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, NX00VP!?!
( ]NKN!S ] JYY!_N!JP! ' cNXM0(RN! 2 VJKU!VZ! " & , / :!X ] J(KNU!_T!0] N!6KNS(UNP0:!JPU!XVW [K(SNU!VZ!0] N!
VZZQXNKS!VZ! " & , / !E2T34JbS:!#K0QXYN!*FD!
, NX00VP!<!
(\ ]NKN!S\ ]JYY!\_N!JP!\ '\ cNXM0QRN!\ .\ N\ [JK0WNP0:!X]\ JQKNU!\_T!0\ ]N!\ '\ cNXM0QRN!+QXN!6KNSQUNP0:!JPU!XVW\ [KQSNU!]
VZ!0]N!1]0NZ!VZ!,0JZZ!JPU!0]N!1JW[MS!#X00R000NS!2VJKU!40J0SVP!E2T34JbS:!#K00XYN!**FD!
, NX00VP!A!
( ]NKN!S ] JYY!_N!J!70PJPX0JY! . N [ JK0WNP0:!X ] J0KNU!_T!0 ]N!70PJPX0JY! + 0XN!6KNS0UNP0:!JPU!XVW [ K0SNU!VZ!
0]N!1 VP0KVYYNK!JPU!70PJPX0JY! O ZZ0XN! # SS0S0JP0S!E2T34JbS:!#K00XYN!*+FD!
, NX00VP!>!
( ]NKN!S]JYY!_N!J!1VWWMPQXJ0QVPS!.N[JK0WNP0:!X]JQKNU!_T!0]N!1VWWMPQXJ0QVPS!+QXN!6KNSQUNP0:!
JPU!XVW[KQ$NU!VZ!(]KNN!E<F!.QKNXQVKS:!/KJ[]QX!.NSQ^P!#$$Q$QJPQ$:!" MYQQWNUQJ!#$$Q$QJPQ$:!JPU!
6M_YQX!$NYJ0QVPS!#SSQS0JP0S!E2T34JbS:!#K0QXYN!+FD!
, NX00VP!C!
( ]NKN!S ] JYY!_N!J!, NPJ0N:!X ] J0KNU!_T!0 ] N!4N^0SYJ0QRN!+0XN!6KNSQUNP0:!JPU!XVW [KQSNU!VZ!0 ] N!
4N^(SYJ0QRN!1YNKe:!JPU!#XJUNW(X!JPU!$NSQUNP0QJY!, NPJ0VKS!E2T34JbS:!#K0QXYN!+*FD!
, NX00VP!B!
( | NKN!S | JYY!_N!JP! O MOKNJX | ! . N | JKOWNPO:!X | JOKNU!_T!O | N! O MOKNJX | ! + QXN!6KNSQUNPO:!JPU!XVW | KQSNU!
VZ!0]N!, NP0VK!, [NJeNK!1 VVKU0PJ0VK:!0]N!
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 $\begin{tabular}{ll} $[KNSNP0NU!_T!0]N!6KNSQUNP0!JPU!QS!SM_gNX0!0V!J[[KVRJY!_T!J!0bV30]QKUS!JZZQKWJ0QRN!RV0N!VZ!\\ 0]N![KNSNP0!,NPJ0ND!!(]N!7QPJPXQJY!+QXN!6KNSQUNP0!S]JYY!0JeN!VZZQXN!VP!IJPMJKT!;>!JPU!\\ SNKRN!MP0QY!7N_KMJKT!;>!VZ!0]N!ZVYYVbQP^!TNJKD!!! \end{tabular}$

- - *P!0]N!NRNP0!0]NKN!JKN!WVKN!0]JP!0bV!XJPUQUJONS!KMPPQP^!ZVK!6KNSQUNP0!6KV3 (NW [VKN!
 [KVXNUMKNS!ZVK!QPS0JP0!KMPVZZ!RV0QP^!bQYY!_N!MSNUD!, NPJ0VKS!bQYY!KJPe!0]NQK! [KNZNKNPXNS!
 VP!0]N!_JYYV0D!!*Z!PV!0QXeN0!KNXNQRNS!J!>@! [NKXNP0!WJgVKQ0T!VZ!RV0NS:!0]N!YJS0! [YJXN!QQXeN0!
 bQYY!_N!UKV [[NU!JPU!0]N!SNXVPU! [YJXN!X]VQXNS!ZKVW!0]VSN!RV0NS!bQYY!_N!KNUQS0KQ_M0NU!JS!
 ZQKS0! [YJXN!RV0NS!0V!0]N!KNWJQPQP^!0QXeN0SD!! (QXeN0S!bQYY!_N!UKV [[NU!JPU!RV0NS!
 KNUQS0KQ_M0NU!MP0QY!J!WJgVKQ0T!QS!KNJX]NU!JPU!J!bQPPNk!QS!UNXYJKNUD!*P!0]N!NRNP0!VZ!J!0QN!
 ZVK!YJS0! [YJXN!b]NP!MSQP^!QPS0JP0!KMPVZZ!RV0QP^![KVXNUMKNS:!"JcQWQ^N!#ZZQKWNU!
 "JgVKQ0QNS!E"#"F!bQYY!0JeN![YJXND!(]N!XJPUQUJ0NESF!b]V!QSGJKN!PV0!QP!YJS0!bQYY!
 JURJPXN!0V!0]N!PNc0!KVMPU!VZ!RV0QP^D!(]N!XJPUQUJ0N!b]V!JURJPXNS!QS!UN0NKWQPNU!_T!
 YVVeQP^!J0!0]N![NKXNP0J^N!VZ!0V0JY!RV0NKS!b]V!KJPeNU!VPN!VRNK!JPV0]NKD!

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, NX0(VP!C!
(]N!6KNS(UNPO!JPU! " & , /!#UR(SVK!S]JYY!J[[V(P0!J!IMU(X(JY!#UW(P(S0KJ0VK:!b]V!S]JYY!0JeN!VZZ(XN!VP!"JT!;!JPU!SNKRN!ZVK!VPN!XJYNPUJK!TNJKD!
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- > ? &@#&#', /B, B/, ''''C'!2&<=7&#'O&@\$%&'G3 ? ?=\%&&' ? &&%=@I'5&\)=5& ? &@\%7'
- > ? &@#&#', , B/ZB/A'''C'! 2 &<=7&#'M\$**'D*&F%=3@7'%=? &*-@&'
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JPU!U0KNX00VP!VZ! " & , / !0]KVM^]!0]N!QW[YNWNP0J00VP!VZ!^NPNKJY!V[NKJ00P^![VY0XTD!
, NX00VP!?!
( ]N!6KNSQUNP0!WJT!XJYY!J!RV0N!VZ!0]N! ' cNXM0QRN!2VJKUD!! ' JX]!WNW_NK!S]JYY!]JRN!VPN!RV0ND!
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VRNKSNNQP^!, 0MUNP0!OK^JPQ`J0QVP!7MPUQP^![KVXNSS!E1VPS0Q0M0QVP:!7QPJPXQJY!6VYQXQNSFD!
, NX00VP!?!
( ]N!6KNSQUNPO!VK! 'cNXM0QRN!+QXN!6KNSQUNPO!WJT!XJYY!J!RV0N!VZ!0]N! 'cNXM0QRN! . N[JK0WNPOD!! 'JX]!
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, NX00VP!<!
(]N!'cNXMOQRN!.N[JKOWNPO!S]JYY!_N!SOKMXOMKNU!JS!ZVYYVbSd!!
   #D! ( ]NKN!S ]JY!_N!0 b V!JSS()SOJP0! [ VS()()()VPSd! 1 ]()NZ!VZ! , 0JZZ!JPU! 1 JW [ MS! #X0)R()()()NS! 2 VJKU!
       40J0SVPD!!
   20! ( ]NKN!S ] JYY!_N!VPN!S0JPUQP^!XVWWQ00NN!VZ!0]N! 'cNXMQQRN! . N[ JK0WNP0d! , 0MUNP0!
       OK^JP0\J00VP!7MPU0P^!1VWW000NN!E, O7FD!!
    10! ( ]N! 'cNXM0QRN!+QXN!6KNSQUNP0:!QP!XVPSMY0J0QVP!bQ0]!0]N!6KNSQUNP0:!WJT!XKNJ0N!JP!JU!]VX!
        'cNXM0QRN!.N[JK0WNP0![VSQ0QVP:!b]QX]!S]JYY!YJS0!PV!YVP^NK!0]JP!0]N!XMKKNP0!0NKW!VZ!0]N!
        'cNXMOQRN!+QXN!6KNSQUNPODi!
6078951!(((!:!>8@2@9825!) 1=207 3 1@7!
, NX00VP!;!
(N!70PJPX0JY!.N[JK0WNP00.2(0)0.2(0)5003T21460.74252(M0)03T21460005062(1](0601003T21460005062)
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 $(\]N!70PJPX0JY!\ .\ N[\ JK0WNP0!S\]\ JYY!_N!S0KMX0MKNU!JS!ZVYYV\ b\ Sd!$

- #D (]N!ZVYYV b (P^!S]JYY!_N![VS(0QVPS! b (0])(P!0]N!7(PJPX(JY! . N[JK0WNP0d! 1 VP0KVYYNK!JPU!0]N! 7(PJPX(JY! O ZZ()XN! #SS()S0JP0SD!
- 2) (]N!7(PJPX(JY!+(XN!6KNS(UNP0:!QP!XVPSMY0J0(VP!b(0)]!0]N!6KNS(UNP0:!WJT!XKNJ0N!JP!\$#'K3F! 7(PJPX(JY!.N[JK0WNP0![VS(00(VP:!b](X]!S]JYY!YJS0!PV!YVP^NK!0]JP!0]N!XMKKNP0!0NKW!VZ!0]N! 7(PJPX(JY!+(XN!6KNS(UNP0)!
- $\texttt{1D} \quad \# \texttt{UU} \texttt{(0)} \texttt{VPJY} \texttt{!SOMUNPOS} \texttt{!WJT}! _ \texttt{N!J} \texttt{[[VQPONU!_T!0]N!7QPJPXQJY}! + \texttt{(XN!6} \texttt{KNSQUNP0} \texttt{!OV!JSSQS0} \texttt{!0]N!}$

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- 2D 'PZVKXN!0]N!1VPS000M00VP!JPU!2T34JbS!VZ! " & , $/\,\text{D!}$
- 1D . NYN^JON!KNS[VPSQ_QYQQQNS!OV!V0]NK!WNW_NKS!VZ! " & , / D!
- . D 2N![KNSNP0!J0!JYY!WNN0QP^S!VZ!0]N!, NPJ0ND!

- $\verb|'D|, \verb|NKRN!JS!JP! \verb|Nc3VZZQXQV! WNW_NK! VZ!, \verb|NPJON!JPU!, \verb|NPJON!XVWWQ00NNSD!||$
- 7D $(JeN!JX00VP!VP!YN^0SYJ00VP!M[VP!J[[KVRJY!_T!,NPJ0N!E2T34JbS:!\#K00XYN!f+*FD!]) + (SYJ00VP!VP!YN^0SYJ00VP!M[VP!J[[KVRJY!_T!,NPJ0N!E2T34JbS:!\#K00XYN!f+*FD!]) + (SYJ00VP!VP!YN^0SYJ00VP!M[VP!J[[KVRJY!_T!,NPJ0N!E2T34JbS:!#K00XYN!f+*FD!]) + (SYJ00VP!M[VP!J[[KVRJY!_T!,NPJ0N!E2T34JbS:!#K00XYN!f+*FD!]) + (SYJ0VP!M[VP!J[[KVRJY!_T!,NPJ0N!E2T34JbS:!#K00XYN!f+*FD!]) + (SYJ0VP!M[VP!J[[KVRJY!_T!,KNPJ0N!E2T34JbS:"K00XYN!f+*FD!]) + (SYJ0VP!M[VP!J[K],KNPJ0N[K],KNPJN[K],KNPJN[K],KNPJN[K],KNPJN[K],$
- /D 2N![KNSNP0!ZVK!J0!YNJS0!VPN!WNN0QP^!VZ!0]N!1VWWMPQXJ0QVPS!.N[JK0WNP0:!7QPJPXQJY!

- 2D 2N!KNS[VPSQ_YN!ZVK!0]N!VRNKSQ^]0!VZ!JYY! " & , /!XVWWMPQXJQQVPSD!

 1D 2N![KNSNP0!J0!JYY!WNNQQP^S!VZ!0]N!, NPJ0ND!!*P!0]N!XJ0 . 2 (!VZ!2 0Z!0) 0 . 2 (]N) 0 . 2 (!,) 0 . 2 (N) 0 . 2

- ?D \$N[VK0!0V!0]N!'cNXM0QRN!2VJKU!VK!, NPJ0N!M[VP!KNLMNS0!_T!0]N!6KNSQUNP0!VK!OM0KNJX]! + QXN!6KNSQUNP00!
- $< 0 \quad 2 \text{ N!KNS} [\text{VPSQ}_{\text{YN}} | \text{ZVK} | \text{UMOQNS} | \text{JS} | \text{JSSQ}^{\text{PNU}} | \text{T!0} | \text{N!OMOKNJX}] | + (\text{XN} | \text{6KNSQUNPOD} | \text{MINSQUNPOD} | \text{$

, NX00VP!>!

(]N!#SSQSOJPOS!OV!0]N!7QPJPXQJY!+QXN!6KNSQUNP0!JKNd!

#D! (]N! 1 VP0KVYYNK:! b]V!S]JYYd!

- ;D 2N!KNS[VPSQ_YN!ZVK![KN[JKQP^![JTKVYY!ZVK!0]N!1VW[0KVYYNKkS!VZZQXND!
- ?D 6KVXNSS!JYY! "&, /!X]NXe!KNLMNSOS!JPU!_QYYS:!RNKQZT!_QYYQP^!UVXMWNP0J0QVP:!JPU![KN[JKN!Z0PJPX0JY!KN[VK0SD!
- <D 6KN[JKN!JYY!UN[VSQ0S!JPU!QPXVWN!KN[VK0S!QP!JXXVKUJPXN!bQ0]!MPQRNKSQ0T![KVXNUMKNS!JS! [KVRQUNU!ZVK!QP!0]N!7QPJPXQJY!6VYQXQNS!JPU![KVXNSS![MKX]JSN!VKUNKSD!
- AD 2N![KNSNP0!J0!WNN00P^S!VZ!0]N!, NPJ0N!b]NP!0]N!70PJPX0JY!+0XN!6KNS0UNP0!XJPPV0!J00NPUD!
- $> 0 2N!KNS[VPSQ_YN!ZVK!UM0QNS!JS!JSSQ^PNU!_T!0]N!7QPJPXQJY! + (XN!6KNSQUNP00!)$
- 20! (]N!70PJPX0JY!OZZ0XN!#SS0S0JP0S:!b]V!S]JYYd!
 - ;D 2N!KNS[VPS(_YN!ZVK!0]N!U(S0K(_M0()VP!VZ![JTX]NXeS!JPU!KN()W_MKSNWNP0!X]NXeSD!
 - ?D 2N!KNS[VPS(_YN!ZVK!UM0()NS!JS!JSS()^PNU!_T!0]N!7()PJPX()JY!+(XN!6KNS()UNP()D!

- AD 2N!KNS[VPS0_YN!ZVK!UM00NS!JS!JSS0^PNU!_T!0]N!4N^0SYJ00RN!+0XN!6KNS0UNP00!
- 2D (]N!4N^QSYJ0QRN!1YNKe:!b]V!S]JYYd!
 - ;D 2N![KNSNP0!J0!NRNKT!WNN00P^!VZ!0]N!, NPJ0N!JPU!KNXVKU!W0PM0NSD!
 - ?D 6KNSNP0!0V!0]N!4N^QSYJ0QRN!+QXN!6KNSQUNP0!0T[NU!WQPM0NS!VZ!NRNKT!WNN0QP^!VZ!0]N!, NPJ0ND!

- <D "JQPOJQP!M[UJONU!RNKSQVPS!VZ!JYY! "&, /!UVXMWNPOSD!</p>
- AD 2N!KNS[VPS0 YN!ZVK!XYNK0XJY!UM00NS!JS!JSS0^PNU! T!0]N!4N^0SYJ00RN!+0XN!6KNS0UNP00!
- >D 2 N!KNS [VPSQ_YN!ZVK!KNXVKUQP^!0] N!RV0QP^!KNXVKU!VZ!NJX] !SNPJ0VK!ZVK!NRNKT!RV0N!XJS0!JPU! U\(\rangle SSNW\(\rangle P) = 0\] N!\(\rangle PZVKW J = 0\) VP!\(\rangle P) !O] N!\(\rangle P = 0\] N!\(\rangle P = 0\) N!\(\rang
- CD #URQSN!0]N!4N^QSYJ0QRN!+QXN!6KNSQUNP0!JPU!6KNSQUNP0!6KV3(NW[VKN!VP!, NPJ0N! [KVXNUMKNS!KN^JKUQP^!0]N!XVPUMX0!VZ!WNN0QP^SD!
- BD 'UMXJ0N!0]N!, NPJ0N!KN^JKUQP^![VQP0S!VZ![JKYQJWNP0JKT![KVXNUMKND!!1D!!(]N!6KNSQUNP0!6KV3(NW[VKN:!b]V!S]JYYd!
 - ;D #SSQS0!QP!0]N!UQSX]JK^N!VZ!0]N!UM0QNS!VZ!0]N!4N^QSYJ0QRN!+QXN!6KNSQUNP0!JPU:!QP!0]N!NRNP0! VZ!J!YNJRN!VZ!J_SNPXN:!S]JYY!JSSMWN!0]N!UM0QNS!VZ!0]N!4N^QSYJ0QRN!+QXN!6KNSQUNP0D!
 - ?D j JRN!0]N![V b NK!0V!RV0N!JS!J!WNW_NK!VZ!JPT!, NPJ0N! 1 VWWQ00NN!QP!0]N!NRNP0!0]J0!0]N!
 4N^QSYJ0QRN!+QXN!6KNSQUNP0!UNNWS!0]N![KNSNPXN!VZ!0]N!6KNSQUNP0!6KV3(NW[VKN!
 PNXNSSJKT!0V!NS0J Y0S]!J!LMVKMW!ZVK!J!^0RNP!XVWW000NND!
 - ' PSMKN!JXXVKUJPXN!VZ! , NPJ0N! [KVXNUMKNS!_T!0]N!4N^QSYJ0QRN! + QXN!6KNSQUNP0!JPU!S]JYY!
 _KQP^!0V!0]N!J00NP0QVP!VZ!0]N!JSSNW_YT!JPT!SQ^PQZQXJP0!RQVYJ0QVP!0]NKNVZD!
- . D! (]N!#XJUNW0X!JPU!\$NSQUNP0QJY!, NPJ0VKS:!b]V!S]JYYd!
 - $; \texttt{D} \quad , \texttt{NNe!VM0!JPU!KN[KNSNP0!0]N!V[QPQVPS:!XVPXNKPS:!JPU!QP0NKNS0S!VZ!XVPS0Q0MNP0SD!} \\$

?[)

! 5]NP!J!WNW_NK!VZ!0]N! 'cNXM0QRN! . N[JK0WNP0!UVNS!PV0!ZMYZQYY!0]N!UM0QNS!VM0YQPNU!_T!0]N! 'cNXM0QRN!+QXN!6KNSQUNP0!JPU!1VPS0Q0M0QVP!E2T34JbS:!#K0QXYN!+***F:!0]N!'cNXM0QRN!+QXN!6KNSQUNP0! S]JYY![KVRQUN!0]NW!bQ0]!J!UVXMWNP0!VM0YQPQP^!0]N!KNJSVPS!ZVK!0]NQK!KNWVRJY:!0]N!WNW_NK!S]JYY!_N! JM0VWJ00XJYYT!KNWVRNU!ZKVW!0]N! 'cNXM00RN! . N[JK0WNP0:!JPU!0]N![VS000VP!UNXYJKNU!RJXJP00! , NX00VP!<! 5]NP!J!WNW NK!VZ!0]N!70PJPX0JY! . N[JK0WNP0!W0SSNS!0]KNN!70PJPX0JY! . N[JK0WNP0!WNN00P^S! b 00] VM0!J!RJY0U! b K000NP!NcXMSN:!0] N!WNW_NK!S] JYY!_N!JM0VWJ00XJYYT!KNWVRNU!ZKVW!0] N!70PJPX0JY! . N[JK0WNP0!JPU!0]N![VS000VP!UNXYJKNU!RJXJP00!!#YY!NcXMSNS!ZVK!PV0!J00NPU0P^!J!70PJPX0JY! $. \ N[JK0WNP0!WNN0(P^!S]JYY!_N!SM_W(00NU!0V!0]N!7(PJPXQJY!+(XN!6KNSQUNP0!b(0)QP!0bV!XYJSS!UJTS!)]$ $ZVYYV b QP^{10} N!WNNQQP^{0!!} (1N!7QPJPXQJY!+QXN!6KNSQUNP0!S1JYY!UNQNKWQPN!RJYQUQQT!VZ!NcXMSNS!ZVK!$ J_SNPXNS!ZKVW!7QPJPXQJY! . N[JK0WNP0!WNNQQP^SD! , NX00VP!A!

 $5\]NP!J!WNW_NK!VZ!0]N!\ 1\ VWWMP0XJ00VPS!\ .\ N[\ JK0WNP0!W0SSNS!0]KNN!\ 1\ VWWMP0X$ WNN0QP^S! b 00] VM0!J!RJ!QU! b K000NP!NcXMSN:!0] N!WNW_NK!S] J!Y!_N!JM0VWJ0QXJ!YT!KNWVRNU!ZKVW!0] N! 1 VWWMP0XJ00VPS!.N[JK0WNP0!JPU!0]N![VS000VP!UNXYJKNU!RJXJP00!!#YY!NcXMSNS!ZVK!PV0!J00NPU0P^!J! $1 \ VWWMP0XJ00VPS! \ . \ N[JK0WNP0!WNN00P^!S]JYY!_N!SM_W000NU!0V!0]N! \ 1 \ VWWMP0XJ00VPS! + 0XN!6KNS0UNP0!$ $b \ \emptyset \] \ \emptyset P!0 \ b \ V!XYJSS!UJTS!ZVYYV \ b \ \emptyset P^!0 \] \ N!WNN0 \ \emptyset P^0!! \ (\] \ N! \ 1 \ VWWMP \ \emptyset XJ0 \ VPS! + \emptyset XN!6 \ KNS \ \emptyset UNP0!S \] \ JYY!$ UNONKWQPN!RJYQUQOT!VZ!NcXMSNS!ZVK!J_SNPXNS!ZKVW!1VWWMPQXJQQVPS!. N

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#!0bV30]0KUS!RV0N!VZ!0]N!SNJ0NU!, NPJ0N!S]JYY! N!PNXNSSJKT!0V!ZJX0Y00J0N!0]N!KNWVRJY!VZ!JPT![NKSVP!
] VYUQP^!JP!NYNXONU! [ VSQQQVP!QP! " & , /: [ KVRQUNU!0 ] JO! b KQOONP!PVQXN!S [ NXQZTQP^!X ] JK^NS!QS!^QRNP!OV!
JYY!WNW_NKS!_T!0]N!IMUQXQJY!#UWQPQS0KJ0VK!ZQRN!XYJSS!UJTS![KQVK!0V!0]N!WV0QVPD!
, NX00VP!<!
&[VP!J!0bV30]QKUS!RV0N!VZ!0]N!SNJ0NU!, NPJ0N!ZJXQYQ0JQQP^!0]N!KNWVRJY!ZKVW!VZZQXN:!J!0]KNN3ZVMK0]S!
RVON!VZ!0]N!SNJ0NU!, NPJ0N!S]JYY! N!PNXNSSJKT!0V!ZVKWJYYT!KNWVRN!JPT!NYNX0NU!WNW NK!VZ! "&, / D!
, NX00VP!A!
5 00] !0] N!NcXN[00VP!VZ! " & , / !VZZ0XNKS!JPU!0] N!IMU0X0JY! #UW0P0S0KJ0VK:!JYY!J[[V0P0NU!WNW_NKS!VZ!
" & , / !WJT!_N!KNWVRNU!ZKVW!VZZQXN!_T!0]NQK!J[[VQPQQP^!VZZQXQJYD!!,MX]!J![NKSVP!WMS0!_N!^QRNP!
; @!XYJSS!UJTS! bK000NP!PV00XN!VZ!KNWVRJYD!
, NX00VP!>!
JPU!0]N!4N^0SYJ00RN!+0XN!6KNS0UNP0!WJT!_N!KNWVRNU!ZKVW!VZZ0XN!_T!0]N!6KNS0UNP0!_T!J!0bV30]0KUS!
RV0N!VZ!0]N!7(PJPX()JY!, NYNX0()VP!1 VWW()0NN:!0]N!1 VWWMP()XJ0()VPS!, NYNX0()VP!1 VWW()0NN:!0]N!
O MOKNJX]!, NYNXOQVP! 1 VWWQ00NN:!VK!0]N!, NPJ0N:!KNS[NXOQRNYTD!*P!JUUQ0QVP:!0]N!, NPJ0N!KNSNKRNS!0]N!
KQ^]0!0V!KNWVRN!JPT!VZZQXNK!VZ! " &, /! T!J!0bV30]0KUS!RV0N!JZ0NK!6KNSQUNP0QJY!KNXVWWNPUJ0QVPD!
, MX]!J![NKSVP!WMS0! N!^ORNP!;@!XYJSS!UJTS!bK000NP!PV00XN!VZ!KNWVRJYD!
, NX00VP!C!
#PT! [NKSVP!KNWVRNU!ZKVW!JP!NYNX0NU!VK!J [ [VQP0NU!VZZQXN!]JS!0]N!KQ^]0!0V!ZQYN!JP!J [ [NJY! b Q0]!0]N!
IMU(XQJY! \# UWQPQS0KJ0VK! b @ 1QP!; @ !XYJSS!UJTS!VK!UMKQP^!0 ] N!0NKW!VZ!0 ] N!PNc0!IMU(XQJY! \# UWQPQS0KJ0VKD!) \\
6078951!F($!:!.7?E1@7!&1D101@E2!
, NX00VP!;!
( ]N!WNW NKS!VZ! " &, /:! T!S]Vb0P^!SMZZ0X0NP0!0P0NKNS0:!S]JYY!]JRN!0]N![VbNK!0V!XJYY!J!S0MUNP0!
KNZNKNPUMWD!!, MZZQXQNP0!SOMUNP0!QP0NKNS0!S]JYY!\_N!UNZQPNU!JS!VPN!VZ!0]N!ZVYYVbQP^d!
   #D! ( ]N!SO^PJOMKNS!JPU!* . !PMW NKS!VZ!VPN30NP0]!VZ!0]N! " JKLMN00N!&P0RNKS00T!ZMYY300WN!
       MPUNK^KJUMJ0N! [V [MYJ0QVP!J00JX]NU!0V!J! [N0Q0QVP!VM0YQPQP^!0]N!KNZNKNPUMW! [KV [VSJYD!
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20! #!0bV

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(]N!KNZNKNPUMW!KNSMYOS!bQYY!_N!XVPSQUNKNU!_QPUQP^!QV!"&,/!QZd!
          #D! 7VK!XVPS000M00VPJY!JPU!ZQPJPXQJY!WJ00NKS:!VPN3]JYZ!VZ! "&, /!WNW_NKS!RV0N!QP!ZJRVK!VZ!0]N!
                   KNZNKNPUMWD!
          20! 7VK!JYY!V0]NK!WJ00NKS:!VPN30]0KU!VZ! " & , / !WNW NKS!RV0N!0P!ZJRVK!VZ!0]N!KNZNKNPUMWD!
                    *Z!0]NSN!XVPU000VPS!JKN!PV0!WN0:!0]N!KNZNKNPUMW!b0YY! N!XVPS0UNKNU!JUR0SVKTD!
                    #!_QPUQP^!KNZNKNPUMW!b(\forall Y!_N!0KNJ0NU!\QP!0]N!SJWN!ZJS]\QVP!JS!\forall Y\forall QS\forall J\forall VP!\forall S\forall S\foral
                    , NPJON!JPU!SO^PNU! T!O]N!6KNSQUNPOD!
6078951!F$!:!M1B8;5278A@!/2;;1E!4H!.1@271!
 , NX00VP!;!
7VK!JPT!YN^0SYJ00VP:!M[VP![JSSJ^N! T!.NPJ0N:!0]N!6KNS0UNP0!b0YY!0JeN!VPN!VZ!0]N!ZVYYVb0P^!JX00VPSd!
          #D! , 0^P!0]N!YN^0SYJ00VP:!WJe0P^!00!NZZNX00RN!0WWNU0J0NYTD!
          20! +N0V!0]N!YN^($YJ00VP:!JPU!KN0MKP!(0!0V!0]N!4N^($YJ00RN!+(XN!6KN$(UNP0!b(0)10P!0]KNN!E<F!XYJ$$!
                   UJTS!VZ!KNXNQRQP^!0]N!YN^QSYJ0QVPD!
          10! (JeN!PV!JX00VP:!b]NKNM[VP!0]N!YN^0SYJ00VP!b0YY!0JeN!NZZNX0!Z0RN!E>F!XYJSS!UJTS!JZ0NK!
                   KNXNQRQP^{1}Q0!ZKVW!0]N!4N^{0}SYJQQRN!+QXN!6KNSQUNPOD!
 , NX00VP!?!
*Z!0]N!6KNSQUNP0!RN0VNS!0]N!YN^QSYJ0QVP:!0]N!4N^QSYJ0QRN!+QXN!6KNSQUNP0!S]JYY!PV0QZT!0]N!,NPJ0ND!!
( ]\(0.5!PV0\(0.72\)\(0.73\)\(0.70\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(0.75\)\(
4N^0SYJ00RN!+0XN!6KNS0UNP0!S]JYY!SNNe!J!WV00VP!0V!XVPS0UNK!RN0V3VRNKK0UN![KVXNUMKNS!ZVK!0]N!
YN^0SYJ00VPD!
 .NX00VP!<!
*Z!0]N!WV00VP!0S!SV!WJUN!JPU!SNXVPUNU:!0]N!RN0V3VRNKK0UN![KVXNUMKNS!S]JYY! N^0PD!
          #D! ( ]N!VKQ^QPJY!JM0]VKS!VZ!0]N!YN^QSYJ0QVP!JKN!^QRNP!0QWN!0V!KNQP0KVUMXN!0]N!WV0QVP!E, NPJ0N!
                     , 0JPU0P^!$MYNS:!, NX00VP!*+:!*0NW!#FD!
          20! OPXN!0]N!JM0]VKS!]JRN!XVPXYMUNU:!0]N! " & , /!6KNSQUNPO!QS!JYYVbNU!J![NKQVU!VZ!ZVMK!
                    W()PMONS!0V!SMWWJK()`N!b]T!0]N!UNX()S()VP!0V!RNOV!0]N!YN^()SYJ0()VP!bJS!WJUND!!(]N!6KNS()UNP0\S!
                   00WN!S]JYY!PV0! N!Nc0NPUNU!MPYNSS!J[[KVRNU! T!J!0bV30]0KUS!WJgVK00T!RV0N!VZ!0]N![KNSNP0!
           1D! %MNS00VPS!VP!0]N!WV00VP!S]JYY!ZVYYVb!E,NPJ0N!,0JPU0P^!$MYNS:!,NX00VP!*+:!*0NW!2FD!
           . D! . N_JON!VZ!0]N!WV00VP!S]JYY!ZVYYVb!E, NPJON!, 0JPU0P^!$MYNS:!, NX00VP!*+:!*0NW!1FD!
           D! OPXN!UN J0N!0S!Nc]JMS0NU:!RV00P^!0V!VRNKK0UN!0]N!RN0V!VP!0]N!YN^0SYJ00VP!S]JYY!0JeN![YJXND!
                    ; D! #PT!YN^QSYJ0QVP!VKQ^QPJYYT!KNLMQKQP^!J!SQW[YN!WJgVKQ0T!RV0N!VZ!NQ0]NK![KNSNP0!VK!SNJ0NU!
                              , NPJON!ZVK!J[[KVRJY!KNLM0KNS!J!0bV30]0KUS!WJgVK00T!RV0N!VZ!SNJ0NU!, NPJ0N!0V!VRNKKQUN!
                             01N!6KNSQUNP0\S!RN0VD!!
                    ?D! #PT!YN^0SYJ00VP!VK0^0PJYYT!KNLM0K0P^!J!0 b V30 ]0KUS!WJgVK00T!RV0N!VZ!N00 ]NK! [KNSNP0!VK!
                             SNJ0NU!, NPJ0N!ZVK!J[[KVRJY!KNLM0KNS!J!0]KNN3ZVMK0]S!WJgVK00T!RV0N!VZ!SNJ0NU!, NPJ0N!0V!
                             VRNKKQUN!0]N!6KNSQUNP0\S!RN0VD!
 , NX00VP!A!
*Z!0]N!6KNSQUNPO\S!RN0V!QS!VRNKKQUUNP:!0]N!SQ^PJ0MKN!VZ!0]N!6KNSQUNPO!QS!PV!YVP^NK!PNXNSSJKT:!
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6078951!F $(!:!6 31@E 31@7!AD!7<1!, +."!JHLM2O;!

(]NSN!2T34JbS!WJT!_N!JWNPUNU!_T!J!0bV30](KUS!RV0N!VZ!0]N!SNJ0NU!, NPJ0ND!!(]N!JWNPUWNP0!

S]JYY!_NXVWN!NZZNX0(RN!M[VP!J[[KVRJY!_T!0]N! "&, /!6KNS(UNP0!JPU!0]N!+(XN!6KNS(UNP0!ZVK!,0MUNP0!#ZZJ(KSD!
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>?&@#&#'AB//BO,'''''C'' DE&F)%=<&'G3)@F=*'''37=%=3@7'
>?&@#&#'IBIBO/''''''C'' 2&@$?&'O&5<=F&7'J3$5#'%3'H53I5$?'J3$5#.'H53I5$?'J3$5#'

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2D! OPYT!VPN!S[VeNS[NKSVP![NK!VK^JPQ`J0QVP!b(YY!_N!KNXV^PQ`NU!MPUNK!2MU^N0!#[[KVRJY!6KVXNUMKNS!**:!*0NW!#!?D!JPU!2MU^N0!#[[KVRJY!6KVXNUMKNS!***:!*0NW!1!?DXD!

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- 1 D! (] N!X] JQK! b QYY!X] VVSN!0] N!J [[KV [KQJON!VZZQXNK!0V!JPS b NK!LMNSQVPS!MPUNK! 2 MU^N0! # [[KVRJY! 6KVXNUMKNS! , NXQVP!**:!*0NW! 1 :! 2 MU^N0! # [[KVRJY!6KVXNUMKNS! , NXQVP!**:!*0NW! 2 :! 2 MU^N0! # [[KVRJY!6KVXNUMKNS! , NXQVP!**:!*0NW! 1 !? DXDQD:!JPU! 2 MU^N0! # [[KVRJY!6KVXNUMKNS! , NXQVP! ***:!*0NW! 1 !? DVDQ!
- . D! #PT!WV0QVP!ZVK!b]QX]!ZMPUS!JKN!MPJRJQYJ_YN!WMS0!S0Q[MYJ0N!b]NKN!ZMPUS!bQYY!_N!0JeNPD!
- 'D! (]N!X]JQK!QS!JYbJTS!QP!VKUNKD!

. 1978A@!\$!:!6 3 1@E 3 1@7!AD!7<1!J?EB17!6==0AG25!/0A91E?01;!

(]NSN!2MU^N0!#[[KVRJY!6KVXNUMKNS!WJT!_N!JWNPUNU!_T!J!WJgVKQ0T!JZZQKWJ0QRN!RV0N!VZ!0]N!SNJ0NU!

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(@70AE?978A@!
( ]NSN!NYNX0QVP! [KVXNUMKNS!JPU!KMYNS!JKN! b KQ00NP!ZVK!0]N! [MK [VSN!VZ!NYNX0QP^'0]N!, NPJ0VKS:!
 "cNXM0QRN! + QXN!6KNSQUNP0: "JPU!6KNSQUNP0!VZ!" JKLMN00N! \& PQRNKSQOT!, 0MUNP0! / VRNKPWNP0!E" \&, / FD!! | VRNKPWNP0!E" &, / FD!! | VRNKPWNP0!E"
( ]NT!]JRN!_NNP!XVW[0YNU!ZKVW!0]N!Nc[NK0NPXNS!VZ!WJPT!S0MUNP0S!VRNK!PMWNKVMS!TNJKS!JPU!]JRN!
NP!J[[KVRNU!_T!0]N! " \&, /!, NPJ0N!JS!0]N!VZZQXQJY!^MQUNYQPNS!JPU!KMYNS!ZVK!0]N!SJQU!NYNXQQVPSD!!
/ NPNKJYYT: 10 ] N!PJ0MKN!VZ10 ] NSN!NYNX0QVPS!WJPUJ0NS!ZYNCQ_QYQ0T!_NXJMSN!SVWN!Q0NWS!JKN!J_SVYM0N!JPU!
V0]NKS!WMS0!_N!QPONK [KNONU!JXXVKUQP^!0V!XQKXMWS0JPXNSD!
( ]VM^]!0]N!KMYNS!JKN!bK000NP!b00]!0]N!JSSMW[0QVP!0]J0!0]N!KNJUNK!]JS!PNRNK![JK00XQ[J0NU!QP!JP!
 "&, /!NYNX0QVP:10]NT!S]VMYU!_N!KNJU!XJKNZMYYT!JPU!XVW[YN0NYTD!!*0!QS!Nc[NX0NU!0]J0!J!ZQKS0!0QWN!
KNJUNK! \ b \ \emptyset YY! \ ] \ JRN!LMNS0 \ VPSh!XYJK \ \emptyset Z \ \emptyset XJ0 \ VP!S \ ] \ VMYU!\_N!SVM^ \ ] \ 0! \ [K \ VK!0 \ V!0 \ Je \ QP^!JPT!JX0 \ VP! \ QP!J!
XJW[J0^P0!!6YNJSN!PV0N!0]J0!) 0!1 # "6#*/)*)/!" # - !2'/*)!2'70$'!#!1#).*. # ('!*,!
$'/*,('$'.D!!(]NSN!KMYNS:![KVXNUMKNS:!JPU!0]NQK!QPONK[KN0JQQVPS!JKN!^VRNKPNU!_T!0]N!'YNXQQVPS!
1 VWW000NN:!X ] J0KNU! T!0]N! 'YNX00VPS! 1 VVKU0PJ0VKD!!*P!JUU000VK01.0.20.2 (PU!] / 0 ) 0.6601.92cmBT 5 BT (
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 $\label{eq:nynx00vP} $$ NYNX00VP![KVXNUMKNSD!(]N![NPJY0T!S]JYY!_N!QW[VSNU!JXXVKUQP^!0V!0]N!SNRNKQ0T!VZ!0]N!RQVYJ0QVP!JPU!WJT!KJP^N!0V:!JPU!QPXYMUN:!UQSLMJYQZQXJ0QVPD!$

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*D) V!WNW_NK!VZ!0]N! ' YNX0QVPS! 1 VWWQ00NN!VK! # [[NJYS! 1 VWWQ00NN!WJT!SNKRN!VP!J!XJW [JQ^P! 0NJW:!bNJK!JPT! [JK0QSJP!XJW [JQ^P!WJ0NKQJY:!VK!QP!JPT!bJT!XJW [JQ^P!ZVK!JPT!XJPUQUJ0ND!

.1978A@!((!:!) 1D8@878A@;!

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#D! M)**XV=?&'O%)#&@%d!#!" JKLMN00N!MPUNK^KJUMJ0N!XJKKTQP^!0bNYRN!VK!WVKN!SNWNS0NK!]VMKSD! 2a' 9@XG\$?")7'O%)#&@%b!

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- ?D! ,0JPUJKU!1JPUQUJON!\$N^QS0KJ0QVP!6JXeN0d!#YY!PNXNSSJKT!UVXMWNPOS!JKN!XVP0JQPNU!QP!0]N!
 S0JPUJKU!XJPUQUJON!KN^QS0KJ0QVP![JXeN0D!#UUQ0QVPJY!XV[QNS!JKN!JRJQYJ_YN!ZKVW!0]N!'YNX0QVPS!
 1VWWQ00NN!JPU!bQYY!_N!JRJQYJ_YN!0]KVM^]VM0!0]N!S0JPUJKU!XJPUQUJON!KN^QS0KJ0QVP![NKQVUD!!
)VWQPNNS!WMS0!SM_WQ0!0]QS![JXeN0!0V!0]N!'YNX0QVPS!1VWWQ00NN!JPU!Q0!WMS0!_N!J[[KVRNU!_NZVKN!J!XJPUQUJ0N!XJP!_N^QP!XJW[JQ^PQP^D!
 - JD <u>1JPUQUJON! \$N^QSOKJOQVP!7VKW</u>d! O ZZQXQJY!UVXMWNPO!0] J0!XVP0JQPS!0] N!XJPUQUJON\S!PJWN! EJS!0V!J[[NJK!VP!0]N!_JYYV0F:!0]N![VSQOQVP!SVM^]0:!XJPUQUJON!XNK0QZQXJQQVP!VZ!NYQ^Q_QYQOT:!

0]N!'YNX0QVP!\$MYNSD!!'YNX0QVP!\$MYNS!RQVYJ0QVPS!XVWWQ00NU!_T!KN^QS0NKNU!XJW[JQ^P!bVKeNKS!bQYY!XVMP0!J^JQPS0!0]N!XJPUQUJ0NSD!

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20! 1# "6#*/)!" #('\$*#4!

- ; D! $\#YY!XJW[J0^P!WJ0NK0JYS!, +.-R!]$
 - JD 2N!J[[KVRNU!_T!0]N!''YNX0QVP!1VVKUQPJ0VK!_NZVKN!0]NQK!MSNh!
 - _D #U]NKN!0V!S0JPUJKUS!SN0!_T!0]N!''YNX0QVPS!1VWWQ00NNh!
 - XD) V0!_N![]TSQXJYYT!UJWJ^QP^!0V!V0]NKSk![NKSVPJY![KV[NK0T!VK!^KVMPUSh!]]
 - UD) V0!SYJPUNK!V[[VPNP0S!VK!0]NQK!XJW[JQ^PSh!
 - ND 1 VW [YT! b 00]! " JKLMN00N!&PQRNKSQ0T! [VSQ0QP^!^MQUNYQPNS!NS0J_YQS]NU!_T!0]N! O ZZQXNS! VZ!\$NSQUNPXN!4QZN!JPU!, 0MUNP0! . NRNYV [WNP0:!JS!bNYY!JS!VKUQPJPXNS!VZ!0]N! 1 Q0T!VZ! " 0YbJMeNNh!
 - ZD *PXYMUN!0]N!XJPUQUJ0NkS!PJWN:![VSQ0QVPESF!SVM^]0:! " & , / !JXKVPTW:!JPU!RV0QP^!

!			

- JD #U]NKN!0V!S0JPUJKUS!SN0!_T!0]N! 'YNX0QVPS! 1 VWWQ00NNh!!
- _D) V0!SYJPUNK!V[[VPNP0S!VK!0]N0K!XJW[J0^PSh!!!
- XD 1 VW [YT! b 00]! " JKLMN00N!&PQRNKSQ0T! [VSQ0QP^!^MQUNYQPNS!NS0J_YQS]NU!_T!0]N! O ZZQXNS! VZ!\$NSQUNPXN!4QZN:!, 0MUNP0! 'P^J^NWNP0!, NKRQXNS!E O ZZQXN!VZ!0]N!#YMWPQ! "NWVKQJY! &PQVPF:!JPU! " JKLMN00N!&PQRNKSQ0T:!JS!bNYY!JS!VKUQPJPXNS!VZ!0]N!1Q0T!VZ! "QYbJMeNNh!

UD) V0!MSN! " JKLMN00N:! " & , /:!VK!V0]NK!PVP3J[[KVRNU!YV^VSh!!

?D!!!!!O0]NK!, [NXQZQX!1VPUQQQVPS!!

- JD 'JX]!XJPUQUJ0N!WMS0!SM_WQ0!J!YQS0!QUNP0QZTQP^!JYY!SVXQJY!WNUQJ!JXXVMP0S!JSSVXQJ0NU!
 0V!0]N!XJW[JQ^PD!(]QS!YQS0!WMS0!_N!SM_WQ00NU!J0!XJPUQUJ0N!KN^QS0KJ0QVPh!!
 - 0D #YY!KN^0S0NKNU!JXXVMP0S!WMS0! N!WJUN![M Y0X!UMK0P^!0]N!NP00KN!NYNX00VP![NK0VUh!!
 - QQD #YY!KN^QS0NKNU!JXXVMP0S!WMS0!QUNP0QZT!b]QX]!XJW[JQ^P!0]NT!JKN!0QNU!0V!JPU!b]J0![YJ0ZVKWS!JPU!MSNKPJWNS!0]NT!bQYY!_N!MPUNKh!!
 - 000 *Z!J!XJW[J0^P!X]VVSNS!0V!JUU!VK!0NKW(PJ0N!J!SVX0JY!WNU(J!JXXVMP0:!VK!X]VVSNS! 0V!X]JP^N!0]N![YJ0ZVKW!VK!MSNKPJWN:!0]NT!WMS0!PV00ZT!0]N!NYNX00VPS!XVWW(000NND!!
- _D #PT!XJW[JQ^PGNYNXQQVP!WJONKQJY!WMS0!_N![VS0NU!_T!J!XJPUQUJ0N!VK!KN^QS0NKNU! XJW[JQ^P!bVKeNK!0]KVM^]!J!KN^QS0NKNU!SVXQJY!WNUQJ!JXXVMP0h!!
 - #PT!XJW[JQ^PGNYNX0QVP!WJ0NKQJY![VS0NU!_T!J!XJPUQUJ0N!VK!XJW[JQ^P!bVKeNK!
 0]J0!QS!PV0!0]KVM^]!J!KN^QS0NKNU!SVXQJY!WNUQJ!JXXVMP0!XJP!_N!SM_gNX0!0V!KNRQNb!
 _T!0]N!'YNX0QVPS!1VWWQ00NNh!!
 - QQD (]N!NP0QKN!0QXeN0!b(YY!_N!]NYU!KNS[VPSQ_YN!ZVK!JYY!WNUQJ![VS0NU!_T!JPT! KN^QS0NKNU![NKSVP!VP!0]N!XJW[JQ^P!0QXeN0D!!
- XD #PT!XJW[J0^P!WJ0NKQJY!WMS0!VKQ^QPJ0N!ZKVW!J!KN^QS0NKNU![NKSVP!VP!J!XJW[J0^P! 00XeN0!ZKVW!J!KN^0S0NKNU!SVX0JY!WNU0J!JXXVMP0h!!
 - 0 1 JW [JQ^PS!XJPPV0!_N![NPJYQ`NU!ZVK!WJ0NKQJY!XKNJ0NU!QPUN[NPUNP0YT!VK!S]JKNU! JPU!KN[VS0NU!_T!PVP3XJW[JQ^P!bVKeNKS!!
 - ((0) 1 JPU(UJ0NS!JPU!XJW [J()^P! b VKeNKS!XJPPV0!KNLMNS0!PVP3XJW [J()^P! b VKeNKS!0V!
 [VS0!XJW [J()^P!WJ0NK(JYS!JPU!SVX(JY!WNU(J! [VS0S!0]KVM^]!PVP3KN^(S0NKNU!
 JXXVMP0SD!!

.1978A@!\$(((!:!%51978A@!.72DD!

#D! (]N!'YNX0QVPS!1VVKUQPJ0VK!S]JYY!KNXKMQ0!J!PNXNSSJKT!PMW_NK!VZ!S0JZZ!ZVK!0]N!"&,/!

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!

1D! 'YNXOQVP!S0JZZ!WNW_NKS!JKN![KV]Q_Q0NU!ZKVW!NP^J^QP^!QP!SVYQXQ0J0QVP!VZ!RV0NS!VK!JPT!
        [JK0QSJP!JX0QRQ0T!J0!0]N! "&, /!'YNX0QVP!jNY[!.NSeD!
!
.1978A@!(F!
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"#$%&'(('!&)*+'$,*(-!,(&.')(!/0+'$)"')(!

>('6'*(6M!/#M(*(%.!))!

#66$0+'.!2-!"&,/!E70$"'$4-!#,"&F!,')#('!?6?=6H>!

#66$0+'.!2-!+*1'!6$',*.')(!70$!,(&.')(!#77#*$,!C6;6H>!

&6.#('.!;;6?<6H=!

"#10$!$'+*,*0)!?0;6@;:!+6,#!#66$0+#4!H6?C6@;!

"#10$!$'+*,*0)!E0K^JPQ`J0QVP!7MPUQP^F!;;6=6@;:!+6,#!#66$0+#4!;6;A6@?!

"#10$!$'+*,*0)!E0K^JPQ`J0QVP!7MPUQP^F!;?6;6;A:!+6,#!;?6;C6;A!

"#10$!$'+*,*0)!E0K^JPQ`J0QVP!7MPUQP^F!@A6@=6?;:!+6,#!@A6@=6?;!

!
1978A@!(!:!6?7<A087H!

[]N!"JKLMNOON!&PQRNKSQOT!,0MUNPO!/VRNKPWNPO!E"&,/F!7QPJPXQJY!6VYQXQNS!UNZQPN!0]N![VYQXQNS!JPU![KVXNUMKNS!b]QX]![NKOJQP!OV!0]N!XVYYNXOQVP!JPU!UQS0KQ_MOQVP!VZ!"&,/!ZMPUS:!JS!WJPUJONU!_T!
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.1978A@!((!:!) 1D8@878A@;!

KOQXYN! + ***! VZ!0] N! " &, / !1 VPS0Q0M0QVPD!

#1)

ZMPUQP^!WNN0QP^S!JPU!S]JYY!0JeN!PV0NS!KN^JKUQP^!0]N!KNJSVPQP^!_N]QPU!JYY!JYYVXJ0QVP!
UNXQSQVPSD! "NW_NK!SNPJ0VKS!S]JYY!SM_WQ0!JP!J[[YQXJ0QVP!0V!0]N!4N^QSYJ0QRN!+QXN!6KNSQUNP0:!
b]QX]!QP!0MKP!bVMYU!_N!UQS0KQ_M0NU!0V!0]N!, NPJ0N!JS!J!b]VYN!_NZVKN!NYNX0QVPSD!&[VP!
KNRQNbQP^!SJQU!J[[YQXJ0QVPS:!0]N!, NPJ0N!bQYY!J[[VQP0!XJPUQUJ0NS!_T!JP!JZZQKWJ0QRN!RV0N!VZ!J!
SQW[YN!WJgVKQ0T!VZ!0]N![KNSNP0!, NPJ0ND!#XJUNWQX!JPU!KNSQUNP0QJY!WNW_NK!SNPJ0VKS!S]JYY!_N!
J[[VQP0NU!J0!0]N!SNXVPU!, NPJ0N!WNN0QP^!ZVYYVbQP^!0]N!S[KQP^!JPU!ZJYY!NYNX0QVPS!
KNS[NX0QRNYT!JPU!S]JYY!SNKRN!ZVK!VPN!XJYNPUJK!TNJKD!*P!0]N!XJSN!VZ!J!RJXJPXT:!JPV0]NK!
,NPJ0VK!S]JYY!_N!J[[VQP0NU!_T!0]N!4N^QSYJ0QRN!+QXN!6KNSQUNP0!JPU!S]JYY!SNKRN!0]N!
KNWJQPUNK!VZ!0]N!VKQ^QPJY!0NKWD!)V!,NPJ0VK!WJT!VXXM[T!SNJ0S!VP!_V0]!0]N!2MU^N0!
1VWWQ00NN!JPU!,0MUNP0!OK^JPQ^JQVP!7MPUQP^!1VWWQ00NN!J0!0]N!SJWN!0QWNDi!

- . D *O%)#&@%'>F%*=<=%+*'M&&'eO>Md*!1!,] JYY!_N!JSSNSSNU!_T!0]N!&PQRNKSQOT!J^JQPS0!0]N!WNW_NKS]Q[! VZ! " & , / !E1 VPS0Q0M0QVP:!#K0QXYN!**FD!!(]N! " & , / ![VK0QVP!VZ!0]N!, #7!S]JYY!_N!XVYYNX0NU!_T! 0]N!&PQRNKSQOT!ZVK! " & , / :!SM_gNX0!0V!J!KNJSVPJ_YN!XVYYNX0QVP!ZNN!J^KNNU!M[VP!_T!0]N! &PQRNKSQOT!1 VW[0KVYYNK!JPU!0]N!7QPJPXQJY!+QXN!6KNSQUNP0D!!!1]JP^NS!0V!0]N!JWVMP0!VZ!0]N! " & , / ![VK0QVP!VZ!0]N!, #7!S]JYY!_N!SM_gNX0!0V!J[[KVRJY!_T!J!0bV30]QKUS!JZZQKWJ0QRN!RV0N!VZ! 0]N!SNJ0NU!, NPJ0N!JPU!JX0QVP!_T!0]N!6KNSQUNP0D!!#PT![KV[VSJY!0V!X]JP^N!0]N! " & , / ![VK0QVP! VZ!0]N!, #7!ZVK!0]N!M[XVWQP^!ZQSXJY!TNJK!WMS0!_N!J[[KVRNU!_T!0]N!+QXN!6KNSQUNP0!ZVK!, 0MUNP0!#ZZJQKS!JPU!SM_WQ00NU!0V!0]N!&PQRNKSQOT!2MU^N0!1VWWQ00NN!PV!YJ0NK!0]JP!OX0V_NK!; D!!(]N!X]JP^N!WMS0!0]NP!_N!J[[KVRNU!_T!0]N!&PQRNKSQOT!2MU^N0!1VWWQ00NND!
- 'D S&5=<&#'M) @#7!1!7MPUS!UNKQRNU!ZKVW! "&, /3S[VPSVKNU!LMJYQZTQP^!S0MUNP0!SNKRQXNS:!VK! JPT!QP0NKNS0!NJKPNU!VP!0]N!QPRNS0WNP0!VZ! "&, /!ZMPUS!QP!0]N!\$NSNKRN!7MPUD!
- 7D G''=\%$*'[33\#'C'\#PT![]TS(XJY!(0NW!b]VSN![MK[VSN!SVYNYT!SNKRNS!0]N!VK^JPQ`J0(VP!VK!(0S!W(0SS(VPD!,MX]!JP!(0NW!WMS0!]JRN!J!MSNZMY!Y(0ZN!ZVK!^KNJ0NK!0]JP!VPN!SNWNS0NK!VK!_N!NSSNP0(JY!0Y!0]N!V[NKJ0(VP!VZ!0]N!VK^JPQ`J0(VPD!,MX]!UN0NKW(PJ0(VPS!b(YY!_N!WJUN!J0!0]N!U(SXKN0(VP!VZ!0]N!,0MUNP0!OK^JPQ`J0(VP!7MPU(P^!1VWW(00NND!$

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 $\texttt{/D-(]N!,0MUNP0!OK^JP0^J00VP!7MPU0P^!E,O7F!1VWW000NN!S]JYY!KNR0Nb!J[[Y0XJ00VPS!ZVK!] } \\$

.1978A@!(\$!:!/2H31@7;!2@E!&1834?0;131@7;!DAO!.#>!655A9278A@;!

- #D ,] VMYU!J!KNXV^PQ`NU!S0MUNP0!VK^JPQ` J0QVP!KNXNQRN!ZMPUQP^!ZVK!J!&PQRNKSQ0T! 'c[NPSN!END^D! # "&!Nc[NPSNS:!XJ0NKQP^:![KQP0QP^:!N0X0F!VK!J![MKX]JSN!ZKVW!J!&PQRNKSQ0T!J[[KVRNU! RNPUVK:! "&, /!S]JYY![JT!0]J0!VP!_N]JYZ!VZ!0]N!KNXV^PQ`NU!S0MUNP0!VK^JPQ` J0QVPD!
- 2D ,]VMYU!J!KNXV^PQ`NU!S0MUNP0!VK^JPQ`J0QVP!KNXNQRN!ZMPUQP^!ZVK!J!1J[Q0JY! / VVU:!JP!VZZQXN!VK! UN[JK0WNP0! b (0)]QP!, 0MUNP0! #ZZJQKS!WJT![MKX]JSN!0]N!1J[Q0JY! / VVU!VP!_N]JYZ!VZ!0]N! S0MUNP0!VK^JPQ`J0QVP!JPU!ZJXQYQ0J0N!J!UN[JK0WNP0!0KJPSZNK! b (0)]!0]N! " & , / !7QPJPXN!OZZQXND! (]N!, O7!1VWWQ00NN!b(YY!ZVKbJKU!JYY!JYYVXJ0QVPS!ZVK!1J[Q0JY! / VVUS!0V!O'*![KQVK!0V!JPT! S0MUNP0!VK^JPQ`J0QVPS!KNLMNS0QP^!O'*![MKX]JSN!JPT!1J[Q0JY! / VVUESFD!!
- 10 #YY!ZQPJPXQJY!UVXMWNP0J0QVP![NK0JQPQP^!0V!LMJYQZTQP^!S0MUNP0!SNKRQXNS!WMS0!_N!SM_WQ00NU! b Q0]!0]N!S [VPSVK\S! 'c0NKPJY!1]NXe!\$NLMNS0!7VKW!PV!YJ0NK!0]JP!0]QK0T!E<@F!UJTS!JZ0NK!0]N! NRNP0!]JS!0JeNP![YJXN!VK!_T!IMPN!;!VZ!0]N!ZQSXJY!TNJK!UMKQP^!b]QX]!0]N!ZMPUQP^!bJS! JYYVXJ0NU:!b]QX]NRNK!VXXMKS!ZQKS0D! #YY!ZQPJPXQJY!UVXMWNP0J0QVP![NK0JQPQP^!0V!ZVVU:! &PQRNKSQOT!Nc [NPSNS:!XJ [Q0JY!^VVUS:!XVPZNKNPXN!KN^QS0KJ0QVP!ZNNS:!0VMKPJWNP0!ZNNS:! 0VMKPJWNP0!OKJRNY!Nc [NPSNS:!SNKRQXN!0KQ [!0KJRNY!Nc [NPSNS:!VK! [M_YQXQOT!WMS0!JYSV!_N! SM_WQ00NU!bQ0]!0]N!S[VPSVK\S! 'c0NKPJY!1]NXe!\$NLMNS0!7VKW!PV!YJ0NK!0]JP!0]QK0T!E<@F!UJTS! JZ0NK!0]N![MKX]JSN!VK!_T!IMPN!;!VZ!0]N!ZQSXJY!TNJK!UMKQP^!b]QX]!0]N!ZMPUQP^!bJS!JYYVXJ0NU:! b]QX]NRNK!VXXMKS!ZQKS0D!#PT!UVXMWNP0J0QVP!KNXNQRNU!JZ0NK!0]NSN!UNJUYQPNS!bQYY!KNSMY0!QP!UNP0JY!VZ!KNOW MKSNWNP0!KNYJ0QP^!0V!0]VSN!Nc[NPSNSD!
- . D #PT!ZMPUS!0] J0!JKN!PV0!M0QYQ`NU!_T!J!S[VPSVK!S] JYY!KN0MKP!0V!0] N!XVYYNX0QRN! [VK0QVP!VZ!0] N! , #7!0] J0!QS!UNSQ^PJ0NU!ZVK! , 0MUNP0! O K^JPQ` J0QVP!7MPUQP^D!

.1978A@!\$!:!.#>!6==125;!

#D #PT!KNXV^PQ`NU!S0MUNP0!VK^JPQ`J0QVP!S]JYY!_N!J_YN!0V!J[[NJY!J!UNXQSQVP!VZ!0]N!, O 7! XVWWQ00NN!QZ!0]NT!XJP!UNWVPS0KJ0N!0]J0d!;D

.1978A@!\$(!:!-<1!&1;10G1!>?@E!

#D (]N!\$NSNKRN!7MPU!S]JYY!_N!JRJQYJ_YN!OV![MKX]JSN!XJ[Q0JY!^VVUS!VK!V0]NK!VZZQXN!KNYJONU!
NLMQ[WNP0!ZVK! " & , /D!!(]N!WQPQWMW!JWVMP0!JYYVXJ_YN!ZVK!SMX]!J![MKX]JSN!S]JYY!_N!
n>@@D@@D!

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- 2D (]N!\$NSNKRN!7MPU!S]JYY!_N!JRJQYJ_YN!0V!SVYNYT!S[VPSVK!VK!0V!SM_SQUQ`N!0]N!S[VPSVKS]Q[!VZ!J!LMJY0ZT0P^!S0MUNP0!SNKR0XND!
 - ;D (]N!SNKRQXN!S]JYY!_N!S[VPSVKNU!_T! " & , / D!
 - ?D #PT!SNKRQXN!PV0!S[VPSVKNU!_T! " & , /!VP!JP!JPPMJY!_JSQS!WJT!_N!SVYNYT!S[VPSVKNU!_T! 0]QS!ZMPUD!
 - <D #PT!SNKRQXN!S[VPSVKNU!_T! " & , /!VP!JP!JPPMJY!_JSQS!WJT!_N!SM_SQUQ`NU:!_M0!PV0!
 SVYNYT!S[VPSVKNU! T:!0]QS!ZMPUD!</pre>
 - AD (]N!SNKRQXN!WJT!^NPNKJON!KNRNPMN:!_MO!S]JYY!PVO!^NPNKJON![KVZQOD!!!#PT!PNO!KNRNPMN! S]JYY! N!UQRQUNU![KV[VK0QVPJYYT!OV!0]N!JWVMPO!VZ!XV3S[VPSVKS]Q[G^MJKJPONND!
- . D *Z!0]N!_JYJPXN!VZ!0]N!\$NSNKRN!7MPU!ZJYYS!_NYV b !0NP![NKXNP0!E;@ o F!VZ!0]N! " & , / !JPPMJY! V [NKJ0QP^!_MU^N0:!J!_MU^N0!YQPN!S]JYY!_N!QPXYMUNU!QP!0]N!PNc0!JPPMJY!V [NKJ0QP^!_MU^N0!0V! SN0!JSQUN!ZMPUS!ZVK!0]N!\$NSNKRN!7MPUD!!(]QS!_MU^N0!YQPN!S]JYY!PV0!_N!^KNJ0NK!0]JP!ZQRN! [NKXNP0!E> o F!VZ!0]N!JPPMJY!V [NKJ0QP^!_MU^N0!JPU!S]JYY!XVP0QPMN!VP!JP!JPPMJY!_JSQS!MP0QY! 0]N!_JYJPXN!VZ!0]N!\$NSNKRN!7MPU!QS!NLMJY!0V!VK!^KNJ0NK!0]JP!0NP![NKXNP0!E;@ o F!VZ!0]N! JPPMJY!V[NKJ0QP^!_MU^N00!
- 'D *Z!0]N!_JYJPXN!VZ!0]N!\$ NSNKRN!7MPU!JWJSSNS!0V!^KNJ0NK!0]JP!ZQZOT![NKXNP0!E>@ o F!VZ!0]N!
 "&, /!JPPMJY!V[NKJ0QP^!_MU^N0!J0!0]N!XYVSN!VZ!JPT!ZQSXJY!TNJK:!J!XJ[!bQYY!_N!QPQ0QJ0NUD!!
 7VYYV bQP^!0]N!QPQ0QJ0QVP!VZ!0]N!XJ[![KVXNSS:!JPT!JUUQ0QVPJY!ZMPUS!0]J0!bVMYU!]JRN!_NNP!
 0KJPSZNKKNU!0V!0]N!\$ NSNKRN!7MPU:!J0!0]N!NPU!VZ!J!ZQSXJY!TNJK:!bQYY!_N!0KJPSZNKKNU!0V!J!
]VYUQP^!JXXVMP0!NS0J_YQS]NU!_T!0]N!"JKLMN00N!&PQRNKSQ0T!OZZQXN!VZ!0]N!1VW[0KVYYNKD!(]N!
 7QPJPXQJY!+QXN!6KNSQUNP0!QS!]NKN_T!JM0]VKQ`NU!0V!VRNKSNN!0]N!0KJPSZNK!VZ!0]N!KVYYVRNK!ZMPUS!
 QP0V!0]N!]VYUQP^!YQPN!J0!0]N!NPU!VZ!0]N!ZQSXJY!TNJKD!(]N!JYYVXJ0QVP!VZ!0]N!ZMPUS!QP!0]N!
 [VYUQP^!JXXVMP0!S]JYY!ZVYYV b!0]N!Z0PJPXQJY![VY0XT!JS!VM0Y0PNU!QP!, NX00VP!+**!SM SNX00VP!jD!
- 7D *Z!0]N!JWVMP0!VZ!ZMPUS!QP!0]N! " & , / !\$NSNKRN!7MPU!ZJYYS!_NYV b !0]N!QPS0Q0M0NU!XJ[!YNRNY:! 0]N!XJ[!S]JYY!_N!YQZ0NUD! 5 Q0]!0]N!YQZ0QP^!VZ!0]N!XJ[:!J0!0]N!NPU!VZ!J!ZQSXJY!TNJK:!JPT!

 KNWJQPQP^!ZMPUS!S]JYY!_N!0KJPSZNKKNU!QP0V!0]N! " & , / !\$NSNKRN!7MPU!MP0QY!SJQU!KNSNKRN!ZMPU!

 KNJX]NS!QOS!XJ[[NU!YQWQ0!0]MS!QPS0Q0M0QP^!0]N!XJ[![KVXNUMKNSD!

.1978A@!\$((!:!-<1!6@@?25!,+."!J?EB17!/0A91;;!

#D 'JX]!UN[JK0WNP0!X]JQK!VZ! "&, /!S]JYY!SM_WQ0!J!UN[JK0WNP0JY!_MU^N0!ZVK!JYY!LMJYQZTQP^!
S0MUNP0!SNKRQXNSD! . N[JK0WNP0JY!_MU^N0!ZVKWS!ZVK!0]N!PNc0!ZQSXJY!TNJK!S]JYY!_N!WJUN!
JRJQYJ_YN!_T!0]N!7QPJPXQJY! . N[JK0WNP0!PV!YJ0NK!0]JP!0]N!ZQKS0!bNne!VZ! . NXNW_NK!JPU!WMS0!

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- !
- $\label{eq:noint} $$ Nc[NPUQ0MKND!7JQYMKN!0V!XVW[YN0N!0]N!J[[YQXJ0QVP!JXXMKJ0NYT!JPU!0QWNYT!bQYY!KNSMY0!QP!0]N!2MU^N0!1VWWQ00NN!UN0NKWQPQP^!0]N!ZQPJY!_MU^N0!ZVK!0]J0!UN[JK0WNP0D!$
- 2D (]N!2MU^N0!1VWWQ00NN!bQYY![KN[JKN!J!S0J0NWNP0!VZ!0]N![KVgNX0NU!JPPMJY!V[NKJ0QP^!_MU^N0!ZVK!0]N!PNc0!ZQSXJY!TNJKD!!(]N!S0J0NWNP0!S]JYY!YQS0!0]N!ZVYYVbQP^d!
 - ;D (]N![KVgNX0NU!KNRNPMN!ZKVW!0]N! "&, /![VK0QVP!VZ!0]N!, #7:!JS!J^KNNU!M[VP!_T!0]N! 2MU^N0!1VWWQ00NN!JPU!0]N!&PQRNKSQ0T\S!OZZQXN!VZ!7QPJPXND!
 - ?D (]N![KVgNX0NU!JWVMP0!VZ!KNRNPMN!ZKVW!UNKQRNU!ZMPUS:!JS!J^KNNU!M[VP!_T!0]N! 2MU^N0!1VWWQ00NN!JPU!0]N!, 0MUNP0!#ZZJQKS!VK!UNSQ^PNND!!(]NSN!ZMPUS!S]JY!!_N! JYYVXJ_YN!VPYT!0V!"&,/D!
 - <D (]N!0V0JY!ZMPUS!JYYVXJ_YN:!b]QX]!S]JYY!NLMJY!0]N!0V0JY!KNRNPMNS!WQPMS!0]N!</pre>

!

.1978A@!\$(((!:!%I=1@E87?01!/0A91E?01;!

- #D #YY!KNRNPMNS!0V!0]N!XKNUQ0!VZ! "&, /!S]JYY!_N!UN[VSQ0NU!QPOV!JP!JM0]VKQ`NU! "&, /!JXXVMP0!
 _T!0]N!7QPJPXQJY! . N[JK0WNP0!QP!0]N!QUNP0QXJY!ZVKW!QP!b]QX]!Q0!bJS!KNXNQRNUD!!(]N!
 7QPJPXQJY!+QXN!6KNSQUNP0!S]JYY!JSXNK0JQP!0]N!JXXVMP0!b]QX]!QS!NP0Q0YNU!0V!0]N!KNRNPMNS:!
 MPUNK!0]N!J[[KVRNU!_MU^N0:!JPU!S]JYY!0KJPSZNK!0]N!UN[VSQ0!JXXVKUQP^YT!0V!0]N!J[[KV[KQJ0N!JXXVMP0SD!
- 20 70PJY! MU^NOJKT!JYYVXJ00VPS!0V!S[VPSVKS!VZ!LMJY0ZT0P^!S0MUNP0!SNKR0XNS!WJT! N!Nc[NPUNU!

- > ? &@#&#', OB/ZBO-'C'' D*= ? =@\$\\=3@'38'O9>'hZ-O'P= ? =\\'P=\\'M35 ? '\$@#'F*\\$5=\\=F\\\-3@'38'5\\F\\\=<=@I' 8)@#=@I'\\S3 ? '43\\K'O9>'\\\#\\K\\'H53I5\\ ? 'J3\\\55\\'
- > ? &@#&#', /B, BO-'''C'' G*\$5=8=F\$%=3@'38'FK\$5=%\$4*&'F3@%5=4)%=3@7'
- $>? \&@\#\&\#'-BABOZ''''C'' \ T\ 3\#=8=\&\#'<3\%=0\ I'''53F\&\#)\ 5\&'835'O\ 9>'\$@\#'J\)\#I\&\%'G3\ ?\ ?=\%\&\&\&'O\&@\$\%357'$
- > ? &@#&#'UBLBOZ''''C'' 2 &= ? 4) 57& ? &@%'#3F) ? &@%\$%=3@'5&\)=5& ? &@%7'
- > ? &@#&#'ABLBOR'''''C'' Y@F5&\$7&#'''35%=3@'38'>F%=<=%+'M&&'%3'O9>'%3'@3'*&77'%K\$@'A-g.'?3#=8=&#' 8)@#=@I'#&\$#*=@&7'835'F*)4'7''35%7.'\$@#'F*\$5=8=&#'%K\$%'35I\$@=_\$%=3@7'?\$+'3@*+' \$''''*+'3@F&'835'\$@'\$F%=<=%+a'
- > ? &@#&#'AB/LBOU'''C' Y@F5&\$7&#'09> %K5&7K3*#'835'0&@\$%&'\$''''53<\$*'\3'h/-00'
- > ? &@#&#'/B/1B,, '''C'

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

.%'6-%!.-6')('"!&+M%.!
!
&6.#('.!=6;6@;:!+6,#!#66$0+#4!H6?C6@;!
!
```

. 1978A@!(!:!/20582 3 1@720H! 6 ?7<A087H!

- #D! (]N![JKYQJWNPOJKT!JM0]VKQOT!VZ!0]N! " & , /!, NPJON!S]JYY!_N!234&5%67'2)*&7'38'95#&5.'
 : & ; *+'2&<=7&#:!NcXN[0!b]NKNJS!JWNPUNU!QP!0]NSN!S0JPUQP^!KMYNSD!!(]N!WVS0!XMKKNP0!
 RNKSQVP!VZ!0]N!, NPJON!S0JPUQP^!KMYNS!S]JYY!_N!QP!NZZNX0!J0!JYY!, NPJON!WNN0QP^SD!
- 20! 5]NP!UQZZNKNPXNS!VXXMK!_N0 b NNP!0]N! 1 VPSQQ0MQVP:!, NPJON!, 0JPUQP^!\$MYNS:!JPU!234&5%67' 2)*&7:!0]N! 1 VPSQQ0MQVP!S]JYY!0JeN![KNXNUNPXN!VRNK!0]N!, NPJON!, 0JPUQP^!\$MYNS:!JPU!0]N!, NPJON!, 0JPUQP^!\$MYNS!S]JYY!0JeN![KNXNUNPXN!VRNK!\$V_NK0\S!\$MYNSD!!!

1 D!

- !
- 1 D! (]N![KNSNP0!JPU!RV0QP^!, NPJ0N!S]JYY!XVPSQS0!VZ!JYY!SNPJ0VKS!RV0QP^!QP!J[[KVRJY!VK!UNPQJY!VZ! J!WV0QVPD!!#_S0NP0QVPS!S]JYY!PV0!_N!XVPSQUNKNU!QP!0]N!XJYXMYJ0QVP!VZ!0]N![NKXNP0J^N! PNNUNUD!
- . D! + VONS!SJYY!PVO! N!WJUN! T![KVcT!RVOND!!E\$NJZZ0KWJ00VPF!]
- 'D! *P!0]N!NRNP0!LMVKMW!QS!PV0!WN0!J0!0]N!0QWN!VZ!J!RV0Nd!
 - ;D (]N!YN^QSYJ0QVP!MPUNK!XVPSQUNKJ0QVP!S] JYY!_N!0J_YNU!QPUNZQPQ0NYT!_T!0]N! 1] JQKD!
 - ?D (]N!KNWJQPQP^!YN^QSYJQQRN![JK0!VZ!0]N!WNNQQP^!bQYY!_N!KNWVRNU!ZKVW!0]N!J^NPUJ!JPU! [YJXNU!VP!0]N!PNc0!J^NPUJD!
 - <D (]N!WNN0QP^!bQYY!0]NP!WVRN!QP0V!0]N!PVP3YN^QSYJ0QRN![JK0!VZ!0]N!WNN0QP^! EJPPVMPXNWNP0S:!N0XDF!!!
 - AD 7(PJYYT: !0] N!WNN0(P^! b (YY!_N!JUgVMKPNU!_T!0] N! 1] J(KD!
- 7D! #YY!RVONS:!MPYNSS!Nc[YQXQ0YT!UNZQPNU!V0]NKbQSN:!S]JYY!_N!XVPSQUNKNU!OV!_N![KNSNP0!RVONSD!! (]N!OT[N!VZ!RVON!PNXNSSJKT!S]JYY!_N!VM0YQPNU!QP!0]N!YJ0NS0!RNKSQVP!VZ!0]N! "&, /! 1VPS000M00VP:!00S!2T34JbS:!234&5%67'2)*&7'38'95#&5:!VK!b00]0P!0]N!,NPJ0N!,0JPU0P^!\$MYNSD!!
- / D! (]N!WN0]VU!VZ!RV0QP^!S]JYY!_N!YNZ0!0V!0]N!UQSXKN0QVP!VZ!0]N!X]JQK:!_M0!0]N!MSN!VZ!SNXKN0!
 _JYYV0!RV0NS!S]JYY!_N![KV]Q_Q0NU!MPYNSS!XVPS0Q0M0QVPJYYT!WJPUJ0NUD! ' JX]!SNPJ0VK\S!RV0N:!
 NQ0]NK!QP!0]N!JZZQKWJ0QRN:!PN^J0QRN:!VK!JP!J_S0NP0QVP:!bQYY!_N!KNXVKUNU!_T!0]N!4N^QSYJ0QRN!
 1 YNKe!JPU!QPXYMUNU!QP!0]N!WNN0QP^!WQPM0NS!JPU![VS0NU!VP!0]N! " & , /!bN_SQ0ND!

.1978A@!(\$!:!*A@;8E10278A@!AD!2!, A78A@!

- #D "V0QVPS! [KV [NKYT!WVRNU!ZVK!XVPSQUNKJ0QVP!S] JYY!_N!QP0KVUMXNU!_T!M [!0V!ZVMK!JM0] VKS!VZ!
 0] N!YN^QSYJ0QVP!0JeNP!QP!VKUNK!VZ!0] NQK!YQS0QP^!VP!0] N!WV0QVPD!! (]QS!QP0KVUMX0QVP!S] JYY!_N!
 QWWNUQJ0NYT!JZ0NK!0] N!WV0QVP!KNXNQRNS!J!SNXVPUD!! . MKQP^!0] QS!0QWN:!NJX]!JM0] VK!S] JYY!] JRN!
 ZVMK!WQPM0NS!0V!S [NJe!VP!_N] JYZ!VZ!0] N!WV0QVPD!! (QWN!QS!0KJPSZNKJ_YN!VPYT!0V!JPT!VZ!0] N!
 V0] NK!0] KNN!JM0] VKSD!! (]N!JM0] VKS\!QP0KVUMX0VKT!0QWN! [NKQVU!S] JYY!PV0!_N!Nc0NPUNUD!
- 2D 7VYYV b 0P^!0] N!0P0KVUMX00VP!0] NKN!S] JYY! N!J! [NK0VU!VZ!LMNS00VPSD!
 - ;D! %MNS0QVPS!S]JYY!_N!JSeNU!VPYT!_T!SNPJ0VKSD!!(]NKN!S]JYY!_N!PV!0QWN!YQWQ0!0V!0]N!
 LMNS0QVPS![NKQVUh!]V b NRNK:!SNPJ0VKS!S]JYY!VPYT!_N!JYYV b NU!0V!JSe!LMNS0QVPS!VP!0 b V!
 VXXJSQVPS!ZVK!0NP!E;@F!WQPM0NS!NJX]D!!\$]N0VKQXJY!LMNS0QVPS!S]JYY!PV0!_N![NKWQ00NUD!
 - ?D! (]N!4+6!E1]J(KF!]JS!0]N!U(\$XKN0(VP!0V!JY0NK!0]N\$N!Y(W(0\$!VP!LMN\$0(VP\$!(Z!JPPVMPXNU! [K()VK!0V!XVP\$()UNKJ0()VP!VZ!0]N!WV0(VPD!!!

 - _D! #!?G<!RV0N!QP!0]N!<u>@&I\$%=<&</u>!VZ!0]N![KNSNP0!, NPJ0N!bQYY!SMS0JQP!0]N!YQWQ0S!JS!bKQ00NP!QP!
 ,0JPUQP^!\$MYNSD!!7JQYMKN!VZ!0]N!, NPJ0N!0V!KNJX]!J!?G<!RV0N!QP!0]N!<u>@&I\$%=<&</u>![NKWQ0S!
 0]N!4+6\S!E1]JQK\SF!WVUQZQXJ0QVP!0V!_N!MSNU!QP!XVPSQUNKJ0QVP!VZ!0]N!QWWNUQJ0N!
 PNc0!WV0QVP!<u>3@*+</u>D!
 - $< \mathbb{D}!$ ($\mathbb{N}!4 + 6!E1 \mathbb{I} J \times \mathbb{S} \mathbb{I} J \times \mathbb{S}$
 - JD! " JQP0JQP!J!S[NJeNK\S!YQS0!JPU!WVPQ0VK!0]N!0QWN!Nc[NPUNUD!
 _D!

- ?D! #!PN b YT!JKKQRQP^!SNPJ0VK:!PV0![KNSNP0!ZVK!LMNS0QVPS!QP!1 VWWQ00NN!VZ!0]N! 5]VYN:!S]JYY!
 _N!^QRNP!0NP!E; @F!WQPM0NS!0V!JSe!LMNS0QVPS!QP!^NPNKJYD!
- <D! (]N!JM0] VKS\!QP0KVUMX0VKT!QQWN! [NKQVU!S] JYY!_N!VWQ00NUD!</p>
- AD! *P!0]N!NRNP0!0]J0!0]N!1]J0K!VZ!1VWWQ00NN!VZ!0]N!5]VYN!_NXVWNS!0]N!1]J0K!VZ!0]N!
 , NPJ0N:!0]N!KQ^]0S!VZ!LMNS0QVPS!JPU!UN_J0N!S]JYY!_N!b(0)]NYUh!]VbNRNK:!0]N!X]J0K!S]JYY!
 _N![NKWQ00NU!0V!RV0N!VP!0]N!WV0QVPD!!)V!RVQXN!RV0N!WJT!_N!XJYYNU:!JPU!0]N!1]J0K!WMS0!
 RV0N!YJS0D!

.1978A@!\$((!:!.?49A3387711!.70?97?01!

!

#D! , M_XVWW(00NNS:!S0JPU(P^!VK!S[NXQJY:!S]JYY!XVPUMX0!_MSQPNSS!JS!UN0JQYNU!QP!0]QS!SNX0QVPD! 2D!

! ! /D

<0 *0!(\OS!SOKVP^\YT!SM^^NSONU!0]J0!J0!\YNJS0!VPN!VZ!0]N!0]KNN!KN[KNSNP0J0\QRNS!_N!J!WNW_NK!VZ! 0]N!INSM\(\O!XVWWMP\(\OTD!\)

!

AD (]N!, NYNX0QVP!1VWWQ00NN!S]JYY!JYSV!]JRN!J!PVP3RV0QP^!JURQSVK:!0]N!+QXN!6KNSQUNP0!ZVK!, 0MUNP0!#ZZJQKS!VK!UNSQ^PNND!!#YY!WNN0QP^S!JPU!UNYQ_NKJ0QVP!VZ!0]N!XVWWQ00NN!WMS0!

]JRN!0]N!JUR0SVK![KNSNP0D!

. 1978A@!(((!:! ' A 3 8@278A@;!2@E!6==589278A@;!

- #D) VW0PJ00VPS!ZVK!, NP0VK!, [NJeNK!S]JYY! N!SVY0X00NU!JS!ZVYYVbSd!
 - ;D) VWQPJ0QVPS!ZVK!, NPQVK!, [NJeNK!WJT!XVWN!ZKVW!JPT!WNW_NK!VZ!0]N!^KJUMJ0QP^!XYJSS! VK!ZKVW!ZJXMY0T:!JUW0PQS0KJ0VKS:!VK!S0JZZD!
 - ?D (]N!KNLMNS0!ZVK!PVWQPJ0QVPS!WMS0!_N!JRJQYJ_YN!0V!0]N!MPQRNKSQ0T!XVWWMPQ0T!J0!YNJS0! 0]KNN!bNneS![KQVK!0V!0]N!PVWQPJ0QVP!UNJUYQPND!
- 20 #[[Y0XJ00VPS!ZVK!, NP0VK!, [NJeNK!S]JYY!_N!SVY0X00NU!JS!ZVYYVbSd!
 - ;D #PT!WNW_NK!VZ!0]N!^KJUMJ0QP^!XYJSS!b]V!]JS!_NNP!PVWQPJ0NU!ZVK!, NPQVK!, [NJeNK!WJT! J[[YTD!
 - ?D) VWQPNNS!S]JYY!_N!PV0QZQNU!_T!NYNX0KVPQX!JPU!S0JPUJKU!WJQY!JPU!QPRQ0NU!0V!XVW[YN0N!JP!J[[YQXJ0QVPD!
 - <D O PYT!0] VSN!PVWQPNNS! b] V!SM_WQ0!J!XVW [YN0NU!J [[YQXJ0QVP!_T!0]N!J [[YQXJ0QVP!UNJUYQPN! WJT!_N!XVPSQUNKNU!ZVK!SNYNXQQVPD!</p>

.1978A@!(\$!:!.151978A@!/0A91;;!

- #D 6KQVK!OV!0]N!J[[YQXJ0QVP!UNJUYQPN:!0]N!, NYNX0QVP!1VWWQ00NN!S]JYY!WNN0!OV!UNRNYV[!XKQ0NKQJ!ZVK!KNRQNb0P^!J[[YQXJ00VPS!JPU!SNYNX00P^!Z0PJYQSOSD!
- 2D #Z0NK!0]N!J[[Y0XJ00VP!UNJUY0PN:10]N!, NYNX00VP!1VWW000NN!S]JYY!NRJYMJ0N!JYY!J[[Y0XJ00VPS!

- #D (]N!1VWW(00NN!b()YY!_N!KNS[VPSQ_YN!ZVK!KNR(Nb!VZ!JYY!XVPS0(0M0()VPS!0]J0!JKN!ZVKbJKUNU!_T! 0]N!OZZ(XN!VZ!'P^J^NWNP0!JPU!*PXYMS()VP!0V!"&, / !ZVK!J[[KVRJY!VZ!XVPS0(0M0()VP!M[UJ0NS)!
- 2D (]N!1VWW000NN!b0YY!KNR0Nb!JPU!J[[KVRN!VK!UNPT!JYY!KNLMNS0S!ZVK!KNXV^P000VP!VZ!PNb! VK^JP0\J00VPS!0]J0!JKN!ZVKbJKUNU!_T!0]N!OZZ0XN!VZ!'P^J^NWNP0!JPU!.NRNYV[WNP0!0V!-"&./D!

.1978A@!(((!:!/0A91E?01!

- #D #!LMVKMW!VZ!XVWW000NN!WNW NKS!0S!KNLM0KNU!ZVK!XVPS0UNKJ00VP!VZ!J!KNLMNS0D!
- $\begin{array}{llll} 20 & \# \left[\left[\text{KVRJY}! \text{VZ}! \text{XVPS}000M00VP}! \text{M} \left[\text{UJONS}! \text{ZVK}! J ! \text{XMKKNPOYT}! \text{KNXV} \text{PQ}^NU}! \text{VK}^J \text{PQ}^J 00VP}! \text{KNLM0KNS}! J ! \\ & \text{WJg} \text{VK}00T}! \text{RVON}! \text{VZ}!0 \right] \text{N}! \text{XVWW}000NN}! \text{WNW}_\text{NKS}! \left[\text{KNSNP0D}!! * \text{Z}! J ! \text{WJg} \text{VK}00T}! \text{UVNS}! \text{PVO}! J \left[\text{KVRN}!0 \right] \text{N}! \\ & \text{KNLMNS}0NU! \text{X} \right] J \text{P}^N \text{S}: !0 \right] \text{N}! \text{VK}^J \text{PQ}^J 100VP}! \text{WJT}! J \left[\text{FNJY}! \text{WMS}0!_N ! \text{WJUN}!0V ! 0 \right] \text{N}! \text{4 N}^0 \text{SYJ}00 \text{RN}! + \text{QXN}! 6 \text{KNS}0 \text{UNP}0! \\ & \text{D} 0 \right] \text{QP}! \text{D} \text{V} : \text{D} \text{NNeS}! \text{VZ}! 0 \right] \text{N}! \text{RVON}! \text{VZ}! 0 \right] \text{N}! , \text{QMUNP}0! \text{D} \text{K}^J \text{PQ}^J 100 \text{VPS}! 1 \text{VWW}000 \text{NND}! \\ \end{array}$
- 1D \$NLMNS0S!ZVK!KNXV^PQ0QVP!VZ!J!PN'b !VK^JPQ`J0QVP!WMS0!_N!J[[KVRNU!_T!J!0]KNN3ZVMK0]S!RV0N!
 VZ!0]N!XVWWQ00NN!WNW_NKS![KNSNP0D!!*Z!J!0]KNN3ZVMK0]S!RV0N!QS!PV0!KNJX]NU:!0]N!WJ00NK!bQYY!
 JM0VWJ0QXJYYT!_N!ZVKbJKUNU!0V!0]N!, NPJ0N!ZVK!XVPSQUNKJ0QVPD!!*P!0]N!, NPJ0N:!0]N!KNLMNS0!ZVK!

 $\begin{array}{l} ! \\ (] NSN!, 0MUNP0! O K^JPQ^J00VP! $NXV^P000VP! 6KVXNUMKNS!WJT!_N!JWNPUNU!_T!J!WJgVK00T!JZZ0KWJ00RN! \\ RV0N!VZ!0] N!SNJ0NU!, NPJ0ND!! (] N!JWNPUWNP0!S] JYY!_NXVWN!NZZNX00RN!JZ0NK!J [[KVRJY!_T!0]N! " & , /! 6KNSQUNP0!JPU!0]N! + QXN!6KNSQUNP0!ZVK!, 0MUNP0! #ZZJQKS!VK!UNSQ^PNND! \\ ! \\ >? &@#&#', , B/ZB, Z''''C'0%) #&@%'951$@=_$%-3@'2&F31@=%-3@'H53F&#)5&7'4&'5&?3<&#'853?'%K&' \\ \end{array}$

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

+'($%&.(-K!*#,,(--%%!

--+)%'-!&%/&%.%'-6-(#'!/&#*%)+&%.!

#66$0+'.!2-!"&,/!,')#('!H6CG@;!

#66$0+'.!2-!+*1'!6$',*.')(!70$!,(&.')(!#77#*$,!HG?CG@;!

[@70AE?978A@!
(]N!ZVYYV b QP^![KVXNUMKNS!]JRN!_NNP!NS0J_YQ$]NU!0V!NPSMKN!JUNLMJ0N!KN[KNSNP0JQQVP!VZ!S0MUNP0!
V[QPQVP!VP!#YY3&PQRNKSQOT!1VWWQ00NNSD!!"&,/kS!^VJY!Q$!0V!WJQP0JQP!JUNLMJ0N!S0MUNP0!V[QPQVP!QP!&PQRNKSQOT!UNXQ$QVPSD!!!
```

. 1978A@!(!:!"1@1025!!

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- #D! #P!#YY3&PQRNKSQOT!1VWWQ00NN!QS!UNZQPNU!JS!VPN!J[[VQP0NU!_T!0]N!6KNSQUNP0!VZ!0]N!
 &PQRNKSQOT!VK!J!+QXN!6KNSQUNP0!VZ!0]N!&PQRNKSQOTD!!(]NSN!XJP!_N!S0JPUQP^!XVWWQ00NNS:!JU!
]VX!XVWWQ00NNS:!VK!0JSe!ZVKXNSD!
- 2D! 1 VWWQ00NN!J [[VQP0WNP0S!JKN!V [NP!0V!ZMYY30QWN!MPUNK^KJUMJ0N!S0MUNP0S!MPYNSS!V0]NK b QSN! S [NXQZQNUD!

.1978A@!((!:!#=1@!*A3 387711!.127;!

- #D! "&, /!S]VMYU!^J0]NK!QPZVKWJ0QVP!ZKVW!1VWWQ00NN!X]JQKS!JS!0V!0]NQK!PNNUS!JPU!RJXJPXQNS!ZVK!0]N!M[XVWQP^!JXJUNWQX!TNJK!QP!0]N!NJKYT!, [KQP^D!!!
- 2D! 1VWWQ00NN!X]JQKS!XJP!JYSV!SM_WQ0!KNLMNS0S!0V!0]N!6KNSQUNP0!J0!JPT!0QWN!ZVK!S0MUNP0!
 KN[KNSNP0J0QVP!VP!0]NQK!XVWWQ00NND!!(]NT!bQYY!_N!S0KVP^YT!NPXVMKJ^NU:!]VbNRNK:!0V!SM_WQ0!
 KNLMNS0S!0P!0]N!NJKYT!S[K0P^!ZVK!0]N!ZVYYVb0P^!JXJUNW0X!TNJKD!

.1978A@!(((!:!6==589278A@!Y!, +."!)'A 3 8@278A@!

- #D! "&, /!b(YY!XKNJON!J![VVY!VZ![VSSQ_YN!SOMUNPOS!ZVK!XVWW(00NN![YJXNWNPOD!!(]N!SOMUNPOS!b(YY!ZQYY!VM0!JP!J[[YQXJ0QVP!UN0JQYQP^!0]NQK!_JSQX!QPZVKWJ0QVP:!SMX]!JS!XVYYN^N:!TNJK!QP!
 SX]VVY:!0]NQK!Nc[NKQNPXNS!JPU!QPRVYRNWNP0!J0!" JKLMN00N:!JPU!0]N!XVWW(00NNS!0]J0!0]NT!JKN!
 QPONKNSONU!QP!SNKRQP^!VPD!!#YSV:!0]N!SOMUNPO!S]VMYU![KVRQUN!0]NQK!SX]NUMYN:!0V!0]N!_NS0!VZ!
 0]NQK!ePVbYNU^N!ZVK!0]N!ONKW!QP!b]QX]!0]NT!JKN!J[[YTQP^D!
- 20! (]N!6KNSQUNPO! b QYY!PVWQPJON!SOMUNPOS!ZKVW!0]N!J [[YQXJPO! [VVY!ZVK!V [NP!XVWWQ00NN!

 $\label{eq:bound} \textbf{b} \ \texttt{QYY}! \ \textbf{JYSV}! \ \texttt{QPXYMUN}! \ \textbf{XVP0JX0}! \ \texttt{QPZVKWJ0} \ \texttt{QVP}! \ \textbf{ZVK}! \ \texttt{0} \ \texttt{JN!X} \ \texttt{JQK}! \ \textbf{VZ}! \ \texttt{0} \ \texttt{JN!XVWWQ00NN}! \ \textbf{0V!} \ \textbf{b} \ \texttt{JQX} \ \texttt{J}! \ \texttt{0} \ \texttt{JNT}! \ \texttt{JRN!} \ \texttt{JNP!J} \ \texttt{I} \ \texttt{VQP0NUD!}$

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1 D! (]N!+QXN!6KNSQUNP0!ZVK!, 0MUNP0!#ZZJQKS!VK!UNSQ^PNN!bQYY!JYSV!SNPU!J!WNWV!0V!NJX]!
KNS[NX0QRN!XVWWQ00NN!X]JQK!PV0QZTQP^!0]NW!VZ!0]N!S0MUNP0!J[[VQP0WNP0SD!!(]N!WNWV!

!			