

7 ci fgY Cj Yfj]Yk

GHJZZ:7cbHJWhi8YHJ]`g

7cbj Ybcfg

BUa Y	9a U]`	5j U]`UV]`] h m	@cWUh]cb	D\cbY
>UbY'A ck``	<u>^a ck ``4 i bgk "YXi "Ui</u>	VmUddc]bha Ybh	A 6%) *	Ž*%(%%&, * +

@YWhi fYfg

BUa Y	9a U]`	5j U]`UV]`] h m	@cWUh]cb	D\cbY
?Yff]Y`>Ua Yg	Yff]Y"'1/2a Yg4 i bgk "YXi "Ui	6m5ddc]bha Ybh	A 6 '% (

Hi hcfg

BUa Y	9a U]`	5j U]`UV]`]lm	@cWUh]cb	D\cbY
>Ygg]Y`7\i b[Ygg]Y"Wi b[4 i bgk "YXi "Ui	6m5ddc]bha Ybh	A cfj Yb 6fck b	

GWXcc``7cbHJWhʻ±bZcfa Uh]cb

GWXcc``cZGcWJU``GWJYbWYg

Fcca '%) -

A cfj Yb 6fck b 7 &\$

Ya U]`. 'gcgg4 i bgk "YXi "Ui

d\cbY. '\$&'-',) '% \$+

5W_bck `YX[Ya YbhcZ7ci bhfm

I BGK '5fhgž'8Yg][b'UbX'5fW]hYWhifY'?Ybg]b[hcb'UbX'DUXX]b[hcb'WUadigYg'UfY'Vi]hhcb'5Vcf][]bU`

7ci fgY 8YHJ] g

I b]hg~cZ7fYX]h~%~

Gi a a UfmcZh\Y'7ci fgY

H\]g']g'h\Y'Z]bU`fWdgrcbYŁ'Wci fgY`cZh\Y'A 7 GK 'dfc[fUa 'UbX'Vf]b[g'rc[Yh\Yf'h\Y'YUfb]b[']b'h\Y'dfYj]ci g Wci fgYg'rc Wf]h]WJ`mYb[U[Y'mci 'k]h\'h\Y'Wca d'Yl]h]Yg'cZWcbhYa dcfUfmgcW]U`k cf_'Wci bgY``]b["'=b'h\Y Wci fgYz'mci 'k]``\Uj Y'h\Y'cddcfhi b]mhc']XYbh]ZmUbX'Wf]h]WJ`mfYZYWicb'UfUb[Y'cZh\YcfmUbX'dfUW]WW [XYUg'h\Uh]bZcfa 'Wca d'Yl 'dfUW]WW']ggi Yg'"H\YgY']bWi XY']ggi Yg'gi W. 'Ug'h\YfUdYi h]WJa dUggY'UbX X]Z]W 'h]Yg']b'h\Y'h\YfUdYi h]WfY`Uh]cbg\]dz'Wfcgg!W 'hi fU`'WcbhYl hg'cZWci bgY``]b[z'k cf_]b['k]h\'hW'h\YfU]b]b['hc X]j Yfg]mh'H\Y Wci fgY']bhY[fUhYg'YUbX]Jggi Yg'dYfhU]b]b['hc Wci bgY``]b[z'UbX']ggi Yg'dYfhU]b]b['hc X]j Yfg]mh'H\Y Wci fgY']bhY[fUhYg'YUfb]b['Zfca 'h\Y'dfc[fUa 'hc YbUV'Y'mci 'hc Zfh\Yf'XYj Y'cd'UbX'Wcbgc']XUhY'Wci bgY``]b[a Yh\cXg'UbX'dfUW]WY'UbU`mg]g'hc Yl d'cfY'UbX'Udd`mg_]`g']b'Wca d'Yl 'W]Ybh]ggi Yg'UbX dfYgYbhUh]cbg"'H\fci [\'U'ZcW g'cb'WJgY'X]gW gg]cb'UbX'UbU`mg]gz'[fci bXYX'X]fYWhm]b'mci f'ck b'gcW]U`k cf_'Wci bgY``]b['dfUW]WY'zh\Y'wci fgY'U`gc'dfcj]XYg'Ub'cddcfhi b]mhc']bhY[fUhY'h\Y'h\Y'h\YcfYh]WJ`'UbX dfUW]WY'_bck 'YX[Y'[U]bYX'Zfca 'ch\Yf'Wci fgYg'UbX'hc'Udd`mh\Ya']b'ddfh]W`'Uf'k cf_'UbX'WJgY'WcbhYl hg"

7ci fgY @YUfb]b[Ci hWca Yg

%" +bHYfdfYhU`fUb[Y`cZh\YcfmUbX`dfUWf]WYg`h\Uh]bZcfa `Wca d`Yl `Wci bgY``]b[`]ggi Yg
&" 5dd`mh\Ycf]Yg`UbX`ZfUa Yk cf_g`rc `Wca d`Yl `W]Ybhg]hi Uh]cbg`UbX`h\Y`Wci bgY``cf`W]YbhfY`Uh]cbg\]d
' "I bXYfghUbX`Wci bgY``]b[`ZfUa Yk cf_g`k \]W\`]bZcfa `]bHY[fUhYX`gcW]U``k cf_`Wci bgY``]b[`dfUWf]WYg"
(" 7 f]h]WU``mfYZYWhcb`UbX`Yj U`i UhY`]bHYfdYfgcbU``fYgdcbgYg`rc 'W\U``Yb[]b[`]ggi Yg`Zfca `Wci bgY``]b[
 dfUWf]WY"

) " ''9a d`cmWc\YfYbhUbX'gi WWbWhWUgY'dfYgYbhUhcb'g_]``q

HYUW]b[GhfUhY[]Yg

H\Y'HYUW\]b['gHUHY']Yg'gYYWHYX']b'h\]g'WtifgY'U]a 'hc'Yb[U[Y'mci'k]h\ WtifgY'a UHYf]U`'UbX'hc'Ugg]ghimci hc']bHY[fUHY'bYk'_bck'YX[Y'UbX'g_]`g']bhc'mci f'W]b]WU`'dfUWI)WY'''''Mci'k]``Z fh\Yf'XYj Y`cd'mci f'g_]`g']b WtibgY``]b['a Yh\cXg'UbX'dfUWI)WY'VmXcW a Ybh]b['UbX'UbU'm]b['mci f'ck b'WUgYg'k]h\ U'dUff]W\ UffZcW g cb'W\U`Yb[Yg']b'h\Y'WtibgY`cf!W]YbhfY`Uh]cbg\]dz'UbX'dfYgYbh]b['mci f'ck b'k cf_']b'ga U``'[fci dg'Zcf W]b]WU`'Wtbgi `HUbh`YX'UbX'dYYf'[fci d'X]gW gg]cb'''Mci f'h\YcfYh]WU`'UbX'Udd`]YX'`YUfb]b['k]`N'Y'ZJW]`]HUHYX h\fci [\'dfYgYbHX''WtifgY'WtbhYbhUbX'X]gW gg]cb'cZWtbHYbhUbX'fYUX]b[g']b'gYa]bUfg'k]h\ h\Y'k\c'Y [fci d''H\]g'YUfb]b[']g'Z fh\Yf'UW\]yYX'h\fci [\'Wf]h]W'''UbU'mg]g'cZWti bgY``]b['dfUW]WY'Ug'XYa cbgHfUHYX]b. 'YI WYfdhg'f]]XYc#cb`]bYE'cZWti bgY``]b['gYgg]cbg/WUgY'UbU'mgYg'UbX'X]gW gg]cb'cZWtygY'j][bYHYg/UbX YI YfW]gYg'UbX'fc'Y!d'UmdfUWI)WY']b'h\Y'gYa]bUf''H\Y'UggYgga YbhfY[]a Y'dfcj]XYg'Ub'cddcfhi b]hmhc XYj Y`cd'U'gi VgHUbh]U''d]YWY'cZk cf_'h\UhfYZYWg'mci f'ck b'dfUWI)WY']bhYfYghgž'UbX'Wti 'X'Zcfa 'h\Y'VUg]g'Zcf U'Z h'fY'ci fbU''Uff]WY'cf'dfUWI)WY'd]YW'''

5ggYgga Ybh' . 7ci bgY``]b['DfUWh]WY 9ggUm

5ggYgga Ybh`Yb[h\.') \$\$\$ Ž# '%\$i 'flYl Wi X]b['fYZYfYbW'`]ghzZ][i fYgz'hUV`YgŁ Gi Va]gg]cb'bchYg. 'H\]g 5ggYgga Ybh'Vi]`Xg'cb'5ggYgga Ybh'% 8i Y'XUhY. '&&#%#&\$&&'%') - 'DA

Gh XYbhg k]``gi Va]hUfYgYUfW YggUmfa Ul "') \$\$\$ k cfXgŁcb Uhcd]WfY`Yj Ubhhc h Y Wci fgY a UhYf]U`"

H\Y`UggYgga Ybhi]g`XYg][bYX`hc`U`ck 'ghi XYbhg`ZYI]V]`]mi]b`W\ccg]b['UbX`Wcbghfi Wf]b['h\Y]f`ck b`hcd]W ei Ygh]cbž'UbX`]h`Vi]`Xg`]bhc`h\Y`gYWcbX`UggYgga YbhiHJg_"'H\Y`UggYgga YbhiHJg_'U`ck g`ghi XYbhg`hc XYa cbghfUhY`h\Y]f`WJdU\Jmhc`]XYbhjZm`UbX`Wf]hJWJ``mfYZYWicb`Wca d`YI 'dfUWfJWY`]ggi Yg`UbX`hc`UfhJW``UhY`U fUb[Y`cZh\YcfmUbX`dfUWfJWY`]XYUg`fY`Yj Ubhihc`h\Y]f`W\cgYb`dfUWfJWY`]ggi Y"'H\Y`k cfX`Wci bhidfcj]XYg cddcfhi b]hmZcf`ghi XYbhg`k \c`gc`k]g\`hc``UhYf`XYj Y`cd`h\Y]f`d]YWY`Zcf`gi Va]gg]cb`hc`U'dYYf`fYj]Yk YX`cf dfUWfJWY`ci fbU`"

Ghi XYbhgʻk]```fYWY]j Y`k f]hhYbʻZYYXVUW_`UbX`U`bi a Yf]WU``[fUXY`k]h\]b`hYb`k cf_]b[`XUmg`cZgi Va]gg]cb"`H\Y ZYYXVUW_`g\YYh#fi Vf]Wk]```VY`Uj U]`UV`Y`hc`ghi XYbhg`Uhih\Y`ghUfhcZh\Y`Wci fgY`gc`h\Uhih\YmWUb`k cf_ hck UfXg`gdYW]ZJYX`ghUbXUfXg"

.

H\]g`Ugg][ba Ybh]g`gi Va]h\YX`h\fci [\`Hi fb]h]b`UbX`gh XYbhg`Wb`gYY`Hi fb]h]b`g]a]`Uf]hmfYdcfhg"

5XX]h]cbU`XYhU]`g

GYY'A ccX`Y'

5 hryb XUb WY F Yei] f Ya Yb hg

5g'U'‰'I b]hg'cZ7fYX]hWci fgYž'GC7:) %%'7ca d'YI 'DfUWfJWY'≡ggi Yg''fYei]fYg'a cfY'h\Ub'%) \$'\ci fg'cZghi Xm''H\]g'ghi Xm']bWi XYg.

! (\$`\ci fg`cZWUgg`h]a Y`Wca df]g]b[`]bhYbg]j YgžWcbgi`h[fci dgžUbX`Ncca `gYa]bUfg

!', '\ci fg''Ghfi Whi fYX''YUfb]b[''UWhji]hjYg'fY"["'Zcfi a gžk UhWk]b[#]ghYb]b['hc'j]XYcgk

! FYUX]b[zdYfgcbU~gh XmzUbXdfYdUfUh]cb~cZUgg][ba Ybhg~

Mci 'UfY'fYgdcbg]V'Y'Zcf'_YYd]b['HfUW_cZmci f'UHY'bXUbW'UbX'WcbHUWf]b['>UbY'A ck ```fWcbj Ybcflz]a a YX]UHY'm]Zmci 'UfY'WcbWYfbYX'UVci hmci f'UHY'bXUbW'fYWcfX'UbX']ng']a dUWicb'mci f'UV]']hmhc'Wca d'YhY mci f'Wci fgY'gi WWYggZ ``m'

Zmci `\Uj Y`Ubm`WcbWffbg`UVci h`UHYbX]b[`]b`dYfgcb`Uh]bHYbg]j Yg`mci `g\ci `X`WcbHUWfih\Y`Wci fgY
Wcbj Ybcf`8 f`>UbY`A ck ```<u>^a ck ``4 i bgk "YXi "Ui</u> ``hc`X]gW gg`mci f`WcbWffbg`Ug`gccb`Ug`dcgg]V`Y`df]cf`hc
h\Y`fY`Yj Ubhi]]bHYbg]j Y`UbX`]ZbYWWggUfmž'a UmUdd`m]b`k f]h]b[`hc`UHYbX`cb`]bY"'₹fYa chY`UHYbXUbW'Zcf
]bHYbg]j Yg`]g`Uddfcj YX`U`Ncca ``]b_'k]```VY`dfcj]XYX`hc`mci "'Mci `a i ghbchg\UfY`h\Y`Ncca ``]b_'k]h\`ch\Yf
ghi XYbhg"

.

7ci fgY GWX YXi `Y

J JYk 'WUqq'Ha YHUV'Y

H]a YHJV`Y`

8UhY	Hmd Y	7 cbhYbh
C 'k YY') 'GYdhYa VYf'! - 'GYdhYa VYf	Hcd]W	7 ca d`YhY`fYUX]b[g`Zcf`k YY_`%gYY`A ccX`Y`
K YY_'%'%&'GYdhYa VYf !'%*'GYdhYa VYf	±ohYbg]jY	GYY'A ccX'Y'Zcf'Wci fgY'XYHJ]`g'
K YY_'&.'%-'GYdhYa VYf !'&' 'GYdhYa VYf	F YUX]b[

Hi hcf]U`

		GYY'A ccX`Y'Zcf'Wti fgY'XYHJ]`g'
	5ggYgga Ybh	9ggUm'd`Ub
K YY_').'%\$'CWcVYf'! %('CWcVYf	Hi hcf]U`	Ga U`

FYgci fWyg

DfYgWf]VYX F Ygci fWYg

 $HYfY'UfY'bc'gYhhYlhVcc_g'Zcf'h\lambda]g'WcifgY''5fYUX]b[``]gh]g'dfcj]XYX'k]h\'UWWgg'h\fci[\'h\Y'accX'Y'g]hY$

DfYgWf]VYX'F Ygci fWfg'7 ca di hYf'#hYW\b]WU''F Yei]fYa Ybhg

5g'dUfficZh\]g'Wci fgY']g'cb`]bY'fNcca 'gYa]bUfgŁ']h]g'bYWrggUfmhc'Ybgi fY'mci '\Uj Y'h\Y'Uddfcdf]UhY Wca di hYf'UbX'hYW\b]WU'Yei]da Ybhhc'UXYei UhY`mdUfh]W]dUhY"'5VWYgg'hc'cb`]bY'gYa]bUfg']g'j]U'h\Y A ccX'Y'dU[Y'Zcf'h\]q'Wci fqY"'

: cfici fiC bi]bY GYa]bUfgimci ik]`ifYei]fY. 5 \\YUXgYhk]h\iUa]\Mcd\cbY 5 \WUa YfU \UbXij]U \A M BGK 5 \\VfcUXVUbX \]bhYfbYh\Wcbf\&) *? V]\#qYWcfiZJqhYfL

FYWca a YbXYX FYgci fWYg

B#5

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

H\]g`WcifgY`\Ug`VYYb`]bZcfaYX`VmZYYXVUW_`fYWY]jYX`Zfca`dfYj]cig`ghiXYbhg`UbX`Zfca`mci`Xif]b[`h\YWcifgY`cZmcif`A7GK`ghiXm'`

: YYXVUW_Zfca dUgh[fci dg \Uj Y.

! *\Dazcfa YX ``YWhi fY 'hcd]Wg

! G\UdYX h\Y W ffYbhUggYgga YbhHJg_q

.

Gi Va]gg]cb cZ5ggYgga YbhHUg_g

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

.

⊋mci 'YbWci bhYf'U'dfcV`Ya 'k \Yb'UhhYa dh]b['hc'gi Va]hmci f'Ugg][ba Ybh'h\fci [\ 'Hi fb]h]bž'd`YUgY hY`Yd\cbY'9| hYfbU``Gi ddcfhcb'-',)'''' %cf'Ya U]`'h\Ya 'cb'Yl hYfbU`hY`hgi ddcfh4 i bgk "YXi "Ui

.

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 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'U\V_bck 'YX[]b[

5 WUXYa]W + DZcfa Uh]cb

8 i Y 'hc 'Yj c'j]b['UXj]WY 'VmB GK '< YU'th\žighi XYbhg'a i gh'W\YW_'Zcf'i dXUhYX']bZcfa Uh]cb 'fY[UfX]b['cb`]bY 'YUfb]b['Zcf'U``'5fhgž'8 Yg][b 'UbX'5fW\]hYWi fY 'Wci fgYg'th\]g'thYfa 'fJ]U'A ccX`Y'cf'Wci fgY']bZcfa Uh]cb dfcj]XYXŁ"

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 $\label{eq:def-weight-def-weight$

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