

# **MODL5108**

DfYdUfUhjcb Zcf 5 WWfYX]hUhjcb ]b HfUbg`Uhjcb

GYa YghYf'C bY''##'&\$%

# 7ci fgY Cj Yfj ]Yk

## GHJZZ7cbHJWh8YHJ]`g

#### 7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`]m	@cWJhjcb	D\cbY
: Y`]W]hmiA i Y``Yf	ZaiY``Yf4 i bgk "YXi "Ui			D`YUgY WcbHUWhj]U YaU]"

#### 'Hi hcfg'

B Ua Y	9a U]`	5j U]`UV]`]m	@cWUh]cb	D\cbY
5`]gU'H]Ub	U`]gU"h]Ub4 i bgk "YXi "Ui		9a U]`	
>Ugcb < YZZYfbUb	1/Ugcb"\YZZYfbUb4 i bgk "YXi "Ui		9a U]`	
5`UbU'G]a dgcb	U`UbU"g]a dgcb4 i bgk "YXi "Ui		9a U]`	
A UgU_c C [ Uk U	a "c[Uk U4 i bgk "YXi "Ui		9a U]`	
9`YbU'A ]_\U]`]_	Y"a ]_\U]`]_4 i bgk "YXi "Ui		9a U]`	

#### GWkcc~7cbhJWh~abZcfa Uhlcb

GWkcc`cZ<iaUb]h]Yg'UbX'@Ub[iU[Yg

@cWUhjcb. 'GW\cc`'C ZZWYž'A cfj Yb'6fck b'6i ]'X]b[ z'@Yj Y``&z'&),

CdYb]b[ < ci fg. A cbXUm! : f]XUmž - Ua ! (.() da

D\cbY.'Ž\*%'&'-',)'%\*,%

: UI . Ž \* % & - ' , ) ', +\$)

9a U]`. \<u>U`4 i bgk "YXi "Ui</u>

#### 5 h Yb X Ub WY F Yei ] f Ya Yb h g

5 'ghi XYbh']g'Yl dYWYX'hc'UhrYbX'U```WUgg'WebhUWi\ci fg'Zcf'U'ZUWY!hc!ZUWYfl &: Ł'cf'V`YbXYX'Wei fgY'UbX Wea d'YhY'U```UWNjj ]hjYg'Zcf'U'VYbXYX'cf'Z ``mcb`]bY'Wei fgY"

5 'ghi XYbhik \c'Uff]j Yg'a cfY'h\Ub'%) 'a ]bi hYg'`UhY'a UmVY'dYbU`]gYX'Zcf'bcb!UhhYbXUbVW'''-Zgi W\'U'dYbU`hm ]g']a dcgYXž'h\Y'ghi XYbha i ghVY']bZcfa YX'j YfVU``mUhh\Y'YbX'cZWUgg'UbX'UXj ]gYX']b'k f]h]b['k]h\]b'&( \ci fg"

ZU'gh XYbhYl dYf]YbW'g']`bYggža ]gUXj Ybh fY'cf'ch\Yf'cWW ffYbW'h\Uha U\_Yg'UVgYbW'Zfca 'U WUgg#JWNjj ]hmi bUj c]XUV`Yž'cf'Yl dYWg'hc'VY'UVgYbhZfca 'U'Zcfh\Wa ]b[ 'WUgg#JWNjj ]hmž'h\Ymg\ci `X'gYY\_ dYfa ]gg]cb'Zfca 'h\Y'7 ci fgY'5i h\cf]hmž'UbX'k \YfY'Udd`]WJV`Yž'h\Y]f'fYei Yghg\ci `X'VY'UVWca dUb]YX'VmUb cf][ ]bU`'cf'WYfh]ZYX'WcdmcZU'a YX]WJ`'WYfh]ZWJHY'cf'ch\Yf'Zcfa 'cZUddfcdf]UhY'Yj ]XYbWY"

5.7 ci fgY'5i h\cf]hma UmYl W gY'U'ghi XYbhiZfca 'WUggYg'cf'UWlj ]hJYg'Zcf'i d'hc'cbY'a cbh\"'< ck Yj Yfz'h\Ym a UmUgg][ b'UXX]hJcbU`'UbX#cf'U`hYfbUhJj Y'HUg\_g'hc'Ybgi fY'Wca d`]UbW\"'5'7 ci fgY'5i h\cf]hmWcbg]XYf]b[ 'h\Y [fUbh]b[ 'cZUVqYbW' a i gh'VY'qUhJgZ[YX'U'ghi XYbhk ]``'qh\"'VY'UV'Y'hc'a YYhh\Y'Wci fqY'g''YUfb]b[ 'ci hWca Yg

UbX#cfij cii a YicZiYUfb]b[ "i5 ighi XYbhigYY\_]b[ iUddfcj UihciVYiUVgYbhiZcfia cfYih\UbicbYia cbh\ia i ghiUddim ]bik f]h]b[ ihcih\Yi8YUbiUbXidfcj ]XYiUiicfiWfh]ZYXigi ddcfh]b[ iXcW a YbfUh]cb"

 $: cf'a\ cfY']bZcfa\ Uhjcb'UVci\ hih\Y'UhhYbXUbW'dfchcWc`g']b'h\Y': UW\ hmcZ5fhg'UbX'GcWJU`\\ GWJYbWYg. `\hdg. #k k k "Ufhg"i bgk "YXi "Ui #W ffYbHghi XYbhg#UWUXYa ]W]bZcfa Uhjcb#dfchcWc`g![i]XY`]bYg#UWUXYa ]W]bZcfa Uhjcb#dfchcWc`g![i]XY`]bYg#UWUXYa ]W]bZcfa Uhjcb#dfchcWc`g![i]XY`]bYg#UWUXYa]$ 

## 5 WUXYa ]W = b Zcfa Uhjcb

: cf`YggYbh]U``ghi XYbh`]bZcfa Uh]cb`fY`Uh]b[ `hc.`fYei Yghg`Zcf`YI hYbg]cb/fYj ]Yk `cZa Uf\_g/cWW dUh]cbU``\YU`h\UbX`gUZYhm'YI Ua ]bUh]cb`dfcWXi fYg/gdYW]U``Wcbg]XYfUh]cb`]b`h\Y`Yj YbhcZ]``bYgg`cf`a ]gUXj Ybhi fY/ghi XYbhYei ]hmUbX`X]gUV]`]hm'UbX`ch\Yf`YggYbh]U``UWUXYa ]W]bZcfa Uh]cbž gYY`\hdg.##k k k "Ufhg"i bgk "YXi "Ui #W ffYbhghi XYbhg#UWUXYa ]W]bZcfa Uh]cb#dfchcWc`g![i]XY`]bYg#

# 7ci fgY 8YW] g

7 fYX]hDc]bhg \*

## Gi a a UfmcZh\Y 7ci fgY

 $H\g"WcifgY'k] \label{eq:hybourded} H\g"wcifgY'k] \label{eq:hybourded}$ 

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

- %" XYa cbglfUhY'dfcZYgg]cbU``lfUbg`Uhjcb`Wca dYhYbVjYg`]b`UfYUg`fYei ]fYX`Vmih\Y`BUhjcbU` 5\W\fYX]hUhjcb'5i h\cf]lmiZcf`HfUbg`Uhcfg`UbX`\DhYfdfYhYfg`fB55H\ZDfcZYgg]cbU``HfUbg`Uhcf YI Ua ]bUhjcb
- &" WflhWU``mUbU`mqY`lfUbg`Uhlcbg`cZh\Y]f`ckb'UbX`dYYfg`VUgYX`cb'h\YcfmUbX`fYgYUfW\
- " a U\_Y ]bZcfa YX 'ffUbg`Uhcb 'Wkc]WYg 'h\UhUfY 'Uddfcdf]UhY ]b [ ]j Yb 'WcbhYl hg

### HYUWX]b[ GlfUhY[]Yg

$$\label{thm:converse} \begin{split} &\text{H}^{\text{T}}\text{fUhjcbUY}^{\text{T}}\text{VY}^{\text{D}}\text{X}^{\text{T}}\text{H}^{\text{T}}\text{UW}^{\text{D}}\text{b}^{\text{C}}\text{UW}^{\text{D}}\text{U}^{\text{D}}\text{C}}\text{UW}^{\text{D}}\text{J}^{\text{D}}\text{J}^{\text{D}}\text{C}}\text{J}^{\text{D}}\text{J}^{\text{D}}\text{L}^{\text{$$

# Gi Va ]gg]cb cZ5ggYgga YbhHUg\_g

 $Gh\ XYbhg\ UfY\ YI\ dYWMYX\ hc\ di\ hih\ Y]f\ bUa\ Yg\ UbX\ gh\ XYbhbi\ a\ VYfg\ cb\ Yj\ YfmdU[\ Y\ cZh\ Y]f\ Ugg][\ ba\ Ybhg\ bug\ Ybhg\ bug\ Yhhg\ Yhhg\ bug\ Yhhg\ Yhhg\ bug\ Yhhg\ bug\ Yhhg\ bug\ Yhhg\ bug\ Yhhg\ bug\ Yhhg\ Yhhg\ bug\ Yhhg\ Yhhg\ bug\ Yhhg\ Yhhg\$ 

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

⊋mci 'YbWci bhYf'U'dfcV'Ya 'k \Yb'UhhYa dhjb[ 'hc'gi Va ]hmci f'Ugg][ ba Ybhh\fci [ \ 'Hi fb]hjbž'd'YUgY hY'Yd\cbY'9| hYfbU''Gi ddcfhcb'-' , ) '' ' '%cf'Ya U]'hXYa 'cb'<u>Yl hYfbU'hY'hgi ddcfh4 i bgk "YXi "Ui</u> ł `G][ b]Z]\WbhmUZZY\Wimci f`dYfZcfa Ub\Wr`]b`UggYggUV`Y`k cf\_ž`VY`]h'U`Zcfa U``YbX!cZgYa YghYf`Yl Ua ]bUh]cbž`U \WUgg`hYghž`U``UVcfUhcfmhYghž`U`gYa ]bUf`dfYgYbhUh]cb`cf`Ubmch\Yf`Zcfa 'cZUggYgga Ybh'

#### 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]XYbhU`mWcdm]b[ 'Zfca `U`gci fWY'k ]h\ci hUW\_bck `YX[ Ya Ybh'

IBGK [fcidgdu[]uf]ga ]bhch\YZc``ck]b[ WuhY[cf]Yg.

7 cdm]b[.'i g]b['h\Y'gUa Y'cf'j Yfmg]a ]`Uf'k cfXg'hc'h\Y'cf][]bU`hYl h'cf']XYU'k ]h\ci h'UW\_bck `YX[]b['h\Y gci fW'cf'i g]b['ei chUh]cb'a Uf\_g"'H\]g'U`gc'Udd`]Yg'hc']a U[Ygž'Ufh'UbX'XYg][b'dfcYWhgž'Ug'k Y``'Ug dfYgYbhUh]cbg'k \YfY'gca YcbY'dfYgYbhg'Ubch\Yf'g']XYUg'cf'k cfXg'k ]h\ci h'WfYX]h'

±DUddfcdf]UhY`dUfUd\fUg]b[.'W\Ub[]b['U'ZYk'kcfXg'UbX'd\fUgYg'k\]`Y`acghmfYhJ]b]b['h\Y`cf][]bU`ghfi WhifY`UbX`]bZcfaUh]cb`k]h\ci hUW\_bck`YX[YaYbh'H\]g'U`gc'Udd`]Yg`]b'dfYgYbhUh]cbg'k\YfY`gcaYcbYdUfUd\fUgYg`Ubch\Yf'g`]XYUg`cf'kcfXg'k]h\ci hWfYX]h''±iU`gc'Udd`]Yg`hc'd]YW]b['hc[Yh\Yf'ei chYg'UbXdUfUd\fUgYg`]bhc'U'bYk'k\c`Yžk]h\ci hfYZ/fYbW]b['UbX'U'ghi XYbh'g`ck b'UbU`mg]g`hc'Vf]b['h\Y`aUhYf]U`hc[Yh\Yf''

7 c``i g]cb. 'k cf\_]b[ 'k ]h\ 'ch\Yfg'Vi h'dUgg]b[ 'cZZh\Y'k cf\_'Ug'U'dYfgcb'g']bX]j ]Xi U``k cf\_"'7 c``i g]cb'U`gc ]bWi XYg'dfcj ]X]b[ 'mci f'k cf\_'hc'Ubch\Yf'ghi XYbhVYZcfY'h\Y'Xi Y'XUhYžcf'Zcf'h\Y'di fdcgY'cZh\Ya d`U[ ]Uf]g]b[ 'Uh'Ubmh]a Yž'dUm]b[ 'Ubch\Yf'dYfgcb'hc'dYfZcfa 'Ub'UWUXYa ]WhUg\_ž'ghYU`]b[ 'cf'UWei ]f]b[ Ubch\Yf'dYfgcb'g'UWUXYa ]Wk cf\_'UbX'Wcdm]b[ ']hz'cZYf]b[ 'hc'Wca d`YhY'Ubch\Yf'dYfgcb'g'k cf\_'cf'gYY\_]b[ dUma YbhZcf'Wca d`Yh]b[ 'UWUXYa ]Wk cf\_"

±bUddfcdf]UhY`W]hUh]cb.`7]h]b[ˈgci fW/gˈk \]WX`\Uj Y`bchVYYb`fYUXžk]h\ci hUW\_bck`YX[]b[ˈh\Y`″gYWcbXUfm″gci fW/Zfca k \]WX`\_bck`YX[Y`cZh\Ya`\Ug'VYYb`cVhU]bYX"

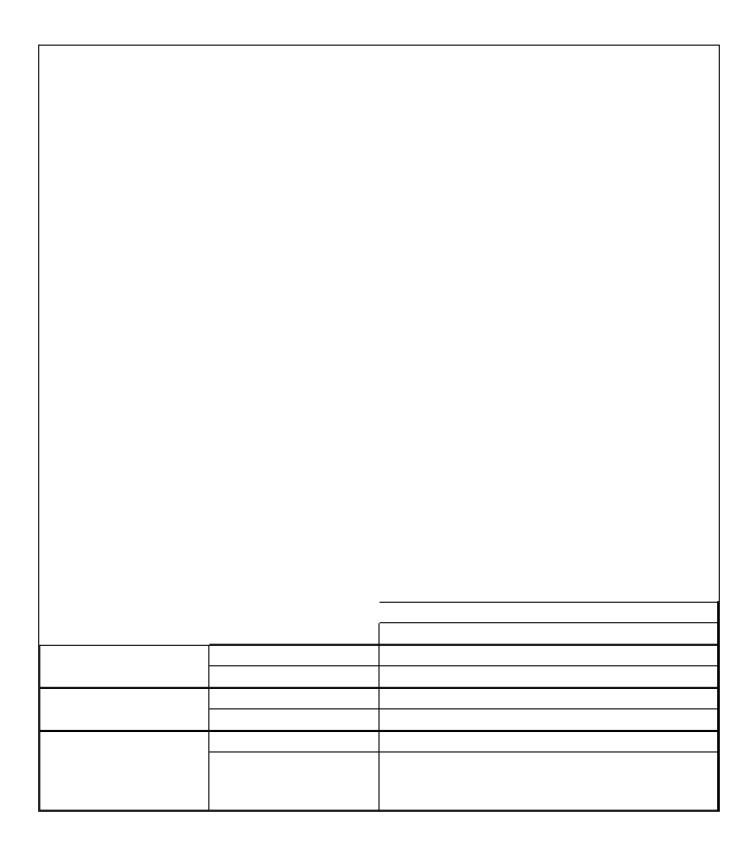
8 i d`]\WUh]cb`ff`gY`Zld`U[]\Uf]ga "Ł`gi Va]\h]b[`mci f`ck b`k cf\_ž]b`k \c`Y`cf`]b`dUfhžk\YfY`]h\Ug`dfYj]ci g`m VYYb`dfYdUfYX`cf`gi Va]\hYX`Zcf`Ubch\\$f`UqqYqqaYYbhcf\\&f`UhI BGK `cf`Ubch\Yf`]\m' '

7 cffy Wrify ZyfybWjb[ 'dfUWf)Wyg.

• DUfUd\fug]b[ ž'gi a a Uf]g]b[ ž'YggUmk f]r]b[ 'UbX'r]a Y'a UbU[ Ya Ybh

‰

• VYHYfa UbU[Ymcifh]a Y



# FYgci fW/g

### DfYgWf]VYX F Ygci fWYg

 $H\Y'a\ UhYf]U\g'Zcf'h\]g'Wci\ fgY']bWi\ XY'hfUbg`Uh]cb'dUggU[\ Yg'XYj\ Y`cdYX']b'9b[`]g\ `UbX'@C\ H9"'H\Ymk\]``VYdfcj\]XYX'cb'A\ ccX`Y"'\dagana'b'XYX']h\Cb'ZhYbW'hcc`g fYWca\ a\ YbXYX']b'h\Y]f'dfYj\ ]ci\ g'hfUbg`Uh]cb'ghi\ X]Ygž'Zcf'Yl\ Ua\ d'Yž']b'A\ C\ 8@) $$$zA\ C\ 8@) $$'\ z'A\ C\ 8@) $$(UbX'A\ C\ 8@) $$*"$ 

#### K YVg]hYg

\hd.#accX`Y"hY`h'i bgk "YXi

FYWca a YbXYX FYgci fWyg

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

 $H\ ]g']bZcfa\ Uh]cb'k\ ]```VY'dfcj\ ]XYX']b'h\Y'Z]fgh`YWh fY'UbX']b'ch\Yf'Wch fgY'a\ UhYf]U`g''$ 

a U[Y'7fYX]h

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

7F=7CG

7F = 7CG Dfcj ]XYf 7cXY. \$\$\$-,;