

MUSC4706

Aig]W9bgYaV`Y

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

7ci fgY'Cj Yfj]Yk

GHJZZ7cbHJWh8YHJ]`g

7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`]m	@cWJhjcb	D\cbY
>c\b'BUd]Yf	- 0	5		\$&'-',) *-)''cf -\$*)')-\$&

GWkcc~7cbhJWh~abZcfa Uh]cb

GWXcc``cZhXY`5fhg`UbX`AYX]U

Fcca " %&ž@Yj Y`" žFcVYffiK YVgfYf'6i]`X]b['f) %(Ł

D\cbY. f\$&L'-',) '(,) *

9a U]` gUa 4 i bgk "YXi "Ui

K YVg]hY. k k k "Ufhg"i bgk "YXi "Ui #gUa

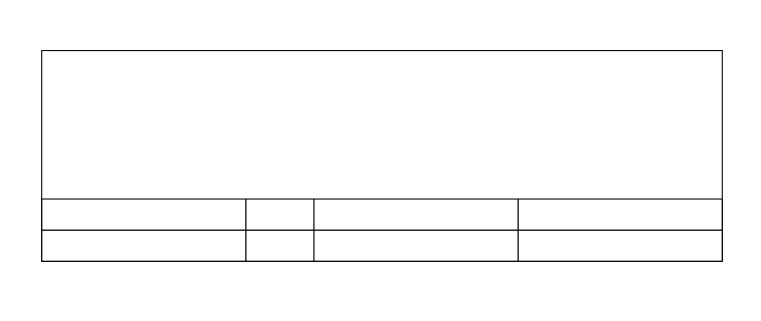
 $\label{eq:hamiltonian} $$HY'GWCC``cZhY'5ftg'UbX'AYX]U'kci`X``]_Y'tc'FYgdYWM\cong \cong m5W_bck`YX[Y'thY'HfUX]tjcbU``7i gtcX]Ubgž thY'6YXY[U'`fPYbg]b[tcb'WJadigŁZ'; UX][U'`fP]tmUbX'5fth/'8Yg][b'7UadigYgŁ'UbX'thY'B[ibbUkU`dYcd'Y'fbigtfU]Ub'8YZYbW': cfW'5WJXYam]b'7UbVYffUŁ'cZthY'`UbXg'k\YfY'YUW\cong WJadig'cZIBGK']g`cWJtYX''$

7ci fgY 8YHJ] g

7fYX]hDc]bhg**

Gi a a UfmcZh\Y 7ci fgY

 $\label{thm:condition} $$H\ g']g'U'dfUWfJWU''a\ i\ g]WWci\ fgY'h\ Uhic ZZYfg'mci\ 'Ub'cddcfhi\ b]hmhc'dUffJWJdUhY']b'hk\ c'gY'ZlgY'YWhYX$



5ggYgga Ybh& '9bgYa V`Y'6'7cblf]Vi h]cb'UbX'DUfH7\YW]b[

GhUfhXUhY. Bch5dd`]WUV`Y

8YHJ]`g.

Ghi XYbhgfidUfhjWldUhjcb: UbX: WcbhfjVi hjcb: hc: YbgYa V:Y:fY\YUfgU'g:k]: `VY:UggYggYX: Zcfa Uhjj Y:mž: Vmh\Y YbgYa V:Y:X]fYWhcf: fY[i: `Uf:ma cb]hcf]b[:'ghi XYbhg:]b: fY\YUfgU'g: hc: Ybgi fY:h\Uh: `YUfb]b[:']g: hU_]b[d: UWY: Gi a a Uhjj Y: UggYgga Ybhi]g: UXa]b]ghYfYX: h\fci [\:U'dUfh!WXYW_]b[: hYgh'Uhih\Y:YbX:cZh\Y:gYgg]cb"

 $: YYXVUW\underline{\ }. "8] fYWhUbX"cb[c]b["ZYYXVUW\underline{\ }"Xif]b["fY\YUfgU"g""UbX"UZhYf"U"aU]b"dYfZcfaUbWl"$

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

H\Y`dUff\W\Y\<u>\</u>]b[`h\ghi gi U``mh_Yg`d`U\\Y`]b`h\Y`k YY_`UZ\Yf`h\Y`Z|bU``fY\YUfgU`#di V`]\\dYfZcfa Ub\\\

: YYXVUW_. k f]hhyb fygdcbgy dfcj]XYX"

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

K f]hhYb'Yj U'i Uh]cbg'UfY'gi Va]hhYX'j]U'hi fb]h]b'UbX']bWi XY'h\Y'Zc'`ck]b[.

%" H]hY'dU[Y.'fUŁ'ghi XYbhfig'Z] ```bUa Y'UbX'=8'fVŁ'bUa Y'cZYUWX'YbgYa V'Yž'UbX'fWŁ'k cfX'Wci bh &" Ub']bhfcXi WhcfmdUfU[fUd\ža U]b'hYl hž'UbX'WcbWi g]cb"

: cf`hjdg`cb`kf]hjb[`UVci ha i g]WWcbgi`hh\Y`<Ufj UfX`kf]hjb[`[i]XY`Uh\hdg.#kf]hjb[dfcYWhZJg"\Ufj UfX"YXi#]Yg#\kd#]Yg#J]S&(S[i]XYShcSdf]bh'dXZ

5XX]hjcbU``]bglfi Whjcbg`cb`k f]hjb['U'Wca dUfUhj Y'Yj U`i Uhjcb`k]``'VY'dfcj]XYX"

 $\label{thm:limit} \begin{tabular}{ll} Hi fb]h]b gYhh]b[."H\]g"ugg][ba Ybh]g"gi Va]hhYX"h\fci [\"Hi fb]h]b "UbX"gh XYbhg"Xc"bchgYY"Hi fb]h]b g]a]"uf]hmfYdcfhg" \\ \end{tabular}$

5 hyb XUb WY F Yei]fYa Ybhg

 $Gh XYbhg `UfY `YI dYWhYX `hc `Uddfc UWX `h\]g `Wci fgY `Ug `dfc ZYgg]cbU`g" `5hhYbXUbW' `g\ci `X `VY `Wcbg]ghYbhUbX di bWh U"" `$

A cghiybgya V`Yg`k]```\Uj Y`U'di V`]WdYfZcfa UbWY'h\Uh]g'bch]b'h\Y'fY[i `UffY\YUfgU`'f]a Y"'Ghi XYbhg'A I GH UhhYbX'h\]g'dYfZcfa UbWY": U]`i fY'hc'Xc'gc'bchicb`ma YUbg'h\Uhmci 'k]``bchfYWY]j Y'h\Y'a Uf_'Zcf'h\Uh dYfZcfa UbWY''=hXYhfUWfq'Zfca 'h\Y'dYfZcfa UbWY'Zcf'U``'dUfh]WdUbhq"''

Bcb!UffYbXUbVW`UhfY\YUfgU`g`]g`\][\`mXYff]a YbfU``fc`YbgYa V`Y`XYj Y`cda Ybf'

D`YUgY`Wcbgi `hik]h\`r\\Y`Wci fgY`Wcbj Ybcf']Zmci '\Uj Y`Ubmei Ygh]cbg'fY`mci f'gi]hUV]`]hm`Zcf'dUfh]W\`Uf YbgYa V`Ygž'Ug`gYj YfU``YbgYa V`Yg`UfY`VmUi X]h]cb'cb`mž'UbX'h\YgY`UbX'ch\Yfg'a UmfYei]fY`gdYW]ZJW]bghfi a YbhU``cf'j cWU``g_]``g"

 $\label{eq:continuous} D`YUgY`Ybgi fY`mci f`YbgYa V`Y`Ybfc``a Ybh]g`Wca d`YhYX`bc``hYf`th`Ub`th`Y`YbX`cZk YY_`%$

.

7ci fgY GWX YXi `Y

J 1Yk 'WUqq'Ha YHUV'Y

H]a YHJV`Y

8UHY	HmdY	7 cbhYbh
K YY'&. '+'>i bY'!'\% >i bY		7 ci fgY`gWkYXi `Y`]bZcfa Uh]cb`j Uf]Yg`XYdYbX]b[`cb h\Y`YbgYa V`Yg`WkcgYb"
K YY_'' .'%) '>i bY'!'% >i bY		

Fygci fWyg

DfYgWf]VYX F Ygci fWYg

5g'dfcj]XYX'VmYbgYa V`Y'X]fYWcfg"

FYWca a YbXYX FYgci fWYg

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

 $8]fYWhUbX`cb[c]b[`ZYYXVUW_Xif]b[`cb`]bY`gYgg]cbg`UbX`UZYf`Z]bU``UggYgga~Ybhgi~Va~]gg]cb''$

Gi Va]gg]cb cZ5ggYgga YbhHUg_g Hi fb]h]b Gi Va]gg]cb

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

D`U[]Uf]ga `]g`i g]b['h\Y`k cfXg`cf`]XYUg`cZch\Yfg`UbX`dfYgYbh]b['h\Ya `Ug`mci f`ck b"`±hWJb`hU_Y`a Ubm Zcfa gžZfca `XY`]VYfUhY`W\YUh]b['hc`UWW]XYbhJ``mWcdm]b['Zfca `U`gci fWY`k]h\ci hUW_bck `YX[Ya Ybh'

IBGK [fcidg'd'U[]Uf]ga]bhc'h\Y'Zc``ck]b['WUhY[cf]Yg.

 $7 \text{ cdm}b[...i g]b[...h\Y.gUa Y.cf.j Yfmig]a] \Uf'k cfXg'hc'h\Y.cf][]bU''hYl h'cf']XYU'k]h\ci h'U\V_bck `YX[]b[...h\Y.cf][]bU''hYl h'cf']XYU'k]h'cf']$

5 WUXYa]W + DZcfa Uhjcb

: cf'YggYbhJU`gh XYbh]bZcfa UhJcb fY`UhJb[hc.

- fYei Yghg Zcf Yl hYbg]cb/
- `UhY 'gi Va]gg]cbg '[i]XY`]bYg/
- fYj]Yk 'cZa Uf_g/
- I BGK < YU`h\ UbX GUZYmdc`]W[Yg/
- YI Ua]bUh]cb dfcW/Xi fYg/
- gdYWJU``Wcbg]XYfUHjcb']b'H\Y'Yj YbhcZ]``bYgg'cf'a]gUXj Ybh fY/
- gh XYbhYei]hmUbX'X]gUV]`]hm/

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