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! "#$%&'()*+",-(."+"*%(
/ 01234)567""
  8930134/(
                                                                   5 (."6 7"89!:"
  #$%&"'&(&$")%*+$,-*&."
                                                /01"*%"23,-*%4"
  ; 0$") %*+$,-*&."<="><,?(%"
                                                5 '@"*%"23,-*%4"
                                                                   >3%$"A9 7"899B"
  160/98930134/(
                                                C'@"*%"%3,-*%4"
                                                                   D$E,3(,."86 7"899F"
  ; 0$"3%*+$,-*&."<="><,?(%"
3::5)64; /64<7(
 3230/;)2((
 G%?*(%(")%*+$,-*&.HD<,&" I (.%$
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!"

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Z/U"'3*@*?$"K,$+$%&*<%"
                                                                        89!["
 R/U""
                                                                         !!\89![HK,$-$%&"
:95@/<<)563>(59836)C34)56(;/;B/9<.):<7((
 5*?Q\$-\&"23,-*\%4"U\$-\$(,@0"'<@*\$\&."M52U'N]"(E-\&,(@\&")
                                                           ^@&<E$,789!B"
 ,$+*$Q$,"
 JT$,*@(%"'<@*$&."<="RL*%*@(L"^%@<L<4."MJ'R^N7"J'R^7"
                                                           89!B"
 2 (&*<%(L_"
                                                           5 (.@O"!87"89!B"H"/.$-$%&"
 5*?Q\$-\&"23,-*%4"U\$-\$(,@0"'<@*\$\&."M52U'N]"R`R"
                                                           :\![\"89!["
 @<TT*&&$$"T$TE$,"
 ';;GHJLKO("@O(K&$,"
                                                           >3L."89!6HK,$-$%&"
 2(\&*<\%(L"W\$(43\$"=<,"23,-*\%4"M2W2N")
                                                           89!FHK,$-$%&"
 \%@<L<4."23,-*%4"'<@*$&."M^2'N"
                                                           89!FHK,$-$%&"
:95@/<<)563>(.5659<(360(3D390<7)(
  ! "KL(@$",$-$(,@O"K<-&$,""
                                                    a^{*}23''(\&W(,4\$'')
                                                                        89!["
                                                    ,\$-\$(,@0"-0<Q@(-\$"
 G)DI"-K$(b$,"-$,*$-"(Q(,?"
                                                   G)DI"
                                                                        ^@&<E$,\89!B"
                                                    '*4T(";0$&(";(3"
  'G;;G"c(@b(&0<%"A,?"KL(@$"(Q(,?"
                                                                        !!\89!B"
                                                   G%&$,%(&*<%(LH
                                                    I J 5 CG"
:95@/<<)563>(0/E/>5:;/647(("
                                                                          0"$&(
 2FG'*&HDF'I*%FJ(4,$-&(
                                      : 'FK,L&'(
  /,<@&<,*%4"J;G"&$-&""
                                                                          8989"
                                      J ; G"
  2 X\& S \% 2 RW a 4\%, (\& < \%
                                                                          898!"
                                      J ; G"
                                                                          [\8989"
 "1*+$,-*&."'&,(&$4*@"/L(%%*%4"G%=<"
                                      G) ' ^ 2 " 1 *+*-*<%"<=" 1 *+$,-*&.7"
  ' $--*<%"
                                      `d3*&."V"G%@L3-*<%"
  ^%@<L<4."%3,-*%4"-<@*$&."@<%4,$--" ^ 2 ' "-<@*$&."
                                                                          89!B"
```

8"

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`X@$LL$%@$"*%",$-$(,@O"1<--*$,"
                                    G)/)G"
                                                                       89!6"
 K,$K(,(\&*<\%"/V;"Q<,b-0<K"
                                    /3,?3\")\%*+\$,-*\&.\"D<,\&\" I (.\%\$\"
                                                                       89!6"
  '3*@*?$"K,$+$%&*<%"
                                    89!6"
  ; O$"(LL*(%@$"&$(@O*%4"-O<O@(-$"
 /3,?3$") %*+$,-*&."D<,&" I (.%$"
                                                                       89!["
 GTK_{,<+}*\%4"-\&3?\%\&"K\$_{,=<,T}(\%@\$"E."
 (??,$--*%4"-&3?$%&"(%?"&$(@0$,"
  T^*-@<\%@$K\&^*<\%"(E<3\&"L$(,\%*\%4"")
                                    89!["
  5 (b*%4" '&3?$%&-" 5 <,$" \ ==$@&*+$"
 W$(,\%$,-"E."RO(LL$\%4\%4\%0\$\*,"
  5 *-0 < \%0 K\&* < \%-"JE < 3\&"W$(, \%*\%4"
 MR`N"
                                    G/DI"
                                                                       89!6"
 /$$,",$+*$Q"$+(L3(&*<%"Q<,b-0<K_"
                                    G)/)G"
                                                                       89!["
 R < \% @ K \& "E(-\$?" \& \$ (@ 0*\%4")
                                    89!6"
  J?+*-*%4"(%?"T$%&<,*%4"G/DI"
 -&3?$%&-"
                                    G%?*(%("
                                                ) %*+$,-*&."
                                                              /3,?3$" 89!["
  ;$(@0*%4"4,(?3(&$"L$+$L""
                                    ) %*+$,-*&."MG/D I N"
                                    G)/)G"
                                                                       ! 89 89!["
  ; 0$"c < \% <, "-< @*$&." <= "23, -* \%4"
  '*4T(";0$&(";(3"G%&$,%(&*<%(L"
                                                                       ^@&<E$,"A9&07"89!["
 @<3\%@$L<,"\&,(*\%*\%4")
4/32.)687((
 160/98930134/(
 2FG'*&(M(
              <%F'$(4,$-&(
                                       @F'+''$(
                                                      9F-&(
```

A"

UA[:"	23,-*%4" ,\$-\$(,@0" (%?" `+*?\$%@\$?HE(-\$?" K,(@&*@\$"	^%"@(TK3-"	*%-&,3@&<,"	'898!"	F:"
C8F9"	D3%?(T\$%&(L-" <=" %3,-*%4H@L*%*@(L"	RL*%*@(L" K,(@&*@\$" (%?" -b*LL-"L(E"	*%-&,3@&<,"	'K,*%4" 89!B"	!9"
C8F9"	D3%?(T\$%&(L-"<="%3,-*%4"	^%"@(TK3-"	"G%-&,3@&<,"	'K,*%4" 89!B"	Y:"
C8F9"	D3%?(T\$%&(L-"<="%3,-*%4"	^%"@(TK3-"	"G%-&,3@&<,"	D89!B"	Y:"
UA[:"	23,-*%4" ,\$-\$(,@0" (%?" +*?\$%@\$?HE(-\$?" K,(@&*@\$"	c .E,*?"	W\$(?"*%-&,3@&<,"	'K,*%4" 89!B"	A:"
C8F9"	D3%?(T\$%&(L-" <=" %3,-*%4H@L*%*@(L"	RL*%*@(L" K,(@&*@\$" (%?" -b*LL-"L(E"	*%-&,3@&<,"	'K,*%4" 89!B"	В"
C8F9"	D3%?(T\$%&(L00 5 047 1 674	`			

```
C(,,<\%"5(@b*\$"(Q(,?"
                             G)/)GH'^2"
                                                           / G"
                                                                                                 A\89!B"
                                                                       Н"
                                                                                   :999"
/DI"'3TT\$,"U\$-\$(,@0"S,(%\&"G/DI"M^==*@\$"<="/G"
                                                                       Н"
                                                                                   6999"
                                                                                                  !!\"89!F"
 \label{eq:hammass} \begin{split} & \text{H"}; 0\$"/,\$+(L\$\%@\$"(\%?"\ ==\$@\&"<=" \ -K<\%-<,\$?" \end{split} 
/(*%7"D(&*43$7"(%?"1$K,$--*<%" K,<4,(TN"
M/D1N"@L3-\&\$,"<\%"K\$,=<,T(\%@\$"
L$+$L" <= "I < T$\%" Q*\&0" C,$(-\&")
R(%@$,"
(6E)4/0(:9/</6434)56<(
```

```
'&3?$%&" U$-$(,@0" (%?" R,$(&*+$" T$TE$,"
                                                                       89! [HK,$-$%&"
  `%?$(+<,"/<-&$,"'.TK<-*3T"
 G) ' ^ 2" 1*+$,-*&." (%?" ` d3*&." 2<T*%(&$?"T$TE$,"
                                                                      !!\89!BHK,$-$%&"
  @<3%@*L"
 G)DI" 1*+\$,-*\&.7" `d3*\&.7" V" R0(*,")
                                                                       'K,*%4"8989HD898!"
  G%@L3-*<%"@<3%@*L"
  89![H!6" /<,&(L" &<" &0$" /3EL*@" G%+*&$?"T$TE$,"(%?",$K,$-$%&(&*+$" 2<+$TE$,"89!["
 D(@3L\&."(\%?"S,(?"'\&3?$\%\&"D$LL<Q-"
: 95@/<<)563>(</9E)2/7(
  >523>(
  5 '0"N,U"$,FN(
                                    3P$,K,$0(
                                                                       )NP-G*,K&(0"$&*(
  JT$,*@(%"R(%@$,"-<@*$&.""
                                    +<L3%&$$,"
                                                                       5 (,@O"89!BHK,$-$%&"
  9/8)563>(
  5 '0"N,U"$,FN(
                                    3 P$,K,$Q(
```

["

```
4/32.)68(
."+"*%?(!V)V7"R0<7">_"G_7"^&(%*7"#_7"1$%47"g_7"V"#L*%4$,7"`_"M8989N_"'&3?$%&"`+(L3(&*<%"<="
23, *%4" '*T3L(&*<%"W(E"W$(,%*%4" `XK$,*$%@$_"G,*-">"<="23,"V"R(,_"AM8N]"8989_"
6>2R_5 '_61_999::B_"1 ^6]"!9_AA::8\6>2R_8989_9A_999::B_"
```

;\$(@0*%4]"G?\$%&*=.*%4"D(@&<,-"<=";\$(@0*%4"&0(&"J==\$@&")%*+\$,-*&."'&3?\$%&-e" $^{+}\$, (LL"U(\&*\%4" <= "G\%-\&, 3@\&<, -"(\%?"R < 3, -\$-"*\%" 5 (\&0\$T(\&*@-H,\$L(\&\$?"R < 3, -\$-i"*\%"G\%\&\$, \%(\&*<\%(L"))))))))$ ><3,%(L"=<,"&0\$" '@0<L(,-0*K"<=";\$(@0*%4"(%?"W\$(,%*%4_">3L."B&07"89!6_"

 $\text{`$3?$\%\&"$} + (\text{L3}(\&^*<\%^-<=";\$(@0^*\%4"\%"("23,-*\%4"/,<4,(T_";\$(@0^*\%4"J\%?"W\$(,\%^*\%4"G\%"23,-*\%47"M8N7")))))))))$?<*]!9_!9!F\f_&\$L%_89!6_9!_998"

9/</392.129/34)E/(324)E)4A(9 &S&' &&L(

 $."+"*\%?(!V()_?"JLHU(Q(-0?0

6"

"

!9"