! "#\$%&'()%*%"+,-./%)0)1%

!"#\$%"\$#&'(

)*'"#\$%"+#,! "#\$%#&!'(#)*+#! ,--*./0!123,!454! 2&#*60!!&#\$%#&78(#)*+#9.:6:\$#;:7/;<!!! ,--*./!=:<\$8>0!":?;#%80!A04B!C&!D!E0BB!C&0!123,!454! ()*'+,-./--'012-*345'64))12-7'-)/+13)-'648'219/1-)'4'*31:)*:*31'611),3;'<,)=')=1',3-)2/.)*2

- & .%/0*1(2''0'".*"'0!

'<&/;(!':&#?!	<u>'<&/;(7':&#?9.:6:\$#;:7/;<</u>!</th></tr><tr><td>,*./!(:<\$80! !</td><td>F</8;#%8!#?;!F(<\$8;#%8!A0BB!C&!D!40BB!C&@!123,!4BA!</td></tr><tr><td>"#G*?/!'H:/?/8.<!
,*./!(:<\$80!!</td><td><math display="block">\frac{" \#G^{?}/78\text{H}: /?/8. < 9.:6:\\$\#;:7/;<}{F(<\\$8;\#\%8!504B!C\&!D!I0BB!C\&!\#H!H(/!'H<;\%!=\#66!)}</math></td></tr><tr><td>'#&</6!=#⊞:?!</td><td><u>'#&</67(#HH:?9.:6:\$#;:7/;<</u>!</td></tr><tr><td>!,*./!(:<\$80!!</td><td>F</8;#%8!504B!C&!D!I0BB!C&!#H!H(/!'H<;%!=#66!</td></tr></tbody></table></u>
---------------	---

J/#.(!K(#C(<C(<#?L!<u>J#?<C:?L7K(#C(<C(<#?L9.:6:\$#;:7/;<</u>! ,--*./!(:<\$80! F</8;#%8!504B!C&!D!I0BB!C&!#I!!I(/!'H<;%!=#66!

9++**5**(4+#(+440%&(/+\$#'0!

- : &%"\$#&',(":?;#%0!S/;?/8;#%0!BQ045!1 "!D!MB0A5!1 "0!123, !MAB!
- ;7.''(<&='0"&0! K1UV1'0!(HHC80NN.#?W#87.:6:\$#;:7/;<N10!1'2U4IMA!
- ;7.''(&>5.07(70'"0! F(\$:<L(!K#?W#8!:?6%!
- &?"'0! X/. H<\$/!?: H/8!#\$/!C:8H/;!:?!K#?W#8!

3*70*&(**8**0'%\$''0+*(4+#\$**5**,(!7.%@A(

U:H/0!166!H/.(?*.#6!&<8H!+/!#8)/;!;<\$*?L!:--*./!(:<\$8!:\$!C:8H/;!:?!C<+6*.!.(#??/68!*?!'6#.)!-*\$8H7!F(/! *?8H\$<.H:\$!#?;!H(/!F1NFT8!Y*66!?:H!\$/C6%!H:!H(/8/!Z</8H*:?8!:W/\$!/&#*6!:\$!C\$*W#H/!&/88#L/8!:?!'6#.)!#?;! K#?W#87!'H<;/?H8!#\$/!'"#+*17B(&*%+\$#.1&8(H:!#?8Y/\$!/#.(!:H(/\$[8!Z</8H*:?87!F(*8!*8!#!L\$/#H!Y#%!H:!Y:\$)! H:L/H(/\$!H:!8:6W/!C\$:+6/&80!#?;!?:H!(#W/!H:!Y#*H!-:\$!#?!*?8H\$<.H:\$!:\$!F1NFT!\$/8C:?8/7!!

'6#.)!L\$:<C0!!

- C#&#&D\$0'0"&'0!
 1 ' 2U!ABBM\ABB4\ABBE!#?;!1 J J " !A4]B0!Y*H(!L\$#;/8!:-!K!:\$!+/HI/\$!*?!/#.(^!*-!H(/!

 .:<\$8/!Y#8!H#)/?!'C\$*?L!ABAB0!Y*H(!L\$#;/8!:-!K\!_J`a!:\$!+/HI/\$!*?!/#.(!</td>
- $; + \#' \& (3 = E\&\%''0F\&'0!! F(/! \&\#^?! :+P/.H^*W/! :-! H(/!.:<\$/! &:! *?H^*::<./! \&::/\$?! &::/\$?! &::/\$?! &::/\$?! &::/\$?! &::/\$?! &::/\$?! &::/\$?! &::/\$! &::/\$?! &::/\$! &::/\%! &:/\%! &::/\%! &:/\%! &:/\%! &:/\%! &:/\%! &::/\%! &:/\%! &:/\%! &:/\%! &:/\%! &:/\%$
- G.E+#(;+\$#'&(-+60%'(.*8(!%/&8\$7&0!6T160TK59!76003.4-cm0Tm20001200-2001206.20012hf96T160TK60.d(03.4-cm0T S//)!

 $\underline{\mathbf{I} + 5 \& < +\#@0! = : \&/Y:\$)!\#88*L?\&/?H8!\#$/!L*W/?!\&:8H!Y//)8!:?!S/;?/8;\#\%!\#?;!\#$/!;</!\#!Y//)!6\#H$!#8! \\ 8C/.*-*/;!*?!H(/!#88*L?&/?H7!U:!(:&/Y:\$)!#88*L?&/?H8!#$/!;</!*?!H(/!Y//)!:-!&*;H/$&!/G#&87! \\ 188*L?&/?H8!L/?/$#66\%!.:W/$!4!H:!5!C$:+6/&8!#?;!#$/!;/8*L?/;H8!(/(C:8H<;/H8!+/.:&/!C$:-*.*/?H!*?!#! \\ 8<+P/.H7!f/-:$/!;:*?L!#?\%!(:&/Y:$))!8H<;/?H8!8(:<6;!$/#;!H(/!C:8H/;!6/.H<$/8!#?;!H$%!H:!-:66:Y!Y:$)/;\!:<H!/G#&C6/87!F(*8!8(:<6;!L*W/!H(/!8H<;/?H!#?!*;/#!:-!H(/!C$*?.*C6/8!*?W:6W/;!#?;!H(/!8:6<H*:?!&/H(::77!$

$$\begin{split} & S \$^{HII}/?! Y: \$) ! 8(:<6;!+/!?/^{HI}!#?;! $/#; #+6/! Y*H(!#;/Z<^{HI}/!8C#./!#?;! & #$L*?87! "/88%! Y: $)! Y*66!+/!6/-H! \\ & <?L\$#;/;!#?;!#!0/$: & .: $/!$/.: $;/;7! F(/!& #*?!#?;!/88/?H*#6!8H/C8!:-!H(/!8:6<H*:?!#CC$: #.(!?//;!H:!+/! 8(:Y?^!-#*6*?L!H:!;:!8:!Y*66!$/8<6H!?/!$!8.: $/7! F(/!-*?#6!$/8<6H!?//;8!H:!+/!*?;*.#H/;!+%!#?!#$$:Y0! \\ & <?;/$6*?/!: $!+:G7! "<6H*C6/!#?8Y/$8! Y(/?!:?/!*8!$/Z<*$/;!Y*66!+/!.:<?H/;!#8!*?.: $$/.H7! K:C%*?L!& #H/$*#6! \\ & -$: & H?\%!$8:< $./!*?.6<;*?L!8:6<H*:?8!& #?<#680!Y/+8*H/80!#?;!1 d\8%8H/& 8a!#?; !8<+& *HH*?L!*H!#8!:?/[8!:Y?! \\ & #$/!.:?8*;/$/;!C6#L*#$*8&!#?;!#$/!#?!=:?:$!K:;/!W*:6#H*:?7!'/#$.(*?L!-:$!(/6C!*?!#!8:6<H*:?\$/C:8*H:$%! Y/+8*H/80!#?;!2.5%.$$

<u>**;**+56\$"&#(J'&</u>0!'/W/\$#6!#88*L?&/?H8!&#%!\$/Z<*\$/!:\$!+/?/-*H!-\$:&!.:&C<H/\$!#../88!#?;!+#8*.! C\$:L\$#&&*?L!8)*668!*?!6#?L<#L/8!8<.(!#8!" 1FX1f!#?;!2G./67!'H<;/?H8!Y*66!(#W/!#../88!H:!H(/!JdX,F! #?;!.:\JdX,F!.:&C<H/\$!H:!;:!.:&C<H/\$!Y:\$)%!:?./!H(/%!(#W/!.:&C6/H/;!H(/!JdX,F!:\$*/?H#H*:?7!

K#.80*1(K\$08&70*&'0!

! d?\.6#88!\$/W*/Y!Z<*0! ?:H!.#66/;!#?!/G#&7a! d?\.6#88!Z<*00/8! K#?W#8!Z<*00/8!! =:&/Y:\$)! ! A!&*;H/\$&!/G#&8! T*?#6!2G#&! ! MAh!_F(/!6:Y/\$!C/\$./?H#L/!*8!H(/!:?6%!\$/#8:?!H(*8!*8!

] h !] h ! MB h ! 4] h !_MR h !/#. (a! <u>4B h</u> ! MBB h !

 $\begin{array}{l} d_{H}(/!6:Y/8H!\&^{*};H/\&\&!8.:$/!_{#}?;!:?6\%!H(/!6:Y/8H!\&^{*};H/\&\&!8.:$/a!#?;!H(/!d?\.6#88!3/W^{*}|'i<*0!#$/!6:Y/$ \\ H(#?!H(/!8.:$/!:-!H(/!-*?#6!/G#\&0!H(#H!\&^{*};H/\&!L$#;/!*8!;$:CC/;0!#?;!H(/!Y/*L(H^{*}?L!:-!H(/!-*?#6!*8!*?.$/#8/; +%!MR h 0!#?;!MA h !$/8C/.H^{*}W6\%7 \\ \end{array}$

L+"&',(

• d?\.6#88! Z<*00/8! L#<L/! H(/! 8H<;/?H[8! 6/W/6! :-! C\$/C#\$#H*:?! -:\$! 6/.H<\$/! #?;! H(/! .:?./CH<#6

2#.(!(:&/Y:\$)!#88*L?&/?H!*?.6<;/8!#!8/H!:-!8/W/\$#6!C\$:+6/&87!F(/!#88*L?&/?H!*8!C#\$H*#66%!L\$#;/;
 :&C6/H/?/88!_A5CH8a0!Y(*6/!:?/!\$#?;:&6%!8/6/.H/;!C\$:+6/&!*8!L\$#;/;!*?!;/H#*6!-:\$!H/.(?*.#6
 :?H/?H!#?;!C\$/8/?H#H*:?!_A5CH8a7!F(<80!H(/!-*?#6!8.:\$/!-:\$!/#.(!(:&/Y:\$)!8/H!*8!:<H!:-!#!H:H#6!:-5BCH8!#?;!.:&C<H/;!+#8/;!<C:?!H(/!?<&/\$*.!+\$/#);:Y?!+/6:Y0

$HW \frac{Score}{50} - 30 pts Rand. Problem + 20 pts \times \frac{\# of Remaining Problems Completed}{\# of Remaining Problems in Set}$

 $::6 < \mathbb{H}^{*}: ?8! -: $! #66! (: & /Y:$)! C$:+6/& 8! Y*66! +/! C: 8\mathbb{H}/;!:?! K1UV1'!#-\mathbb{H}^{!} \mathbb{H}(/!;</!; \#\mathbb{H}/7! F(/! (: & /Y:$)!#88*L?&/?\mathbb{H}8!Y*\mathbb{H}(\mathbb{H}(/\mathbb{H}Y:\mathbb{G}:Y/8\mathbb{H}8.:$/8!Y*66!+/!;$:CC/;7!=:&/Y:$)!?//;8\mathbb{H}:\mathbb{H}/\mathbb{H}^{!} \mathbb{H}^{!}; (: & /Y:$)!?//;8\mathbb{H}:\mathbb{H}/\mathbb{H}^{!} \mathbb{H}^{!}; (: & /Y:$)!?//;8\mathbb{H}:\mathbb{H}/\mathbb{H}^{!}; (: & /Y:$)!?/;8\mathbb{H}:\mathbb{H}/\mathbb{H}^{!}; (: & /Y:$)!?/:8(: <6; \mathbb{H}/\mathbb{H}^{!}; (: & /Y:$)!?/:8(: <6)!?: \mathbb{H}^{!}; (: & /Y:$)!?/:8(: <6)!?: \mathbb{H}^{$

 $\label{eq:started_st$

F(/!-*?#6!/G#&!8C#?8!H(/!/?H*\$/!.:<\$8/!+<H!Y*H(!#;;*H*:?#6!/&C(#8*8!:?!&#H/\$*#6!.:W/\$/;!8*?./!H(/6#8H!&*;H/\$&7

 $\begin{array}{l} 1 \ 66!\%: <\$!8: \$/8!\#?; !L\$\#; /8!Y*66!+/!C:8H/; !:?!K1UV1'!\#?; !?//; !H: !+/!.(/.)/; !Y*H(*?!N(<&&@' #-H/\$!H(/\%!\#\$/!C:8H/;^!\$/Z</8H8!H:!.(#?L/!#!8.:\$/!:?!K1UV1'!?//; !H: !+/!&\#; /!Y*H(*?!H(*8!C/\$:;7F(/8/!\$/Z</8H8!&<8H!+/!&\#; /!; *$/.H6\%!*?!e$#; /8.:C/7 \\ \end{array}$

e\$#;/;!(:&/Y:\$)!*8!\$/H<\$?/;!W*#!e\$#;/8.:C/^!8//!*?-:\$&#H*:?!+/6:Y7!'H<;/?H8!8(:<6;!.(/.)!H(/#88*L?&/?H!-:\$!L\$#;*?L!.:\$\$/.H?/88!#?;!\$/Z</8H!#!.(#?L/!:-!8.:\$/!W*#!e\$#;/8.:C/!*-!*?.:\$\$/.H L\$#;*?L!*8!-:<?;7

"*;H/\$&8!Y*66!+/!8.#??/;!#?;!#;;/;!H:!e\$#;/8.:C/7!'H<;/?H8!.#?!\$/Z</8H!H:!(#W/!H(/!C#C/\$!W/\$8*:? :-!H(/!/G#&!\$/H<\$?/;7!,?./!H(/%!#\$/!\$/H<\$?/;0!:?6%!H(/!8.#??/;!W/\$8*:?!Y*66!+/!<8/;!-:\$!L\$#;*?L7

d?8H\$<.H*:?8!:?!<C6:#;*?L!#88*L?&/?H8!.#?!+/!-:<?;!#H0!

(HHC80NNYYY7%: <H<+/7.: &NY#H. (kW1g "J:+%5Lm?27!!

d?8H\$<.H*:?8!:?!W*/Y*?L!8.:\$/8!#?;!-//;+#.)!#-H/\$!#?!#88*L?&/?H!*8!L\$#;/;!.#?!+/!-:<?;!#H0! (HHC80NNYYY7%:<H<+/7.:&NY#H.(kH*&/m.:?H*?</1AnW1F,=K)dMA&(B7!

,

W*#!H(/!8H<;/?H!C:\$H#6^!H(:8/!C\$/-/\$\$/;!?#&/8!#?;!C\$:?:<?8!#\$/!6*8H/;!:?!*?8H\$<.H:\$8q!.6#88!\$:8H/\$87!d?! H(/!#+8/?./!:-!8<.(!<C;#H/80!H(/!?#&/!H(#H!#CC/#\$8!:?!H(/!.6#88!\$:8H/\$!*8!H(/!8H<;/?Hq8!6/L#6!?#&/7!