh XYbh'i bgk "YXi "Ui #d`U[]Uf]ga</u>."

5```A]b]b[''9b[]bYYf]b['gh XYbhg'UfY'fYei]fYX'hc'Wcad`YhY'U'gh XYbhXYWUfUh]cb'Zcf'UWUXYa]W]bhY[f]hm k \]WX']g'ci h]bYX']b'h\Y'Ugg][baYbhWcjYf'g\YYhg'''6mg][b]b['h\]g'XYWUfUh]cbz'mci 'U[fYY'h\Uhmcif'k cf_']g mcif'ckb'cf][]bU'`k cf_"

-Zmci 'bYYX'gca Y'UXX]h]cbU``gi ddcfhk]h\ 'mci f`k f]h]b['g_]`gž'd`YUgY WcbhUWh\Y'@YUfb]b['7 YbhY'cf'j]Yk gca Y'cZh\Y'fYgci fW'g'cb'h\Y]f`k YVg]hY. <u>k k k "`Wi bgk "YXi "Ui</u>"'H\Y'@YUfb]b['7 YbhY']g'XYg][bYX'hc`\Y`d mci ']a dfcj Y'mci f'UWUXYa]Wk f]h]b['UbX'Wca a i b]WUh]cb'g_]``g"'Gca Y'gh XYbhg'i gY'h\Y'7 YbhY'gYfj]WYg VYWUi gY'h\Ym'UfY'Z]bX]b['h\Y]f'Ugg][ba Ybhg'U'W\U``Yb[Yž'ch\Yfg'VYWUi gY'h\Ymk Ubhhc']a dfcj Y'Ub'U'fYUXm gi WWYggZ ``UWUXYa]WdYfZcfa UbWY"

5WUXYa]W=bZcfaUh]cb

7 ci fgY FYgi `hg

: cf^{*}XYHJ]`gʻcbʻI BGK ^{*}UggYgga Ybhdc`]Whž'd`YUgY`j]g]h<u>'k k k "gh XYbh'i bgk "YXi "Ui #UggYgga Ybh</u>

=b`gcaY`]bgHJbWfg`mcif`Z]bU``WcifgY`fYgi`haUmVY`k]h\\Y`X`UbX`bchfY`YUgYX`cb`h\Y`IBGK`d`UbbYX`XUhY" H\]g`]g`]bX]WJhYX`VmU`WcifgY`[fUXY`fYgi`hcZY]h\Yf.

• @9'-']bX]WUHYg'mci '\Uj Y'bchWca d'YHYX'cbY'cf'a cfY']HYa g'cZUggYgga Ybh/cf

- VfcUXVUbX'WcbbYWfjcb'f&) * '_V]h#gYWcf'ZJghYfŁ
- UV]`]hmhc`j]Yk `ghfYUa]b[`j]XYc`fN][\`cf``ck `XYZ]b]h]cb`l BGK `HJ `cdh]cbgŁ

A cfY`]bZcfa Uh]cb'UVci hgmghYa 'fYei]fYa Ybhg']g'Uj U]`UV`Y Uh<u>k k k "ghi XYbh'i bgk "YXi "Ui #a ccX`Y!gmghYa !fYei]fYa Ybhg</u>

$5WWWgg]b[^7cifgYAUHYf]UgH\fci[\^AccXY]$

7 ci fgY'ci h]bYgžgi ddcfha UhYf]U`gʻUfY'i d`cUXYX'hc`A ccX`Yž'h\Y'i b]j Yfg]hnighUbXUfX'@YUfb]b[A UbU[Ya YbhGmghYa 'f@A GŁ"'±b`UXX]h]cbžcb!`]bY`Ugg][ba Ybhigi Va]gg]cbg`UfY'a UXY'i g]b['h\Y Ugg][ba YbhXfcdVcI 'ZJW]`]hnidfcj]XYX']b`A ccX`Y"'5``Ybfc``YX'ghi XYbhg`UfY'Ui hca Uh]WU``m`]bWi XYX']b $\label{eq:linear} \begin{array}{l} K_{1}^{*}(UW\underline{b}ck^{*}YX[Y^{*}hY^{*}GYXY[U^{*}dYcd^{*}Y^{*}k \setminus c^{*}UfY^{*}hY^{*}fUX]h]cbU^{*}WghcX]Ubg^{*}cZhY^{*}UbXg^{*}cb^{*}k \setminus]W_{1} \mid B\,GK \mid P_{2}^{*}(Wdy^{*}hY^{*}h$