

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

) *+,#\$,-%./0%1213

Joe Phua, Ph.D.

4 *\$5678%9:"66;%6<%(" *%=,(8%
96#(" *,>%4 *("65'8(%?>'@ * ,8'(-%
? AB" , * -%C * *%D * >(* ,0%EE22%F - * ,%9(GO%
F\$;;\$80%HI %JK12K%
! "6> *L%M1 .3N%JOPQO.EE%
RA\$';%L%\$B"#\$T8A#C*5#%

%
! "GF0%
%
4G=GO%
%
VG=GO%
%

0%12..0%D6AA#>':\$(6>%

0%12230%D6AA#>':\$(6>%4\$>\$U* A * >(%

0%12210%D'> * A\$%\$>5%4 * 5'\$9(#5' * 8%

F' , * : (6,0%H* A * ,;>%=5@* ,('8'>U%W>8'(#(*0%4 *\$5678%9:"66;%6<%(" *%=,(8%M)\$;,%1211%

! "#\$%&'(\$%1%
%

) *+,#\$, - . / 0%1213

=88'8(\$>(!, < * 886, %MH* > #, * Q(, \$: \NO% F * B\$, (A * > (%6<%=5@* , ('8'>U%\$>5% ! #+; ' : %
Y* ; \$('6>80%Z, \$5-%D6;; * U*%6< %[6#, > \$; '8A % \$>5% 4 \$88%D6A A#> ' : \$('6>%M) \$; ; %12. . %X%
9B, '>U%12. JN%

%
H6B% ! \$B* , %= 7\$, 5%12110% = 7\$, 5*5%+ -L% = 886: '\$('6>%<6, %R5#: '\$('6>%> [6#, > \$; '8A %
\$>5% 4 \$88%D6A A#> ' : \$('6>%M=R [4 DNO%=5@* , ('8'>U%F '@'8'6>G%

%
Y*8*\$, : (%) * ; ; 678 " 'B%D6AB* ('(6>% = 7\$, 5%121. Q12110% = 7\$, 5*5%+ -L% = A* , ' : \$>%
=: \$5* A -%6<%=5@* , ('8'>U%M===NG%

%
V*8(=%, (' : ; *% = 7\$, 5%12. P%6<%) [6#, > \$; %6<%W> (*, \$: ('@*% = 5@* , ('8'>U^0% = 7\$, 5*5%+ -L%
= A* , ' : \$>% =: \$5* A -%6<%=5@* , ('8'>U%M===NG%

%
_6#>U%9 : " 6;\$, %= 7\$, 5%12. P%M ` 6A'> * *NO%W> (*, > \$('6>\$; %D6A A#> ' : \$('6>% = 886: '\$('6>%
MWD=NG%

%
H6B% ! \$B* , %= 7\$, 5%12. 00% = 7\$, 5*5%+ -L%W> (*, > \$('6>\$; %D6A A#> ' : \$('6>% = 886: '\$('6>%
MWD=NO%9B6, (8%D6A A#> ' : \$('6>%W> (*, *8(%Z, 6#BG%

%
F'88* , (\$('6>%6<%(" *% _ *\$, %= 7\$, 5%12. 10% = 7\$, 5*5%+ -L%W> (*, > \$('6>\$; %D6A A#> ' : \$('6>%
= 886: '\$('6>%MWD=NO%\$>5% ` \$('6>\$; %D6A A#> ' : \$('6>% = 886: '\$('6>%M ` D=NO% a *\$; (" %
D6A A#> ' : \$('6>%F '@'8'6>8G%

%
9#A A * , %F6: (6, \$; %9 : " 6;\$, 8 " 'B%12. 20% = 7\$, 5*5%+ -L% b c<6, 5%W> (*, > * (%W>8('(#(*%M b WWNO%
?>'@* , 8'(-%6<b c<6, 50% b c<6, 50% ?>'(*5'd'>U56AG%

%
&'8'(>U%9 : " 6;\$, %) * ; ; 678 " 'B%12. 20% = 7\$, 5*5%+ -L%9'>U\$B6, *%W> (*, > * (%Y*8*\$, : " %
D*> (*, %M9%YDNO% ` \$> - \$>U%H* : ">6;6U' : \$; % ?>'@* , 8'(-0%9'>U\$B6, *G%

%
H6B%9(#5*>(! \$B* , %= 7\$, 5%122/0% = 7\$, 5*5%+ -L% ` \$('6>\$; %D6A A#> ' : \$('6>%
= 886: '\$('6>%M ` D=NO% a #A \$>%D6A A#> ' : \$('6>% \$>5%H* : ">6;6U - %F '@'8'6>G%

%
H6B%9(#5*>(! \$B* , %= 7\$, 5%122PO% = 7\$, 5*5%+ -L%W> (*, > \$('6>\$; %D6A A#> ' : \$('6>%
= 886: '\$('6>%MWD=NO%W> (*, U, 6#B%D6A A#> ' : \$('6>%W> (*, *8(%Z, 6#BG%

%
?>'@* , 8'(-%6<Z*6, U'\$0%Z, \$>(%F* @* ; 6BA * > (% ! , 6U, \$A % ! \$, (' : 'B\$>(%12. 3Q12. 00%
b 7*>8%W>8('(#(*%<6, %V* "\$@'6, \$; %Y*8*\$, : " %M b WVYNG%

%
?>'@* , 8'(-%6<Z*6, U'\$0%D "\$, ; *8%VGd>\$BB%R\$, ; - %D\$, * * , %9 : " 6;\$, %= 7\$, 5%12. 0%
M ` 6A'> * *NO% ?>'@* , 8'(-%6<Z*6, U'\$Y*8*\$, : (%) 6#>5\$('6>%M ? Z=Y) NG%

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

) *+,#\$, -% . / 0%1213

% %

%%

?>'@*,8'(-%6<%Z*6,U'\$0%C';;-H*\$:" '>U%) *;;67%12.1Q12.30%D*>(*,%<6,%H*\$:" '>U\$>5% C*\$,>'>U%MDHCNG%

%

?>'@*,8'(-%6<%96#(" *,>%D\$;<6,>'\$0%Y*8*\$,: "%=7\$,5%<6,%W>(*,>\$('6>\$;%F'88* ,(\$('6>% 9(#5-%12.2Q12..0%=>*+*,U%9:" 66;%<6,%D6A A#>':\$('6>%\$>5% [6#,>\$;'8AG%

%

?>'@*,8'(-%6<%96#(" *,>%D\$;<6,>'\$0%F6:(6,\$;%9(#5'*8%) *;;678" 'B%=7\$,5%1220Q12..0% =>*+*,U%9:" 66;%<6,%D6A A#>':\$('6>%\$>5% [6#,>\$;'8AG%

[Note: * denotes undergraduate or graduate co-authors at the time research was conducted; ISI Web of Science Impact Factor in parentheses.]

G C C (F 19, 2024):

: 6,010 - : 28, 10- : 40

(0)

%

.G% ` \6;>\$\6#0=>U*;' \0% 0%\$>5%R#>%966\d76>%M! , *88NG% e "\$(% F,'@*8%=55' ;6>%6>%96:'\$;%4 *5'\$%9>(*8f%H" *%Y*;\$('6>8" 'B8%+*(7**>% !8-:"6;6U':\$;%e *;;QV*'>U%9(\$(*80%96:'\$;%4 *5'\$%=55':('6>0%V,\$>5%=55':('6>0% \$>5%W AB#;8*%V#-'>U%6>%96:'\$;%4 *5'\$G% % g121. %W AB\$:(%) \$:(6,L%PG /KJh%

%

1G% C**0%_>QW0%_'>UQD "\$%a8#i0%

0%H\$'Q_**% e #0%\$>5%9\$,\$" a\$:" A\$>i%

! "#\$%&'(\$3%
%

) *+,#\$, -% . / 0%1213

OG% , 0%\$>5%F6>U%[\$*%C'Ai%M121ENC%D\$>% e \$,>>U%;\$+*;8%A>('U\$(*%
R<<*: (8%6<%=5@* ,('8'>U% 4 *88\$U*%D;\$'A8%'>%D*; *+,'(-QR>56,8*5%W>8(\$U,\$AQ
V\$8*5%R;*:(,6>':%D'U\$, *((*%=5@* ,('8* A *>(8f%W><#*>: *%6>%96:'\$;% 4 *5'\$%
?8*,8j%RQD'U\$, *((*%=(('5*8%\$>5%V* "\$@'6,\$;%W>(*>('6>8G%
MKNO%3KKQ3JK %

JG% !<*#<<*,0%*=;*c\$>5*,0%\$>5% %M1211

! "#\$%&'(\$%0%
% %

) *+,#\$, -% . / 0%1213

11G% , 0% [" " Q9-#\$>%C'>0%\$>5%F6>U%[\$*%C'Ai%M12.PNG?>5*,8(\$>5'>U%
D6>8#A*,%R>U\$U* A*>(%7'("%D*;*+,'(-QR>56,8*5%RQD'U\$,*((%=5@*,'8'>U%
6>%W>8(\$U,\$AG% 0%/EQ.21G%
g121.%WAB\$:(%)\$:(6,L%PG/KJh%

%

1EG% , 0% !6QC'>%!\$>0%\$>5%d#\$>Q[#%D"*>i%M12.PNG%9B6,(%H*\$A

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

) * + , # \$, - % . /

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

) *+,#\$, -% . / 0%1213

%

%

%

33G%['>0%9*#>U\$%&*>#80%\$>5% %M12.3NG%)6;;67'>U%D*;*+,('8j%H7** (8%
 \$+6#(%V,\$>58L%H"*%W AB\$:(%6<%H7'((*QV\$8*5%R;*:(,6>'-%e6,5Q6<Q46#(""
 M*e64N%6>%D6>8#A*,8j%96#,:*%D,*5'+';(-!*,:*B('6>0%V#-'>U%W>(*>'6>0%
 \$>5%96:'\$;%W5*>('<:'\$('6>%7'("D*;*+,('8G% M1NO%
 .P.Q./KG%
 g121.%W AB\$:(%)\$:(6,L%OGK1Ph%
 %

%

3KG% , %M12.ENG!\$,(:'B\$(>U%'>%a*\$;("W88#*Q9B*:'<:%96:'\$;%`*(76,\>U%
 9'(*8%M9`98N%(6%k#'(9A6\>UL%a67%56*8%b>:'> *%96:'\$;%
 W>(*,:6>>*:(*5>*88%'><;#*>:*%9A6\>U%D*88\$('6>%9*;<QR<<:'\$:-f%
 MKNO%/EEQ/K1G%%
 g121.%W AB\$:(%)\$:(6,L%KGJK2h%

30G% , %M12.ENG%H"*%Y*<*,*>:*%Z,6#B%!*,8B*:(@*%<6,%9A6\>U%
 D*88\$('6>L%=>%Rc\$A'>\$('6>%6<(" *%W><;#*>:*%6<%96:'\$;%`6,A8%\$>5%96:'\$;%
 W5*>('<:'\$('6>%7'("Y*<*,*>:*%Z,6#B%6>%9A6\>U%D*88\$('6>%9*;<

! "#\$%&'(\$%. 2%
% %

) *+,#\$, -% . / 0%1213

L%

0%H" 6#8\$>5% b\$\80%D=L%9\$U*0%

J12QJ1PG%

(1)

%
.G% !< *#<<*,0% =; *c\$>5*,0%
9: ,#('>'n* f%Q%

0%\$>5% 4\$,'; ->% !, 'A6@': i %M1213NG%H,#8(%+##(%

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

) * +, # \$, - . / 0 % 1 2 1 3

0 % 9 (G %

! * (, 8 + # , U 0 %) C 0 % 4 \$, : " % 1 2 1 1 G !

!

PG % ! < * # < < * , 0 % = ; * c \$ > 5 * , 0 % 0 % \$ > 5 % 4 \$, ; - > % ! , ' A 6 @ ' : i % M 1 2 1 . N G % H , # 8 (' > U % 6 > %
\$ % e " ' A f % = % 4 # ; (' Q 4 * (" 6 5 % W > p # ' , - % 6 < % D # * Q V \$ 8 * 5 % H , # 8 (' > % b > ; ' > * % D 6 > 8 # A * , %
! , 6 5 # : (% Y * @ ' * 7 8 G %
& ' , (# \$; 0 % [# > * % 1 2 1 . G !

!

/ G % C ' # 0 % [' \$ - ' > U 0 % 0 % F * \$ > % d , # U A \$ > 0 % C ' > S ' \$ % I # i 0 % Z , * > % ` 6 7 \$ \ 0 % \$ > 5 % C # : - %
! 6 B 6 @ \$ % M 1 2 1 . N G % F 6 % _ 6 # > U % = 5 # ; (8 % = ((* > 5 % (6 % a * \$; (" % e \$, > > U 8 % ' > (" * %) ' , 8 (%
W k b 9 % = 5 @ * , (' 8 * A * > (' > % (" * % ? G 9 G f % = > % R - * Q H , \$: \ ' > U % = B B , 6 \$: " G %
& ' , (# \$; 0 % 4 \$ - % 1 2 1 . G !

!

. 2 G % ! < * # < < * , 0 % = ; * c \$ > 5 * , 0 % \$ > 5 % % M 1 2 1 . N G % 9 (, \$ > U * , F \$ > U * , f % D # * Q + \$ 8 * 5 %
H , # 8 (' > % b > ; ' > * % D 6 > 8 # A * , % ! , 6 5 # : (% Y * @ ' * 7 % & ' 5 * 6 8 G %
& ' , (# \$; 0 % 4 \$, : " % 1 2 1 . G !

%

. . G % ` \ ' 6 ; > \$ \ 6 # 0 % = > U * ; \ ' 0 % \$ > 5 % % M 1 2 1 . N G % e " \$ (% A \$ \ * 8 % \$ % C 6 - \$; %) \$ > % \$ %
V , \$ > 5 % = 5 @ 6 : \$ (* % 6 > % 9 6 : ' \$; % 4 * 5 ' \$ f % D \$ B ' (\$; ' n ' > U % 6 > % V , \$ > 5 % ! \$ U * % C 6 - \$; (- % (6 %
+ # ' ; 5 % 9 * ; < Q R c B \$ > 8 ' 6 > % V * > * < ' (8 % < 6 , %) \$ > 8 G %
& ' , (# \$; 0 % 4 \$, : " % 1 2 1 . G %

%

. 1 G % ! , ' A 6 @ ' : 0 % 4 \$, ; - > i 0 % \$ > 5 % % M 1 2 1 2 N G % D 6 A B \$, ' > U % R c B * : (\$ > : - %
& ' 6 ; \$ (' 6 > 8 % D 6 A A ' ((* 5 % + - % W > < ; # * > : * , % = 5 @ * , (' 8 ' > U % 9 6 # , : * 8 % 6 > % 9 6 : ' \$; % 4 * 5 ' \$ G %

9 \$ > %) , \$ > : ' 8 : 6 0 % D = 0 % = # U # 8 (% 1 2 1 2 G %

%

. E G % d ' A 0 % [' " 6 6 > i 0 % 0 % ` \$ " % Y \$ - % a \$ > i 0 % \$ > 5 % H \$ * - * 6 > % d ' A i % M 1 2 1 2 N G %
W > @ * 8 (' U \$ (' > U (" * % W A B \$: (% 6 < % W A A * , 8 ' @ * % = 5 @ * , (' 8 ' > U % 6 > % = ((' # 5 * % (6 7 \$, 5 % (" * %

! "#\$%&'(\$% . 1%
% %

) *+,#\$, -% . / 0%1213

.0G% , 0%9*#>U\$%&* >#8% ['>%\$>5% ['"66>%d'Ai%M12. /NG%W>(*,\$:('6>%R<<* : (%
6<%96#, : *%H-B*%\$>5%4 *88\$U*%&\$; * >: *%'>%W>8(\$U,\$AQ+\$8*5%=5@* , ('8'>U%
4 *88\$U*8%\$+6#(%&*U\$>'8AG%

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

) *+,#\$, -% . / 0%1213

% %

13G% , 0%\$>5% ['"66>%d'Ai%M12.PNG%9(\$, '>U%'>%_6#,%b7>%9>\$B: "\$(%
 =5@* ,('8* A*>(L%W><;#* >: *%6<%9*;<QV,\$>5%D6>U,#'(-0%9*;<QY* <*, * >:'>U%\$>5%
 ! * ,: *'@*5%a#A6,%6>%V,\$>5%=(('5*%\$>5%!#,: "\$8*%W>(*>('6>%6<%=5@* ,('8*5%
 V,\$>58G%
 ` * 7%_6,\0%` _0% 4\$, : "%12.PG%

%

1KG'D\$A * ,6>0%d,'8(*>i0% 0%\$>5%9B*>: * ,%H'>\ "\$A%M12.PNG%H" *%R<<*: (%6<%
 !6;(':\$;%D\$>5'5\$(*%=#(" * >(':'(-%\$>5%96#,: *%D, *5'+; '(-%6>%&6('>U%V* "\$@'6,%
 '>(" *%12.0%?G9G%!, *8'5*>('\$;%R;* : ('6>L%4 *88\$U*0%4 *5'\$0%\$>5%H\$,U*('>U%
 WAB;:\$('6>8%<6,%=5@* ,('8'>U! , \$: (': *G%
 ` * 7%_6,\0%` _0% 4\$, : "%12.PG%

%

10G% , 0% ["' "Q9-#\$>%C'>%\$>5%F6>U% [\$*%C'Ai%M12.JNG%Rc\$A'>'>U%RQ
 : 'U\$, * ((*% =5@* ,('8'>U%(" ,6#U"%96:'\$;%4 *5'\$L%R<<*: (8%6<%D6>8#A * ,QD* ; * +, '(-%
 Y'8\Q

! "#\$%&'(\$%. 3%

) *+,#\$, -% . / 0%1213

% %

%
 E1G% , 0%9*#>U\$%&* >#8% ['>0%\$>5% [' "66>%d' A i %M12.ONG%?8*8%\$>5%
 Z,\$('<':\$('6>8%6<%96:'\$;% ` *(76,\>U%9'(*8%<6,%96:'\$;D\$B'(\$;L%D6AB\$, '>U%
)\$: *+66\0%H7'((*,0%W>8(\$U,\$A0%\$>5%9>\$B: "\$(\$G%
 0%)#\#6\0%[\$B\$>0%[#>*%12.0G%

%
 EEG%! \$>0% !6QC'>0% 0%\$>5%D"\$>U% e \$>% e 66%M12.ONG% ! * , : *'@*5%V,\$>5%
 ! *,86>\$;'(-%(" ,6#U"%9B6,(8%9B6>86,8" 'BL%C6:\$('>U%\$%V;#,, *5%C'>*%+*(7* *>%
 R>(*,(\$>A *>(\$>5%! *,8#\$8'6>%>4 *5'(\$*5%9B6,(8G%
 0%)#\#6\0%[\$B\$>0%

[%>*%12.0G%

%

%
 E3G% , 0%9*#>U\$%&* >#8% ['>0%\$>5% [' "66>%d' A i %M12.ONG%Z,\$('<':\$('6>8%6<%
 #8'>U%)\$: *+66\0%H7'((*,0%W>8(\$U,\$A0%\$>5%9>\$B: "\$(%(6%<6;;67%V,\$>58L%
 W><;#* >: *%6>%V,\$>5%D6A A#>'(-

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

32G% , 0%

) *+,#\$, -% . / 0%1213

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

) *+, #\$, -% . / 0% 1213

KJG% , %M122/NG%9B6,(8%) \$>8j% ? 8 *%6<%) \$: * +66 \ % 9B6,(8% Z,6#B8%\$>5%
=BB;' :\$('6>8L%W AB;' :\$('6>8%<6,%V,'5U'>U%\$>5%\V6>5'>U%96:'\$,%D\$B'(\$;G%

D "' : \$U60%

W; ; '>6'80% ` 6@ * A+ * ,%122/G%
%

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

) *+,#\$, -% . / 0%1213

!,6U,\$A%R5#:\$('6>%M9` = !QR5N0^%) _12.K0%D6Q!, '>:'B\$;%W>@*8('U\$(6,0%
!,6S*:(%qL%31J22Q232Q22222E201/

?>'(*5%9(\$(*8F*B\$, (A*>(%6<%=U,':#;(#, *M?F9=NO%) 665%\$>5%`#('6>%9*,@':*0%Z=%
F*B\$, (A*>(%6<%a#A\$>%9*,@':*80%]Z*6,U'\$9#BB;*A*>(\$;%`#('6>%=88'8(\$>:*%
!,6U,\$A%R5#:\$('6>%M9` = !QR5N0^%) _12.K0%D6Q!, '>:'B\$;%W>@*8('U\$(6,0%
!,6S*:(%qL%31J22Q232Q22222E201/

%

()

\$3 , 2

?>'@*,8'(-%6<%Z*6,U'\$0%=F!Y%)\$:#;(-%=5%a6:%9* *5%Z,\$>(0%]?8'>U%`\$('@*%
=5@*,'8'>U%<6,%RQD'U\$,*((*%!,*@*>('6>%!#+;':%9*,@':*%=>6#>:*A*>(8%M!9=8NL%
R<<*: (8%6<%F'8;:68#, *%H-B*0%!#+;':\$('6>%H-B*%\$>5%b,U\$>'n\$('6>%H-B*%6>%
D6>8#A*,8j%=(('5*8%(67\$,58%RQD'U\$,*((80%W>(*>('6>8%(6%#8*%RQD'U\$,*((8%\$>5%
9*;<Q

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

! "#\$%&'(\$%12%
% %

) *+,#\$, -% . / 0%1213

=F!Y%)\$:#;(-%9*\$,: "%D6AA'((*%M?Z=%Z,\$5-%D6;;*U*N%M12..N%

&

! "#\$%&'(\$%1. %
% %

) *+,#\$, -% . / 0%1213

Y* @' * 7 * , 0% [6# , >\$; % 6 < % 4 \$, \ * (' > U % D6 A A # > ' : \$ (' 6 > 8 % M 12 . P % X % ! , * 8 * > (N %

Y* @' * 7 * , 0% D6 A A # > ' : \$ (' 6 > % Y * 8 * \$, : " % Y * B 6 , (8 % M 12 . P % X % ! , * 8 * > (N %

Y* @' * 7 * , 0% H * ; * A \$ (' : 8 % \$ > 5 % W > < 6 , A \$ (' : 8 % M 12 . P % X % ! , * 8 * > (N %

Y* @' * 7 * , 0% D6 A A # > ' : \$ (' 6 > % k # \$, (* , ; - % M 12 . P % X % ! , * 8 * > (N %

Y* @' * 7 * , 0% [6# , >\$; % 6 < % D " ' ; 5 , * > % t % 4 * 5 ' \$ % M 12 . P % X % ! , * 8 * > (N %

Y* @' * 7 * , 0% [6# , >\$; % 6 < % D # , , * > (% W 8 8 # * 8 % t % Y * 8 * \$, : " % ' > % = 5 @ * , (' 8 ' > U % M 12 . P % X % ! , * 8 * > (N %

Y* @' * 7 * , 0% W > (* , > \$ (' 6 > \$; % [6# , >\$; % 6 < % 9 (, \$ (* U ' : % D6 A A # > ' : \$ (' 6 > % M 12 . P % X % ! , * 8 * > (N %

! "#\$%&'(\$%11%

) *+,#\$,-%./0%1213

% %

=A *,':\$>%=:\$5* A-%6<%=5@* ,('8'>U%M===NO% 4 * A+*,8 " 'B%D6A A'((* *0% 4 * A+*,%
M12.0%X%12. /N%

W>(* ,>\$('6>\$;%D6A A#>':\$('6>%=886:\$('6>%MWD=NO% a *\$;(" %D6A A#>':\$('6>%F '@'8'6>%
4 *>(6,8 " 'B! ,6U,\$A0% 4 *>(6,%M12.0%X% ! , *8*>(N%

Z *6,U'\$%a *\$;(" :\$, *%)6#>5\$('6>0%R@\$;#\$('6>%Y *86# , : *%D * >(* ,%MRYDNO%Z ,>(%
Y * @ ' * 7 * ,%\$>5% ! ,6U,\$A %R@\$;#\$(6,%M12. E%Q%1211N%

D6>86,(' #A %<6,Z;6+\$;% 4 *5'\$%D#;(#, *%\$>5%D6A A#>':\$('6>0% 4 * A+*,%M12. E%Q%1211N%
?9D%=>> * >+*,U%D6A A#>':\$('6>%Z,\$5#\$(*%9(#5 * >(%=886:\$('6>0% 4 * A+*,%M1220%X%
12. .N%

?9D% `6,A\$>%H6BB'>U%D6A A#>'(-b#(, *\$: "%=886:\$('6>0% 4 * A+*,%M1220%X%12. . N%
%

?>'@*,8'(-%6<Z *6,U'\$0%D\$, **,%D * >(* ,%MD6>(' +#('6>%('6%D\$, **,%F * @ * ;6BA * >(%6<

?Z=%9(#5 * >(8N%M=7\$,5 * 5%<6,%12.30%12. KO%12.00%12. JO%12. P%\$>5%1212N%

?>'@*,8'(-%6<Z *6,U'\$0%=;B"\$%b A ': ,6>! '0%CSA+5\$%9'UA\$%D "\$B(* ,%MD * ,(' <':\$(*%6<
=BB, * :\$('6>N%M=7\$,5 * 5%<6,%121. N%

?>'@*,8'(-%6<Z *6,U'\$0%=F !Y%F *B\$, (A * >(\$;%H * \$: " * ,%6<(" * % _ * \$,%12. E%M `6A '> * *N%
%

! "#\$%&'(\$1E%
% %

) *+,#\$, -% . / 0%1213

[Y 4 D%P2K2%M ` \$ "%Y\$- %a\$>NO%9B,'>U%12.P%
[Y 4 D%P2K2%MD\$,6;'> *%d6B6(NO%)\$;,%12.J%
[Y 4 D%J112%M 4\$((" * 7%!'A *>(\$NO%9#AA *,%12.K%
[Y 4 D%P2K2%M_ \$>%9 "\$>NO%)\$;,%12.E%
[Y 4 D%P2K2%M [#>U%a 7\$>% !\$, \ NO%9B,'>U%12.E%
[Y 4 D%J112%MD", '8('> *%Y6+ *, (8NO%9#AA *,%12.1%
[Y 4 D%P2K2%MR#>%966\%d 76>NO%)\$;,%12.1%
[Y 4 D%P2K2%M d#\$>Q

! "#\$%&'(\$%13%

) *+,#\$, -% . / 0%1213

% %

[Y 4 DP . E2L%F'U'(\$;%\$>5%96: '\$;% 4 *5'\$%=5@* ,('8'>U%D6A A#>':\$('6>%9(\$(*U'*8% M9B,'>U%12.30%9B,'>U%12.K0%9B,'>U%12.ON%

=F ! YKJ02L%F'U'(\$;%\$>5%96: '\$;%D6A A#>':\$('6>%9(\$(*U'*8%M)\$;,%12.E0%9B,'>U% 12.30%)\$;,%12.3%\$>5%)\$;,%12.K0%9B,'>U%12.00%)\$;,%12.00%9B,'>U%12.J0%)\$;,%12.J0% 9#A A * ,%12.P0%)\$;,%12.P0%9B,'>U%12./0%9#A A * ,%12./0%)\$;,%12./0%9B,'>U%12120%)\$;,%12120%9B,'>U%121.0%)\$;,%121.0%9B,'>U%1211N%

=F ! YKJ.2L%=5@* ,('8'>U%\$>5%D6A A#>':\$('6>%4\$>U*A *>(%M9B,'>U%12.10%)\$;,% 12.10%9B,'>U%12.E0%)\$;,%12.E0%)\$;,%12.30%)\$;,%12.K0%)\$;,%12.00%9B,'>U%12.J0%)\$;,% 12.J0%9B,'>U%12.P0%)\$;,%12.P0%9B,'>U%12./0%)\$;,%12./0%9B,'>U%12120%9B,'>U%121.0% 9B,'>U%1211N%

=F ! YK//2L%F'U'(\$;%=5@* ,('8'>U%M)\$;,%12..0%)\$;,%12.1N%)_b9%.22.L%96: '\$;% 4 *5'\$0%=5@* ,('8'>U%\$>5%V,\$>5'>U%M)\$;,%12.P0%9B,'>U%12./0%)\$;,%12./N%)_b9%.22.L%a67%(6%4\$,\ *(\$%V,\$>5%#8'>U%96: '\$;% 4 *5'\$%M)\$;,%12120%)\$;,%121.N% %

Db 4 4 E1 . L%D6A A#>':\$('6>%>%(" *%&' ,(#\$;%Z,6#B%M9B,'>U%12. . N%MM>8(,#:(6,%6<% Y* :6,5N%

Db 4 4 E12L%9A\$;,%Z,6#B%\$>5%H*\$A%D6A A#>':\$('6>%M)\$;,%12.2N%MM>8(,#:(6,%6<% Y* :6,5N%

Db 4 4 121L%W>(,6%(6%D6A A#>':\$('6>%H* : ">6;6U-%M)\$;,%122/N%MH=N%

Db 4 4 122L%D6A A#>':\$('6>%\$8%\$%96: '\$;%9:'*>: *%M)\$;,%122PN%MH=N%

Db 4 4 E2 . CL%RAB',':\$;%Y*8*\$, : "%'>%D6A A#>':\$('6>%M9B,'>U%122PN%MH=N%

Db 4 4 EPEL%9B6,(80%D6A A#>':\$('6>%\$>5%D#;(,#, *%M)\$;,%122JN%MH=N%

Db 4 4 E/OL%)\$8"'6>0%D6A A#>':\$('6>%\$>5%D#;(,#, *%M9B,'>U%122JN%MH=N%

Db 4 4 E22L%)6#>5\$('6>8%<6,%9(#5-%6<%R>(*,(\$>A *>(0%D6A A#>':\$('6>%\$>5%96: '*(-% M)\$;,%122ON%MH=N%