

# **ARTS3068**

8c]b[:]`a:Yghjj U`g

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

## 7ci fgY'Cj Yfj ]Yk

### GHJZZ7cbHJWh8YHJ]`g

#### 7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`]hm	@cWJhjcb	D\cbY
; fY[ '8c`[ cdc`cj	[fY[X4 i bgk "YXi "Ui		fa "&\$+ž"F cVYfh	-',)'(,**
			KYVghYf 6i]`X]b[	

#### GWkcc~7cbhJWh~abZcfa Uh]cb

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

Fcca ' %&ž@YjY`' žFcVYfhK YVghYf6i]X]b[fl %(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 8YW] g

### 7 fYX]h'Dc]bhg'\*

### Gi a a UfmcZh\Y 7ci fgY

#Jih ]g'Wti fgY'mci ik ]```XYj Y`cd'Ub'i bXYfgHUbX]b[ icZh\Y`]bhYfbU`ik cf\_]b[g'cZU::]`a :: Yghjj U``UbX'h\Y WfYUhjj Yž\]ghcf]\WJ``UbX'`c[]gh]\WJ``fYei ]fYa Ybhg'cZj ]XYc'dfcXi Whjcb']b'`Ub']\Wcb]\W'`c\WJhjcb'''\Mci ik ]```Yl Ua ]bYh\Ya U'cf'a cj Ya YbhgždfcXi Whjcb'hfYbXg'UbX'g\Wc'\UfmXYVUhYg']b'h\Y'Z]`a g'h\Uhmci j']Yk 'UbX'X]g\W gg k ]h\'mci f'\Wc'``YU[i Yg'''\Mci ik]```k cf\_'\Wc'``UVcfUhjj Y`mhc'dfcXi \W'`U'g\cfh'Z]\Wjcb'cf'Xc\W a YbhUfm'Z]`a 'Xi f]b[ h\Y'\Wci fgY'''\Mci ik]```YUfb'\ck 'dfcXi \Wjb[ 'U'Z]`a ']b'U'gdY\WjZ]\W\cbhYl ha UmUXXfYgg'Yh\]\WJ``UbX d\]`cgcd\]\WJ``ei Yghjcbg'\Wcb\Wfb]b[ 'h\Y'fY`Uhjcbg\]d'\Yhk YYb'Z]`a a U\_Yfgz'h\Y'\Wca a i b]\mUbX'\Ui X]Yb\Wg''\Mci ik]```XYj Y`cd'g\_]``g']b'k cf\_]b[ 'k ]h\'h\Y'\Wca a i b]\mUbX'\mci f'dYYfg''\Mci ik ]```[U]b'j U'i UVY'Yl dYf]Yb\W'\Jb'k f]h]b[ 'UbX'd]\h\X]b[ 'U'g\cfh'Z]`a 'g\Wf]dh''\Mci ik]```XYj Y`cd'mci f'dfcXi \Whjcb'g\_]``g'\mi bXYfhU\_]b[ 'U'fUb[ YcZ]`a '\WfYk 'Yl dYf]Yb\Wg''\Mci k]```Yj Y``k ]h\'dfcZygg]cbU``Yei ]da YbhU\Wfcgg'Ubi a VYf'cZZ[`a g']b'U'\WfUhYX': Ygh]j U`'dfc[ fUa 'UbX'Yl dYf]Yb\W' \Wca a ]hhYX': Ygh]j U`'UhhYX': Ygh]j U`'dfc[ fUa 'UbX'Yl dYf]Yb\W' \Wca a ]hhYX': Ygh]j U`'UhhYX': Ygh]j U`'dfc[ fUa 'UbX'Yl dYf]Yb\W' \Wca a ]hhYX': Ygh]j U`'UhhYX': Ygh]j U`'dfc[ fUa 'UbX'Yl dYf]Yb\W' \Wca a ]hhYX': Ygh]j U`'UhhYX': Ygh]j U`'dfc[ fUa 'UbX'Yl dYf]Yb\W' \Wca a ]hhYX': Ygh]j U`'UhhYX': Ygh]j U`'dfc[ fUa 'UbX'Yl dYf]Yb\W' \Wca a ]hhYX': Ygh]j U`'UhhYX': Ygh]j U`'dfc[ fUa 'UbX'Yl dYf]Yb\W' \Wca a ]hhYX': Ygh]j U`'

### 7ci fgY @YUfb]b[ 'Ci hWca Yg

- %" 5dd`m'U`fUb[Y`cZhYW\b]\\\\\"g\_]``g`hc`XYjY`cd`\\\YUh]jY`k cf\_`gYhcb``c\\\\\]cb"
- &" 5dd`miU'j Uf]YhmcZWf]r]WU``WcbWfdhg`UbX`hYfa g`fY`Uh]b[ 'hc'h\Y'dfcXi Wf]cbž'X]ghf]Vi h]cb`UbX ]bhYfdfYhUh]cb`cZ5i qhfU`]Ub`Z|Wf]cb`UbX`XcW a YbhUfmW]bYa Ug"
- $\label{eq:continuity} $$ Ya cbglfUlY`fYgYUfW.`UbX`d`Ubb]b[`g_]`g`]b`[Ulh\Yf]b[žWUgg]Zm]b[`UbX`Wcaaib]WUlf]b[`Z]`agh X]Yg`WcbWYdlg`UbX`dfU[aUlf]Wgc`ilf]cbg`k\]Y`kcf_]b[`WYYUlf]jY`m]b`gaU```dfcXiWf]cb`[fcidg"("Kcf_'Wc``UVcfUlf]jY`mUbX`ibXYflU_Y`U`fUb[Y`cZWfYk`fc`Yg'lc`U`dfcZYgg]cbU``glUbXUfX`k]h\]b$
- U'Wcaaib]m''

## HYUW ]b[ 'GhfUhY[ ]Yg'

H\Y'WcbhYbhcZh\Y'Wci fgY'f]bWi X]b[ "YWh fY'hcd]WgžfYUX]b[ g'UbX'gWfYYb]b[ gŁ\Ug'VYYb'gY`YWhYX'hc dfcj ]XY'U'ZcW gYX'UbX']b!XYdh\']bhYffc[ Uh]cb'cZh\Y'WcfY'WcbW'dhg'cZh\Y'Wci fgY"'H\]g']g']b'`]bY'k ]h\'h\Y \fcUX'cV'YW]j Yg'cZ'Yj Y``' 'Wci fgYgžk \]W\'dfcj ]XY'ghi XYbhg'k ]h\'h\Y'cddcfhi b]hmhc'i bXYfhU\_Y'UXj UbW'X ghi Xm]b'h\Y'X]gW]d`]bY"'H\Y'gY`YWhYX'WcbhYbh']g'U`gc'WcgY`mU`][ bYX'k ]h\'UbX'XYj Y`cdYX'Zfca 'h\Y'fYgYUfW\ ]bhYfYghg'UbX'YI dYfh]gY'cZh\Y'Wci fgY'Wcbj Ybcf"'H\]g'dfcj ]XYg'ghi XYbhg'k ]h\'Ub'cddcfhi b]hmhc'fYZYWhcb h\Y'fY`Uh]cbg\]d'VYhk YYb'fYgYUfW\ VY]b[ 'WcbXi WhYX']b'h\Y'GW\cc`'UbX'W ffYbhXYVUh'g']b'Zja 'ghi X]Yg"'

H\Y 'H'UW\]b[ 'gHfUHY[ mYa d'cmYX ']b'h\]g'Wti fgY 'fYd\UW\g'h\Y 'HfUX]h[cbU\'Y\Whi fY!gWfYYb]b[!hi hcf]U\'a cXY\ k ]h\ 'Ub']bHYbg]j Y 'Wti fgY 'a cXY\`VUgYX cb'dfcXi W]b[ 'U'g]b[ 'Y'g\cfhZ]a 'Xi f]b[ 'U'Z]a 'Zygh]j U\'Zcf'dchYbh]U' gWfYYb]b[ 'cb'h\Y 'Z]bU'b][ \hcZh\Y Z]a 'Zygh]j U\']b 'Wta dYh]ncb''H\Y'dfc YWh]g'gi ddcfhYX 'VmYl hYbg]j Y Wtbgi 'hUh]cbz'ZYYXVUW\_UbX'cj Yfj ]Yk "'Ghi XYbhg'UfY 'gi ddcfhYX']b 'Wgh]b[ 'k ]h\ ']bhfcXi Wljcbg'hc 'Wta a i b]hm a Ya VYfg'k ]\']b[ 'hc 'dUfh]\W]dUhY''Ghi XYbhg'UfY Xf]j Yb'hc 'j Uf]ci g'ci hVUW\_'cwUh]cbg'bYUf'h\Y'hck b'cZK ]bhcb Zcf'h\Y]f'`cWUh]cb'g\cchjb[ "'GYa ]bUfg'UbX'k cf\_g\cdg'UbX'a YYh]b[ g'k ]h\ 'Z]a 'ghUfg'UfY YbUV'YX'h\fci [ \h\Y'Wti fgY'HU\_]b[ 'd'UW\'Uhh\Y'gUa Y'h]a Y'Ug'h\Y'J ]g]cb'Gd'YbX]X'Ci hVUW\_: ]a ': Yghjj U'''Ghi XYbhg\\Uj Y UW\Y'gg'hc 'Z]a ']bXi ghfmdfcZygg]cbU'g'j ]g]h]b[ 'Zcf'h\Y'Ja 'Zygh]j U''UbX'dfcj ]X]b[ 'UbX'g\Uf]b[ 'h\Y'fYl dYfh]gY'' H\Y'ghi XYbhg'\ck Yj Yf'UfY'i 'h]a UhY`mfYgdcbg]V'Y 'Zcf'h\Y]f'h]a Y'a UbU[ Ya YbhUbX'h\Y'Yb[ U[ Ya Ybhk ]h\h\Y'Yb[ U[ Ya Ybhk ]h\h\Y'Yb[ U[ Ya Ybhk ]h\h\Y'Yb[ U[ Ya Ybhk ]h\h\Y'Ya'a 'Zygh]j U''UbX'h\Y]f'ck b'dfc YWhXY`]j YfUV'Yg''' H\]g']g']b'']bY'k ]h\'h\Y'[YbfU`'U]a cZ'Yj Y`'' 'Z'a 'ghi X]yg'gi VYW\g'nc 'dfca chY'U'\][ \Yf'XY[ fYY'cZghi XYbh'YX'fygYUfW\'UbX'XYVUhY'cb X]gW]d']bY!gdY\\Z\W\cbW'dhg'''

## 5ggYgga Ybh

Dfc YWg XYj Y`cdYX

H\i fgXUm\%Ua - \&da

GWXYXi `Y K YY\_%fA cbXUm%+5i [i gh : f]XUm&%5i [i gh&\$&\$Ł A cbXUmi%Ua '-'%da A cbXUmi%da '-' (da K YVghYf@UVg~% \*#% +#%, 7 ci fgY ⇒hfcXi Whob : ]`a : Ygh]j U``H\Ycfm#: ]`a : Ygh]j U``7 i `hi fY 8cWa YbłUfmDfcXi Wjcb HYWkb]ei Yg Hi YgXUm‰Ua - ‰da K YVghYf; %+ Hi YgXUm'%da '-' (da K YVghYf'@UVg'% \*#% +#%, : ]`a : Ygh]j U``H\Ycfm#: ]`a : Ygh]j U``7 i `hi fY 8cWa YbłUfmDfcXi Wjcb HYWkb]ei Yg Dfc YWhD]hWX]b[ 'UbX'; fci dg': cfa YX K YXbYgXUm%Ua - %&da K YVghYf; %+ K YXbYgXUm'%da '-'(da K YVghYf@UVg% \*#% +#%, : ]`a : Ygh]j U``H\Ycfm#: ]`a : Ygh]j U``7 i `hi fY 8cW a YbhUfmDfcXi Whob HYWkblei Yg : ]`a ': Ygh]j U`'A Uf\_Yh]b[ 'UbX'Dfca ch]cb : ]`a : Ygh]j U``7 i fUh]cb UbX Dfc[fUa a ]b[

```
K YVghYf'; %+
H\i fgXUm%da - (da
K YVghYf'@UVg'% *#% +#%,
: ]`a : Ygh]j U``H\Ycfm'#: ]`a : Ygh]j U``7 i `hi fY
8cW a YbhUfmDfcXi Whcb HYVXb]ei Yg
: ]`a : Yghj U``A Uf_Yhjb[ 'UbX'Dfca chjcb
: ]`a : Ygh]j U``7 i fUh]cb UbX Dfc[fUa a ]b[
DfcXi Whob Dfc YWho DfygYbhYX Zcf: YYXVUW_
5ggYgga Ybh%8i Y: f]XUm&%5i [i gh) da
K YY_&fA cbXUm&( 5i [i gh : f]XUm&, 5i [i gh&$&$Ł
A cbXUmi%Ua '-'%&da
K YVghYf; %+
A cbXUmi%da - (da
K YVghYf@UVg.% *#% +#%,
: Yghji U`7 UgY Ghi X]Yg
: ]`a : Yghj U` H\Ycfm#: ]`a : Yghj U` 7 i `h fY
8cWa YbłUfmDfcXi Wjcb HYWkb]ei Yg
: ]`a : Ygh]j U``A Uf_Yh]b[ 'UbX'Dfca ch]cb
: ]`a : Yghjj U``7 i `hi fY
7 i fUhch UbX Dfc[fUa a ]b[
DfcXi Whcb Dfc YWha
Hi YgXUm‰Ua - ‰da
K YVghYf; %+
```

Hi YgXUm'%da '-' (da

### 5ggYgga Ybh&8i Y &, 5i [i gh) da

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K YY\_" "fA cbXUm" %5i [i gh" : f]XUm( GYdhYa VYf &\$&\$Ł

A cbXUmi%\$Ua '-'%&da

 $K \ YVghYf^{\cdot}\% \ *\#\% +\#\% \ ,$ 

DfcXi Wgcb Dfc YWg F Yj ]Yk YX

H\i fgXUmi&da '--'( da

K YVghYf'; %+

DfcXi Wgcb'dfcYWg'dfYgYbhYX

: ]bU``DfYgYbhUh]cbg

FYgYUfWX'K YY\_

: ]bU``5ggYgga Ybh' '8i Y`: f]XUm( 'GYdhYa VYf') da '

 $5\,\text{WUXYa}\,]\text{WfYZYfYbW} b\,[\,\text{`ghm}Y\,\text{`WUb}\,\text{`VY}\,\text{`A}\,\text{@}5\,\text{`cf}\,\text{`}7\,\text{`]}\text{WU}\,[\,\text{c}\,\text{`Vi}\,\text{hia}\,\text{i}\,\text{ghiVY}\,\text{`Wc}\,\text{bg}]\text{ghY}\,\text{bh'}\,\text{'H}\,\text{YfY}\,\text{'a}\,\text{i}\,\text{ghiVY}\,\text{`Uh}\,\text{`YUghh}\,\text{fYY}\,\text{df}]\text{a}\,\text{UfmfYZYfYbW}\,\text{g}\,\text{i}\,\text{h}]\,\text{`gyX}\,\text{`]}\text{b}\,\text{'mci}\,\text{f}\,\text{'fYgYUfW}\,\text{'YggUm}\,\text{'}}$ 

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### 5ggYgga Ybh'HUg\_g'

5ggYgga Ybh'hUg_	K Y][ \h	8iY'8UhY	

h/Wkb]WU``m'i'9Id`cfY`\ck 'h\YgY`Z]`ag`UfY`g]hiUh/X`k]h\]b'h\Y`dfYgYbh]b[`Z]`a`ZYgh]jU`'!'h\Y`Wcbh/Ih`zh\Yghf]wify'Wy`\ck 'h\Y`ZYgh]jU`'!'h\Y`bch]cb'cZfZ]`a`W``hifYf'i'GYY\_`hc`XcWaYbhY`UiX]YbWYfygdcbgYg`cf'Ubm'Z]`a`W``hifY`Ufh]ZUW\g''`

 $H\ [g'WUb'VY'giVa] \ [hh'X'Ug'U'k f] \ [hh'b'YggUmcf'Ug'j] \ [XYc'YggUmk] \ [hh'jc] \ Yf'bUffUh] \ cb'Vihk \ [hh'U'ZcW'g'cb'Wf] \ ffUh] \ cb'V'hk \ c'Z[ag'ibXYf'YIUa] \ [bUh] \ cb''$ 

@Yb[h\. '

k]``fYWY]jY'U'bi a Yf]WU`'[fUXY"

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### 5XX]h]cbU`XYhU]`g.

.

 $\label{thm:condition} $$HY'dfcYWiXi fUhjcb'g\ci`X'VY'UVci hiZji Y'a ]bi hYg'':H\]g']g'U'[ fci d'dfcYWiUbX'ghi XYbhg'k ]```VY'UggYggYX cb'U'Wca V]bUhjcb'cZh\Y'Wc\Yg]j YbYgg'cZh\Y]f'Wc``UVcfUhjcb'UbX'cb']bX]j ]Xi U``Wcbhf]Vi hjcbg'UbX `YUXYfg\]d']b'h\Y'YI YW' hjcb'cZ_YmWfYk 'fc`Yg'''$ 

Hi fb]hjb gYhjb[. H\]g ]g bchU Hi fb]hjb Ugg][ ba Ybh

5ggYgga Ybh' . F YgYUfVX '9ggUm

GhUfh'XUhY.

@Yb[h\. &\$\$\$ k cfXg a Ul]a i a

8YHJ]`g.

Ghi XYbhgik ]``i bXYfhU\_YiUifYgYUfWkiYggUmVUgYXicbiWkiccg]b[i'Uihcd]WZfca i'UigYf]YgicZei Ygh]cbihcihYgh

## 5 https://bxubwww.Fyei ]fya Ybhg

Ghi XYbhgʻUfYʻghfcb[`miYbWci fU[YX'hcʻUhhYbX'U```WUggYgʻUbX'fYj ]Yk '`YWhi fY`fYWcfX]b[g"

## 7ci fgY'GWXYXi `Y

### J ]Yk 'WUgg'h]a YhUV'Y

## H]a YtUV`Y

8 UhY	Hmd Y	7 cbhYbh
K YY_'% '%+'5i [i ghi! &%		A cbXUmi‰Ja '-'‰da '@97HI F9
5i [i gh		A cbXUmi%da '-'(da 'G9A -B5F
		7 ci fgY ±olfcXi Wijcb
		: ]`a ': Yghj U`'H\Ycfm#: ]`a
		: Yghjj U`'7 i `hi fY
		HYVXb]ei Yg
		5ggYgga YbhX]gW gg]cb
		Hi YgXUmi‰Ua i i i i i i i i i i i i i i i i i i i
		: ]`a : Yghjj U``H\Ycfm#: ]`a
		: Yghjj U`'7 i `hi fY
		H\Y`6i g]bYgg`cZ: ]`a `: Yghjj U`g
		: Ygh]j U`gʻUgʻ`]j YʻYj YbhgʻUbX': Ygh]j U`gʻcb`]bYʻXi f]b[ h\YʻdUbXYa ]W
		DfcYWhD]hWX]b[ 'UbX'; fci dg': cfa YX
		K YXbYgXUm%;Ja '-'%&da
		: ]`a ': Ygh]j U``H\Ycfmi#: ]`a
		: Yghjj U``7 i `hi fY
		: ]`a '7 ca dUf]gcb'HYW\b]ei Yg
		: ]`a ': Yghjj U``A Uf_Yhjb[ 'UbX'Dfca chjcb

	: ]`a : Yghjj U``7 i fUhjcb`UbX`Dfc[fUa a ]b[
	Dfc^YV <b>V</b> g^XYj_Y^cdYX
	H\i fgXUm'%⁄Ja ` '%&da
	: ]`a ': Yghjj U``H\Ycfmi#: ]`a
	: Yghjj U``7 i `hi fY
	: ]`a '5bU`mg]g'HYW\b]ei Yg
	: ]`a `: Yghjj U``A Uf_Yhjb[ 'UbX'Dfca chjcb
	: ]`a : Yghjj U``7 i fUhjcb`UbX`Dfc[fUa a ]b[
	DfcXi Wjcb DfcYWg
	: f]XUm! F YgYUfVX 8Um
	Gi Va ]gg]cbˈcZ: ]fgh5ggYgga Ybh
K YY_'&.'&('5i[igh!'&, 5i[igh	A cbXUm
	: Yghjj U``7 UgY`Ghi X]Yg
	: ]`a ': Yghjj U`'H\Ycfm#: ]`a
	: Yghjj U`7i `hi fY
	6i g]bYgg*cZ: ]`a ': Yghjj U`g
	: ]`a gʻUVci h: ]`a ': Yghjj U`g
	: ]`a ': Yghjj U`'A Uf_Yhjb[ 'UbX'Dfca chjcb
	: ]`a ': Ygh]j U`'7i `h fY
	7 i fUhjcb UbX Dfc[fUa a ]b[
	DfcXi Whjcb'DfcYWhg
	Hi YgXUm
	: ]`a ': Yghjj U`'H\Ycfm'#: ]`a

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: Yghjj U`7i `hi fY
6i g]bYgg cZ: ]`a : Yghjj U`g
6i X[Yh]b[ HYWXb]ei Yg
: ]`a :: Ygh]j U``A Uf_Yh]b[ 'UbX
Dfca chcb
: ]`a : Yghjj U``7 i fUhjcb UbX Dfc[fUa a ]b[
DfcXi Wgcb DfcYWg
K YXbYgXUm
: ]`a ': Yghjj U`'H\Ycfm'#: ]`a
: Ygh]j U``7 i `hi fY
8 cW a YbhUfmDfcXi Wjcb
5i X]YbWg
: ]`a ': Ygh]j U``A Uf_Yh]b[ 'UbX'Dfca ch]cb
DfYgYbhJhjcb UbX Wc``UVcfUhjcb'
H\i fgXUm
: ]`a : Yghjj U``H\Ycfm#: ]`a
: Yghjj U`'7 i `hi fY
8 cW a YbhJfmDfcXi Wjcb
5i X]YbW/g
: ]`a : Ygh]j U``A Uf_Yh]b[ 'UbX'Dfca ch]cb
DfYgYbhJhjcb UbX Wc``UVcfJhjcb
: f]XUm
FYgYUfWX 8Um
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	5ggYgga Ybh&Gi Va ]hhYXVm) da
K YY_"."%5i[igh!( GYdhYa VYf	A cbXUmi%\$Ua '-'&da 'DfcXi Wfjcb'DfcYWfg F Yj ]Yk YX'UbX'U``: Ygf]j U`g`ci fWca Yg`g\UfYX'k ]h\ h\Y`[ fci d
	Hi Yg'!: f]XUmGY`Z; i ]XYX'F YgYUfW\'
	: f]XUmi5ggYgga Ybh' 'F YgYUfW\'9ggUmi]g'Xi Y'Vm ) da

## FYgci fWyg

### DfYgWf]VYX F Ygci fWYg

: Ua ]`U]f]gY`mci fgY`Zk ]h\ '5XcVY`DfYa ]YfY`Dfc`YX]h]b[ `gcZk UfY"`fYZfYg\`mci f`g\_]``g`Vmj ]Yk ]b[ `h\YgY hi hcf]U`g``\hdg.#\Y`dl "UXcVY"Wca #dfYa ]YfY!dfc#i hcf]U`g"\ha`

.

### FYWca a YbXYX FYgci fWyg

5i ghfu`]ub': ]`a ': Ygh]j u`g. 5i X]YbWYž'D`uWYž'UbX'9I \ [V]h]cb'7i `h fY'5i h\cf. 'GhYj Ybgž'? ]fghYb

\mdg.#k k k "du`[ fUj Y"Wta # d#/cc\_# +, %% +), \*' ++

G\cfhŽGk YYh: ]`a : YghJj U`. `\hdg.#g\cfhUbXgk YYh'cf[

?cfYUb:: ]`a:: Ygh]j U```\hd.#k k k "\_cZ]U"Wca "Ui #

@YVUbYgY: ]`a : Ygh]j U``\hdg.##Z/cf[ "Ui #

A Ub]ZYghc. \hdg.#k k k "Zja ZYgh'bYh'Ui #&\$%) #\$- #&' #\\Y!Zja !ZYgha Ub]ZYghc#

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

 $H\ [g']hYfUh]cb'cZ5FHG''\ \$^*,\ [g'U'bYk'WcifgY']b'U'X]ZZYfYbhWcbhYlhUbX'k\ ]h\ X]ZZYfYbhghfi\ WhifYg'hcdfYj\ [cig']hYfUh]cbg'cZ5FHG''\ \$^*,\ [gc'dfYj\ ]cig'ZYYXVUW_a UmbchVY'fY'Yj\ Ubh$ 

Gh XYbhg k ] "VY YbWci fU[ YX hc i gY A m9I dYf]YbW hc dfci ]XY Zcfa Uhj Y ZYYXVUW\_

Gh XYbhg k ] ``VY YbWci fU[ YX hc dfcj ]XY ZYYXVUW\_Xi f]b[ h\Y Wci fgY ]

.

## Gi Va ]gg]cb cZ5ggYgga YbhHUg\_g

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

Image: Ybwei bhyfu'dfcv'ya k \yb'uhhya dhjb[ 'hc'gi va ]hmci f'Ugg][ ba Ybhh\fci [ \ 'Hi fb]h]bž'd'YUgY

Hy'Yd\cby'9| hy'fbu''Gi ddcfhcb'-', ) "''' %cf'Ya U] hya 'cb'Yl hy'fbu'hy'ngi ddcfh4 i bgk "YXi "Ui "''Gi ddcfh
\ci fg'UfY', .\$\$Ua '-'%\$.\$\$da 'cb'k YY\_XUmg'UbX'-.\$\$Ua '-').\$\$da 'cb'k YY\_YbXg'fl \*) 'XUmg'U'mYUft"'=Z'mci
UfY'i bUV'Y'hc'gi va ]hmci f'Ugg][ ba YbhXi Y'hc'U'ZJi 'hk ]h\ 'Hi fb]h]b'mci 'a Um'Udd'mZcf'Ub'Yl hy'bg]cbž'Vi hmci
a i ghfYhJ]b'mci f'h]W\_Yhbi a VYf'Zfca '9| hy'fbu''Gi ddcfhfU'cb[ 'k ]h\ 'Ubmch\Yf'fy'Yj UbhXcW a Ybhgthc
]bWi XY'Ug'Yj ]XYbW'hc'gi ddcfhmci f'Yl hy'bg]cb'Udd']WUh]cb"'=Zmci 'Ya U]''9| hy'fbu''Gi ddcfhmci 'k ]'`
Ui hca Uh]WJ'`mfYW']j Y'U'h]W\_Yhbi a VYfZ'Vi h]Zmci 'hy'Yd\cby'mci 'k ]``bYYX'hc'gdYW]Z]WJ'`mUg\_'Zcf'cby''
Hi fb]h]b'U'gc'dfcj ]XYg'i dXUhy'g'cb'h\Y]f'gmghYa 'ghUh' g'cb'Hk]hyf''

; YbYfU`mž'UggYgga YbhiHug\_g'a i ghVY'gi Va ]hhYX'Y`YVWfcb]\WJ``mij ]U'Y]h\Yf'Hi fb]h]b'cf'U'A ccX`Y Ugg][ ba Ybh''=b']bgHJb\W'g'k \YfY'h\]g']g'bchdcgg]V`Yž']hk ]```VY'gHJhYX'cb'mci f'\\circ i fgY'g'A ccX`Y'g]hY'k ]h\U`hYfbUh]j Y'gi Va ]gg]cb'XYHJ]`g"

cfi]bZcfa Uhjcbicbi\ckihcigi Va ]hUgg][ ba Ybhgicbi]bYij ]UiA ccXiY.i\hdg.#gh XYbhi bgk "YXi "Ui #\ck! gi Va ]hUgg][ ba Ybha ccXiY

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

D`U[]Uf]ga i]gii g]b[ih\Yik cfXgicfi]XYUgicZch\YfgiUbXidfYgYbh]b[ih\Ya iUgimci fick b"i=hWJbihU\_Yia Ubm Zcfa gžZfca iXYi]VYfUhYiWXYUh]b[ihciUWW]XYbhU`mWcdm]b[iZfca iUigci fWYik]h\ci hiUW\_bck iYX[Ya Ybh'

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

- 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 žch\Yfg'k]``VY'bYk"'; U]b]b['U'gc`]X'i bXYfgHJbX]b['cZU``h\YfY`UhYX'UgdYWhg'cZ9@&9'k]``\Y`d'mci 'a U\_Y'h\Y'a cghicZmci f'ghi X]Yg'Uh'l BGK "'\\hd.##gi V'YWfi |XYg"`]VfUfm'i bgk "YXi "Ui #\`]qY#JVci hY`]qY

### 5 WUXYa ]W = b Zcfa Uh cb

: 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'GUZYhm'dc`]W[Yg/
- YI Ua ]bUh]cb dfcW/Xi fYg/
- qdYWJU``Wcbq]XYfUHjcb`]b`H\Y`Yj YbhcZ]``bYgg`cf`a ]gUXj Ybhi fY/
- gh XYbhYei ]mUbX X]gUV]`]m/
- UbX'ch\Yf'YggYbhJU`'UWUXYa ]W]bZcfa UhJcbz'gYY

\hdg.#k k k "Ufhg"i bgk "YXi "Ui #W ffYbhgh XYbhg#UWJXYa ]W]bZcfa Uh]cb#dfchcWc`g![i ]XY`]bYg#

.

### =a U[ Y 7 fYX]h

5i gh]b^4 Ui gh]bh\YdUd]``cb"^D\chc[fUd\YX^cb^GYd^&\$% "

#### 7F = 7CG

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

#### 5W\_bck `YX[ Ya YbhcZ7ci bhfm

 $K Y : UW\underline{b} ck `YX[Y : h, Y : 6YXY[U : dY cd `Y : k \ c : UfY : h, Y : hfUX]h\underline{b} cb : `W ghc X]Ubg : c Z : h, Y ``UbXg : cb : k \ ]WX : I B G K ? Ybg]b[hcb : WUa di g : ]g ``c WUhY X''$