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\*\$ : H+=+, \*+!=\$!+, 9(, \*+! '+#&A+%; !\$5!W+9(A&\$%(#19+(-#9!-+%A&\*+!=\$!)\* #>%(##; !  
' &A+%-+!H\$H>#(=&\$, -D!V, !@D)D!) +A&, ! !6D!X(, -\$ , !LS ' -DNI! !/I\* . ")\$/\*&'/?'  
@, <"8\$/; "%<, "%<LHHD!CK2ZCC1ND!<H%&, ?+%!c (=>%+D! [10.1007/ 7 -3-030-1\\_435-3 15](http://10.1007/7-3-030-1-435-3-15)(

89&%W\$?(I!ED6D! I !X+%, (, ' +a! YD!LKO21ND!Y>#=&\*>#>%(#!\*\$ : H+=+, \*+!&, !?+%\$H-; \*9\$#?; DIV, !  
.D6D!)&\*9=+, W+%?!I!@DGD!Y (-I!@DED!8(%H+, =+%I! I !^D!) \$+W(\*9! k +=9+##!LS ' -DNI!A>' < '\* . @//B'/?': %\$\*\$: "%9, ;/4&7:</%/97C'D/%EF'O&)/; 7'"\* . '&")I&'/?')<, '?\$, % . "'\* . '  
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6--\$\*&(=&\$, D [9=H-7UU '\\$&D\\$?U20D20C3U2PP1MZ000!](http://9=H-7UU '$&D$?U20D20C3U2PP1MZ000!)

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+55+\*=&A+!\*\$ : H%+9+, -&A+!-; -=+ : !\$5!\*(%+D!V, !@D6D!<=%\$>#! I !gDYD!@#(>!LS ' -DN!5<, ' &7&), #/'/?': "; , '<'\*. @//BF'5; '\*&?;/; #\*\$9'#, \*)"'<, "%<'&, ;8\$: , &'/?/; ': <\$% . ; , \*C'7/I)<C'  
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Y(%=&, +a! j D!LKO0MND!<+%A&\*+!-\$5!/ \$>9!(, ' !=9+&%" ( : &#&+-!&, !E&A+%-+!  
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! X+%, (, ' +a! YDI! ` +%?\$, ! j D!<DI! I !Y ( ; \$!^D!LKO0MND! Y\$, &=\$%&, ?!5&' +#&-; !-\$!-; -=+ : !  
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&, ;8\$: , &'I : : , &&?I%'&, ;\$, &C'! KOL'4I@G'\*/G'MNOPEQ!LHHD!2ZKKN!G( : H(I!) ?!B, &A+%-&=& ;!  
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G(%&, ?!8+, =+%!5\$%!89&# ' %+, h-!Y+, =(#!X+(-#9D!

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8(##+d(-I! I !ED!Y\$F+%; !LS ' -DND!LKO0JND!HI"#\$\*\$9'<, ', &, " ; : <'@ '&, '&144/; )\$\*9'  
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<, "%<'&, ;8\$: , &'I : : , &&?I%'&, ;\$, &C'! KOL'4I@G'\*/G'MNOPEQ!LHHD!2C3Z21PND!G( : H(I!) ?!

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"%&+' : (, I!\_DI!@+-=I! j DI!6% : -=%\$, ?!YDI!E>\*9, \$F-i &I!6DI!SA(, -I!YDI!X+%, (, '+a!YDI!  
X\$' ?+-I!<DI! I! j >=(-9I! j DI!LK00CND!89&#! : +, =(#!9+(#-9!HS#&\*; G'V, !@D)D!) +A&, I!^D!  
. +=%&#(I! I! j DED!X+, , +--; !LS' -DN!K, \*)''%<, ''%)<'&, ;8\$:, &F'A'4I!@\$: '<, ''%)<'4, ;&4, :)\$8, '  
LK !+' DN!LHHD!2KOZ21CND! c+F! / \$%i!c / ?!4R5\$%'!B, &A+% -&=; !. %+-=D!

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X+%, (, '+a!YD! I!X\$' ?+-I!<DI!LK002ND!V, =%\$'>\*=&\$, D!V, !YD!X+%, (, '+a! I!<DI!X\$' ?+-!LS' -DNI!  
+, 8, %/4\$\*9'/I): /# , '&); ''), 9\$, &'\$\*': <\$%. ; , \*R&'#, \*)''%<, ''%)<LHHD!RR&&&ZRR&&ND!  
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X+%, (, '+a!YD! I!X\$' ?+-I!<DI!LK002ND!G9+\$%; QW(-+'!(\*\*\$>, =(W&#&=; D!V, !YD!X+%, (, '+a! I!<DI!  
X\$' ?+-!LS' -DNI!+, 8, %/4\$\*9'/I): /# , '&); ''), 9\$, &'\$\*': <\$%. ; , \*R&'#, \*)''%<, ''%)<LHHD!K2Z  
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X+%, (, '+a!YDI!X\$' ?+-I!<DI! c+- : (, I!GDI! I!\_&, ?+&-+, I!XD!) DI!LK002ND!"&, '&, ?-!5\$ : !=9+!  
89&, -+?>=!%+=%+(=DI!V, !YD!X+%, (, '+a! I!<DI!X\$' ?+-!LS' -DNI!+, 8, %/4\$\*9'/I): /# , '  
&); ''), 9\$, &'\$\*': <\$%. ; , \*R&'#, \*)''%<, ''%)<LHHD!CZKOND!@(#=& : \$%+I!YE7! . (>#!6D!@%\$\$i+-!  
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X+%, (, '+a!YD! I!X\$' ?+-I!<DI!LK000ND!E+-&? , &, ?I!& : H# : +, =&, ?I!(, '!>-&, ?!\*9&#!'\$>=\$ : +-!  
: +(->%+ : +, =!-; -=+ : -D!) +-=\$, -!#+(%, +'!(=!9+!89&, -+?>=\$>=\$ : +-!%+=%+(=I!V, ! j D YD!  
8\$>?9#&, !LS'9+\$%;

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X+%, (, ' +a! YDI! 6% : -=%\$, ?! YDI! g%+, I! 6D) DI! 1 ! ^\$9, -\$ , I! YDXD! LK023ND! c (=k\$, (#!->%A+; ! \$5!!  
-=(+!\*9k# '%+, h-! : +, =(#!9+(#-9! ' &%+\*=\$%-7! 8>%+, !=-(=>-!(, '!5>=>%+!' &%+\*=\$, -D!T/I; \*"'%  
/'6, <"8\$/; "'0, '"')<'S, ;8\$: , &' '\* . 'W, &, " ; : <I!NMI!CQKPD!  
' \$&720D2003U-22P2PZ02JZ012PZ; !!

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SA(, -! YDI! @%>, -! SDI! 6% : -=%\$, ?! YDI! X\$ ' ?+-I! <8! X+%, (, ' +a! YDI! LS ' -DN! LK02JND! c +F!  
5%\$, =k+%-!&, !W>&# ' &, ?! : +, =(#!I!+ : \$=k\$, (#I!(, '!W+9(A&\$% (#19+(#-9!5\$%!\*9&# ' %+, !(, '!  
; \$>=9!V, =%\$ ' >\*=\$, !=\$!-9+!-H+\*k(#!-+\*=\$, D!A #, ; \$: " \*T/I; \*"'%/'?X; )</4&7: <\$"); 7D!  
VYLKNI'20CZ20MD!'  
' \$&d20D20C3U\$%=000021P!

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8(##+d(-I!) D YDI! X+%, (, ' +a! YDI! c+- : (, !GDI! 1 ! Y\$F+%; I! ED! LK02OND! 8%+(=k, ?!(!5%\$, =!H\$%\*9!!  
&, !-; -=+ : -!\$5!\*(%+7!V : H%\$A&, ?!( \*\*+--!-\$!W+9(A&\$% (#19+(#-9!-+!A&\*+-!5\$%! ' &A+%-+!  
\*9&# '%+, !(, '!5( : &#&+-D!H8 " "I ")\$/\*"'\* . '>; /9; " # '>% " \*\$\*9C'ZC'CKDC1D!  
' \$&7!20D202JUd+A(#H%\$?H#( , DK000D01D020!

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X+%, (, ' +a! YDI! c+- : (, !GDI! Y\$F+%; I! EDI! 6 \*+A+ ' \$Z. \$#( i \$A&\*9!VD! EDI! 1 ! 8(##+d(-I!) D! YDI!  
LK00ND! 8>#>%(#!\*\$ : H+=+, \*+7! 6!#k+=%(=>%+!%+A&+F!(, '!\*\$, \*+H=>(#! : \$ ' +!5\$%!  
H-; \*9k(=%&\*!(, '! : +, =(#!9+(#-9!-+%A&\*+-D!>&7: <\$"); \$: 'S, ; 8\$: , &C'YOC'20PJZ010D!  
' \$&7!20D223JUH-DK000D JODMD20PJ!

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c+- : (, !GDI! @ (= \*9+I! 8DI! 1 ! X+%, (, ' +a! YDI! LK003ND! G9+\$%; ZW(-+ ' !+A(#> (=k\$, ! \$5!(  
\*\$ : H%+9+, -&A+!) (=k, \$!+ ' >\*(=k\$, !k, &=k(=kA+7! 6 , !k, =+%( \*=-kA+!+A(#> (=k\$, !(HH\$(\*9D!  
H8 " "I ")\$/\*"'\* . '>; /9; " # '>% " \*\$\*9C'ZOC'KJ3ZKM2D!  
' \$&7!20D202JUd+A(#H%\$?H#( , DK003DOPDOOP!

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X\$ ' ?+-I! <DI! X+%, (, ' +a! YDI! . &, =!I! 6DI! 1 ! Baa+##! 8D! LK003ND! G9+!>-+! \$5! \>( #k(=kA+! : +=9\$ ' -!  
&, !-; -=+ : -!\$5!\*(%+!%+-(%\*9!m@%&+5!%+H\$%=nd!T/I; \*"'%/'?6, <"8\$/; "'0, '"')<'S, ;8\$: , &' [ '  
W, &, " ; : <C'ZMLPNI' CJ2ZCJMG'  
' \$&7!20D2003U-22P2PZ003ZOOM3ZR!

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^>#k(, I! ED 6DI! X+%, (, ' +a! YDI! 1 ! X\$ ' ?+-I! <D! LK00JND! SR+ : H#( % -! \$5! \*\$ : : >, & ; !H% (\*=-k\*+D!  
' A# , ; \$: " \*T/I; \*"'%/'?3 / # # I \*\$) 7' > & 7: < / % / 97C'ZVC'2P2Z2PKG'  
' \$&d\$% ?U20D2003U-20PJPZ00JZ003CZO'

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X+%, (, ' +a! YDI! 1 ! X\$ ' ?+-I! <D! LK00JND! 6HH#; &, ?!(!-9+\$%; ! \$5! \*9(, ?+!(HH\$(\*9!=\$!  
&, =+%( ?+ , \* ; !H#( , &, ?!&, !\*9&# ' ! : +, =(#!9+(#-9D!A #, ; \$: " \*T/I; \*"'%/'?3 / # # I \*\$) 7'  
>&7: < / % / 97C'ZVC'2J1Z231G' ' \$&7!20D2003U-20PJPZ00JZ003OZ3!

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SA& ' +, \*+ZW(-+ ' !=%+(= : +, =-!&, !=9+!5k+# ' 7! 6 !W%&+5!%+H\$%=!\$, !H%\$A& ' +%! i , \$F#+ ' ?+I!  
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ZC'KPPZK1CD! ' \$&7!20D2003U-22P2PZ001ZOOMZOD!

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' \$&720D20KCU@7^8 " <D00000PP3K3DOCKJ2D01!  
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/ ( : H\$#- i ( ; ( !<DI! c+- : (, !GD! YDI! X+%, (, ' +a! YDI! I ! j \$\*9! ED! LK00PND! B- &, ?! \*\$ , \*+H!  
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<+H9+, -I! \_D) I! X\$# ' +, !SD k DI! I ! X+%, (, ' +a! YD! LK00PND! <; -+ : Z\$5Z\* (%+! H% (\*=&\*+! %A&+F!  
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T/I; \*"'/?'3 <\$%. ''\* . ' ! "#\$%7'S) I. \$, &C'EZC'230Z202D!  
' \$&720D20KCU@7^8 " <D000002130JD33P03D\*W'  
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X+%, (, ' +a! YD! LS ' ND! LK00CND! V, =% '\$ > \*=&\$ , !- \$! -9+! -H+ \* & (#! -+ %&+ -! \$ , !\*9&# ' %+, h-! : +, =( #!  
9+(#9D! T/I; \*"'/?'H# /) \$/ \*"' '\* . '6, <"8\$ /; "'%+ \$& /; . , ; &C'EEC'ZCPD!  
9=H-7UU ' \$&\$% ?U20D2233U20JCPKJJOC02200202!  
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X\$ ' ?+ -I! <DI! X+%, (, ' +a! YDI! I ! c+- : (, !GD! LK00CND! 6! ' +A+#\$H : +, =( #! 5% ( : +F\$% i 5\$%!  
\*\$##(W\$ ( =&\$ , !&, !\*9&# ' Z-+ %A&, ?! ( ?+ , \* &+ -D! T/I; \*"'/?'3 <\$%. ''\* . ' ! "#\$%7'S) I. \$, &C'EMI!  
K02ZC01D! 9=H-7UU ' \$&\$% ?U20D20KCU6720KCOM3320J22!  
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) \$> %&+! VD! I ! X+%, (, ' +a! YD! LK00CND! 6! 9& -=\$%&\* (#! H+ % -H+ \* =&A+! \$ , ! , (= &\$ , (#! \*9&# ' ! : +, =( #! 9+ (#-9!  
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9=H-7UU ' \$&\$% ?U20D2233U20JCPKJJOC0220020K!  
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"%&+ ' : (, ! \_D) I ! X+%, (, ' +a! YD! LK00KND! G9+!, (= &\$ , (#! +A (#> (= &\$ , ! \$5! -9+! \*\$ : H%+9+ , -&A+!  
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\*\$ : : +, =( % ; G'3 <\$% . ; , \*=&'S , ; 8\$ : , &F'S / : \$ "'> / % \$ : 7C'W , &, " ; : <C' '\* . ' > ; " : ) \$ : , C' \ C! J3Z3PD!  
' \$&720D2K03U<21CKJ02M8<0102oJ!  
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LK002ND! B- +! \$5! -9+! - ; -+ : ! \$5! \* (%+! H% (\*=&\*+! %A&+F !&, !-9+! , (= &\$ , (#! +A (#> (= &\$ , 7!  
SA (#> (= &, ?! -9+! 5& ' + #&= ; ! \$5! H% (\*=&\*+! = \$! - ; -+ : ! \$5! \* (%+! H%& , \* &H#+ -D! T/I; \*"'/?'H# /) \$/ \*"' '\*  
''\* . '6, <"8\$ /; "'%+ \$& /; . , ; &C'UC!PCZ1KD!  
9=H-7UU ' \$&\$% ?U20D2233U20JCPKJJ0200000201!  
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X+%, (, ' +a! YD! LK00OND! B- &, ?! # \$ ? &\*! : \$ ' +#! (, ' !H\$?% ( : !-9+\$% ; !- \$! W> &# ' ! \$> = \$ : +!  
(\* \$> , =( W&#&- ; D! H. I. " ) \$/ \*"' '\* . '5 ; ; " ) # , \* ) / ? '3 <\$% . ; , \*I! MZC! KPQPOD!  
9=H-7UU F F F Dd = \$ % \$ % ? U = ( W # + U P K M O O J O 2 !  
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>%"\*\*\$\*9C'MMI!2CZKOD!9=H-7UU '\$&D\$%?U20D202JU<02POZ32MOLOMN000CJZJ!

X\$' ?+-I!<D! I !X+% , ( ' +a! YD!L2000ND!X\$F!\$%?(, &a(=&\$, (#!\*>#=>%+!&, 5#>+, \*+-\$>=\$ : +!  
&, 5\$% : (=&\$, !>=&#&a(=&\$, D!H8""I")\$/\*\*"\* . '>:/9;""# '>%"\*\*\$\*9C'MMC!2MCQ203D!!  
'\$&7!20D202JU-02POZ32MOLOON00001Z2D!

X+%, ( ' +a! YD!LS 'DN!L200MND!<H+\*&(#!&->+!+ ' &=\$%7!<; -+ : !(\*\$>, =(W&#&=: !&, !\*9&# ' %+, h-!  
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X+%, ( ' +a! YD!L200MND!<H+\*&(#!&->+!+ ' &=\$%h-! , \$=+D'T/I; \*"'/'?'6, <"8\$/; ""'0, ""')<'S, ;8\$: , &' '\* . 'W, &, "; :<C'M\!2CKZ2CPD!9=H-7UU '\$&D\$%?U20D2003U@ "OKKM3P3P!

X+%, ( ' +a! YDI!X\$' ?+-I!<DI! I !8 (-\*(% &I! YD!L200MND!G9+!+\*\$#\$?; !5!\$>=\$ : +-7!<; -+ : !  
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S, ;8\$: , &' / 'W, &, "; :<I!M\C!2CJQ210D!9=H-7UU '\$&D\$%?U20D2003U@ "OKKM3P3J!

V\*9&, \$-+I!8D! j DI! j &, ? '\$, I!ED! k DI! I !X+% , ( ' +a! YD!L200PND!E+A+#\$H&, ?!\*\$ : : >, &=: !  
(#=#, (=&A+!=\$!?'\$>H!9\$ : +!H#( \*+ : +, =!5\$%!<SE!-H+\*&(#!+ '>\* (=&\$, !->' +, =-!&, !-9+!  
' +, =>%(!8\$>, =; !-; -+ : !5\$!\*(+D!T/I; \*"'/'?'3<\$%. ""\* . '!' "#\$%7'S)I . \$, &C'ZC!20CQK20D!  
9=H-7UU '\$&D\$%?U20D2003U@ "OKKCP0J3!

^\$% ' (, I!ED!ED! I !X+% , ( ' +a! YD!L2000ND!G9+!` +, =>%(!H#(, , &, ?! : \$' +#7!6!H#\$H\$-(#15\$!  
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\$1E1-113!, -D.FG1B!.2!C-1BB!

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Y(%=&, +a! j DI!8(##+d(-I!)D YDI! I !X+% , ( ' +a! YD!LKO20ND!8\$ : : >, &=: Z'+5&, +'!+A&' +, \*+7!6!  
eW\$=\$ : !>Hf!W+9(A&\$%(#!9+(#-9!)(H#\$( \*9!=\$! : +(->%+!eF9(=!F\$%i-f!&,!) (=&, \$!  
\*\$ : : >, &=&+D!W, 4/;)'/\*'H#/)\$/\*\*"' [ '6, <"8\$/; ""'+&/; . , ;&'\$\*'^/I)<C!EOL2NI!22Z2JD!

X\$' ?+-I!<D! I !X+% , ( ' +a! YD!LS ' -DN!LK003N!H8""I")\$/\*'14. ), F'(/9\$: '#/ . , %&' '\* . '  
:/## #I\*\$)7'4%"\*\*\$\*9G'\_\*\$iA&##+I!YE7'c (=&\$, (#!SA(#>(&\$, !5!-9+!8\$ : H%+9+, -&A+!  
8\$ : : >, &=: !Y+, =(#!X+(#-9!<+&A&\*+-!5\$%!89&# ' %+, !(, '!-9+&%" ( : &#&+-! . %\$?%( : DI!

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5<, '\$\*); & ; )\$/\*\*/'?' , 8\$. , \* : , P@"&, '4;":): , &' '\* . ':I%)I; ""':/#4, ) , \* : , '\$\*':<\$% . ; , \*R&  
# , \*)"'<, ""')<'G( : H(I!)?B, &A+&-&=: !5!<\$>=9!"#\$%&' (I) )\$>&-!'+!#(!. (%=+!"#\$%&' (!  
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X+(#-9D!

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Y\*c+&-9I!\_DI!X\$'?+-I!<DI!X+%, (,'+aI!YDI!G&\$=&I!YDI!k (#i+%I!8DI!\_&??I!j DI!I!<& : :\$, -I!8D!

LK02JND!K"B\$\*9':/\*\*, :)\$/\*&'?/;'#, \*)"'% '<, "%)29.5-2292Tm/TT6ITf (88)TjETQ@.204.2587., "% -D

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!)7!B,&A+%&=;!\$5!<\$>9!"#\$%&'(I!)\$>&-!'+'#!.(%="+!"#\$%&'(!Y+,#(X+(#-9!V,-&=>=+I!  
!E+H(%=:+,#\$5!89&#!('!'("(:&#!<=>'&+-D!  
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X\$'?+-I!<DI!X+%,( '+aI!YDI!1!)&H&+,I!)D!LKOOCND!6";\$I#'S4;\$\*9&'O/#,'?/;'3<\$%.;,\*F'  
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89&#'%+,h-!Y+,(#!X+(#=9D!!!

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3/\*:,4)'#"44\$\*9';,4/;)D!G(:H(I!" )7!B ,&A+%&=;!\$5!<\$>=9!"#\$%&'(I!)\$>&-!'!#(!.(%+=!  
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Y+,=(#!X+(#-9!V, -=&=>=+I!E+H(%=: +,=!\$5!89&# '!(, '!' ( : &#;!<=>'&+-D!

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X+%, (, '+al!YD! I !@%\$F, I! k D!L200PND! b I ";), ;%7';, 4/;)F'S, ;8\$, '&7&), #'.' "":/%%, :)\$/\*'<br>?;"#, \_/;BF'5<,'#");\$:, &D!G( : H(I!" )7!B, &A+%&-&;!\$5!<\$>=9!"#\$%&' (I!) \$>&-!' +!#(!<br>.(%=+!"#\$%&' (!Y+,=(#!X+(#-9!V, -=&=>=+I!E+H(%=: +,=!\$5!89&# '!(, '!' ( : &#;!<=>'&+-D!

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X+%, (, '+al!YDI! \_\$+W>\*iI!)DI! \_\$??+, W(> : I!<DI!<H\$\$I!YDI! I !@%\$\$i-I. D!L200PND! ^, ";')\_/'<br>;, 4/;)'/?!%/;\$: ."R&'&"), \_\$. , %/: "%&7&), #'&);"), 97'\$#4%, #, \*)")\$//\*'9;"\*)D!G( : H(I!" )7!B, &A+%&-&;!\$5!<\$>=9!"#\$%&' (I!) \$>&-!' +!#(!. (%=+!"#\$%&' (!Y+,=(#!X+(#-9!V, -=&=>=+I!  
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S, ;8\$\*9', 8, ;7/\*, ''')<, ')''@%, F'S);'), 9\$, &'?/;', \*<"\*:\$\*9')<, "'8"\$"\$@\$)7'/?':I%)I; ""%7'  
:/#4, ), \*)'#, \*)''<, ''%)<'&, ;8\$: , &G'G( : H(I!" )7!B, &A+%-&=; !5!<\$>=9!"#\$%&' (I!8\$##+?+!  
\$5!@+9(A&\$\$(#!(, '!8\$ : :>, &=; !<\*&+, \*+!-I) \$>&-!' +!#(!. (%=+!"#\$%&' (!Y+, =(#!X+(#-9!  
V, -&=>=+I! \_+++(%\*9! 1!G%(&, &, ?!8+, =+!5\$%!89&#%' +, h-!Y+, =(#!X+(#-9D!  
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. %&,\*+!V, &-I!^DI! 1!X+%, (, '+aI! YD!LK00OND!" 6<<G!& : H#++ : +, =(=&\$, !-\$\$#i&=D!  
J+, 8, %/4\$\*9'I&)"\$\*""@%, '\$\*?;'&);I:)I; , '\$\*&I44/;)'/?'cI""\$)7'?\$, %P@''&, . '4;":):, '  
&, ;\$, &C'! K O L'd'MNVP\QG!G( : H(I!" )7!B, &A+%-&=; !5!<\$>=9!"#\$%&' (I!8\$##+?+!\$5!  
@+9(A&\$\$(#!(, '!8\$ : :>, &=; !<\*&+, \*+!-I) \$>&-!' +!#(!. (%=+!"#\$%&' (!Y+, =(#!X+(#-9!  
V, -&=>=+I!E+H(%=: +, =!\$5!89&#!(, '!'( : &#; !<=>'&+-D!  
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8(##+d(-I!)D)YDI! c+- : (, !GDI! Y\$F+% ;!EDI! 1!X+%, (, '+aI! YD!LK00MND!3; , ")\$\*9'""?;/\*)'4/; :<F'  
S);"), 9\$, &'?/;'#\$4;/8\$\*9'"" : :&&)/# , \*)''<, ''%)<'&, ;8\$: , &G'G( : H(I!" )7!B, &A+%-&=; !5!  
<\$>=9!"#\$%&' (I!) \$>&-!' +!#(!. (%=+!"#\$%&' (!Y+, =(#!X+(#-9!V, -&=>=+I! \_+++(%\*9! 1!  
G%(&, &, ?!8+, =+!5\$%!89&#%' +, h-!Y+, =(#!X+(#-9D!  
!

X(%H+%I! YDI!X+%, (, '+aI! YDI! c+- : (, !GDI! Y\$F+% ;!EDI! k \$%=9&, ?=\$, I!^DI! 1!V-(((\*-I! YD!  
LK00JND!X;9"\*\$`")\$/\*""':I%)I; ""%:/#4, ), \*.:, F'A';, 8\$, \_ '/?''&&, &&# , \*)'4;/)/:/%&'  
JK "B\$\*9':<\$%. ; , \*=&'# , \*)''<, ''%)<'&, ;8\$: , &'I: : , &&?I%&, ;\$, &C'! K O L'4I@G'\*/G'MNOPMQD!  
G( : H(I!" )7!B, &A+%-&=; !5!<\$>=9!"#\$%&' (I!) \$>&-!' +!#(!. (%=+!"#\$%&' (!Y+, =(#!X+(#-9!  
V, -&=>=+I! \_+++(%\*9! 1!G%(&, &, ?!8+, =+!5\$%!89&#%' +, h-!Y+, =(#!X+(#-9D!  
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X+%, (, '+aI! YDI! c+- : (, !GDI!V-(((\*-I! YDI!8(##+d(-I!)D)YDI! 1!Y\$F+% ;!ED!LS' -DND!LK00JND!  
HI"#\$\*\$\*9')<, ;, &, " : :<'@''&, '&I44/;)\$\*9':I%)I; ""%7'/#4, ), \*)':<\$%. ; , \*=&'# , \*)''  
<, ''%)<'&, ;8\$: , &G'JK "B\$\*9':<\$%. ; , \*=&'# , \*)''<, ''%)<'&, ;8\$: , &'I: : , &&?I%&, ;\$, &C'! K O L'  
4I@G'\*/G'MNOPEQD!G( : H(I!" )7!B, &A+%-&=; !5!<\$>=9!"#\$%&' (I!) \$>&-!' +!#(!. (%=+!"#\$%&' (!  
Y+, =(#!X+(#-9!V, -&=>=+I! \_+++(%\*9! 1!G%(&, &, ?!8+, =+!5\$%!89&#%' +, h-!Y+, =(#!X+(#-9D!  
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X+%, (, '+aI! YDI! k \$%=9&, ?=\$, I!^DI! 1!E(A&-I!8D!LK001ND!K, "&I;\$\*9')<, '?\$. , %\$)7'/?'&, ;8\$: , '  
4""\*\*\$\*9'""\* . . , %\$8, ;7)'/&7&), #'/?':"; , '4;\$\*:\$4, &F'5<, '&7&), #'/?':"; , '4;":):, '  
; , 8\$, \_ 'JSX3>WQD!G( : H(I!" )7!B, &A+%-&=; !5!<\$>=9!"#\$%&' (I!) \$>&-!' +!#(!. (%=+!"#\$%&' (!  
Y+, =(#!X+(#-9!V, -&=>=+I!E+H(%=: +, =!\$5!89&#!(, '!'( : &#; !<=>'&+-D!  
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X+%, (, '+aI! YDI! 1!XS' ?+-I!<DI!LK001ND!3; ""?)\$\*9%/9\$:'#/ . , %&'?/;'&7&), #&'/?':"; , F'L. , ""&'\$\*)/'  
":)\$/\*'J; , 8G', . Q'JK "B\$\*9':<\$%. ; , \*=&'# , \*)''<, ''%)<'&, ;8\$: , &'I: : , &&?I%&, ;\$, &C'8/I# , '  
EQD!G( : H(I!" )7!B, &A+%-&=; !5!<\$>=9!"#\$%&' (I!G9+!) \$>&-!' +!#(!. (%=+!"#\$%&' (!Y+, =(#!  
X+(#-9!V, -&=>=+I!  
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X+%, (, '+aI! YDI! 1!XS' ?+-I!<DI!LK001ND!+\$&, i""\* . /#/. , %/&%j9\$:/&'4"; ""%&'&(\$&), #''&' . , '  
:I\$. " . /F'L. , ""&' , \*"" : :\$j\*J, . G'W, 8GQ'JS, ;\$, %/9; ""\* . /&, ;8\$: \$/&' , I\$)/&/&'4"; ""%''  
&'%I . /# , \*)''&' . , ""''\*\$i , `C'8/I# , \*'EQD!G( : H(I!" )7!B, &A+%-&=; ('!' +!#(<=>'!' +!#(!"\$%&' (I!  
V, -&=>=\$! . (%(!#(<(>'!' Y+, =(#!' +!#(!"\$%&' (I) \$>&-!' +!#(!. (%=+D!!  
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X+%, (, '+aI! YDI! 1!XS' ?+-I!<DI!LK00CN!3; ""?)\$\*9%/9\$:'#/ . , %&'?/;'&7&), #&'/?':"; , F'L. , ""&'

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\$\*)/'':)\$/\*G'JK "B\$\*9':<\$%.;, \*=&'#, \*)"'%<, "%<'&, ;8\$:., &'&I:., &&?I%'&, ;\$, &c'8/%I#, 'EQG!  
G( : H(I!" )7!B, &A+%-&=;!\$5!<\$>=9!"#\$%&' (I!) \$>&-!' +!#(!. (%=+!"#\$%&' (!Y+, =(#!X+(#=9!  
V, -=&=>=+D! 6A(&#(W#+!\$, #&, +!  
9=H7UU\*5-D5 : 9&D>-5D+'>UG S 6 EU 8 YX-+%&+-UV'+(-&,-\$6\*=&\$,UV'+(-&,-\$6\*=&\$,. %&, =DH  
'5D!

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X+%, (, '+a!YDI! I!X\$' ?+-I!<DI!LKOOCND!+\$&, i"\*./'#/., %/&%j9\$: /&'4"; "%/&'&\$&), #''&'. , '  
: I\$. "/FL., "&', \*"'': \$j\*G'JS, ;\$, %/9; "\*./'&, ;8\$: \$/&', I\$)/&/&'4"; "%''&'&I. '#, \*)"'%'  
. , "%''\*\$i, `c'8/%I#, \*'EQG'G( : H(I!" )7!B, &A+%-&' ('!' +#!<>%!' +!#(!"#\$%&' (IV, -=&=>=\$!  
. (%(!#(!<(#>'!Y+, =(#!' +!#(!"#\$%&' (!) \$>&-!' +!#(!. (%=+D!E&-H\$, &W#+!+, !+-H(r\$#7!  
9=H7UU#\$?&\* : \$' +#D5 : 9&D>-5D+'>U 8 YX-+%&+-UV'+(-&,-\$6\*=&\$,o-H(, &-9D9= : #!

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k \$%-9&, ?=\$, I!^DI!X+%, (, '+a!YDI!"%&+' : (, !@DI! I!Baa+##I!E!LKO02ND!(, ", \*\$\*9'?;/#'

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<1KBC,C1-!\* -D.FG1B!

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X+%, ('+a!YD!LK02MI!Y(;!2OND!"\$\*>-!\$,!i&'-h! :

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LG6N!=9(=!% (F-\$,!, (=k\$, (#!%+?&\$, (#!(, '#\$\*(#1+RH+%&-+!=\$!W>k# '!=9+!\* (H(\*&=;!\$!?!% (, =++-!  
(, '!-=%+, ?=9+, !=(=+!(, '#\$\*(#1e&, Z9\$>-+f!G6!\* (H(\*&=;D!G9+!G6!c +=F\$%i!W\$=-9!F&=9&, !&=-!  
#+( '+%-9&H!(, '!-(=55&, ?!+R+: H#k5&+!-; -+= !:\$!\*(%+!A(#>+-\$!W+&, ?!5( : &#;Z '%&A+, !; \$>=9Z  
?>&' + 'I(, '!\*>#>%(##;! (, '!#&, ?>&-&\* (##;!\* \$ : H+=+, =I(, '!&-!\* \$ : : &=+ ' !-\$!H\$A&' &, ?!  
&, '&A&' >(##a+ 'I!-=%+, ?=9-ZW(-+'!(, '!+55+\*=&A+!G6!=\$!-9+!<48!?!% (, =+!-=(=+! (, '!  
\*\$ : : >, &=&+D!!G9+!G6!c +=F\$%i!W%&, ?-!=\$?+=9+%(, !+R=%(\$% ' &, (% ;!H(%=, +% -9&H!\$!-9+! : \$=-!  
+-=++ : +'!, ( : +-!&, !<48!&, !=9+!B, &=+ ' !<=(=+! (, 'I!=\$?+=9+!F&=9!&=-!+R=+, -&A+!(, '!  
\*\$ : H%+9+, -&A+!H\$!\$!\$!\* \$, ->#=(, =-I!=\$!+H%+--+, =!(, !+R\*+H=&\$, (#!=( : !:\$!+RH+%=-!% (, -#(=&, ?!  
&, \$A(=&A+!%++(%\*9(, '!H%(\*=&\*+!&, =-\$!+(#&=; !5\$!(, '!F&=9!\$>!, (=k\$, h-!\*9&#%' +, !; \$>=9!(, '!  
5( : &#&+D!!6 : \$>, =7!]KOJ1CK!

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**6-.2F.C, G!%2M1BD.J, D/ -!N ' , -F75!PQRP!Y!ZH215!PQRXV8!E+H(%= : +, =!\$!89&# ' ! ! " ( : &# ; !  
<=> ' &+-I!) \$>&-' +!#(!. (%=+!'#\$%&' (!Y+, =(#!X+(#9!V, -=&=>+I!8\$##+?+\$!5!@+9(A&\$%#(, '!  
8\$ : : >, &=; !<\*&+, \*+-I!B, &A+%&=; !:\$!<\$>=9!"#\$%&' (D!Y (--(\*9>+==<; -+ : !:\$!8(%+! . (%=\*&\*+!  
\_+A&+F!LY6!<48 . \_ND!G9+!H>H\$-+!\$!-9&-!H%\$d+\*!&-!=\$!H%\$A&' +!(, (#; -&-!\$!-=(+ZF&' +!  
<48 . \_!' (=(\$!%+9+!<=(=+!\$!Y (--(\*9>+==<(, '!G+\*9, &\* (#!6--&=(, \*+!8\$##(W\$% (=k\$+!LG68ND!  
G9&-!H%\$d+\*!F&##!9+H!&' +, =k5; !=%+, '-!(, '!SHH\$=>, &=&-!5\$!H%\$?%( : !& : H%\$A+ : +, =!(=+9+!  
-=(+!#A+#!6 -!H(%=\$!-9&-!H%\$\*+--!( !' (=(\*\$##+\*=&\$, ! (, '! ' (=(!=\$% (?+!H%\$\*+--!F&##!W+!  
' +A+#\$H+ ' !F9&\*9!F&##!(##\$F!5\$!\* \$ : H(%&-\$, -!\$! ' (=(!=%+, '-!\$A+%!& : +D!6 : \$>, =7!]PKIK1OD!  
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**6-.2F.C, G!%2M1BD.J, D/ -!NZHG[5!PQRR!91F1O11-5!PQRXV8!S=(W#&-9+ ' !=9+!c (=k\$, (#!\_+-(%\*9!  
(, '!SA(#>(=k\$, !8+, =+!5\$!XV . / !B<6D!!G9+!\*+, =+%!&-!+-(W#&-9+ ' !F&=9!(?!&5=\$!\$ : \$, +; !  
5%\$ : !XV . / B<6!-\$!\$A+%+#!(!, (=k\$, (#!%+-(%\*9!-=(+? ; !&, !=9+!(%+(-!\$!+(%# ; !  
\*9&# ' 9\$ \$ ' U5( : &# ; !#&=+% (\* ; ! (, '!+(%# ; !\*9&# ' 9\$ \$ ' !'+A+#\$H : +, =D!6 : \$>, =7!]10I000!5>, ' + ' !W ; !  
XV . / !B<6!(, '! ]32IO10!5>, ' + ' !5\$ : !455&\*+!\$! \_+-(%\*9! 1 IV, , \$A(=&\$, !(=+9+!B, &A+%&=; !  
\$!<\$>=9!"#\$%&' (D!E+H(%= : +, =!\$!89&# ' ! ! " ( : &# ; !<=> ' &+-I!8\$##+?+\$!5!@+9(A&\$%#( ! !  
8\$ : : >, &=; !<\*&+, \*+-I!B, &A+%&=; !:\$!<\$>=9!"#\$%&' (D!  
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**6-.2F.C, G!%2M1BD.J, D/ -!N\* C-.G5!PQRPT!ZH215!PQRXV8!Y (--(\*9>+==-'!\$ \$, =! . \$%\*9!<=>' ; D!6!  
-kRZ : \$, -9!\*\$, =% (\*=\$!\$! \$\* > : +, =!9\$F!8\$ : : >, &=; !<+%A&\*+!6?+, \*&+-(%+!( ' (H=&, ?!-9+!  
F%(H(\$>, '!-+%A&\*+!IV, +=, -&A+!8(%+!8\$ \$ \$ ' &, (=k\$, I!\* \$ : W&, + ' !F&=9!" ( : &# ; !. (%=, +% !-+%A&\*+!  
=\$! : ++=+9+!, ++ ' !-\$!\*>#>%(##; I!+=9, &\* (##; I!(, '!#&, ?>&-&\* (##; !' &A+%+!5( : &#&+!&, !=9+&!  
\*\$ : : >, &=&+!&, !=+% : -\$!(\*+--I!\>(##=; I(, '!\$>=\$ : +-\$!+!+A&\*+D!">, ' + ' !W ; !=9+!  
8\$ : : \$, F+(#9!\$!Y (--(\*9>+==<I!E+H(%= : +, =!\$!Y+, =(#!X+(#9!<+%A&\*+D!6 : \$>, =7!  
]J3IOJMD!  
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**6-.2F.C, G!%2M1BD.J, D/ -!N ' , -F75!PQQ\TZH215!PQRQV8!E+H(%= : +, =!\$!89&# ' ! ! " ( : &# ; !<=> ' &+-I!  
) \$>&- ' !+!#(!. (%=+!'#\$%&' (!Y+, =(#!X+(#9!V, -=&=>+I!B, &A+%&=; !:\$!<\$>=9!"#\$%&' (D!G!H%\$A&' +!  
=+\*9, &\* (#!(-&=&=(, \*+!->HHS%!=!\$!-9+!6&a\$, (!` &=&\$, !5\$!\*9&# ' %+, ! (, '!-9+!2K!H%&, \*&H(#->H\$, !  
F9&\*9!&=&-!W>k#!=9\$>?9!'+A+#\$H : +, =!\$!(!\*9+&A+!(, '!\*#+(%# ; !(%=&\*>#(=+ ' !=9+\$ ; !:\$!9(, ?+!  
5\$%!=9+!'+&A+%; !:\$!W+9(A&\$% (#!9+(#9!-+%A&\*+!=\$!9&# ' %+, ! (, '!5( : &#&+D!G9+!'+A+#\$H : +, =!\$!  
=9&-!9+\$ ; !:\$!9(, ?+!F&##!\$\* > %!&, !=F!H9(-+D!.9(-+!V!F&##!5( : +!-9+!&, &=&(#!-9+\$ ; !:\$!  
\*9(, ?+!(, '!&, \*\$H\$% (=+!i+; !=(55!%+A&+F!(, '!5++ ' W(\*iD!.9(-+!V!F&##!W+!'+A+#\$H+ ' !&, !' &#&+\*=  
%+-H\$, -+!=\$!-9+!+>#-!\$!-9+!.9(-+!V!H%\$\*+--D!6 : \$>, =7!]31IP31!  
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"#\$%&'(D!eSA(#>(=k\$, !5!=9+!.>+, =+!8\$##(W\$(=kA+!V, k=k(=kA+fD!SA(#>(=k\$, !5!) (=k, \$!k, k=k(=kA+!  
5\$\*>-+ '\$, !k : H%\$A&, ?!(\*\*+--!=\$! : +, =(#!9+(#!9!-+%A&\*+-D!">, ' + ' !W; !8+, =+%!5\$! Y+, =(#!  
X+(#!9!<+%A&\*+-!9%\$>?9!->W\*\$, =( \*!=!\$" ( : k#; !<+%A&\*+!6 -- \$\*k(=k\$, !5!Xk##-W\$\$>?9!8\$>, =;!  
5\$%!\$, +! ;+(%D!\_+5+%++ 'D! 6 : \$>, =7! ]2KKIKPOD!

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6-.2F.C,6!%2M1BD.J,D/ -!

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W;!9+!E+H(%=:+,=!\$5!89&#'%+,!(, '!'(: &#&+-!G(##(9(-++I!"#\$%&'(D!c\$,Z%+5+%++'D!6:\$>,=7!  
]2K0I000D!

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**6-.2F.C,G!%2M1BD.J,D/-!NR^^W!Y!R^^^V8!E+H(%=:+,=!\$5!89&#!1!"(: &#;!<=>'&+-I!\_+++(%\*9!  
(, 'G%(&, &, ?!8+, =+%!5\$%!89&#'%+, [-!Y+,=(#!X+(#9I!)\$>&-!'!+#!(!.(%="!#\$%&'(!Y+,=(#!X+(#9!  
V, -=&=>+I!B, &A+%&-&=;!\$5!<\$>=9!"#\$%&'(D!<=>' ;!&' +, =&5&+'!(, '!+A(#>(=+'!+R+ : H#(% ;!**

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@+9(A&\$%(!X+(#9!E&-H(%&=k+-!F&=9&, !X+(#9!\_+5\$% : !5\$%!Y+, =(#!X+(#9!<+%A&\*+!-!6 " / 6I!  
V, \*DI!<(, !E&+?SI! 8 6D!!

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\$5!-9+\$%&+-!\$5!\*9(, ?+!(, ' !#\$?&\*! : \$'+#!-15\$%!Y (%&(!. &, a\$, I(!\*\$ : : >, &=; !H(%, +%D!X&-H(, &\*!  
<+%A&\*+!8\$>, \*&#I!G( : H(I!" )D!

8\$, ->#=(, =!L^>, +!K020ND! 8\$, ->#=(=k\$, !\$, !=9+!' +A+#\$H : +, !=\$5!(!=9+\$% ; !\$5!\*9(, ?+!5\$%!  
\*>#=>% (!\*\$ : H+=+, \*+I!&, \*#>' &, ?!=+\*9, &\*(!(-&=(, \*+!=\$!->HH\$%=!=9+!8\$>, =; !5\$!\_&A+%&-&' +!  
E+H(%, = : +, !=\$5!Y+, =(#!X+(#9!8>#>%(#!8\$ : H+=+, \*; !. %\$?%( : !&, !' +A+#\$H&, ?!(!=9+\$% ; !5\$!  
\*9(, ?+!5\$%!=9+!+, 9(, \*+ : +, !=\$5!\*>#=>% (!\*\$ : H+=+, \*+!&, !=9+!\$%?(, &a(=k\$, !=9%\$>?9! '\$\*> : +, !=  
%+A&+F-!(, '!F\$%i!F&=9!(!\*\$%+!?\$%>H!\$5!i+; !-(i+9\$#' +%-I!\_&A+%&-&' +! 8 6D!

8\$, ->#=(, =!L6H%&#!K020ND! 8\$, ->#=(=k\$, !=\$!-9+!8\$>, =; !5\$!\_&A+%&-&' +!E+H(%, = : +, !=\$5!Y+, =(#!  
X+(#9!8>#>%(#!8\$ : H+=+, \*; !. %\$?%( : I!\_&A+%&-&' +! 8 6D!

8\$, ->#=(, =!L^<, >( ; !K020ND! 8\$, ->#=(=k\$, !=\$!-9+!8+, =+%!5\$%!\_>%(#!(, '!8\$ : : >, &=; !  
@+9(A&\$%(!X+(#9!6#W>\>+% \>+! c YD!!

8\$, ->#=(, =!L6>?>-!K000ND! 8\$, ->#=(=k\$, !=\$!-9+!S#& : &, (=k, ?!Y+, =(#!X+(#9!E&-H(%&=k+-!  
LSYXEN!)+(' +%-9&H! 6\*( '+ : ; !=9%\$>?9!g+\$%?+=F, !B, &A+%&-&=; !(, '!6 " / 6I!V, \*DI!

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5\$!' +A+#\$H&, ?!(!\*\$ : H%+9+, -&A+!\>(#k=;! : \$, k=\$%k, ?!(, ' !H%(\*=k\*+!k : H%\$A+ : +, =!-; -+= : I!  
.9\$+, &RI!6qD!

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8\$, ->#=(, =!LKOOPZ! . %+-+, =ND! c (=k\$, (#!) (=k\$, \$!@+9(Ak\$\$(#!X+(#-9!6--\$\*k(=k\$, !Lc ) @X6NI!  
8\$\*9k=k!) (i+I! c YD!  
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8\$, ->#=(, =!LKOOCZ. %+-+, =ND! 4, ?\$k, ?!\*\$, ->#=(=k\$, !%+?(% 'k, ?!-9+!\*%+(=k\$, !5!-9+\$%k+-!5!  
\*9(, ?+!(, '!#?k\*! : \$'+#-!5\$!\*\$ : :>, k=k+-!-+%A&, ?!; \$>=9!k, !=(, -k=k\$, !=!( '>#-9\$\$ 'D!  
. (%=, +% -9kH-!5\$! / \$>=9!G%(, -k=k\$, !c (=k\$, (#!G+\*9, k\*(#!6--k=(, \*+!8+, =+!I!) \$>k-!'+!#(!. (%=+!  
"#\$\$k' (!Y+, =(#!X+(#-9!V, -k=>=+!G( : H(I!" )D!  
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8\$, ->#=(, =!G%(k, +%!L^>#; !KOOOND! 8\$, ->#=(=k\$, !%+?(% 'k, ?!5% ( : +F\$%i -!5\$%!SA(>=(k\$, !5!  
. %\$ : k-k, ?!k, =+%A+, =k\$, -!5\$%!6-k(, !6 : +%k\*(, U. (\*k5k\*!V-#(, '+%-!H\$A&'+'!5\$%!8+, =+!5\$%!  
Y+, =(#!X+(#-9!<+%A&\*+-(, '!8+, =+!5\$%!89k#!'X+(#-9!(, '!Y+, =(#!X+(#-9! . \$#k\*; !g+\$%?+=F\$, !  
B, &A+% -k=; !89k#!'E+A+\$H : +, =!8+, =+!I! k (-9k, ?-\$, !E 8D!  
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8\$, ->#=(, =!G%(k, +%!L^>#; !KOOOND! 8\$, ->#=(=k\$, !\$, !5% ( : +F\$%i -!5\$%!+A(>=(k\$, !5!H\$ : k-k, ?!  
k, =+!A+, =k\$, !=(k, k, ?!H\$A&'+'!5\$%!E+A+%>R!V, -k=>=+!5\$!8#k, k\*(#!G%(k, k, ?!(, '!\_+-(%\*9!  
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8\$, ->#=(, =!LY ( ; !200OND! 8\$, ->#=(=k\$, !H\$A&'+'!-\$!-9+!c (=k\$, (#!G+\*9, k\*(#!6--k=(, \*+!  
8+, =+%!%+?(% 'k, ?!(--+-k, ?!(, '! : (ik, ?!%+\*\$ : :+, '(=k\$, -!5\$%! .>+=\$!\_k\*\$h-!89k#!'+, h-!  
Y+, =(#!X+(#-9!@#\$\*i!g%(, =!<(, !^>(, !! .>+=\$!\_k\*\$D!  
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8\$, ->#=(, =!G%(k, +%!L"+W%>( ; !200OND! 8\$, ->#=(=k\$, !%+?(% 'k, ?!\*>#->%(#!\*\$ : H+ +=, \*+!5\$%!  
\*9k#!'+, h-! : +, =(#!9+(#-9!5\$%!c \$>=9!8 (%\$k, (!E+H(= : +, =!5\$!Y+, =(#!X+(#-9!(!c \$>=9!8 (%\$k, (!  
8>#>%(#!8\$ : H+ +=, \*+!V, k=k(=kA+I!\_ (#+k?9!c 8D!  
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8\$, ->#=(, =!L^>( ; !200OND!G+\*9, k\*(#!SRH+=! k \$%i ?%\$>H!Y++=k, ?!(, '!6, (#; --!-!5\$%!  
V : H\$A+!V, 5\$% : (=k\$, !k, !Y(, (?+'!8 (%+!I!@+9+- '(I!YED!  
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8\$, ->#=(, =!L4\*=\$W+%I!20MON! 4, ?\$k, ?!k, AS#A+ : +, =!Fk-9!g+\$%?+=F\$, !B, &A+% -k=; h-!G+\*9, k\*(#!  
6--k=(, \*+!8+, =+![-!8>#>%(#!8\$ : H+ +=, \*+!\_+-\$>\*+!8\$ : : k=++D!g+\$%?+=F\$, !B, &A+% -k=; !  
89k#!'E+A+\$H : +, =!8+, =+!I! k (-9k, ?-\$, !E 8D!  
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SRH+%=!. (, +#!L 6H%&#!2003ND! 8\$, ->#=(=k\$, !%+?(% 'k, ?!W+9(Ak\$\$(#!9+(#-9!(, '!F+#5(%+!-; -+ : !  
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\_+-(%\*9!G%k(, ?#!V, -k=>=+!5\$%!BD<D!E+H(= : +, =!5\$!X+(#-9!(, '!X> : (, !<+%A&\*+I!  
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SRH+%=!. (, +#!L 6H%&#!2003ND!V, =+?%(=k, ?!-+%A&\*+!-!5\$%!\*9k#!'+, !>, '+%! : (, (?+'!\*(%+!I!6@G!  
6--\$\*k(=+-!V, \*DI!5\$%!-9+!8+, =+!5\$%!Y+, =(#!X+(#-9!<+%A&\*+I!8( : W%k' ?+!Y 6D!  
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8\$, ->#=(, =!L"+W%>( ; !2003ND! . %\$A&'+'!\*\$, ->#=(=k\$, !k, !-9+!'A+\$H : +, =!5\$!\$>=\$ : +!  
(\*\*\$>, =(W%k=& ; !-\$!' +#!+?(=k\$, -!5\$% : !Y(k, +!I! k +=-!` k%?k, k!(, '!<\$>=9!8 (%\$k, (D!Y(, (?+'!

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g+\$%?+=\$F, !B, &A+%&-k=; !89&#' !E+A+#\$H : +, =!8+, =+%I! k (-9&, ?=\$, !E8D!!

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8\$, ->#=(, =!Lc \$A+ : W+%I!200JND! 6--&-+= '!F&-9!' +A+#\$H : +, =!\$5!(, !(\*\$>, =(W&#&=; !(HH%\$(\*9!  
(HH#&+ '!(=!9+!#\$\*(#!#+A+#D) 4%+?\$, !8\$ : : &-&\$, !\$, !89&#' %+, !(, '!" ( : &#&+-I!<(#+ : I!4 \_D!!

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\$#4%, #, \*)\$\*9':I%)I;''%7''\*.'%\$\*9I\$&):''%7':/#4, ), \*)'&, ;8\$:, &G'8>#>%(#!8\$ : H+=+, \*+!  
<+ : &, (%D!B, &A+%&=;!\$5!<\$>=9!#\$%&' (I!G( : H(I!" )D!

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89&# ' %+, h-!Y+, =(#!X+(#-9!(=9+!B, &A+%&-&=; !5!<\$>=9!"#\$%&' (! (, '!9+!c (=&\$, (#!  
G+\*9, &\*(#!6--&-=(, \*+!8+, =+!5\$%!89&# ' %+, h-!Y+, =(#!X+(#-9!(=9+!g+\$%?+=F, !  
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8+, =+!5\$%!89&# ' %+, h-!Y+, =(#!X+(#-9!G( : H(I!" )D'

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I)\$S`")\$/\*?/?;'. \$8, ;&, '4/4I")\$/\*&D! . %+-+, =+ '!(=9+!< : H\$-&> : 7!S=9, &\*!E&-H(%&=&+-!  
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/4)\$/\*&C'""\*. ' . ; :\$&\$/\*&'?/; ;', I, :I)\$8, &D! . %+-+, =+'!(= !SA(#>(&\$, ! k \$% i -9\$H!  
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a &\$\*9%/9\$ : #' / . , %&'/?%/: ""')<, /; \$, &'/?':<"\*9, D! k \$% i -9\$H!H%+-+, =+'!(= !G9+!  
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&7&), #'/?': " ; ; D! . #+, (% ; !-+--&\$, !(= !9+!8\$ : H%+9+, -&A+!8\$ : : >, &=; !Y+, =(#!X+(#-9!  
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k \$% i-9\$H!H%+-+, =+ '!(!. %\$ : &-&, ?! . % (\*=&\*+-!V, -=&=>=+-I! 6%#&, ?=\$, I! ` 6D!  
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<\$\*k(#!k \$%i!k,!Y+,#!X+(#-9! ! ! ! ! "+W%>(%;IK021!  
k <YXZK02PZ0021D\_K!  
\_+A&+F+%!  
!  
6 ' : k , k -=% (=k\$,!(, '!.\$#k\*;!k,!Y+,#!X+(#-9!L6 . YXN! ! ^(>(>);IK021!  
6 . YXZEZ2PZ002MK!  
\_+A&+F+%!  
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. - ; \*9k(=%k\*!\_+9(W&#k=(=k\$,!^\$>%, (#!! ! ! ! ! E+\*+ : W+%IK02P!



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6 'A&-\$%! ! ! ! ! ! ! !  
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6 : +%&\*(!, !SA(#>(&=&\$, !6--\$\*&(&=&\$, ! ! ! ! ! <+H=+ : W+%I!K000!  
Y+ : W+%!  
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X\$, \$%&, ?!SR\*+###, \*+!&, !SA(#>(&=&\$, !\_+\*\$?, &=&\$, !.%\$?%( : ! ! Y( ;I!K000!  
\_+A&+F+%!  
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g+\$%?+=F\$, !B, &A+%-&=;!)( '+%-9&H!6\*( '+ : ;! ! ! ^(>(>(%;I!K000!  
"(\*>#-;!Y+ : W+%!  
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6--\$\*&(&=&\$, !Lc 6 Y@X 6N! !  
. %+-&' +, =!  
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X\$, \$%&, ?!SR\*+###, \*+!&, !SA(#>(&=&\$, !\_+\*\$?, &=&\$, !.%\$?%( : ! ! Y( ;I!K00M!  
\_+A&+F+%!  
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V, =+% ' &-\*&H#&, (%;!^\$>%, (#!\$5!6HH#&+'!'"(: &#;!<=>'&+-!  
g>+-=!\_+A&+F+%!  
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<>W=(&, \*+!6W>-+!(, '!Y+, =(#!X+(#-9!<+%A&\*+!-!! ! ! K003ZK02K!  
6' : &, &-=(&=&\$, !L<6 YX<6N!c (&=&\$, (#!c +=F\$%i!5\$%!!  
S#& : &, (&=&, ?!E&-H(%&=&+-! ! ! !  
"\$>, ' &, ?!Y+ : W+%!!  
!  
<+%A&\*+!-!SA(#>(&=&\$, !8\$ : : &=++!L<S 8N! ! ! ! Y(%\*9I!K003!  
Y+ : W+%!  
!  
S#& : &, (&=&, !\$5!Y+, =(#!X+(#-9!E&-H(%&=&+-!SR=+%, (#!! ! ! Y(%\*9I!K003ZK020!  
k \$%i ?%\$>HU<6 YX<6Z8 YX<!  
Y+ : W+%! ! !  
!  
<H+\*&(&#!V--E T Qq0(-)-0136(41 T 20050 T 21 T f[(Y T f587.96 cm7.96 cm7-)-0.2(87.96 cm500f(!) T j E T



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 8>#>%(!8\$ : H+=+, \*+!\_+-\$>%\*+!<+, &\$%!6 'A&-\$%!! ! !  
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 c (=k\$, (#!6##k(, \*+!\$5!Y>#-kZS=9, &\*!@+9(A&\$\$(#! ! ! KOOPZK00M!  
 X+(#-9!6--\$\*k(=k\$, !Lc 6 Y@X6N! ! ! ! ! ! ! !  
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 !  
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 6--\$\*k(=k\$, !Lc )@X6N!  
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 89(k%!\$5!.\$#k\*;!(!, '!.#(, , &, ?!8\$ : : k==+!! ! ! ! KO03ZK02P!  
 Y+ : W+%!\$5!\_+\*%>k= : +, =!8\$ : : k==+!!! ! ! ! KO03ZK02P!  
 !  
 6 : +%k\*(, !. - ; \*9\$#\$?k\*(#!6--\$\*k(=k\$, !! ! ! ! KO01ZK003!  
 E&A&-k\$, !C3!  
 .%\$?%( : !89(k%!!  
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 6 : +%k\*(, !. - ; \*9\$#\$?k\*(#!6--\$\*k(=k\$, !Y+ : W+%! ! ! KO01!  
 8\$ : : k==+!\$5%!/ \$>-9!(, '!"( : k&+!  
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 E&A&-k\$, !C3!  
 Y+ : W+%!  
 !  
 X\$??!"\$>, '(=k\$, !5\$%!Y+, =(#!X+(#-9! ! ! ! ! KOOPZK00J!  
 G9+!B, &A+%&-k=; !\$5!G+R(-!(=!6>-k, !  
 c (=k\$, (#!6 'A&-k\$; !@\$(% '!  
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6 ' : &, &-=%(=&\$, !L<6 Y X<6N!

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200JZ200M!

Y+ : W+%I!6 'A&-\$%;!@\$(% '!

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8+, =%( ) &, i!

G&W>%\$, I!8 (#&5\$%, &(!

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SR=+%, (!\_+A&+F+%!

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c(=&\$, (!G+\*9, &\*(!6--&-=(, \*+!8+, =+%%!

2000ZK001!

5\$!89&#'%+, [-!Y+, =(#!X+(#9!

g+\$%?+=\$F, !B, &A+%&-&-; !89&#!E+A+#\$H : +, =!8+, =+%

8>#>%(!8\$ : H+=+, \*+!\_+-\$>%\*+!@\$(% ' !Y+ : W+%!! ! !

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B, &A+%&-&-; !5\$!G( : H(!

\_+A&+F! . (, +#!5\$%!9+!8+%&5&\* (=+[-!5&, (!->' +, =!H%\$d+\*!L-\$\*&(!+, =%+H%+, +>%9&H!(, '!\*%+(=&, ?!

W>-&, +--!H#(, -ND!

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"( : &#&(-!) (=&, (-!E+d(, '\$!X>+##(-!G( : H(!@(;!89(H=+%!! ! KOOP!

"+'+% (=&\$, !5\$!" ( : &#&+-!5\$%!89&#'%+, [-!Y+, =(#!X+(#9!! ! !!

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X&-H(, &\*!c++'-!(, '!<+%A&\*+!8\$>, \*&#!G( : H(I!" )!

Y+ : W+%I!6 'A&-\$%;!@\$(% ' ! ! ! ! ! 200MZ T T 21 T f(Z) T j E T Qq0.24000.