

# **ARTS2486**

H\Y: fYbW.GdYU\_]b[ K cfX

HYfa 'C bY''##'&\$&%

# 7ci fgY<sup>-</sup>Cj Yfj ]Yk

## GHJZ7cbHJWh8YHJ]`g

### 7cbj Ybcfg

B Ua Y	9a U]`	5j U]`UV]`]lm	@cWJhjcb	D\cbY
<i[iyg<sup>·D9H9FG</i[iyg<sup>	\"dYhYfg4 i bgk "YXi "Ui	*	A cfj Yb <sup>·</sup> 6fck b &+)	- \$*) - ++)

### GWXcc`7cbHJWhi±bZcfa Uh]cb

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

@c\\U||cb. G\\cc``C\\Z|\\\žA\cfj\Yb'6fck\b'6i]\X]b[\z'@\j\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>

## 7ci fgY 8YHJ] g

#### 7 fYX]hDc]bhg \* \*

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

♣ 'h\]g'Wci fgYzghi XYbhg'k]```\Uj Y'h\Y'cddcfhi b]hmhc 'X]gWcj Yf'h\Y'WYbhfU`]hmcZh\Y': fYbW\``Ub[i U[Y']b ZfUa]b[: fYbW\`]XYbh]hmz'UbX'hc YI d`cfY'h\Y'W ffYbhghUh g'cZh\Y': fYbW\``Ub[i U[Y']b'gcW]Yh]Yg'UbX ]bgh]hi h]cbg'Ufci bX'h\Y'k cfX"'H\]g'Wci fgY'k]``'dfcj ]XY'ghi XYbhg'k]h\`Ub'cj Yfj ]Yk 'cZh\Y'\]ghcfmcZh\Y : fYbW\``Ub[i U[Y'Z̄ca ']hg'cf][]b'hc'h\Y'WcbhYa dcfUfmdYf]cX'ffYZ̄cfhg'hc'WcX]Zmh\Y'`Ub[i U[Y'k]``'fYWY]j Y dUfh]W `Uf'UhYbh]cbtZ'UbX'k]h\`Ub'cj Yfj ]Yk 'cZh\Y'UWi U'`X]j Yfg]hmcZ: fYbW\']b': fUbW'`UbX'UbX'UbX'\Land YfyW']j Y dUfh]W`\Uf'UhYbh]cbtZ'UbX'k]h\`Ub'cj Yfj ]Yk 'cZh\Y'UWi U'`X]j Yfg]hmcZ: fYbW\']b''C WYUb'fY[]cbg'fcZ]W]U' dc`]W]Yg'hc'UggYfhh\Y'ghUh g'cZ: fYbW\']b'h\Y'k cfX'k]``fYWY]j Y'dUfh]W`\Uf'UhYbh]cbt''5 j Uf]YhmcZk f]hhYb UbX'Ui X]c!j ]qi U'`a UhYf]U'g'k]'``YY'i gYX'hc']``i ghfUhY'h\Y'`YWi fYg''

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

%" 8 YgWf]VY h\Y a U]b ghU[ Yg cZh\Y \]ghcf]WU`Yj c`i h]cb cZ: fYbWX
&" &" F YWc[ b]nY h\Y j Uf]ci g Zcfa g cZ: fYbWX h\Uh'UfY W ffYbhmgdc\_Yb j]b h\Y k cfX
' " ' " I gY 'U'gYhcZWcbWhdhggdYWJZ]Whc h\Y X]gWJd`]bY gi W\ 'Ug 'GhUbXUfX': fYbWX ž'WfYc Y 'UbX X][ `cgg]U
( " ( " 8 ]gW gg 'UbX fYZYWhcb \ck h\Y Yj c`i h]cb 'UbX h\Y 'W ffYbhghUh g cZ: fYbWX ``Ub[ i U[ Y fY`UhYg hc gcW]cdc`]h]WJ``]ggi Yg
) " ) " 7 ca dUfY h\YgY'd\Ybca YbU'k ]h\ 'h\Y g]hi UhJcb cZmci f'ck b ``Ub[ i U[ Y

## HYUWX]b[ GhfUhY[]Yg

H\Y`Wci fgY`]g`XYg][ bYX`fc`ZUW]]hUfY`f\Y`XYj Y`cda YbficZU`gW\c`Uf`mUbX`Wf]hJWU``i bXYfgfUbX]b[ `cZf\Y Yj c`i f]cbžYl dUbg]cb`UbX`W ffYbfigfUfi g`cZ: fYbW\`]b`f\Y`k cf`X"`H\Y`WcbfYbfi]g`f]W\`]b`]bZcfa Uf]cb`UVci h f\Y``Ub[ i U[ Y`UbX`]h'UXXfYggYg`WcbfYa dcfUfmgcW]YhU``]ggi Yg`cZfY`Yj UbW'`Zcf`: fYbW\`gfi XYbfg`]b dfcZYgg]cbU``UbX`X]gW[d`]bUfmZ]Y`Xg"

\*JWI g]j Y 'HYUW\]b[ 'gHfUHY[ ]Ygž'Ui X]c!j ]gi U``gi ddcfh'UbX'dYYf'Wc``UVcfUHjcb'U]a 'Uh'Yb[ U[ ]b[ 'ghi XYbhg`]b 'YUfb]b[ 'h\YgY'WcbhYbhg":5 'fUb[ Y cZUggYgga Ybh'HUg\_g'UfY'gYhhc'gi ddcfh'h\Y'UW\]Yj Ya YbhcZ\_Ym\_bck 'YX[ Y 'fWUgg'HYgHc'UbX'h\Y'XYj Y`cda YbhcZWf]hJWU``H\]b\_]b[ 'UbX'fYZYWf]cb'g\_]`g'ffci fbU'ž'h hcf]U` 'YUXYfg\]dž'fYgYUfW\'dfc YWH": YYXVUW\_']g'fY[ i 'Ufmdfcj ]XYX']b'h\Y'h hcf]U`g'UbX'Wca d`Ya Ybhg gi a a Uhjj Y'UggYgga Ybh'H\YfY'UfY'bc'Zcfa U``YI Ua ]bUhjcbg"

H\Y'HYUW\]b[''UddfcUW\'']bjcjYg'WUgg'X]gW gg]cbg'Ug'kY``'Ug'ga U``'[fci d'X]gW gg]cbg'Xi f]b['h\Y'`\YMi fYg"'H\]g']g'UW\]YjYX'Vma YUbg'cZU'j Uf]YmcZfUg\_g'a cghcZk\]W\'fYei ]fY qhi XYbhg'hc'dfYdUfY']b'UXj UbW\"

 $H\Y'Wci fgY']g'HJi [\h]b'9b[`]g\UbX'h\Y'fYUX]b[g'UfY']b'9b[`]g\Ug']h]g'cbY'cZh\Y'WcbhYI hi U``gh X]Yg Wci fgYg']b'h\Y'a U'cf']b': fYbW\Gh X]Yg''$ 

# 5ggYgga Ybh

# 5ggYgga Ybh HUg\_g

5ggYgga Ybh'hUg_	K Y][\h	8i Y'8UHY	Gh XYbh@YUfb]b[ Ci hWca Ygʻ5ggYggYX
HYgh	&\$ı	\$%#\$'#&\$&%'fK_YY'' Ł	% <u></u> "'
C fu`X]gW gg]cb	&\$I	8 ]gW gg]cb Xi f]b[ 'hi hcf]U`g. k YY_g'&'hc') ž'7 f]h]WU` fYZYWf]cb Xi Y Vm) 'da 'cb'h\Y XUmcZh\Y'hi hcf]U`X]gW gg]cb	
; fci d'dfYgYbfUf]cb'	&\$I	F YWcfXYX dfYgYbfUf]cb Xi Y Vm) da cb fNY XUmVYZcfY NY h hcf]U`" 8 ]gW gg]cb cZ dfYgYbfUf]cb Xi f]b[ 'h hcf]U`g. k YY_g + hc '%\$"	&ž (
: ]bU``YggUm	(\$1	\$' #\$) #&\$&%'\$) .\$\$'DA	(ž')

## 5ggYgga Ybh'8YHJ]`g

5ggYgga Ybh'% 'HYgh

#### 8YHJ]`g.

C bY ']b! WUgg 'ei ]n 'Wej Yf]b[ 'th Y 'Webth' bhic Zth Y 'Wei fgY 'k ]``'tU\_Y 'd 'UW' 'Xi f]b[ 'th Y '`YWfi fYgž WU'' () 'a ]bi th'g" : YYXVUW\_j JU']b! WUgg 'X]gW gg]cb 'UbX 'WeffYWficb'c Zth'gth'

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

 $\label{thm:condition} $$HY'HYghk_]^VY'XcbY'cb^]bY'j_U'A_ccXY'Xi_f]b['hXY'Z]fgh\ci_f'cZhXY'bcfa_U^@97HI_F_9'\ci_fg'cb'k_YY_'' "$$Hi_fb]h]b'gYh]b[.'$ 

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

H\Y`Ufh]WYg`k]```VY`Uj U]`UV`Y`j ]U`A ccX`Y"`H\Y`[fci d]b[g`k]```VY`Wcbgh]hi hYX`Xi f]b[`k YY\_`%"

 $\label{eq:higher} \mbox{Hi fb]h]b'gYh]b[.'H\]g'gg][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''$ 

5ggYgga Ybh' .; fci d'dfYgYbhJh]cb

@Yb[h\.; fciddfygYbhUh]cb.) a ]bi hYgdYfghi XYbh

#### 8YHJ]`g.

Ghi XYbhgʻk]``YUW\`Wcbhf]Vi hYʻhcʻUʻ%) ʻa ]bʻ[ fci dʻdfYgYbhUh]cbʻcbʻUʻhcd]WfY`Yj Ubhihcʻh\YʻWci fgYžgi [ [ YghYX Vmh\Y`Wcbj Ybcf''

 $: YYXVUW\underline{\quad 'j \ ]}U^{\cdot }]b!WUgg^{\cdot }X]gW^{\cdot }gg]cb\check{z}^{\cdot }fi\ Vf]Wg^{\cdot }UbX^{\cdot }]bX]j\ ]Xi\ U^{\cdot }k\ f]WYb^{\cdot }W^{\cdot }a\ a\ Yb^{\prime }g^{\cdot }cb^{\cdot }U^{\cdot }a\ Uf\underline{\quad }g\backslash YYh^{\prime }b)$ 

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

H\Y`[fcid`cfU``dfYgYbhJh]cb`k]```VY`giVa]hhYX`j]U`Jc]WYH\fYUX`]b`h\Y`Zcfa`cZU`bUffUhYX`DckYfDc]bhXcWaYbhgiVa]hhYX`]b`U`j]XYc`ZcfaUh`h\Y`fYWcfX]b[`f]b`ad(`cf`Yei]jU`Ybhz`hc`VY`giVa]hhYX`Vm)da`h\YXVmVYZcfY`h\Y`h`hcf]U``XUmf]"Y"ž'cb`KYXbYgXUmz/kY`k]```\UjY`U`X]gW`gg]cb`UVcihh\Y`dfYgYbhJh]cbXif]b[`h\Y`h`hcf]U``cb`h\Y`Zc``ck]b[`XUm'

5XX]h]cbU``mžgi Va ]gg]cb'cZh\Y'[ fci d'Dck YfDc]bhXcW a Ybh]b'dXZZcfa Uhicb'A cXX`Y'Vmi) da 'cZh\Y h hcf]U``XUmf]"Y"žcb'H\i fgXUmŁ"'

DG. '5`HYfbUhjj Y`mž'h\Y`[fci d'WUb`XYWJXY`hc`Xc'h\Y`dfYgYbHUhjcb`gmbW\fcb]WU``mj]U'6`UW\_VcUfX`7c``UVcfUhY I`hfU`Xifjb['h\Y'hihcf]U``f]bghYUX`cZgi Va]hhjb['h\Y`XcWiaYbhj]U'Jc]WY'H\fYUX\!"

Gi Va ]gg]cb bch/g. Gi Va ]gg]cb cZDck YfDc]bhXcW a Ybhj ]U A ccX`Y

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

5ggYgga Ybh( . : ]bU`YggUm

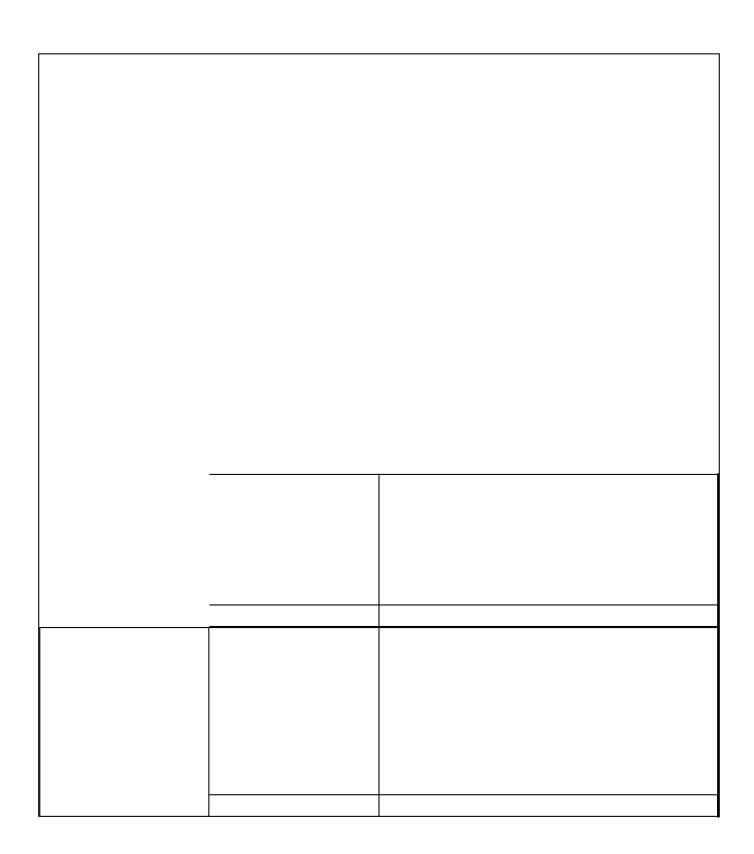
**@Yb[h**. &ž\$\$\$ k cfXg

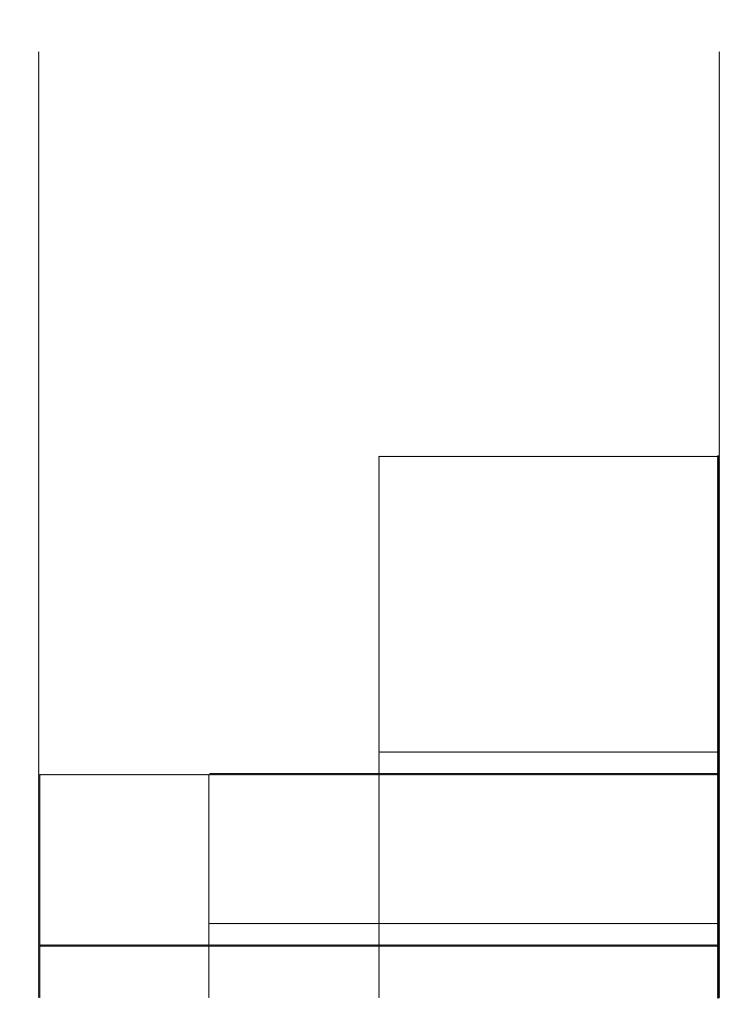
8YHJ]`g.

 $: ]bU``YggUmcZWU"`\&ž\$\$\$`k cfXgž'k ]h\``Uddfcdf]UhY``fYZYfYbW]b[ ~z`gi ~Va ~]hhYX`cb``Hi ~fb]h]b"$ 

: YYXVUW\_j ]UFiVf]Wg^UbX^kf]hhYb^Wcaa Ybhg^cb^Hifb]hjb"

Hi fb]h]b'gYh]b[.'H\]g'Ugg][ ba Ybh]g'gi Va ]h\YX'h\fci [\'Hi fb]h]b'UbX'gh XYbhg'Xc'bchgYY'Hi fb]h]b g]a ]'Uf]hmfYdcfhg"





	'8₲`Y∕S[e

# FYgci fWyg

#### DfYgWf]VYX F Ygci fWYg

• 5```a UhYf]U`g`hc`VY`a UXY`Uj U]`UV`Y`cb`A ccX`Y

#### FYWca a YbXYX FYgci fW/g

- F Ygci fWg hc VY a UXY Uj Uj UV Y cb A ccXY
- < YfY`]g`U`gi [[YghYX`hYI hVcc\_`fbcb!Wca di `gcfmŁmci `WUb`cfXYf`Uhih\Y`Vcc\_ghcfY`]b`df]bhicf Y`YWfcb]WZcfa Uh

FcXbYm6U``'UbX'8Ukb'AUfYm''&\$%+`fgYWcbX'YX]r]cbŁ"'H\Y': fYbW\'GdYU\_]b['KcfX"'5'dfUWf]WU`]bfcXi Wfcb'hc'gcWjc]b[i]gh]W]ggi Yg"'Fci hYX[Y"

Df]bh

\htdg.#k k k "Vcc\_g\cd"i bgk "YXi "Ui #XYhU]`g"W[]3+H9A BC1-+, %%,,\$%+()

8][]W.

\htdg.## bgk Vcc\_g\cd"j ]hU`gci f\\"\"\ca #dfcXi \\\"\"\-+, \% \%+\* &(, --

.

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

# 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]''h\Ya 'cb'Y! hy'fbu'hy'hgi 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'Y! 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 Ybhgt'hc
]bWi XY'Ug'Yj ]XYbW' hc'gi ddcfhmci f'Y! 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 VYfž'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 bXYfgHJbX'mci f'f][\hg'UbX'fYgdcbg]V]`]h]Yg'Ug'U'gh XYbh'Uhil BGK

# 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/
- UbX'ch\Yf'YggYbhJU`'UWUXYa ]W]bZcfa UhJcbž'gYY