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F3!!!126! - 7GH7@IH6!7J!) 2487<7K2: !45!1267879: !4<!9@I5H6=!?: !E7<H75!+788696!LK75!H26! @6G7>>65=IH475!7J!4H<!1267879:! - 6KI@H>65H3!

126! > 6 > ?60 < !7J! | 126! - 6KI0H > 65H! M27! G75 < | 14HLH6! | 126! - 7GH70I8! (IGL8H : | 1106!06 < | 1207L92! | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126! < | 126

 $126!K784G46<!I5=!K@7G6=L@6<!7J!E7<!H75!+788696S<!\#7@4<<6:!+788696!T@I=LIH6!.G2778!\\7J!"@H<!I5=!.G465G6<!I8<7!97;6@5!7L@!K@79@I>!I5=!I@6!57H!=LK84GIH6=!26@63!)86I<6!G75<L8H!H264@!M6?<4H6!IHU!$

2HHK<UVVMMM3?G36=LVG75H65HV?GWM6?V<G2778<V>GI<V9@I=LIH6VGL@665HW9@I=LIH6W<HL=65H<VK784G46<WI5=WK@7G6=L@6<32H>8!!!

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A3!!!126!JL5=I>65HI8!97I8!7J!9@I=LIH6!6=LGIH475!45!1267879:!L5=6@!H24<!K@79@I>!4<!H7!7JJ6@!45H6886GHLI8!86I=6@<24K!H7!H26!IGI=6>:/!H26!G2L@G2/!15=!<7G46H:3!

 $\begin{array}{l} D3!!!126!)23-3!45!1267879: !4<!45H65=6=!H7!6PL4K!>65!I5=!M7>65!?7H2!J70!IGI=6>4G!\\ ;7GIH475<!I5=!J70!7H260!>454<H046<!<LG2!I<!G2L0G2!I5=!L54;60<4H:!I=>454<H0IH475/!\\ H2678794GI8!0656MI8/!26I8H2!GI06!6H24G</!I5=!7H260!GI0660<!J70!M24G2!H2678794GI8!\\ 6XK60H4<6!4<!45G06I<4598: !<665!H7!?6!56G6<<I0:3!126!G7L0<6<!7J!<HL=:!7JJ606=!H7MI0=<!\\ H24<!=69066!IGG70=4598:!I4>!IH:57L04<2459!I!G7>>L54H:!7J!J14H2/!<G278I08:!\\ G75;60<IH475/!06<6I0G2/!I5=!H6IG2459!H2IH4<!G65H606=!75!H26!IKK07K04IH475!7J!+204<H4I5!\\ 84J6!I5=!H27L92H/!KI<H!I5=!K06<65H/!45!MI:<!H2IH!G75H04?LH6!H7!H24<!97I83!\\ \end{array}$

 $Y3!!!126! - 7GH7018! (IGL8H: !65=6I; 70<!H7!K07; 4=6!4H<!) 23 - 3!<HL=65H<!M4H2!I5!6=LGIH475! \\ M24G2!4<!45H690IH4; 6!0IH260!H2I5!5I007M8: !<K6G4I84O6=N!M24G2!4<!<6H!M4H245!H26!G75H6XH! \\ 7J!H26!+204<H4I5!G2L0G26<!45!I88!H26!04G256<<!7J!H2640!6GL>654GI8!I5=!G75J6<<475I8! \\ =4; 60<4H: !I5=!45!H2640!068IH475!H7!G75H6>K70I0: !GL8HL06N!M24G2!4<!4H<68J!ZG75J6<<475I8S! \\ 45!5IHL06N!I5=!J70!M24G2!H267879: !4<!=756!I<!ZJI4H2!<66R459!L5=60<:HI5=4593S! \\ $6; 60H2686<</!H26!G75J6<<475I8!?IGR907L5=!70!<:H15G6!7J!IKK84GI5H</!M26H260!+204<:H4I5! \\ 70!57H/!M488!57H!7J!H8(68J!45J8L65G6!I5: !=6G4<475!I<!H7!H2640!I=>4<<4753!$

75'6%8"'\$%/)9*':49\$4*'-)

 $\begin{bmatrix} 3!!! \, 1\, 267879 \, : \, !I < !I \cdot !M2786 \cdot !4 < !2606 \cdot !L5 = 60 < H77 = !I < !I5 \cdot !65 \cdot H60 \cdot \&04 < 6 \cdot |H2I \cdot H145 \, ; \, 4H6 < !H26 \cdot H26 \cdot H26$

] 3!!! # 6 > ?6@<!7J!H26! 1 267879 : ! - 6KI@H > 65H!JIGL8H : !I@6!G7 > > 4HH6=!?7H2!H7!H26!M4<6! IKK@7K@4IH475!7J!H264@!H2678794GI8!I5=!=7GH@45I8!H@I=4H475/!I5=!H7!G@4H4GI8!I5=! G75<H@LGH4 : 6!=4I879L6!M4H2!7H26@!H2678794GI8!K7<4H475<!I5=!M4H2!G75H6 > K7@I@ : !GL8HL@63!

 $^3!!! + @6IH4; 6!H2678794GI8! = 4 < GL < < 475!I5 = ! < K6G4I8406 = !@6 < 6I@G2!H7 = I : !@6PL4@6! < 6@47L < !I5 = ! \\ 45W = 6KH2!IKK@7K@4IH475!7J!H26!9@6IH!H2678794GI8!I5 = !K2487 < 7K24GI8!26@4HI96!7J!H26!KI < H/! \\ I < !M688!I < !6GL > 654GI8/!45H6@W@684947L < / !45H6@ = 4 < G4K845I@ : /!I5 = !G@7 < < WGL8HL@I8! \\ G77K6@IH4753!$

_3! ` 2486!J7@!KL@K7<6<!7J!H24<! # I5LI8!ZH267879:S!4<!L5=6@<H77=!I<!45G8L=459!E4?84GI8! . HL=46</!12678794GI8! , H24G</! \ 4<H7@4GI8!1267879:V \ 4<H7@:!7J!+2@4<H4I54H:/!+7>KI@IH4;6! 1267879:/!I5=! . : <H6>IH4G!1267879:/!H26@6!4<!57!4>K84GIH475!H2IH!H267879:!6>?@IG6<! 758:!H26<6!I@6I<!7J!45PL4@:3!

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4*9\$*#%/7%95/\$=!06J60<!H7!>6>?60<!7J!H26!JIGL8H:!7J!H26!1267879:!-6KI0H>65H!I<!=6J456=!45!eF[!?687M3!]

. *5#-")*1)-\$56=!@6J6@<!K@45G4K188:!H7!I!K1@H4GL81@!8I56!7J!H26!2492MI:!H2IH!86I=<!H7!H26!
) 23 - 3!45!1267879:3!126!H6@>!<\H15=<!H7!!#*(#%8!I<!<\K6G46<!\H15=<!H7!965L<3! ` 4H245!H26!
) 23 - 3!) @79@I>!I!5L>?6@!7J!G7L@<6<!7J!\HL=:!I@6!I;148I?863!

4 &#"'9\$*#/!L<6=!M4H27LH!JL@H26@!<K6G4J4GIH475/!@6J6@<!H7!H26! - 4@6GH7@!7J!T@I=LIH6!.HL=46<! 45!H26! - 6KI@H>65H3!

 $?\#''\%)@*1)A!'''9\&\%\&B\%\&*'C!4<!H26!G7>>75!=6<495IH475!7J!H27<6!<L?W=4<G4K8456<!M4H245!\\H267879:!45!M24G2!<HL=65H<!>I:!6I@5!H26!)23-3!=69@66/!5I>68:U!E4?84GI8!.HL=46</!+7>KI@IH4;6!1267879:/!12678794GI8!,H24G</!\4<H7@4GI8!1267879:V\4<H7@:!7J!+2@4<H4I54H:/!I5=!.:<H6>IH4G!1267879:3!$

?#''%!4<!18<7!L<6=!H7!@6J6@!H7!H27<6!>6>?6@<!7J!H26!-7GH7@18! (IGL8H:!M27/!J7@!I=>454<H@1H4;6!15=!7H26@!KL@K7<6</!1@6!4=65H4J46=!M4H2!756!7J!H26!<L?W=4<G4K8456<!>65H4756=!1?7;63!

126!G7L0<6!7J!<hL=: !H207L92!M24G2!I!<hL=65H!G7>K86H6<!06PL406>65H<!J70!H26!) 23 - 3! 566=!57H/!I8H27L92!4H!>I::!6")1%9\$*D!G7006<K75=!M4H2!758:!756!7J!H26! "06I<!45!M24G2! - 7GH70I8! (IGL8H:!>6>?60<!I06!907LK6=3!!

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 $\begin{tabular}{l} H6IG2459!IKK@7K@4IH6!G7L@<6</!45G8L=459!<LG2!G7887PL4I!I<!>I:!?6!K@6<G@4?6=!?:!H264@!\\ @6<K6GH4:6!"@6I<3! \end{tabular}$

 $F^3!!!126!?L<456<<!7J!H26!-7GH7@I8!(IGL8H:!4<!7@=45I@48:!=4<GL<<6=!I5=!H@I5<IGH6=!IH!>66H459<!7J!H26!M2786!-6KI@H>65H!7J!1267879:3!126!-6KI@H>65H8<!>66H459<!I@6!GI886=/!I5=!H264@!I965=I!<6H/!?:!H26!+2I4@K6@<75!I5=!,X6GLH4;6!+7>>4HH66!7J!H26!-6KI@H>65H3!$

?#''%-)*1)A! ''9&%/&B%\$&*')

4 &: &-&*')*1)?#"%-)

 $F_3!!!126! (1GL8H: !M24G2!<60; 6<!H26!=7GH70I8!K0790I>!45!1267879: !4<!907LK6=!45!H26<6! \\ "06I<U!E4?84GI8!. HL=46</!+7>KI0IH4; 6!1267879: /!12678794GI8!, H24G</! \ 4<H704GI8! \\ 1267879: V \ 4<H70: !7J!+204<H4I54H: /!I5=!..: <H6>IH4G!1267879: 3!$

126! (IGL&H: !>6> ?60<!I<<7G4IH6=!M4H2!6IG2!7J!H26<6! "06I<!7JJ60!I!G7L0<6!70!G7L0<6<!7J! <HL=: !86I=459!H7!H26!) 23 - 3!

. +%'("-)&')?#"%)-\$#59\$5#")

FB3!!! " 5 : !06G75J49L0IH475!7J!H26<6! " 06I</!I5=!H26!6<HI?84<2>65H!7J!I5 : !56M! " 06I/!4<! <\L?06GH!H7!H26!IKK07; I8!7J!H26!M2786! - 7GH70I8! (IGL8H : 3!

 $\begin{array}{l} AC3!!!\ "5:!56M!G7L@<6!7J!<HL=:!H2IH!GI557H!?6!IGG7>>7=IH6=!M4H245!H26!<H0LGHL@6<!I5=!\\ K@7G6=L@6<!7J!H24<!\ \#\ I5LI8!>L<H!?6!IKK@7;6=!57H!758:!?:!H26!E7<H75!+788696!\\ 1267879:!-6KI@H>65H/!?LH!I8<7!?:!H26!-6I5!7J!H26!\ \#\ 7@04<<6:!+788696!7J!\ "0H<!I5=!\\ .G465G6</!H26!T@I=LIH6!-6I5!7J!H26!\ \#\ 7@04<<6:!+788696!7J!\ "0H<!I5=!\ .G465G6</!I5=!H26!\\ "GI=6>4G!\ h\ 4G6!)\ @6<4=65H!IH!E7<H75!+7886963!05!I==4H475/!4H!>L<H!2I;6!<6GL@6=!\\ IKK@7K@4IH6!JL5=459!iM26H26@!56M!70!H207L92!@6I887GIH475c3) \end{array}$

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AF3!!! ` 4H245!6IG2! " @6I/!H26!G7L@<6!7@!G7L@<6<!7J!<HL=: !K@6<G@4?6=!J7@!<HL=65H<!<66R459!
H26!) 23 - 3!I@6!<K6G4J46=!I5=!@6; 4<6=!?:!>6>?6@<!7J!H26! " @6I!J7887M459!<LG2!
K@7G6=L@6<!I<!H26:!<2I88!6<HI?84<2/!!#*: &6"6!H2IH:H26!K@6<G@4KH475<!45!H24<! # I5LI8!I@6!
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 $AA3!!!" @61!G75; 656@<!I@6!G27<65!?: !H26!I@61!JIGL8H: !45!G75<L8HIH475!M4H2!H26!\\ =6KI@H>65H!G2I4@3! 1 26!G75; 656@!<6@:; 6<!64H26@!I!HM7!7@!H2@66W: 6I@!@656MI?86!H6@>/!\\ =6K65=459!75!H26!I@613! ' @=45I@48: /!G75; 656@<!M488!?6!G27<65!J@7>!I>759!H26!H65L@6=!\\ JIGL8H: !45!H26!I@613! 1 26!G75; 656@$<!@6<K75<4?484H46<!9656@188: !45G8L=6U!Fc!\\ 4>K86>65HIH475!7J!K784G46<!7LH8456=!45!H26!I@618<!>I5LI8!4J!4H!2I<!756/!Ac!G75; 65459!\\ K6@47=4G!I@61!JIGL8H: !>66H459</!Dc!H26!G77@=45IH475!7J!H26!I=>4<<475<!K@7G6<<!M4H245!$

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 $-406GH70!7J!T0I=LIH6!.HL=46<3!126!-)*+S<!G7>>65H<!<27L8=!?6!=4<GL<<6=!?:!H26!\\<HL=65H!M4H2!H26!-4<<60HIH475!-406GH70!I5=!*6I=60<3!$

. *'-\$&\$5\$&*')

A^3!!!126!G7>>4H166!G75<4<H<!7J!

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. #&\$''#&%)*1)%68&--&*')%'6)15'6&'()

$$\begin{split} &YC3!!05!@6IG2459!4H<!=6G4<475</!I<!069I@=<!?7H2!I=>4<<475!I5=!JL5=459/!H26!+7>>4HH66!\\ &M488!?6!9L4=6=/!45!H26!J40<H!45<HI5G6/!?:!G04H604I!7J!6=LGIH475I8!K06KI0IH475/!\\ &=6>75<H0IH6=!IGI=6>4G!IG246;6>65H/!I5=!K07>4<6!7J!6XG68865G6!45!H2678794GI8!\\ &<G278I0<24K3!"<!<HIH6=!I?7;6/!H26!G75J6<<475I8!?IGR907L5=!70!<HI5G6!7J!IKK84GI5H</td>

M26H260!+204<H4I5!70!57H/!M488!57H!7J!4H<68J!45J8L65G6!H26!+7>>4HH66S<!=6G4<475!I<!H7!H2640!I=>4<<4753!</td>$$

YF3!!!126!+7>>4HH66!M488!I004;6!IH!4H<!=6G4<475<!M4H27LH!06J6065G6!H7!M26H260!
IKK84GI5H<!2I;6!70!I06!84R68:!H7!2I;6!J45I5G4I8!<LKK70H!IKI0H!J07>!H26!%54;60<4H:!
(6887M<24K!H2IH!70=45I048:!IGG7>KI546<!I=>4<<4753!

 $"5:!7JJ60!7J!J45I5G4I8!I4=!7H260!H2I5!H26!\% 54; 60<4H:!(6887M<24K!>L<H/!J70!KL0K7<6<!7J!\\ J45I5G4I8!7; 60<492H/!?6!IKK07; 6=!?7H2!?:!H26!+2I40!7J!H26!1267879:!-6KI0H>65H/!I5=!\\ ?:!H26!T0I=LIH6!-6I5!7J!"0H<!I5=!.G465G6<3!.LG2!I5!7JJ60!>I:!?6!IGG6KH6=!758:!?:!\\ I5!IKK84GI5H!M27>!H26!+7>>4HH66!2I<!=66>6=!M70H2:!7J!I=>4<<475/!75!H26!?I<<4<!7J!\\ H26!G04H604I!<HIH6=!I?7; 6/!I5=!758:!4J!H26!IKK07; I8!2606!<H4KL8IH6=!2I<!?665!6XK84G4H8:!94:653!$

 $\begin{array}{lll} YA3!!! & \text{4H27LH!4} > \text{K7} < 459! @6 < \text{H04GH475} < !70! @6 \\ PL4@6 > 65 \\ | & \text{45}! \\ | & \text{15} | & \text{15} | & \text{16} | & \text{18} | & \text$

 $\label{eq:YD3!!!0H!4<!L5=60<H77=!H2IH!H26!J70697459!G04H604I!IKK8:!6PLI88:!H7!H27<6!IKK84GI5H<!} $$M27>!H26!+7>>4HH66!06G7>>65=<!J70!I=>4<<475!I5=!H7!H27<6!4J!I5:/!M27>!4H!=6<495IH6<!I<!C4HI?86!J70!I=>4<<475!45!GI<6!I5:!7J!H27<6!H7!M27>!I=>4<<475!2I<!?665!7JJ606=!<27L8=!=6G8456!H7!IGG6KH!4H3!} $$$

4 &#"9\$*#)*1) O#%65%\$")A\$56&"-)

75'9\&*')&')("'"#%/)

75'9\$&*'-)&')!%#\$&95/%#)

Y[3!!!126!-406GH70!7J!T0I=LIH6!.HL=46<!I=>454<H60<!H26!K07G6=L06<!7J!H24<!# I5LI8/! 6XG6KH!M2606!7H260M4<6!K07;4=6=N!6<HI?84<26<!G26=L86<!I5=!65<L06<!H2IH:H26:!106!>6HN!

В

> L < H!? 6!7? HI456 = !J07 > !H26! - 406GH70!7J!T0I = LIH6! . HL = 46 < !45!G75 < L8HIH475!M4H2!H26! < HL = 65HS < !I = ; 4 < 70 < 3!!

?6:&-*#-)

A"/"9\$&*')*1)%6:&-*#-)

$$\begin{split} & [F3!!!126! - 406GH70!7J!T0I = LIH6! . HL = 46 < !45!G75 < L8HIH475!M4H2!H26! "06I! + 75;6560!M488! \\ & I < < 495!H7!6IG2!J40 < HW:6I0! < HL = 65H!I! \# IQ70! "=;4 < 70!45!H26! "06I!H7!M24G2!IKK84GIH475!MI <! \\ & > I = 63! "H!I5: !H4 > 6!IJH60!H26!J40 < H! < 6 > 6 < H60!7J!06 < 4 = 65G6/!I! < HL = 65H! > I:06PL6 < H!H2IH!I! \end{aligned}$$

! FF

 $[\, ^3!!! \, "\, 5:! \, "\, @61! > I:! \, @6PL4@6!188! < HL = 65H < !M4H245!4H < !KL@\, ; 46M!H7!65@788!45!1!KI@H4GL8I@! \, | 1.5 Health | 1$

! FA

- Gc '56!7J!H26!HM7!H6XH<!M488!?6!IH!I!86;68!7J!8I59LI96!M04HH65!J70!I5!45H6884965H! 575W<K6G4I84<H/!4=6I88:!K602IK<!I5!65G:G87K6=4I!I0H4G863!126!7H260!7J!H26! HM7!H6XH<!M488!7JJ60!I!H6G254GI8!I5=!<G278I08:!86;68!7J!=4<G7L0<63!
- =c 126!<\tL=65\text{HL}=65\text{H!M488!?6!1887M6}=!I!=4G\text{H475I0}:!?L\text{H!57!7\text{H260!06}<7L\0G6<3!}

FD

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. *8!#"+"'-&:")"H%8&'%$&*'-)
O"''#%/)!#*:&-&*'-)
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]B3!!!

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\$\$ \$\$ D3! 126! > 4570! M488! 570 > I88: !?6! @6K @6 < 65H6 = !?: !I!H2 @66W 27L @!6XI > !M4H245!H26! < HL = 65HS < !HM68; 6!27L @ < !7J!G7 > K @6265 < 4; 6!6XI > < 3! 126! < K 6G4J4G!8659H2!7J!H24 < !> 4570!6XI > !> I: !?6! I = UL < H6 = !H7!IGG7 > 7 = IH6!H26! < H0LGHL @6!7J!H26! < HL = 65HS < !> IQ70!G7 > K @6265 < 4; 6! 6XI > 45 IH475 < U!

- , H24G<!>IQ7@<!84R68: !M488!@6PL4@6!I!HM7W27L@!>457@!6XI>!?6GIL<6!7J!H26!I@6IS<! 6XI>!<H@LGHL@6N!!
- +7>KI@IH4;6!1267879:!>IQ7@<!84R68:!M488!@6PL4@6!I!J7L@W27L@!>457@!6XI>!?6GIL<6! 7J!H26!@786!7J!H26!>457@!45!H26!<HL=65HS<!G7>KI@IH4;6!M7@RN!
- E4?86! > I070 < HIR6!I5!45H605I88: H=>454 < H606=!>4570!6XI> H26!f7H260gH6 < HI>65H3!

 $^{Y3!}126!G2I40!7J!H26!G7> K06265<4; 6!6XI>!?7I0=!=6H60>456<!M24G2!JIGL8H:!I06!\\ 06<K75<4?86!J70!G0IJH459!M24G2!KI0H!7J!H26!6XI><3!126!JIGL8H:!>6>?60!J07>!H26!\\ <HL=65HS<!>4570!I06I!M488!M04H6!H26!0686; I5H!6XI>!PL6<H475i<c3!!$

, *%#6)*1)"H%8&'"#-)

 $\begin{tabular}{ll} $$ \cap_{3!!!} 126! < \text{HL} = 65 \text{HS} < !M@4 \text{HH} 65! 6XI > 45 \text{ IH} 475 < !M488!? 6!@6I = !I5 = !I = QL = 4G \text{IH} 6 = !?:!I!?7I@ = !7J! \text{IH}! \\ $6I < \text{H!} J7L@! > 6 > ?6@ < /!756!7J! M27 > ! > L < \text{H!} ?6! \text{H2} 6! < \text{HL} = 65 \text{HS} < !\# 1Q7@! " = ; 4<7@3! " 5:! " @6I! \\ > I: /!I5 = ! < 7 > 6! " @6I < != 7/!I887 M! 7@!@6PL 4@6! J4; 6! 6XI > 456@ < 3! 124 < !?7I@ = !I8 < 7! G75 = LGH < !# 26! < HL = 65 \text{HS} < !7@ I8! 7@!: & : %): *9"!6XI > 45 \text{ IH} 4753! \\ \end{tabular}$

 $^{3!!!126!>6>?60<!7J!H26!?7I0=!7J!6XI>4560</!7H260!H2I5!H26! \# IQ70! "=;4<70/!I06! \\ I<<4956=!45!G75<L8HIH475!M4H2!H26! \# IQ70! "=;4<70/!H26!<HL=65H/!I5=!H26! "06I!+75;6560! \\ M27!70=45I048: !HIR6<!45H7!IGG7L5H!iFc!H26!<HL=65HS<!>4570!I06I/!iAc!H26!<HL=65HS<!<HIH6=! \\ K06J6065G6</!I5=!iDc!H26!I; I48I?484H: !7J! (IGL8H: !>6>?60<!=L0459!H26!K6047=!=6<495IH6=! \\ J70!G7>K06265<4;6!6XI>45IH475<3!-6HI48<!7J!H26!6XI>45IH475!K07G6=L06!I5=! \\ IKK84GIH475!J70><!I06!>I=6!I;I48I?86!?: !H26!-406GH70!7J!T0I=LIH6!. HL=46<$!7JJ4G63! \\$

 $^{3}!!!126! < HL = 65HS < ! \# IQ70! " = ; 4 < 70!70 = 45I048 : !G2I40 < !H26!?7I0 = !7J!6XI > 4560 < /! < 7!8759!I < !H26! # IQ70! " = ; 4 < 70!4 < !I! > 6 > ?60!7J!H26!1267879 : ! - 6KI0H > 65H!i . 66!eF[!069I0 = 459!KI0H4G4KIH475!7J!H65L06 = !I5 = !H65L06WH0IGR!JIGL8H : !7J!H26! . 1 # c3!!$

 $126!?7I@=!>I:!57H!45G8L=6!>7@6!H2I5!HM7!6XI>456@<!J@7>!7LH<4=6!7J!H26!-7GH7@I8!\\ (IGL8H:3!"5:!6XI>456@<!7H26@!H2I5!-7GH7@I8!(IGL8H:!>6>?6@<!>L<H!?6!H65L@6=!7@!H65L@6W68494?86!JIGL8H:!>6>?6@<!7J!"&$+"#!I!E7<H75!+788696!=6KI@H>65H!?6<4=6<!1267879:/!*#!$

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4 &--"#\$%\$&*")

, %-&9)#"K5&#"8"'\$)

4 &--"#\$%\$&*')9*8 8 &\$\$"")

_]3!!!.LGG6<<JL8!G7>K86H475!7J!H26!=4<<6@HIH475!M488!?6!QL=96=!?:!I!=4<<6@HIH475!G7>>4HH66!7J!H2@66!>6>?6@</!756!7J!M27>!<6@;6<!I<!H26!-4<<6@HIH475!-4@6GH7@3!!

 $\label{eq:control_co$

. L?()6GH!H7!H26<6!K()7;4<475</!H26!>6>?6()<24K!7J!H26!G7>>4HH66!>I:/!IH!H26!=4<G()6H475!
7J!H26!-4()GH70!7J!T()I=LIH6!. HL=46</!?6!IL9>65H6=!?:!756!7()/!IH!>7<H/HM7!>6>?6()3!

4&--"#\$%\$&*")!#*!*-%/L)!5#!*-")%"6)1*#8)

_^3!!!1796H26@!M4H2!24<!7@!26@!=4<<6@HIH475!G7>> 4\text{H}66/!\text{H}L=65\text{H}!M488!M@4\text{H}6!I!K@7K7<I8!} J7@!\text{H}26!=4<<6@HIH475!K@7K7<I8!<27L\text{L}8=!?6!<LGG45G\text{L}G45G\text{H}157\text{H}215!J4;6!} \text{H}27L<\text{L}5=!\text{M}7@=<!i45G\text{L}=459!J77\text{H}57\text{H}6<!?L\text{H}16XG\text{R}L=459!\text{H}26!?4?\text{8}479@IK2:c3!O\text{H}<\text{2}7L\text{8}=!?6!} G@IJ\text{H}6=!<7!I<\text{H}7!?6!G\text{G}6I@!I5=!G7965\text{H}17!\text{K}6@<75<!\text{M}27!I\text{B}6!\text{G}6!\text{H}26!\text{L}6!\text{H}26!\text{L}6!\text{H}26!\text{L}6!\text{H}26!\text{L}161=6>4G!<\text{H}L=:!} 7J!\text{H}267\text{8}79:!\text{M}4\text{H}27L\text{H}!56G6<<\Text{I}04\text{B}:!?6459!6XK6\text{B}45!\text{H}26!<K6G4T\text{B}406=!<L?\text{Q}6G\text{H}!>T\text{H}160!7J!\text{H}26!} =4<<6\text{B}1\text{H}4753!}

__3!126!K@7K7<I8!<2I88!45G8L=6!IH!86I<H!H26<6!686>65H<U!
n!I!=68456IH475!7J!H26!-9*!"!7J!H26!K@7Q6GH/!H796H26@!M4H2!I!G86I@!I5=!G75G4<6!\$+"-&-)
-\$%\$"8"'\$N!

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- n!15!1GG7L5H!7J!H26!=4<<6@H1H475\$<!@681H475!H7!6X4<H459!M7@R!45!H26!J468=/!15=!27M!4H! M488!G75H04?LH6!H7!H26!GL@665H!<H1H6!7J!<G2781@<24KN!
- n!15!6XK8151H475!7J!H26!1KK@71G2!15=!>6H27=<!H21H!M488!?6!L<6=N!

n!I!K@684>45I@: !45=4GIH475!7J!27M!H26!7;6@I88!I@9L>65H!M488!L5J78=N!

- n!I!G75G@6H6!I<<6<<>>65H!7J!H26!K@7Q6GHS<!J6I<4?484H:!45!@68IH475!H7!84?@I@:!I5=!7H26@! @6<7L@G6<!I;I48I?86!H7!H26!<HL=65HN!
- n!6; 4 = 65G6!7J!H26! < HL = 65HS < !G7 > K6H65G6!45!H26!@686; I5H! / %' (5% ("-!7J! < G278I@ < 24KN!) I5 = !
- n!<LJJ4G465H!6; 4=65G6!7J!H26!<HL=65HS<!K@684>451@:!I5=!GL@65H!@6<6I@G2/!45G8L=459! M4H27LH!?6459!84>4H6=!H7!I!?4?8479@IK2:3!

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; & 8 &\$\%\$&*'-)\%-)\$*)\$& 8'')

 $BD3!!! . HL=65H<!M27!2I; 6!G7>K86H6=!188!06PL406>65H<!J70!H26!) 23-3!6XG6KH!H26!\\ =4<<60HIH475!>L<H!<H488!G75J70>!H7!H26!069L8IH475<!G75G605459!0694<H0IH475!<6H!?: !H26!\\ T0I=LIH6! . G2778!7J!H26! # 7004<<6:!+788696!7J! "0H<!I5=! . G465G6<!IH!E7<H75!+7886963!\\ 126!T0I=LIH6! . G2778!18<7!06PL406<!H2IH!=4<<60HIH475<!?6!<L?>4HH6=!J70!=6J65<6!M4H245!\\ 6492H! : 610<!7J!H26!<HL=65HS<!65H0I5G6!45H7!H26!K0790I>!i<HL=65H<!M27!M606!6507886=!45!\\ H26!<K0459!7J!ACAC!2I; 6!?665!90I5H6=!756!I==4H475I8! : 610!H7!06=06<<!H26!GJIGGH!7J!H26!\\ G7; 4=!KI5=6>4G!75!H2640!<HL=46<c3! , XH65<475<!>I:!?6!90I5H6=!758: !J70!H26!>7<H!\\ 6XG6KH475I8!7J!G40GL><HI5G6<!I5=!H265!758: !M4H2!H26!IKK07; I8!7J!Ic!H26!-406GH70!7J!\\ T0I=LIH6! . HL=46<!I5=!?c!H26!-4<<60HIH475!-406GH70!G75H45965H!LK75!6; 4=65G6!H2IH!H26!\\ <HL=65H!2I<!K07=LG6=!K0684>45I0::!6; 4=65G6!7J!<G278I0<24K!45!H2640!=4<<60HIH475!\\ G7>>65<L0IH6!M4H2!H26!<HI5=I0=<!7J!H26!=6KI0H>65H!I5=!H2IH!?7H2!H26!-406GH70!7J!\\ T0I=LIH6! . HL=46<!I5=!H26!-4<<60HIH475!-406GH70!I06!G75J4=65H!H2IH!H26!-4<<60HIH475!\\ G7L8=!?6!G7>K86H6=!M4H245!H26!K6047=!I887M6=!J70!?::!H26!6KH65<4753!$

A5F8&--&*')*1)6&--"#\$%\$&*')

BY3!!! ` 265!H26!=4<<6@HIH475!4<!G7>K86H6/!4H!4<!H7!?6!<L?>4HH6=!H7!H26! - 7GH7@I8! (IGL8H: ! H2@7L92!H26! - 4@6GH7@!7J!T@I=LIH6! . HL=46</!H796H26@!M4H2!I!756WKI96!I?<H0IGH!7J!4H<! G75H65H<3!126! - 4@6GH7@!7J!T@I=LIH6! . HL=46<\$!7JJ4G6!M488!I@I596!J7@!G7K46<!7J!H26! =4<<6@HIH475!I5=!H26!I?<H0IGH!H7!?6!I; I48I?86!J7@!H26!45<K6GH475!7J! (IGL8H: !>6>?6@<3! " H!

FB

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N'\$"##5!\$&*')*1)1&'%'9&%/)-5!!*#\$)

FCD3!!! - L@459!H26!K@7?IH475I@:!<6>6<H6@/!H26!<HL=65H!75!K@7?IH475!4<!84I?86!H7!
45H6@@LKH475!7J!24<!7@!26@!J45I5G4I8!I4=/!4J!I5:3!126!=6G4<475!H7!M4H2278=!<H4K65=<!@6<H<!
M4H2!H26! - 4@6GH7@!7J!T@I=LIH6!. HL=46<3!126! - 4@6GH7@!7J!T@I=LIH6!. HL=46<!>I:!<H4KL8IH6!
H2IH!@6<L>KH475!7@!G75H45LIH475!7J!I!<H4K65=!4<!G75H45965H!LK75!H26!<HL=65HS<!
@6>7:459!<K6G4J4G!=6J4G465G46<!M4H245!I!<K6G4J46=!H4>63!

2 *--&F&/&\$=)*1)"H\$"'-&*')

 $FCY3!!!126!K@7?IH475I@:!K6@47=!>I:!?6!6XH65=6=!?6:75=!I!<6>6<H6@/!4J!45!H26!\\ \emptyset L=9>65H!7J!H26!-4@6GH7@!7J!T@I=LIH6!.HL=46</!<L?<HI5H4I8!K@79@6<<!H7MI@=<!@6>6=:459!\\ =6J4G465G46<!4<!?6459!>I=6/!7@!4J!6XH@I7@=45I@:!G4@GL><HI5G6<!MI@@I5H!I5!6XH65<4753!$

4 & - 8 & --%/)1#*8)2+343)-\$56&"-)

FC[3!!!" !<HL=65H!M27!JI48<!H7!>66H!<HIH6=!6XK6GHIH475<!=L0459!H26!K07?IH475I0:!K6047=! 4<!84I?86!H7!=4<>4<I8!J07>!=7GH70I8!<HL=46<!?:!H26!-406GH70!7J!T0I=LIH6!. HL=46<!LK75! IKK07K04IH6!G75<L8HIH4753! 'KK70HL54H:!M488!45!H2IH!GI<6!?6!K07;4=6=!J70!H26!<HL=65H!H7! ?6!IMI0=6=!I!H60>45I8!#3"3!=690663!

FC]3!!!126! - 406GH70!7J!T0I=LIH6!.HL=46<!M488!57H4J: !H26!<HL=65H!45!M04H459/!<HIH459!H26!
907L5=<!J70!=4<>4<<I83!+7K46<!7J!H24<!57H4J4GIH475!M488!?6!J486=!M4H2!H26! - 6I5!7J!H26!
E7<H75!+788696!T0I=LIH6!.G2778!7J!"@H<!I5=!.G465G6<3!

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