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!''#$#%&'()'*+,(-.$#(%,'/$'$0+'1%#$+'''2/$#(%,!
!
!''#$%&'(#)%''*
"#$!
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L'!&(!&, '$5$('&, 3!'.!, .'$!'#)'!'#5.03#.0'!'#$!8.5*%2!*$3)*!'$E'(!)5$!.7'$,!$%&'$%!
7.**.8\&3!.$3.'\&)'\&..!).\%!.='\&...!N.5!$E)1=*$2!'#$5$!8)(!).!)5'&/*$!&.!
                  )5'&/*$J;!
!
7#$'(#'$3*%2*$3.%4'#)%''.*
             L7!)!%5)7'!5$(.*0'&.,!&(!(091&''$%!&,!1.5$!'#),!.,$!*),30)3$!:$5(&.,2!$)/#!:$5(&.,!
 1$),'!'.!9$!$B0)**6!)0'#$,'\&/2!'#$,!'#$!*),30)3$!\&(!\&,\%\/)'$\!\&,!'#$!1)('#$)\!)(2!7.5!
$E) 1 = \$2!PC5\&3\&, \$0!I, 3*\&(\#!), \%!N5\$, /\#R;!
                - .!.5&3&,)*!*),30)3$!&(!&,%&/)'$%!&,''#$!1)('#$)%!.7!)%.='$%!5$(.*0'&.,($!)**!*),30)3$(!
)5$!'.!9$!/.,(&%$5$%!$B0)**6!)0'#$,'&/;!
          H$(.*0'\&.,(!)5$!$((\$,'\&)**6!.,\$!*.,3!(\$,'\$,/\$:!"#$5$!)5$!,.51)**6!'#5$$!$*$1$,'(!&,!)!
5$(.*0'\(\dagger, 0\)! \(\dagger, 0\) 1 $!.7!'\(\dagger, 0\) 2!'\(\dagger, 0\) 1 9*$!), \(\dagger, 0\)! \(\dagger, 0\)! \(\dagger, 0\) \(\dagger, 0\)! \(\dagge
                                                                                                   !)5$!,..'!,019$5$%;!"#$6!($5:$!'.!=5$($,'!'#$!9)/435.0,%!
                      '.!'#$!)/'\(\dagger, !=)5'!.7!'#$!5\(.*0'\(\dagger, \dagger, !T5\)\)190*)5!=)5)35)=#(!
                      &,!'#$!7.51!.7!)!=5$($,'2!=)('!.5!=$57$/'!=)5'&/&=*$!.5!),!)%U$/'&:$!&,!&')*&/(;!IE)1=*$(!
                       .7!'#$!'6=$(!.7!:$59(!),%!)%U$/'&:$(!0($%!&,!=5$) 190*)5!=)5)35)=#(!)5$!=5.:&\$\%!&,!
                       '#$!),,$E;!
                                                                                            !)5$!,019$5$%;!"#$6!$E=5$((!'#$!.=\(\ell.\),(!.7!A\(\section\)19$5!D')'\(\section\)
                      ),%!/.,')&,!'#$!)/'&.,!'#)'!'#$6!)5$!)35$$&,3!'.!')4$;!C=$5)'&:$!=)5)35)=#(!
                                       |8\&'\#!\rangle, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, |1/\&|, 
                       K#$,!'#$!.=$.&,3!:$59!.7!)!=)5)35)=#!&(!5$=$)'$%!&,!'#$!7.**.8&,3!=)5)35)=#2!'#$!
                                                    &(!O($%;|L7!'#$!:$59!&(!5$=$)'$%!)!($/.,%!'&1$!&,!(O//$((&.,2!'#$!8.5%!
                                               &(!O($%;!<*(.!),%!705'#$5!)5$!=*)/$%!)7'$5!'#$!:$59!&,!'#$!=5$)19*$!),%!
                      9$7.5$!'#$!:$59!\(\&\),!'#$!.=$5)'\(\&\):$!=)5';!
!
            D09=)5)35)=#(!)5$!*$''$5$%!F)J2!F9J2!F/J;!I)/#!(09=)5)35)=#!9$3&,(!&&'#!)!/)=&')*!*$''$5;!
 <**! .7!'#$!(09=)5)35)=#(!&.!)!=)5)35)=#!10('!#):$!)!(&1 &*)5!(6,')/'&/)*!('50/'05$;!"#$!</p>
7.**. 8 \& 3!$E) 1 = \$!75.1!5\$(.*0'\&.,!VVGWVX!(#.8(!=5.=\$5!(09=)5)35) = \#(0!)
                      V:!!
                                                                 )**!D')'$(0!
                                 F)J ".!')4$!$77$/'\&:$!1$)(05$(!'.!$,(05$Y!
                                 F9J ".!7.('$5!5$*&3&.0(!75$$%.1!),%!=*05)*&(1 Y!
                                 F/J ".!$, \( \. 05)3$!'#$!5$=5$($, ')'\( \), \( \)! \( \), \( \), \( \), \( \), \( \), \( \), \( \) 370*!=)5'\( \)/\( \)=)'\( \), \( \). \( \)!
                                 F%J ".!1)4$!)!('5.,3!$77.5'!'. Y!
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<, .'#\$5!3..%!\$E) 1=\*\$2!75. 1!5\$(.\*0'\&.,!VV\6Z\[0!\]

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- F)J K\$\*/. 1\$(!'#\$!\&,\&'\&)'\&:\$(!.7!'#\$!@. 1 1\&((\&., Y!))'
- F9J IE=5\$((\$( $\frac{1}{6}$ '(!)==5\$/\&)'\&.,!'.!'#\$!@.11\&((\&.,Y!
- F/J ")4\$(!,.'\$!8&'#!&,'\$5\$('!.7!'#\$!/.1=5\$#\$,(&:\$!)==5.)/#Y!
- F%J IE=5\$((\$(!\lambda'(!)==5\$/\lambda)'\lambda.,!'.!'#\$!?.:\$5, 1\$,'(Y!

## 891 / 043.\*%2\*( ,1'':3.\* / 1&3\*#%\*&\$12#\*\$3.%4'#)%''.\*&'\$)'':\*# ,3\*3&)#)'':\*0\$%(3..\*

"&'\*\$(!),%!7)/'(!F(O/#!)(!%)'\$(J!)5\$!/#\$/4\$%!),%!/.55\$/'\$%!)(!,\$\$%\$%\$!35) 1 1)5!),%!
(6,')E!/.55\$/'\$%\$!7...',..'\$(!/.55\$/'\$%2!)%%\$%!.5!%\$\*\$'\$%!8#\$5\$!,\$/\$(()56\$!),%!1&,.5!
)%UO('1\$,'(!'.!('6\*\$!1)%\$!'.!95&,3!'#\$!'\$E'!&,'..!\*&,\$!8&'#!+,&'\$%!-)'&.,(!\$%&'.5&)\*!('),%)5%(!),%!=5)/'&/\$!),%!'.!5\$,%\$5!'#\$!'\$E'!'5),(\*)')9\*\$;!"#\$!7.\*\*.8&,3!&(!)!\*&('!.7!/.11.,!/.55\$/'&.,(0!

- !8&\*\*!9\$!/#\$/4\$%!),%!/.55\$/'\$%!&7!
  ,\$/\$(()56;!"#\$!70\*\*!'&'\*\$!8&\*\*!9\$!0(\$%!)'!7&5('!1\$,'&.,!&,!9.'#!'#\$!=5\$)19\*\$!),%!'#\$!
  .=\$5)'&:\$!=)5';!"#\$5\$)7'\$5!)!(#.5'\$,\$%!:\$5(&.,!.7!'#\$!'&'\*\$!1)6!9\$!0(\$%;!"#\$!
  7.\*\*.8&,3!&(!),!\$E)1=\*\$!75.1!5\$(.\*0'&.,!VXGW][0!
  - ^;! '#\$!=5.35\$((!1)%\$!'#0(!7)5!&,!'#\$!=5\$=)5)'&.,(!7.5!'#\$!"#&5'\$\$,'#! +,&'\$%!-)'&.,(!@.,35\$((!.,!@5&1\$!T5\$:\$,'&.,!),%!@5&1&,)\*!\_0('&/\$\$!
  - `;! !'#)'!'#\$!%05)'&.,!.7!'#\$!"#&5'\$\$,'#!@.,35\$((!(#.0\*%!,.'!\$E/\$\$%!\$\3#'!%)6(\$!
- !)5\$!,.'!0(\$%!&,!5\$(.\*0'&.,(!),%!8&\*\*!9\$!(=\$\*\*\$%!.0'!&,!70\*\*!'#\$!7&5('!'&1\$!'#\$6!.//05!&,!9.'#!'#\$!=5\$)19\*\$!),%!'#\$!.=\$5)'&:\$!=)5';!"#\$5\$)7'\$5!)!(#.5'\$,\$%!:\$5(&.,!.7!'#\$!'&'\*\$!1)6!9\$!0(\$%;!
- !F.7! 1 \$\$'\&,3(2!)\%.='\&.,!.7!5\\$(.\\*O'\&.,(2!/.,:\\$,'\&.,(2!\%\\*)5)'\&.,(2!\\$'/;J! 8 \&\\*\*!9\\$! /#\\$/4\\$\!),\%!/.55\\$/'\\$\!\\!\\$/\\$(()56;!
- !L,!+,&'\$%!-)'&.,(!%./O1\$,'(!),%!5\$(.\*O'&.,(2!'#\$!(#.5'!7.51!.7!'#\$!,))1\$(!.7!/.0,'5&\$(!&(!O(\$%;!N.5!)!\*&('!.7!'#\$!.77&/&)\*!(#.5'!,))1\$(!.7!/.0,'5&\$(2!(\$\$!0,'\$51;0,;.53;!
- !-) 1 \$(!.7!/\dark\dark\dark\dark\dark)5\$!7.\*\*. 8 \$\%!96!'\#\$!/.0,'56!,) 1 \$2!0,\*\$((!'\#\$!/\dark')6! \dark(!'\#\$!/)=\dark')\*;!
- !K\$!)5\$!\$E=\$5'(!&,!=0,/'0)'&.,!&((0\$(!),%!8&\*\*!)==\*6!+,&'\$%!-)'&.,(! ('6\*\$!&,!'#&(!5\$3)5%;!L72!&,!),!0,0(0)\*!/)(\$2!)!=0,/'0)'&.,!1)54!9\$/.1\$(!)!1)''\$5!.7!
  =.\*&'&/)\*!(\$,(&'&:&'6!%05&,3!,\$3.'&)'&.,(2!8\$!,\$\$%!'.!9\$!&,7.51\$%!'.!\$,(05\$!'#)'!&'!&(!...'!1.%\%\%\%'!7.5!35)11)'&/)\*!5\$)(.,(:!

- '\$51&,.\*.362!8#\dark/#!(#.0\*\dark!9\$!7\*)33\$\dark!\dark.!\#\$!.5\dark3\dark,)\*!(091&((\dark.,\S!\\\dark(!)==\dark\\dark(!'.!)\dark! .77 & / &) \*!\*),30)3\$(;!
- !<!5\$(.\*0'&.,!.5!5\$=.5'!%.\$(!,.'!%\$/&%\$65\$/.11\$,%6\*)0,/#6! /.,:\$,\$6\$E'\$,%!)!1),%)'\$2!\$'/;\$!&'!&(!'#\$!)0'#.5!.5!9.%6!)%.='&,3!'#\$!5\$(.\*0'&.,!.5!  $5\$=.5'!8\#.!')4\$(!'\#\$!)/\&.;!K\$!8\&^{**}!/.55\$/'!=\$5(.,\&7\&/)\&.,laIE)1=^*\$0!P?\$,\$5)^*!$ <((\$19\*6!5\$(.\*0'&.,!VbGW[!5\$BO\$('\$%!'#\$!D\$/5\$')56c?\$,\$5)\*!'.!5\$=.5'YR!8&\*\*!9\$! /#),3\$%!'.!5\$)%!P"#\$!?\$,\$5)\*!<((\$19\*62!\lambda,\lambda'(!5\$(.\*0'\lambda.,\lVbGW[2!5\$BO\$('\$%!'#\$! D\$/5\$')56c?\$,\$5)\*!'.!5\$=.5'YRd!
- !L,!3\$,\$5)\*2!P')4\$(!,.'\$R!&(!O(\$%!8#\$,!'#\$!.9U\$/'!&(!)!5\$=.5'2! (') '\$ 1\$, '!.5!%\$/&(&.,;!P - .'\$(R!&(!O(\$%!&,!'#\$!(\$,(\$!.7!P.9(\$5:\$(R;!
- !K\$!8&\*\*!  $/., (0^{*}!8 \%'#!'#\$!)0'#.5!'.!/.1\$!0=!8 \%'#!)!1.5\$!)==5.=5 \%'\$!:\$592!(0/#!)(!P5\$/)**(R!)$ .5!P5\$)77&51 (R;!

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8&)#%$)14*,340&3.;*1''&*%#,3$*$3.%'$(3.**
          "#$!(')77!.7!'#$!I,3*&(#!"5),(*)'&.,!),%!I%&'.5&)*!D$5:&/$!)5$!):)&*)9*$!'.!.77$5!
          (((('), /\$!), \%!)\%: ((-\$/\$;!) > \$*\$3) ' ((!) 5 \$!\$, /.05) 3 \%!' . !/., ') / '! ((((1/4.5)!) \%!) , !
          $%&'.5\(\delta\)\*!.5!\*),30)3\(\delta\)\$('\delta\.,!.,!)!\%5)7'!5\(\delta\)\$(.\(d\).,0!
          I" IDN5.,'>$(4 g 0, ...53!)
         C'#$5!5$(.05/$(0!
     • +, \& \%! -) \& \, ( ! \ 1 \% \& \ .5 \&) * ! \ A), 0) * ! \ C, <math>\& \, \& \ 8 \ 8 \ ; 0, \ldots 536 \% 3) / 1 \ 6 \$, 6 / \ldots, $ \ $, $ \ ( \$ \% \& \ .5 \&) * \ c
          (1),0)*J!
     • + - "IHA!F0,'$51;0,;.53J!
     • C77\(\ell/\ell\)*!>./01$,'!D6('$1!F.\(\(\(\)\)(;0,;.53J!!
    !
     "#), 4!6.0!7.5!6.05!=)5'k/k=)'\(\ell., \lk, \!'\#\$!(\$(\(\ell., \; \!T^*\$)(\$!3\$'!\ell, \!'.0/\#!)'!
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## <""39\*

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i): \&, 3!/., (\&\%\$5\$\%2! i): \&, 3!\#\$)5\%2! i): \&, 3!5\$/\$\&: \$\%!
A\&, \%70*!
-.'^{k}, 3^{2}! -.'^{k}, 3^{1}8^{k}!'! /... /^{5}, 2^{1}! -.'^{k}, 3^{1}8^{k}!! ) == 5^{k}/^{k})^{k}, 2^{1}! -.'^{k}, 3^{1}8^{k}!! ()^{k}(7)^{k}... !!
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H$)*kek, 3!
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H$/.3, kek, 3!
D'5$((&, 3!
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")4&,3!,.'$2!")4&,3!,.'$!8&'#!)==5$/&)'&.,2!")4&,3!,.'$!8&'#!/.,/$5,!
"#),4\&,3!
+, \%$5*\&, \&, 32!+, \%$5(/.5\&, 3!'#$!7)/'!'#)'!
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