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Please contact the University of South Florida Technology Transfer office
representative for submission - Karla Schramm at kschramm@usf.edu
"#$%\' (!)*!+' \%$#!' ,!-. (/&(0!122' 3%. (&\%4!5#6$3&2\%' (!
! "#$%&' (
7816!,. (/1/40! 22 3%. (1/4/6. 22 3%)!. (. 6. 9::4114(('; 9%); #114(%#3; #(%) (!3#6#93$8! < 8114)!.
6. $$#66,.:=!<' .:/!89; #!9!>9?' 3!&>29$%' (!23#; #(%(0=!3#/. $&(0=!'3!#:&>&(9%(0!8#9:%8!/&62938%#6!
9(/!9/; 9($&(0!8#9:\%8!#@. \\data\data\data)(\\data\data); #(\\data' (6!9//3\data\data)(0!3\data\data)3\8\!@. \\data\data' (6!\\data)9\\\930\data\data' \\data\data' (6!\\data)9\\\930\data' \\data' \data' \\data' \\d
/#%#3>&(9(%6!',!8#9:%8!A"51BC=!<8&$8!&($:. /#!6%3. $%. 39:!,9$%' 36!9(/!$' (/&&' (6!',!/9&:4!:&,#=!93#!
3#@. &3#/!, '3!%8&6!&(&%49%; #!A"##!+)B!"51B!$'($#2%. 9:&D9%; (!
8#3#!8%26EFF<<<<*(&(3*(&8*0';F3#6#93$89(/,.(/&(0F(&866/'83$$H\%916JC*!"51B!$9(!I#!
9//3#66#/!9:' (#!' 3!&(!$' > 1 &(9%\' (!<&%8!' %8#3!/#%#3>&(9(%6!' ,!8#9:%8!9(/!96!293%\' ,!9!6&(0:#!' 3!
> .: \%:#; #:!\%(\%#3; #(\%' (!9223' 9\$8*!K:\%8' . 08!9!, '3 > 9\%; #!3#6#93\$8!2896#! > 94!1 #! (#\$#66934!, '3!
6' >#!23' ?#$%6=!9(!&(%#3; #(%\' (!3#6#93$8!$' >2' (#(%\6\!3#@. \83#/!, ' 3\!#9\$8\!23' 2' 6#/\!23' ?#$\%!
K22:&$9(%6!>94!23' 2' 6#!&(%#3; #(%k' (6!9//3#66&(0!/&6293&%#6!&(!9(4!8#9:%8!$' (/&%k' (±/&6#96#±!' 3!
8#9:%8!1#89; &' 3!%89%19:&0 (!<&%8!%8#!23&' 3&%4!3#6#93$8!93#96!' ,!:&6%#/!+)B!) (6\&\\. \\. \\#6=!L#(\\#36=!9(/!
1,,&$#6*!
78&6!&(&&9&: #!&(; &%#6!&(%#3; #(%!' (!3#6#93$8!, '$. 6#/!' (!%39(6, '3>9%; #!3#6#93$8!&/#96*!7'!! #!
$' (6\%\#3\#/!\%39(6, '3>9\%; \#=!23' ?\#$\%\!68' . :/!3\#,:\#$\%\\#96!6. I 6\%9(\%9::4!/\%, \#3\#(\%,3' >!\%39/\%\\'(9:!
$' ($#2\%!9(/!89; #!8\\08!2' \\# (\\\9:!\\' !:\#9/!\\' !>9?' 3!\\>23' ; #>#(\\6!\\(!8\\9:\\8!\\83' . 08!\\8\\!
/#; #:' 2>#(%=l&>2:#>#(%9%d' (=!' 3!/&66#>&(9%d' (!' ,!&(('; 9%d; #!&(%#3; #(%d' (6!%' !9//3#66!8#9:%8!
/\(\delta 293\dau\)#6!9(\(\delta #9:\delta !\delta \)#6!7' !9$$#:#39\dau\)#!23' 03#66!\(\delta (!3#\). $\(\delta (0!8\)#9:\(\delta !\delta \)8\(\delta !\delta \)\(\delta 6 !\delta !\delta \)\(\delta 1 \)
,. (/&(O!' 22' 3%. (&%4!6##M6!%' !6. 22' 3%&(%#3; #(%d' (6!%89%!9/; 9($#!' 3!6' :&/&,4!6%39%#0&#6=!2' :&$&#6=!
23' 039 > 6=!9 (/!#(; &3' (>#(%9:!$89 (0#6!%' !9//3#66!%8#!+9%' (N6!> '6%23#66&(0!8#9:%8!$89::#(0#6*!
)(('; 9%; #!&(%#3; #(%'(6!$'.:/!%9M#!>9(4!, '3>6!/#2#(/&(0!'(!%8#!2'2.:9%'(!',!&(%#3#6%!9(/!
8#9:%8!/\delta293\delta4!1#\delta(0!9//3#66#/*!+'\delta!\delta99\delta((';9\delta'(0!\delta9(!\delta(\delta:/#!/#;#:'2>#(\delta9(/!\delta\delta(0!)
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QR9 > 2:#6!',!23'?#\$%6!6. 22'3%#/!&(!%8\&6!\$9\#0'34!&(\$:. /#=|1. \%193\#!('\%:\&>\&\#/!\%'!6\%. /\!\\&9\\! #;9:. 9\\#!\&> 29\\\%6!'(!8\#9:\\&1)\\6293\\\\&4\29\$\\\6293\\\\&4\6!',|E!

- -#/#39:=!%&I 9:=!6%9%#=!:' \$9:=!' 3!' 309(&D9%!' (9:!/#>' (6%39%\' (!23' ?#\$\%!9\\>#/!9\\ 9//3#66\(0!''51B!
- 73&I 9:!2' :&\$!' 3!23' 039>6!9&>#/!%' !9//3#66!"51B!9>' (0!K>#3&\$9(!)(/&9(FK:96M9! +9\%; #!2' 2. :9\%' (6!
- +#<!6%9(/93/6!',!\$93#=!\$89(0#6!&(!8#9:%8!&(6.39(\$#!\$';#390#=!#R29(6&'(!',!9\$\$#66!%'!6'\$\text{\$\chinteta}\$\$\text{\$\t

- \3' ?#\$%6!%89%!/'!(' %!9//3#66!' (#!' 3! > ' 3#!"51B!96!\$' (\$#2%. 9:&D#/!96!6%3. \$%. 39:!,9\$%' 36! 9(/!\$' (/&%' (6!' ,!/9&:4!:&,#!
- \3' ?#\$%6!%89%\(\%#3; #(#!6' :#:4!9\\%8#!\(\%; \&\/. 9:F,9>\&:4!:#; #:!9(\/!('\%' (!"51B!96! \\$' (\\$#2\%. 9:\B)#\/!! 4!\\%#!+\B!
- $\bullet \quad)(\% \# 3; \# (\% \ (!23' ? \# \% 6!\% 89\% / ' ! (' \% \& (\$: . / \# !9!\$' >> . \ (\&\% 4!293\% (\# 368\& 2!)))))))$

•

 $6. \$\#66, . : \exists <' . : /!89; \#!9! > 9?' 3! \& > 29 \$ \&' (!23\#; \#(\& (0 \exists 3\# / . \$\& (0 \exists !' 3! \# : \& > \& (9 \& (0!8\# 9 : \& 8! /\& 6293 \& \& \# 6!)))))$

>#%8' /':' 0¼#6!%' !#:. \$&/9%#!>#\$89(\%>6!9(/!6':\%/\&,4!6\%39\#0\#6!,'3!9/;9(\$&(0!51L!8#9:\%!#@. \%4!

- Q:&>&(9%(0!&>2:#>#(%9%'(!1933\#36=!.(&(%#(/#/!\$'(6#@.#(\$#6=!9(/!#(89(\$&(0!,9\$\&:\mathbb{k})\mathbb{k}))))))
- K//3#66&(0!6' \$&9:!/#\#3>&(9(\%6!',!8\#9:\%8\\=!\$'>>' (!3\\%6M!,9\\$\'36\\!9(/!6\\3.\\$\%. 39:F646\\#>! 1933\\#36!\&>29\\\%(0!\\$'\G>'31\\%\\#6!',!51\L!/\\%6\\#96\\#6!9(/!\\$'\(/\\\\\\)\\ (6!!!
- Q(89(\$&(0!9\$\$#2%91&:&%4F. 2%9M#=!#,,#\$%&;#(#66=!\$'6%69;&(0=!6.6%9&(91&:&%4=!9(/!;9:.#!
- Q:&>&(9%(0!&(#,,#\$%;#=!:' <G;9:.#=!9(/!/%6\$3&>&(9%'34!239\$%\$#6=!1#89;&'36=!9(/F'3!\$93#!

-] Q5=!8&08!6\$8' ':!\$' >2:#&' (=!?' | 166##M&(0!6. 22' 3%=!' 3!9223# (%&\$#68&2!%39&(&(0!23' 039>! 29&3#/!<&%8!>#(%' 368&2!,' 3!&(/&; &/. 9:6!90&(0!' . %!' ,!\$8&:/!<#:,93#=!9,,#\$\#/!! 4!3#0&' (9:! ?' 1!:' 66=!&(!\%#!\$3&>&(9:!:#09:!646\#>=!' 3!#R2#3&# (\$&(0!> . :\%0# (#39\%' (9:!2' ; #3\%4*!

15/-%. 5C(>. &/-/''/' (%,(B. =-#%. F' . /5C(A' 5C/O(@6-' . 6' &(K1>BA@L! +)OB''N!>&66&' (!&6!%' !/&6\$' ; #3!8' <!%8#!#(; &3' (>#(%!9,,#\$%6!2#' 2:#!&(!' 3/#3!%' !23' >' %#!8#9:%8\#3! :\%; #6!9(/!896!:' (0!<' 3M#/!%' !3#/. \$#!#(; \&3' (>#(\%9:!8#9:\%8!/\&6293\\!9(/!23' >' \##!

- 5#; #:' 2!9 (/!%#6%! (#<!># (%9:!8#9:%8!23#; # (%; #=!%3#9%># (%-!9 (/!6#3; &\$#6!&(%#3; # (%' 6!9 (/F' 3!6%9%#0!, '3!&>2:#># (%(0!&(%#3; # (%' 6!<8%8!#6%91:\&68#/!#,, #\$\%; # (#66=!<\\8!9!, '\$. 6!' (!6' \$\9:!/#\%#3>&(9 (\%!', !8#9:\\8!A''51BC!96!23\&>934!>#\$89 (\&6 > 6*!

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+) \wedge B!#($' . 390#6!9!/#2:' 4>#(%,' $. 6#/!>' /#:!' ,!&(%#3; #(%\' (!9(/!6#3; &$#6!/#6\\0(!9(/!
#; 9:. 9%' (!%89%%9M#6!&(%' !9$$' . (%\%8#!2#362#$%; #!' ,\13#:#; 9(%\6%9M#8' :/#36!A#*0*=\6#3; &$#!. 6#36=\
23'; &/#36=!9/>&(&6%39%' 36=!294#36C!9(/!%8#!M#4!$8939$%#3&6%$6!',!%8#!6#%&(06!A#*0*=13#6'. 3$#6=!
&($:. /&(0!<'3M,'3$#!$929$&%4W#R&6%&(0!$:&(&$9:!<'3M,:'<6C!%89%!93#!&(%#(/#/!%'!&>2:#>#(%)
' 2%%>&D#/!>#(%9:!8#9:%8!&(%#3; #(%&' (6*!78&6!9%;#(%&' (!%' !#(/G. 6#3!2#362#$%; #6!9(/!
$8939$%#366%$6!',!&(%#(/#/!$:&(&$9:!9(/F'3!$'>>. (&%4!239$%$#!6#%%(06!&6!&(%#(/#/!%'!#(6.3#!%8#!
3#6.:%9(%\&(%\#3; \#(\%\' (6!9(/!6\#3; \&\$\#!/\#:\&; \#34!6\%39\\#0\&\#6!93\\#!9\\\$\#2\\91:\\#!\\' !\$\' (6. >\#36!9(/!
23'; &/#36=!%8#!9223' 9$8#6!93#!,#96&| :#!9(/!6$9:91:#!&(!%8#!6#%&(06!<8#3#!&(/&; &/. 9:6!93#!6#3; #/=!
9(/!%8#!3#6#93$8!3#6.:%6!<&::!89;#!. %&:\%4!, '3!#(/!.6#36*!
+) ^ B!#($' . 390#6!3#6#93$8!' (!2' %#(%49::4!6$9:91 :#!23#; #(%4; #=!%8#392#. %4$=!9(/!6#3; &$#6!
&(%#3; #(%' (6!%89%, '$. 6#6!' (!239$%$#63#:#; 9(%@. #6%' (6*!K$$' 3/&(0:4=!$' ::91 ' 39%' (6!1#%<##(!
9$9/#>&$!3#6#93$8#36!9(/!$:&(&$9:!'3!$'>>. (&\d!239$\\$#!293\\(#36!'3!(#\\<'3\)6!93#!#($'.390#/*!
6. 22' 3%#/!cdd!". &$&/#!9(/!L3&6&6!a&,#:&(#!6#3; &$#6!9(/!%39&(&(0!&(,396%). $%. 3#=!9(/!<8#(!
2'66&|:#=!+)^B!#($'.390#6!922:&$9\\('6!\)89\\;#;#390#!#R\\(\0\)8\\((0!3\)#6\#93\$8!3\#6'.3\$\#6\!A\#*0\*=!
239$\%$#GI 96#/!3#6#93$8!(#%<' 3M6!6. $8!96!\%8#!+) ^ BG62' (6' 3#/! ^ # (\%9:\B#9:\\&\!P#6#93$8\!
+#%<' 3M!A^BP+C=!+)^BG6. 22' 3%#/!KaKLP)7e!9(/!\39$\%$#GI 96#/!". &$&/#!\\3#; #(\%' (!P#6#93$8!
L#(%#36=1&(6%8%. %d' (6!<8%8!L:&(&$9:!9(/!739(6:9%d' (9:!"$&#($#!K<93/6C*!7'!,9$&:8%9%#!%8#!.:%&>9%#!
```

 $\begin{array}{l} \mathsf{K}22:\$\$9 (\%6!93\#!\#(\$':390\#/!\%'!:\%\&\&D\#!\%8\#!+)+5"!"51B!,39>\#<'3M!,'3!9//3\#66\&(0!8\#9:\%8!\\ \underline{\&(\#@.\&\%\#6!9(/!\&(\$':32'39\%\#!\$')>>. (\&\%4!\#(090\#>\#(\%6\%9)\%9)\#6!\&(\%'!\%8\#\&3!\$:\&(\$\$9:!6\%./4!/\#6\&0(6*!^9)(4!\$':3\#!23\&(\$\&2:\#6!',!\$'>>. (\&\%4!\#(090\#>\#(\%A\%3.6\%-1\&(\$:.6\&;\&\%4-1\$.:\%.39::4G\$\#(\%\#3\#/-1\#%\$^*C!93\#!'). &\&(\#/!\&(!\%8\#!+9\&'(9:!K\$9/\#>4!',!^*\#/\&\&(\#M6!K/;9(\$\&(0!B\#9:\%8!0@.\&\%4!9(/!"46\#>6!). &&&(390\%)(1.88\%)(1.6\%)(1.88\%)(1.6\%)(1.88$

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&>23'; #!8#9:%8!9(/!23#; #(%!/\&#96#!&(!>.:\%2:#!\&(\\#3$'((#$\\#/!\\8#392#.\\\$\!>'/9:\\\#6!9(/F'3!
29%8<946!93#!#($'.390#/*!
)(;#6%409%' 36!93#!#($' . 390#/!%' !3#;&#<!%8#!+LL)B!L:&(&$9:!P#6#93$8!7' ':1 'R!%' !:#93(!> '3#!
91'. %+LL)Bq6!3#@. &3#>#(%6=!2':&$&#6=!0. &/#:&(#6=!9(/!3#@. &3#/!%#>2:9%#6!,'3!$:&(&$9:!%&9:6*!
K22:&$9(%6!93#!6%3' (0:4!#($' . 390#/!%' !/&6$. 66!%8#&3!23' 2' 6#/!3#6#93$8!&(\#3#6\!<\&\8!\8#!
/#6&0(9%#/!+LL)B!"$&#(%,&$FP#6#93$8!L' (%9$%:&6%#/!I#:' <!%' !$' (,&3>!&%6!3#:#;9($#!%' !%8#!
+LL)B!>&66&' (!93#96*!
2_{,,'}-6' (%,(+-&' 5&' (! #' =' . /-%. (K2+! L!
78#!15\!&6!%8#!:#9/!', \&$#!9\%8#!+)B!3#62' (6&| :#!, '3!966#66&(0=|,9&&\\9\\(0=\)9(/!6\\>.:9\\(0!
3#6#93$8!&(!/&6#96#!23#;#(&' (*!)(!293%(#368&2!<&\8!\8#!Jh!+)B!)(6\&\\.\#6!9(/!L#(\\#36=\\8#!15\!
6%3&; #6!%' !&($3#96#!%8#!6$' 2#=!@. 9:&%4=!/&66#>&(9%\' (=!9(/!&>29$%\' ,!+)BG6. 22' 3%#/!23#; #(%\' (!
3#6#93$8*!78#!15\!&6\&(\%#3#6\%#/\&(\!23';\&/\&(0\!$'\G,..\(/\&(0\!6.22'3\\),'\3\!3\#6\#93$8\!\&9\\\89\!89\!6\%\'\(0\!
&>2:&$9%' (6!,' 3!/&6#96#!9(/!&(?. 34!23#; #(%t' (!9(/!8#9:%8!#@. &%4!9(/!%89%&($:. /#!&(('; 9%; #!9(/!
9223' 23&9%#!3#6#93$8!/#6&0(=!>#96. 3#>#(%!9(/!9(9:46&6!>#%8' /6*!-' 3!%8&6!P-K=!15\!&6!
&(%#3#6%#/!&(!>.:\%G6\%#!9(/F'3!>.:\%G6#$\%'39:!&(\%#3;#(\%'(6!\%89\%9//3#66!$'>>'(!3\&6\)!,9$\%'36!
,'3!>'31\%\%\4!9(/!>'3\%9:&\4!9>'(0!2'2.:9\%'(6!\&89\%#R2#3\#($#!8#9:\&!/\\6293\%\#6=!\($:./\(0!
%' | 19$$'!. 6#=!';#3<#&08%F' | 1#6&%4=!2' '3!/&#%=!2846&$9:!&(9$%;&%4=!9:$'8':!>&6. 6#=!/3. 0!>&6. 6#=!
3&6M4!6#R. 9:!1 #89; &' 3=!&(?. 34!9 (/!; &' :#($#=!&(,#$%&' . 6!/&6#96#=!9 (/!#(; &3' (>#(%9:!8#9:%8*!-' 3!
9//&&' (9:1&(,'3>9%\' (!91'. %15\\\0!3#6#93$8!23&'3&\&#6!9(/!&(\\#3#6\\6-\!2:\#96\\!13#,\#3!\\'!\\8\\#!15\\!
"%39\#0\\\:9(!.'3!-\6\$9:!e\#936!JTVcSJTJU\*!
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2,,-6' (%,(: '&' 5#60(%. (O%F' . P&(A' 5C/O(K2: OAL!

- 6. I > &66&' (=!2:#96#!3#, #3#(\$#!+)B!] 39(%6!\':&\$4!"\%9\\#>#(\%!"#\$\\%' (!J*\C*J!Q:\#\$\\%' (\&\$9::4! ". I > &\\#/!K22:&\$9\\%' (6!,' 3!9//&\\%' (9:!&(,' 3>9\\%' (!
 - "46%#>!,'3!K<93/!^9(90#>#(%A''K^C!S!K22:&\$9(%6!>.6%\\$'>2:#\%#!9(/!>9&(\%9\&(!9(!9\))))
 9\$%\\$;#!3#0\%39\%'(\delta\)'\80-60(\(\delta\)''\delta''\8(\(\delta\)'\80-60(\(\delta\)''\\80-60(\(\delta\)'\80-60(\(\delta\)'\80-60(\(\delta\)'\80-60(\(\delta\)'\80-60(\(\delta\)'\80-60(\(\delta\)'\80-60(\(\delta\)'\80-60(\(\delta\)'\80-60(\(\delta\)'\80-60\(\delta\)'\80-6\(\d

 - X (&@. #!Q (\%\A!)/# (\%,\\#3!AXQ)C!G!K!XQ)!\\6!\\66. #/!96!293\\%',!\\8#!''K \^*0';!\\3#0\\6\\39\\\6!\\$ (! 23'\\$#66*!7\\8#!\69 > \#!XQ)! > .6\\1\\#!.\\6#/!,'\\3!\9::!\\3#0\\6\\39\\\\6\\\$'\\6!\96!<\\#::!\96!'\\(!\\8\\#!\\93\)(\\\8</p>

- 78#!\05\!68' . :/!23' ; &/#!9!8' :&6%\$!9(/!&(%#039%#/!; &#<!' ,!8' <!#(89(\$&(0!/&; #36#! 2#362#\$%; #6!&6!; &#<#/!9(/!6. 22' 3%#/!%83' . 08' . %|%8#!922:&\$9%\' (!9(/!\$9(!&(\$' 32' 39%#!

- 5#6\$3%2%' (!',!9(4!%39%(%(0!9(/F'3!>#(%'3%(0!'22'3%. (&%#6!9;9%:91:#!%'!#(\$'.390#!293%\$%29%' (!',!6%. /#(%6=!2'6%/'\$%'39:!3#6#93\$8#36!9(/!\$'6%(;#6%09%'36!,3'>!/%;#36#!19\$M03'. (/6*!
- \:9(!%'!/#;#:'2!%39(6/\)6\\2:\(934!\\$'::91'39\\(\)4\(66!\\89\)\3#@. \\3#!. (\\@.#!#R2#3\\6#!9(/F'3!

E!Y3&#,:4!/#6\$3&I #!<89%I&6!I #&(0!23' 2' 6#/=I&(\$:. /&(0!%8#!"51B!9(/!

8#9:%8!/\&293\\!2' 2.:9\&' (!\%89\\%#!3#6#93\$8!<\&::!9//3#66*!K:6' !/#6\$3\\ #!<84!9(/!8' <!\%#! 23' 2' 6#/!3#6#93\$8!\&!\&>2' 3\%9(\\%' !9/; 9(\\$\(0!8#9:\\8!#@. \\\\4*\!5#6\\$3\\ #!I 3\\#,:4!\\8#!\\(('; 9\\\; #! 962\#\\6!', \\\8*\!23' 2' 6\#/!3\#6\#93\$8!\\89\\\:. >\((9\\#!\\\6!\\9)(6,' 3>9\\\; #!2' \\#(\\\9:\!!!

?\$\$'. 9-DG!1 (:4!:&>&\#/!K22#(/&R!>9\#3&9:6!93#!9::' <#/*!-'::' <!9::!&(6\%3. \$\%' (6!,' 3!\%#!K22#(/\&R! 96!/#6\$3&I #/!&(!\%8#!B' <!\%' !K22:4!K22:&\$9\%' (!]. &\/#*!

• +'!2.1:&\$9%' (6!'3!'%8#3!>9%#3&9:=!<&%8!%8#!#R\$#2%'(!',!1:9(M!@.#6%'((9&3#6!'3!1:9(M! 6.3;#46=!>94!1#!&(\$:./#/!&(!%8#!K22#(/&R*!

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K22:&$9%' (6!> . 6%&($:. /#!9((. 9:!> &:#6%' (#6*!K22:&$9%' (6!%89%,9&:!%' !&($:. /#!9((. 9:!> &:#6%' (#6!
<&::!| #!$' (6&/#3#/!&($' >2:#%#!9(/!<&::|| #!<&\8/39<(*!K22:&\$9\&' (6!>.6\\&(\$:./#!9!\Q5\!
6. I > &\\#/!96!1\\8#3!\3' ?\#$\\)(,' 3 > 9\\\' (!96!9(!9\\9\$8 > \#(\\1\)!K22:\\$9\\\' (6!\\89\\,9\\!\\ !\\(\$:. /\#!9!
! %&/(@"; F-&&-%. (N5/' #-50&(
K22:&$9(%6!93#!3#@. &3#/!%'!,'::'<!%8#!&(6%3. $%&'(6!,'3!2'6%6. I > &6&\'(! > 9\#3&9:6=!96!/#6$3&I#/!
&(!\%#!2' :\$4!
K (4!&(6%3. $%' (6!23' ; &/#/!8#3#!93#!&(!9//&%' (!%' !%8#!&(6%3. $%' (6!&(!%8#!2' :&$4*!
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$' (6\%\#39\%\' (!' ,!\%\#!,' ::' <\(0!3\#;\\#<!\$3\\\#3\\9!9(/!9//\\\\\ (9:!3\#;\\\#<!\$3\\\\#3\\9!\A96!922:\\$91:\#!,' 3!
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•

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-)6!%8#!2939/&0>!I #&(0!\$89::#(0#/!'3!23'2'6#/!,. (/9>#(%9:!%'!%8#!6\$&#(%,&\$!,&#:/j!
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1 3&#,!2:9(6!23' 2' 6#/!,' 3!&/#(%,4&(0!9(/!#(6. 3&(0!%8#!; 9:&/&%4!' ,!%8' 6#!3#6' . 3$#6*!
Y. /0#%!9(/!\#3&' /!' ,!". 22' 3%!!
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?. 6\%,\&\mu/!9(/!3\#96' (91:\#!\&(!3\#:9\\&' (!\%' !\\8\#!23' 2' 6\#/!3\#6\#93\$8\*!
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]3' \cdot 2! < \&:: | 1 # !68' < (! \& (! \% 8 # ! # PK! L' > > ' (6*!))
K6!293%'',!%8#!6$&#(%,&$!2##3!3#;&#<=!9::!922:&$9%'(6!<&::!3#$#&;#!9!<3&%#(!$3&&@.#*!
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9223' 23%9%#!+)B!)(6%%. %#!' 3!L#(%#3*!K22:&$9%' (6!<&:!$' >2#%#!,' 3!9; 9&91:#!,. (/6!<&8:9:!' %8#3!
3\#\$' > \#(/\#/!922:\&\$9\%') (6!<&::!3#\$\#\\;\#!9!6\#\$'\(/!:\#\;\#:!'\,!3\#\;\&\#<!1\4!\\8\#!+9\\\'\(9:!\K/\;\&6'\34!\)
L' . (\$\&!, 3! + .36\&(0!P\#6\#93\$8^*!78\#!, ::' < \&(0! < \&::!1 \#!\$' (6\&/\#3\#/!\&(! > 9M\&(0!, .(/\&(0!/\#\$\&6\&'))))))))))
      "$&# (%, &$!9 (/!%#$8 (&$9:!>#3&%!' ,!%8#!23' 2' 6#/!23' ?#$\%96!/#\%#3>&(#/!1 4!6$&# (\%, &$!2##3!
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3#; &#<=!9/; &6' 34!$'. ($&:!3#; &#<=!9(/!#93:&#6\%6\%93\%1/9\\#*!
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,3' >!%8#!922:&$9(%!96!/#6$3&I #/!&(!%8#!+)B!] 39(%!\':&$4!"%9%#>#(%*!
K!, '3>9:!(' %, &$9%' (!&(!%8#!, '3>!', !9!+' %$#!', !K<93/!A+' KC!<&::!1 #!23'; &/#/!%'!%8#!922:&$9(%
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),!9!3#\$&2&#(%3#\$#&;#6!9(!9<93/=\%8#!3#\$&2&#(%!>.6%,'::'<!9::!922:&\$91:#!('(/&6\$3&>&(9%'(!:9<6*!78#!3#\$&2&#(%!903##6!%'!%8&6!<8#(!3#0&6%#3&(0!&(!''K^*0';*!78#!3#\$&2&#(%!>.6%!9:6'!6.1>&%!9(!K66.39(\$#!',!L'>2:&9(\$#!ABB''GZCTC*!7'!:#93(!>'3#=!6##!%8#!BB''!1,,&\$#!,'3!L&;&:!P&08%6!<#16&#*!BB''!3#\$'0(&D#6!%89%!+)B!3#6#93\$8!23'?#\$%6!93#!',%#(!:&>&##/!&(!6\$'2#!,'3!>9(4!3#96'(6!%89%!93#!('(/&6\$3&>&(9%'34=6.\$8!96!%8#!23&(\$&29:!&(;#6%09%'3N6!6\$&#(%,&\$!&(%#3#6%=!,.(/&(0!:&>&%9%'(6=!3**3.8%)),#(%!3#@.&3#>#(%6=!9(/!'%8#3!\$'(6&/#39%'(6*!78.6=!\$3\;\#3\;\#3\;\#1.3\;\#6\;\#93\$8!23'%\$':6!%89%!

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562. %#!P#6':. %\' (!\9(#:!$' > 2' 6#/!' ,!%83##! > # > 1 #36! < &::!1 #!$' (; #(#/*! ^ # > 1 #36! < &::!1 #E!9!
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/'#6!('%19:%#3!%8#!9<93/##q6!3&08%%'!922#9:!9(!9/;#36#!9$%&'(!%89%&6!'%8#3<&6#!922#9:91:#!&(!
9$$' 3/9($#!<88!\B"!3#0. :9%' (!mJ!L-P!\93%|T-!". | 293%|5!9(/!5BB"!3#0. :9%' (!ml !L-P!\93%|VZ*!
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P#2'3%193#!3#@. &3#/!,'3!$:'6#'.%!',!9(!9<93/=!96!/#6$3&I#/!&(!%8#!+)B!]39(%6!\':&$4!"%9%#>#(%
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 $9!-\#/\#39: !9 < 93/ \exists !> .\ 6 \% 3 \# 2 '\ 3 \% 9 \ (/!> 9 \& (\% 9 \& (!\% 8 \# !\$.\ 33 \# (\$ 4!'\ ,!\& (,'\ 3> 9 \%'\ (!3 \# 2'\ 3 \% \# /!\& (!\% 8 \# !'' 46 \% > !))))$