

þ j ˆ • ø j T ˆ ~ ˆ \_  
Ã = ~ j •



DXMN\ ^RN CS^VN 8G 6\SN`JXL  
CRN 5SXJV A\_VN

1 \_ î

ǒ CS^VN 8G

ǒ CS^VN 8G J^ D=2 0]RN`SVVN

ǒ 0M`S]Y\ AYVN

Ø 8 î α = ~ 1 = α T S Ý

?J\UN\ ?YN `SMNY ^SWN]^JWZ ò ò  
BNb\_JV <S]LYXM\_L^ JXM 8X^N\ZN\]YXJV ESYVNXL  
^RN 5SXJV A\_VNó L\_\N^ ?YVSLc S] 2YWZVSJX^à  
Jđ BNb\_JV <S]LYXM\_L^

1 = α T S Y ^ α À s ~ 8 ã = T T

ö 2 Y W Z V J S X ^ J X M = Y ^ S J L J ^ S Y X

Jö B \_ Z Z Y \ ^ S ` N < N J ] \_ \ N ] 2 Y W Z V J S X J X ^ J X M A N ] Z Y X M N X ^

Kö 8 X O Y \ W J V ? \ Y L N ] ]

Lö 5 Y \ W J V ? \ Y L N ] ]

j]•Tî = \_α î\_ sjα = Ý îα = j\_

B\_ZZY\^S`N <NJ]\_\N] βJZZVSNM ^Y KY^R  
ZJ\^SN] OY\ SXOY\WJV JXM OY\WJV YZ^SYX]à  
2Y\_X]NVSXQ  
2Y\_\]N OMT\_]^WNX^]  
2VJ]] BLRNM\_VN  
4]LY\^]  
FY\U BLRNM\_VN  
=Y 2YX^JL^ >\MN\]

' = ~ ] = ~ ~ ^ T \_ ^ T Ê ~ = ~

ř CS^VN 8G 2YY\MSXJ^Y\ \N[\_S\NM ^Y MY J MS]WS  
ř CRN C8GB7 KNRJ`SY\ W\_] ^ WNN^ ^RN XJ\\YaNM M  
Jř 1NRJ`SY\ RJM ^Y YLL\_\ SX ^RN DXS^NM B^J^N]  
Kř 1NRJ`SY\ RJM ^Y WNN^ JVV ^R\NN ]^JXMJ\M]ò BN`N\Nó ?N\  
Lř 1NRJ`SY\ RJM ^Y ^JUN ZVJLN aS^RSX JX NM\_LJ^SYXJV Z\Y  
Sř >H LJWZ\_] ZJ\^SN] SX aRSLR JX S]]\_N YLL\_\ \NM aY\_VM  
SSř >X LJWZ\_] ZJ\^SN]>N`NX^]>JL^S`S^SN] SXLV\_MSXQ \N

S\_Ã ~ α = 1 î α = j \_

DXKSJ]NM JXM 8WZJ\^SJV ^Y KY^R ZJ\^SN]

SX`N]^SQJ^Y\ WYMNv

0M`JXLN a\S^^NX XY^SLN YO ^RN SX^N\`SNa JXM ]L

3\_\SXQ ^RN SX^N\`SNa

0M`S]Y\] LJX ^JUN XY^N] ^Y J]U ^RNS\ ZJ\^c JKY\_^ VJ^N\

0M`S]Y\] LJXXY^ KN MSJ\\_Z^S`N Y\ SX^N\]\\_Z^ ^RN SX^N\`SNa

0M`S]Y\] LJXXY^ JX]aN\ YX KNRJVO YO ^RN ZJ\^c

CRN]N SX^N\`SNa] J\N Ū JKY\_^ ^RN ZJ\^SN] `XY^ ^RN JM`S]Y\

1N Z\NZJ\NM OY\ ^RN SX^N\`SNa] ^Y SXLV\_MN JXM LY`N\ `N\c Nb

KN \_XLYWOY\^JKVN

8X`N]^SQJ^Y\] aSVV JV]Y LYVVNL^ N`SMNXLN O\YW ^RN ZJ\^SN]

MYL\_WNX^J^SYX JL\Y]] WJXc ZVJ^OY\W]ô JXM `N\KJV JLLY\_X^] C

4JLR ZJ\^c WJc Z\N]NX^ N`SMNXLN YX ^RNS\ KNRJVO

4JLR ZJ\^c RJ] J LRJXLN ^Y \N]ZYXM ^Y ^RN N`SMNXLN LYVVNL^

8X`N]^SQJ^Y\ \NZY\^ WJc JV]Y KN \N]ZYXMNM ^Y SX a\S^SXQ Kc

HY\_ WJc RNVZ cY\_\ ZJ\^c aS^R ^RN]N a\S^^NX \N]ZYX]N] SO ^RN

K\_^ ^RNC LJX MNXc cY\_\ RNVZ aS^R XY [\_N]^SYX] J]UNM

N î• = \_ 1

BNb\_JV <S]LYXM\_L^ 7NJ\SXQ 1YJ\M ß YO WNWKN



α ~ j T ¬ α = j \_

8 X O Y \ W J V

< \_ ^ \_ J V V c J Q \ N N M \_ Z Y X Y ^ R N \ a S ] N S ^ Q Y N ] ^ Y J O Y \ W J V Z

= Y J Z Z N J V Y Z ^ S Y X

4 M \_ L J ^ S Y X J V B J X L ^ S Y X ] Y X V c

> \_ ^ L Y W N ] M N V S ` N \ N M S X a \ S ^ S X Q ^ Y K Y ^ R Z J \ ^ S N ]

7 N J \ S X Q > N L N \ ]

3 \ ð 5 Y b ó 1 V J S \ 9 N X U S X ] a S V V K N ^ R N M N L S ] S Y X W J U N \ ]

5 Y \ W J V

; S ` N R N J \ S X Q \ N [ \_ S \ N M S X ^ R N ] N L J ] N ]

0 M ` S ] Y \ ] \ N [ \_ S \ N M O Y \ N J L R Z J \ ^ c J ^ ^ R N R N J \ S X Q

4 M ] J X L ^ S Y X ] Z V \_ ] ] \_ ] Z N X ] S Y X J X M N b Z \_ V ] S Y X J V V Y a N M R N

> \_ ^ L Y W N ] M N V S ` N \ N M ^ Y K Y ^ R Z J \ ^ S N ] S X a \ S ^ S X Q

B N b \_ J V < S ] L Y X M \_ L ^ 7 N J \ S X Q 1 Y J \ M ^ \ J S X N M 5 J L \_ V ^ c J X

B N b \_ J V < S ] L Y X M \_ L ^ 2 J ] N ] J X M ] N \ ` N J ] ^ R N M N L S ] S Y X W J U N

0 Z Z N J V ] J V V Y a N M V N ` N V ]

$$\tilde{A} = \tilde{j} \cdot \alpha_j T$$

?J\UN\ ?YN ESMNY CSWN]^JWZ ò ò

0M`S]Y\ 5Y\W

0M`S]Y\[ ?VJc J KJLUQ\Y\_XM \YVN SX ^RN]N LJ]N

HY\_ aYX ^ KN SX^N\`SNaNM

HY\_ aYX ^ ^N]^SOc

HY\_\ ]Z NJUSXQ \YVN J^ ^RN RNJ\SXQ aSVV KN VSWS^NM ^Y

YO ^RN ZJ\^c cY\_ J\N ]\_ZZY\^SXQ

HY\_ J\N XY^ NXLY\_\JQNM XY\ aSVV cY\_ KN J]UNM ^Y ]RJ\N c

aRSLR cY\_ JXM cY\_\]NVO \NZ\N]NX^SXQ J ZJ\^SL\_VJ\ ZJ\^c

HY\_ J\N YXVc JM`S]SXQ ]^\_MNX^]ó cY\_ aSVV XY^ JM`S]N JXc

Z\YLN]]

HY\_ J\N ^RN\N ^Y ]\_ZZY\^ JXM JM`YLJ^N KNLJ\_]N cY\_ LJ\N J

cY\_ JQ\NN aS^R N`N\c JL^SYX ^RN ZJ\^c cY\_ J\N ]\_ZZY\^SXQ

$$j \cdot \hat{i} \alpha = \hat{i}^T j_{\sim} = \alpha \cdot \hat{i} = j_{\sim}$$

80 cY\_\ ZJ\^c aJX^] cY\_ ^Y J^^NXM J WNN^SXQ Y\ S

£ ¬ ~ α = j \_ ~ # #

Öóv Öm " v i " m Ö m " B 7 viÖ§ ó 7 " v ö i  
m " m Ö i K Ö ø 7 " B ø " v " B v i m óv " K B n ö

$x = j$

þ j ¬ • ø j T î ~ î \_  
• • î T ~ ~ Û •



DXMN\ ^RN CS^VN 8G 6\SN`JXL  
CRN 5SXJV A\_VN

1 \_ î

ǒ CS^VN 8G 5SXJV A\_VN 2RJXQN]  
ǒ D=2 0]RN`SVVN ?\YLMN\_\JV 8WZJL^]  
ǒ 0ZZNV] AYVN

Ø 8 î α = ~ 1 = α T S Ý

” B N b \_ J V < S ] L Y X M \_ L ^ J X M 8 X ^ N \ Z N \ ] Y X J V E S Y V N X L  
2 Y W Z V S J X ^ ó M N J X S ^ S Y X ] R J ` N ^ Y L R J X Q N ] Y ^ R Y  
J ě B N b \_ J V < S ] L Y X M \_ L ^  
K ě B N b \_ J V 7 J \ ] ] W N X ^  
L ě 8 X ^ N \ Z N \ ] Y X J V E S Y V N X L N  
M ě 5 J L \_ V ^ c ó B ^ J H ó J X M B ^ \_ M N X ^ ] J Z Z V S L J ^ S Y X  
” C R N 5 S X J V A \_ V N S W Z J L ^ N M ^ R N Z \ Y L N M \_ \ J V \ N [ \_  
L Y W Z V J S X ^ ] B C S ^ V N 8 G B N b \_ J V 7 J \ ] ] W N X ^ à  
J ě C R S ] S X L V \_ M N ] ^ R N \ Y V N ó ] L Y Z N J X M Z \_ \ Z Y ] N Y O J M ` S ] Y \ ]  
K ě 8 X L V \_ M N ] J X J \ \ Y a N \ M N J X S ^ S Y X Y O C 8 G B 7 Y X L J W Z \_ ]  
L ě 8 X L V \_ M N ] J M S ] W S ] ] J V J X J V c ] S ] J X M J Z Z N J V  
M ě ? J \ U N \ ? Y N C S W N ] ^ J W Z ě ò F J ^ L R



1 = α T S Y ^ α À s ~ 8 ã = T T

ö 2 Y W Z V J S X ^ J X M = Y ^ S J L J ^ S Y X

Jö B \_ Z Z Y \ ^ S ` N < N J ] \_ \ N ] 2 Y W Z V J S X J X ^ J X M A N ] Z Y X M N X ^

Kö 8 X O Y \ W J V ? \ Y L N ] ]

Lö 5 Y \ W J V ? \ Y L N ] ]

j]•Tî = \_α î\_ sjα = Ý îα = j\_

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” B_ZZY\^S`N <NJ]_\N] βJZZVSNM ^Y KY^R
ZJ\^SN] OY\ SXOY\WJV JXM OY\WJV YZ^SYX]à
| 2Y_X]NVSXQ
| 2Y_\]N OMT_]^WNX^]
| 2VJ]] BLRNM_VN
| 4]LY\^]
| FY\U BLRNM_VN
| =Y 2YX^JL^ >\MN\]
|
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' = ~ ] = ~ ~ ^ T \_ ^ T Ê ~ = ~

ř CS^VN 8G 2YY\MSXJ^Y\ \N[\_S\NM ^Y MY J MS]WS  
ř CRN C8GB7 KNRJ`SY\ W\_] ^ WNN^ ^RN XJ\\YaNM M  
Jř 1NRJ`SY\ RJM ^Y YLL\_\ SX ^RN DXS^NM B^J^N]  
Kř 1NRJ`SY\ RJM ^Y WNN^ JVV ^R\NN ]^JXMJ\M]ò BN`N\Nó ?N\  
Lř 1NRJ`SY\ RJM ^Y ^JUN ZVJLN aS^RSX JX NM\_LJ^SYXJV Z\Y  
Sř >H LJWZ\_] ZJ\^SN] SX aRSLR JX S]]\_N YLL\_\ \NM aY\_VM  
SSř >X LJWZ\_] ZJ\^SN]>N`NX^]>JL^S`S^SN] SXLV\_MSXQ \N

S\_Ã ~ α = 1 î α = j \_

” DXKSJ]NM JXM 8WZJ\^SJV ^Y KY^R ZJ\^SN]

” SX`N]^SQJ^Y\ WYMNV

” 0M`JXLN a\S^^NX XY^SLN YO ^RN SX^N\`SNa JXM ]L

” 3\_\SXQ ^RN SX^N\`SNa

| 0M`S]Y\] LJX ^JUN XY^N] ^Y J]U ^RNS\ ZJ\^c JKY\_^ VJ^N\

| 0M`S]Y\] LJXXY^ KN MS]\\_Z^S`N Y\ SX^N\]\\_Z^ ^RN SX^N\`SNa

| 0M`S]Y\] LJXXY^ JX]aN\ YX KNRJVO YO ^RN ZJ\^c

| CRN]N SX^N\`SNa] J\N Û JKY\_^ ^RN ZJ\^SN] `XY^ ^RN JM`S]Y\

| 1N Z\NZJ\NM OY\ ^RN SX^N\`SNa] ^Y SXLV\_MN JXM LY`N\ `N\c Nb

KN \_XLYWOY\^JKVN

| 8X`N]^SQJ^Y\] aSVV JV]Y LYVVNL^ N`SMNXLN O\YW ^RN ZJ\^SN]

MYL\_WNX^J^SYX JL\Y]] WJXc ZVJ^OY\W]ô JXM `N\KJV JLLY\_X^] C

” 4JLR ZJ\^c WJc Z\N]NX^ N`SMNXLN YX ^RNS\ KNRJVO

| 4JLR ZJ\^c RJ] J LRJXLN ^Y \N]ZYXM ^Y ^RN N`SMNXLN LYVVNL^

| 8X`N]^SQJ^Y\ \NZY\^ WJc JV]Y KN \N]ZYXMNM ^Y SX a\S^SXQ Kc

| HY\_ WJc RNVZ cY\_\ ZJ\^c aS^R ^RN]N a\S^^NX \N]ZYX]N] SO ^RN

K\_^ ^RNC LJX MNXc cY\_\ RNVZ aS^R XY [\_N]^SYX] J]UNM

$$\tilde{A} = \tilde{j} \cdot \alpha_j T$$

" HY\_ W\_] ^ SXLV\_ MN JM`S]Y\] JXM NX]\_ \N ^RNS\ ZJ

" 0M`S]Y\ 5Y\W

" 0M`S]Y\] ?VJc J KJLUQ\Y\_XM \YVN SX ^RN]N LJ]N

| HY\_ aYX ^ KN SX^N\`SNaNM

| HY\_ aYX ^ ^N]^SOc

| HY\_ \ ]Z NJUSXQ \YVN J^ ^RN RNJ\SXQ aSVV KN VSWS^NM ^Y  
YO ^RN ZJ\^c cY\_ J\N ]\_ZZY\^SXQ

| HY\_ J\N XY^ NXLY\_ \JQNM XY\ aSVV cY\_ KN J]UNM ^Y ]RJ\N c  
aRSLR cY\_ JXM cY\_ \]NVO \NZ\N]NX^SXQ J ZJ\^SL\_VJ\ ZJ\^c

| HY\_ J\N YXVc JM`S]SXQ ]^\_MNX^]ó cY\_ aSVV XY^ JM`S]N JXc  
Z\YLN]]

| HY\_ J\N ^RN\N ^Y ]\_ZZY\^ JXM JM`YLJ^N KNLJ\_]N cY\_ LJ\N J  
cY\_ JQ\NN aS^R N`N\c JL^SYX ^RN ZJ\^c cY\_ J\N ]\_ZZY\^SXQ

N î• = \_ 1 ~ • α = j \_ 6 S \_ 0 j • ] î T i • j

” CS^VN 8G 2YY\MSXJ^Y\ SJ VNJM 2YY\MSXJ^Y\ OY  
Z\YLN]] \_Z \_X^SV ^RN RNJ\SXQ SJ ]LRNM\_VNMđ  
” 7NJ\SXQ >NLN\] J\N VNJM MNLS]SYX WJUN\] OY\  
| FN VSUNX ^RS] ^Y 0MWSXS]^\J^S`N AN]YV\_^SYX] Y\ <NMSJ^  
| 3SHN\NXLN]đ  
v <\_^\_JV JQ\NNWNX^ ^Y NXQJQN SX ^RS] ^cZN YO RNJ\SX  
v <\_^\_JV JQ\NNWNX^ ^Y SMNX^SJNM ]JXL^SYX]  
v CRN RNJ\SXQ W\_]^ KN VS`N aS^R ^RN ZJ\^SN] JXM ^RN  
v CRN RNJ\SXQ YNLN\ W\_]^ JVVYa L\Y]] [\_N]^SYXSXQ ^R\Y  
v >XVc 4M\_LJ^SYXJV BJXL^SYX] J\N ZN\WS^^NM XY ]\_]Z  
LYX]SMN\NM  
v 58XJV Y\_^LYWN]ó aS^R \J^SYXJVN W\_]^ KN MYL\_WNX^NM  
v =Y 0ZZNJV YZ^SYX OY\ NS^RN\ ZJ\^c  
v >XLN ^RN LJ]N SJ \N]YV`NMó ^RN\N SJ XY ]^JXMSXQ \NL



j \_ ø = \_ 7

” CS^VN 8G 2YY\MSXJ^Y\ S] VNJM LYY\MSXJ^Y\ YO

8X`N]^SQJ^SYXđ 0X SX`N]^SQJ^S`N \NZY\^ aSVV I

” 7NJ\SXQ >NLN\] JL^ J] VNJM LYXM\_L^>RNJ\SXQ Y

YO ^RN Bnb\_JV <S]LYXM\_L^ 1YJ\M OY\ J VS`N RN

C8G2 S] ^RN\N ^Y ]\_ZZY\^ JXM Q\_SMNó K\_^ VN^^M

MYL\_WNX^J^SYX LYWN] O\YW ^RN 7NJ\SXQ >NLN\

\N]YV`N LJ]N] ^R\Y\_QR ^RN OY\WJV LYWZVJSX^ Z

” 5Y\WJV

| ;S`N RNJ\SXQ \N[\_S\NM SX ^RN]N LJ]N]

| 0M`S]Y\] \N[\_S\NM OY\ NJLR ZJ\^c J^ ^RN RNJ\SXQ

| 4M ]JXL^SYX] ZV\_] ]\_]ZNX]SYX JXM NbZ\_V]SYX JVVYaNM RN

| >\_^LYWN] MNVS`N\NM ^Y KY^R ZJ\^SN] SX a\S^SXQ <Y\N M

|



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? J \ UN \ ? Y N ð ò

CR \ NN ß JXM YXVc à KJ]N] OY \ JZZNJV

ð ? \ Y L N M \_ \ J V 8 \ \ N Q \_ V J \ S ^ c

ð 2 Y X M S L ^ Y O 8 X ^ N \ N ] ^ > 1 S J ]

ð = N a 4 ` S M N X L N

ë H Y \_ L J X X Y ^ Q \ J X ^ J X J Z Z N J V K N L J \_ ] N c Y \_ Y \ Y X N Y

V S U N ^ R N Y \_ ^ L Y W N ð H Y \_ M N X Y ^ Y L \ Y X ß N b ð S W ß J X S X C

L J ] N J X M W J U N J K \ J X M X N a O \ N ] R M N L S ] S Y X ð H Y \_ J

L Y V V N J Q \_ N ] K J ] N M Y X ^ R N Z S N L N ] Y O J X J V c ] S ] J K

i • j    ¬ • î T    S • •    1 ¬ T î • = α Ê

CRN JZZNVVJX^ W\_] ^ ò

đ 8MNX^SOc J Z\YLN M\_\JV S\NQ\_VJ\S^c

Jđ 0ZZNJV] YNLN\] W\_] ^ UXYa ^RN Z\YLN]] SX O\_VV SX Y\MN\

Kđ 3S]WS]]JV 0XJvc]S]ó 8X`N]^SQJ^SYXó 7NJ\SXQó JXM A\_VSX

LYX]SMN\J^SYX SX MN^N\WSXSXQ S\NQ\_VJ\S^SN]

đ <JUN J LJ]N ^RJ^ S^ ß^RN S\NQ\_VJ\S^cà JHNL^M

Jđ 8O ^RS] LJX KN Z\Y`NX ^RNX ^RN JZZNVVJX^ ]RY\_VM KN ]\_

Kđ 8O ^RS] LJXXY^ KN Z\Y`NX ^RN JZZNVVJX^ ]RY\_VM XY^ KN

1Y^R OJL^Y\] RJ`N ^Y KN Z\N]NX^ OY\ J ]\_LLN]]O\_V JZZNJVđ 5JL^Y

YO CS^VN 8G a\JZZNM \_Z SX R\_WJX N\Y\      K\_^ Z\Y`SXQ OJL^Y\

/Éî]•T

CRN SX`N]^SQJ^Y\ JJUNM ^RN \N]ZYXMNX^ ^Y QN^ J  
aRY LY\_VM ]\_ZZY\^ RN\ JVSksđ AN]ZYXMNX^ OJSVN  
\N]ZYX]SKVN OY\ ]^JVUSXQđ CRN \N]ZYXMNX^ JZZN

XLN JXM S

RJ`N KNN

$j_p = \alpha_j S_\alpha \cdot \tilde{\alpha} (= \hat{\alpha})$

CRN 0ZZNVVJX^ W\_]^ò

đ 8MNX^SOc J LYXMSL^ YO SX^N\N]^ Y\ KSJ]

/Éî]•T

8X \N]ZYX]N ^Y L\_\N^ N`NX^]ó Z\YON]]Y\ ZNX] JX Y  
RJ\J]]WNX^ SX`N]^SQJ^SYX] RJ`N KNLYWN aS^LR R]  
O\YW JLL\_]J^SYX] ^RJ^ RS] `N\c NbS]^NXLN S] YZZ\

s Ä / Ã = \_

CRN 0ZZNVVJX^ W\_]^ò

đ 8MNX^SOc XNa N`SMNXLN ^RJ^ aJ] XY^ \NJ]YXJK  
MN^N\WSXJ^SYXđ

Jđ <\_]^ MNWYX]^ \J^N ^RJ^ ^RN N`SMNXLN aJ] XY^ J`JSVJKVN

Kđ CRS] \N[\_S\N] [\_N]^SYXSXQ J\Y\_XM aRc N`SMNXLN aJ] J`JS

JZZNJV `]đ aRNX ^RN MNLS]SYX aJ] WJMN

Sđ MJc] S] XY^ J VYXQ ^SWN ^Y ]\_MMNXVc RJ`N XNa N`S

KNOY\N SX ]\_LR J XJ\\Ya ^SWNO\JWNđ

đ <JUN J LJ]N ^RJ^ S^ JHNL^NM ^RN Y\_^LYWN YO ^

Jđ FY\_VM ^RN N`SMNXLNó ^RJ^ S] XYa XNaVc J`JSVJKVN aS^R

MSHN\NXLN SX ^RN \\_VSXQ



' = ǫ 8 = ~ ~ 7 î Ú ǫ ǫ 8 j 7 ǫ j ] #

? \ J L ^ S L J V 2 Y X ] S M N \ J ^ S Y X ]

ǫ ; S ] ^ ^ R N J V V N Q N M Z Y V S L c ` S Y V J ^ S Y X ]

ǫ 2 J ^ J V Y Q \_ N ^ R N N V N W N X ^ ] Y O ^ R Y ] N Y H N X ] N ]

ǫ 2 Y X ] S M N \ a R N ^ R N \ ^ R N S ] ] \_ N S W Z J L ^ N M ^ R N N ] ^  
Z \ N ` N X ^ N M S ^ O \ Y W K N S X Q N ] ^ J K V S ] R N M Y \ J V V Y

K ǫ 8 O ^ R N J X ] a N \ S ] c N ] ^ Y J X c Y O ^ R N ] N ^ R N X ^ R N S ] ] \_ N M

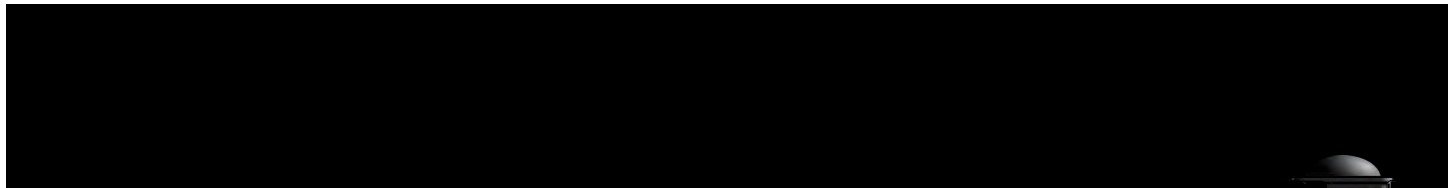
J K  
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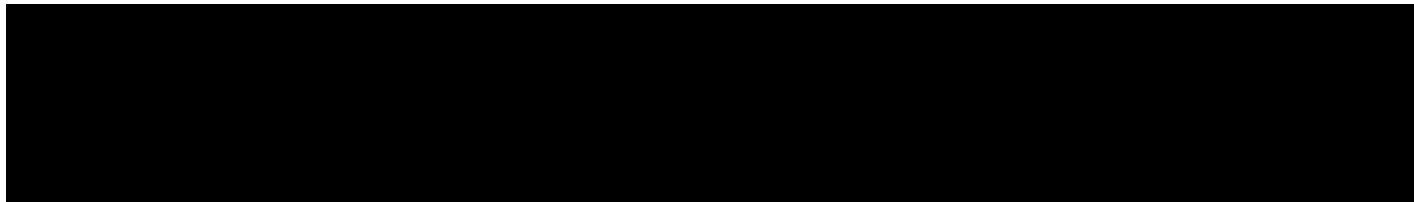
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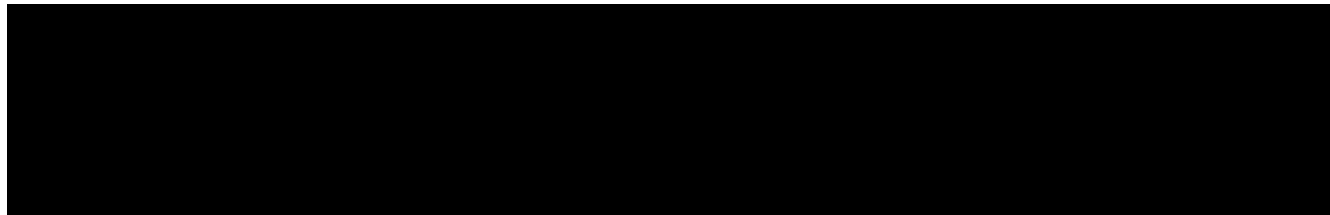
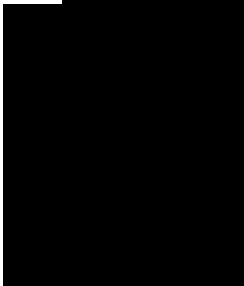
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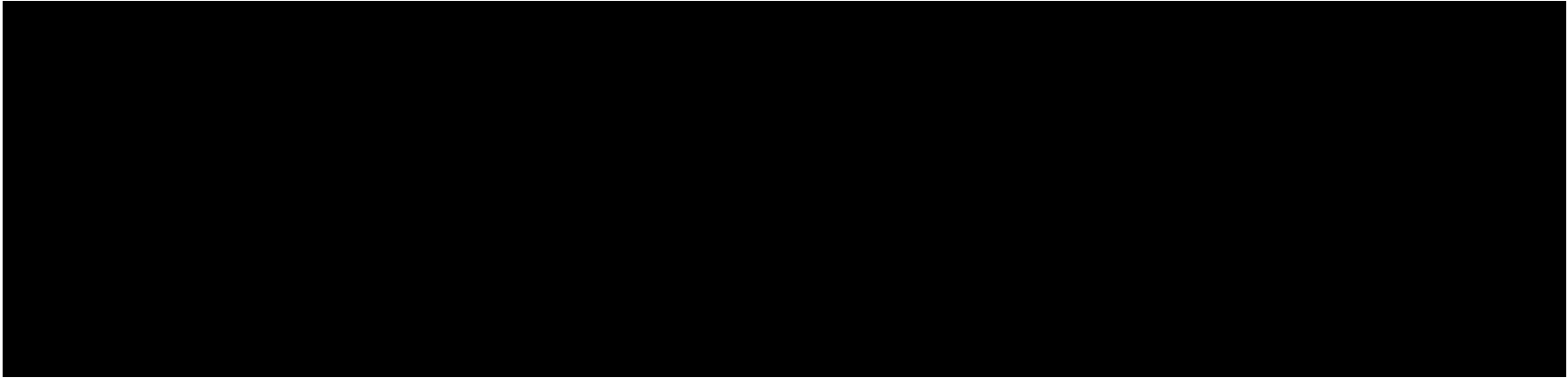
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£ ¬ ~ α = j \_ ~ #

DZMJ^N] ^Y ZYVSLc ^Y SXLV\_MN ^RN Z\Y\_LNM\_\JVV  
5Y\W] OY\ JZZNJV] JXM \N[\_S\NWNX^] aSVV KN ]R  
JVNMM  
4bZNL^NM MJ^N OY\ JVV ^\JSXSXQó ZYVSLSN]ó Z  
XNa \\_VN S] BNZ^NWKN\ ð



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5 R O H R I W K H 6 H [ X D O 0 L V F R Q G



LQYHVWLJDWRUV MRE"

" <HV EXW DV SHUVRQ ZKR UHYLHZV WKH LQYHVW  
ZK\ ZKHUH DQG ZKDW OHDG DQ LQYHVWLJDWRU  
QRW LV LPSRUWDQW DV LW PD\ FORXG \RXU MXC

” 3URFHVV RI ZHLJKLQJ WKH DFFXUDF\ DQG YHUV  
” ,QYHVWLJDWRUV HYDOXDWH WKH VRXUFH WKH  
RIIHUHG  
” :KHQ VRXUFH FRQWHQW DQG SODXVLELOLW\ D  
” &UHGLELOLW\ LV EHVW HVWDEOLVKHG WKURXJK  
” &UHGLELOLW\ H[LVWV RQ D SRLQW VFDOH ZI  
DQG WKH OHDVW DW  
” ORVW HYLGHQFH LV OLHV VRPHZKHUH LQ EHWZH  
” ,QYHVWLJDWRUV PXVW GHWHUPLQH ZKHUH EHOL  
HQRXJK WR HVWDEOLVK D SROLF\ YLRODWLRQ





” 3RVLWLRQDO /RFDWLRQDO &UHGLELOLW\ &RXO  
WKH\ KHDUG VHH ZKDW WKH\ VDZ RU NQRZ ZKD  
SRVLWLRQ RU ORFDWLRQ RI HYHQWV WKDW ZHU  
” &UHGHQWLDQV .QRZOHGJH ([SHUWLWH ([SHUWV  
HVWDEOLVKHG QRW DVVXPHG  
” 1HXWUDOLW\ 7KH PRUH OR\DO D ZLWQHVV LV W  
ELDVHG WKHLU HYLGHQFH PD\ EH 1HXWUDO ZLV  
SDUWLVDQ ZLWQHVVHV  
” ,PSDUWLDOLW\ )DLUQHVV  
” 2EMHFWLYLW\ \$EVHQFH RI ELDV

1RW DERXW ZLWQHVVHV DJUHHLQJ ZLWK RQH SDUV  
HYLGHQWLDU\ VXSSRUW IRU ZKDW D ZLWQHVV FRQ  
FRQWHQW DQG SODXVLELWL\

" 6RXUFH ,V WKH SHUVRQ SURYLGGLQJ LQIRUPDWL  
KDELWXDO WUXWKIXOQHVV"

" &RQWHQW ,V WKH VXEVWDQFH RI WKH LQIRUPD

" 3ODXVLELWL\ ,V WKH LQIRUPDWLRQ EHLQJ VK



” 7KH XVH RI WZR RU PRUH GDWD SRLQWV WR H[W  
SRLQW LV PRUH OLNHO\ WKDQ RWKHU SRVVLELC  
| ,I ; DQG < DUH WUXH = LV PRUH OLNHO\ WR EH WUXH WKD  
| ([DPSOH 5HSHDW 2IIHQGHUV RI +DUDVVPHQW RU 6H[XDO C  
” \$YRLG OLFUR ([SUHVVLQRQ DQDO\VLV DQG JHVWL  
| &URVVLQJ OLPEV ORRNQJ XS WR WKH ULJKW DQG RWKH  
EH GDWD SRLQWV

” +DUDVVLQJ EHKDYLRU LI LW LV HVWDEOLVKHG WKDW  
SDUW\ ZDV LQIRUPHG LW ZDV XQZHOFRPH WKLW DGGV  
DFFRXQW DV FRUURERUDWLYH

” 0DMRU LQFRQVLVWHQFLHV LQ WHVWLPRQ\ :RXOG OLN

” 0LQRU LQFRQVLVWHQFLHV LQ WHVWLPRQ\ :RXOG QRW  
SHUVRQ OLHG WR DYRLG SXQLVKPHQW RQ DQ DOFRKP  
GHHUPLQLQJ LI WKH OLH SURYHV RU GLVSURYHV WK  
DOOHJDWLRQ

” 'HOD\ V LQ UHSRUWLQJ 'R QRW GHWUDFW IURP FUHGL  
WKH SURFHVV GR QRW PHDQ D SHUVRQ LV O\LQJ

” )DOVH 5HSRUWLQJ 7KHUH LV D GLIIHUHQFH EHWZHHQ  
DQG DQ DFWXDO YLRODWLRQ RFFXUULQJ WKDW LV QP

YLRODWLRQ



” 1RW NQRZLQJ EHKDYLRU LV XQZHOFRPH LV QRW D GH  
VWDQGDUG LQ DVVHVVLQJ LI WKH EHKDYLRU ZRXOG K  
RIHQVLYH LV HPSOR\HG

” 7KH IDFW WKDW WKH SHUVRQ ZKR PDGH WKH DOOHJDV  
WKH EHKDYLRU ZDV RIIHQVLYH GRHV QRW DIIHFW FUH  
| 0DQ\ SHRSOH DUH IHUOXO RI GRLQJ VR  
| 7KHUH LV QR REOLJDWLRQ RI WKH UHSRUWLQJ SDU  
EHKDYLRU LV RIIHQVLYH

” 0RWLYDWLRQ WR OLH H[DJJHUDWH RU GLVWRUW LQI  
GLIIHUHQFHV LQ ZKDW ZDV UHSRUWHG RU TXHVWLRQV

” +RZ PLJKW D UHDVRQDEOH SHUVRQ UHDFW WR V  
” :KDW ZDV WKH HIIHFW RI WKH EHKDYLRU RQ WK

\$ SUHSRQGHUDQFH FDQ EH HVWDEOLVKHG VLPSON\  
SDUW\ DQG QRW WKH RWKHU EDVHG RQ WKH DVVH  
HYLGHQFH SURYLGHG



3HRSOH ZKR KDYH HQJDJHG LQ VH[XDO PLVFRQGGXPF  
ZD\ V WKDW GR QRW MXVWLI\ WKHLU DFWLRQV DQG

” ,W ZDV DQ DFFLGHQW , GLGQ¶W PHDQW WR PDM  
WRXFKHG WKHLU FURWFK

” , GLGQ¶W NQRZ FRHUFLRQ ZDV D WKLQJ QRU GL

” 6KH ZDV JLYLQJ PH VLJQDOV WKDW OHW PH NQR  
EDFN

” 6KH¶V D VOXW VR , DP VXUSULVHG WKDW VKH L

” ,W ZDVQ¶W D ELJ GHDO D VLP SOH NLVV , DP C





)UHG IRQGOHG 6KHOO\¶V EUHDVWV ZLWKRXW FRQV

)UHG DOVR WULHG WR JLYH D KDQGMRE WR %LOO  
GLG QRW <

-RH FDPH IRUZDUG DOOHJLQJ WKDW KH EHOLHYHG  
VOHHSLQJ LQ )UHG¶V URRP EXW LVQ¶W SRVLWLYH

)UHG OLNHV JLUOV = SRWHQWLDO DV ZH GRQ¶W

%\ WULDQJXODWLQJ ; DQG < , FDQ EHOLHYH WKH

, QYHVWLJDWRU ¶ V 1RWH

, NQRZ WKDW )UHG PD\ OLNH JLUOV ~~EXWUDHOR~~ BHZD;  
QRW UXOH RXW = , W PDNHV = PRUH SODXVLEOH W

, DOVR NQRZ WKDW )UHG KDV IRQGOHG D SHQLV E  
QR LGHD DERXW ; DQG < 7KXV = ¶ V EHOLHI WKDW  
LQIOXHQFHG E\ DQ\WKLQJ EXW KLV RZQ EHOLHI +  
KH FDQ ¶ W VD\ IRU VXUH WKDW WKH FRQGXFWR RFFX

7ULDQJXODWLQJ IURP ; DQG < PDNHV = PRUH OLNH  
D SDWWHUQ WKDW )UHG KDV HQDFWHG EHIRUH DQ  
FLUXPVWDQFHV WR =

7KLV LV KRZ DEGXFPLYH UHDVRQLQJ IRU WKH LQK  
FRPHV IURP ZKDW LQYHVWLJDWRUV NQRZ DERXW ;  
ZHLJKW RI = ¶ V HYLGHQFH LWVHOI

6LPLODUO\ LQYHVWLJDWRUV XVH WULDQJXODWLRQ  
DQG ; GRQ¶W PDNH = PRUH OLNHO\ EXW = LV DVVH  
DUH WXUH = ZLOO IDLO ZKHQ ; DQG < WULDQJXOD  
WKDQ WR =

3DUWLHV ZLOO ZDQW WR YHULI\ WKH FUHGHW  
 D :KHQ \RX UHFHLYH D UHSRUW IURP DQ LQYHVWLJDWRU W  
 \RX FDQ DVN WKH LQYHVWLJDWRUV WR VSHDN WR WKHLU  
 ([DPLQH WKH ZD\ WKH LQYHVWLJDWRU DVVHV  
 D ,I LW PDNHV VHQVH WKURXJK LQKHUHQW SODXVLELOLW  
 WR LGHQWLI\ DV D SDQHO  
 'HWHUPLQH LI WKH LQYHVWLJDWRU XVHG D FRQ  
 FUHGLELOLW\ RI DOO SDUWLHV DQG ZLWQHVVHV  
 D &UHGLELOLW\ VKRXOG EH H[SODLQHG LQ WKH UHSRUW ,I  
 IRU RQH SHUVRQ RYHU RWKHUV ZLWKRXW VXIILFLHQW H[S  
 DGGUHVHG LQ WKH KHDULQJ  
 \$VN WKH ,QYHVWLJDWRU 4XHVWLRQV QRW MXV  
 D ,I WKH UHSRUW GRHVQ\W DGG XS \RX KDYH D UHVSRQV  
 WKH DQVZHU LV QRW VDWLVI\LQJ \RX PD\ MXVWO\ ILQG \R

3DUWLHV KDYH WKH ULJKW WR DVN HDFK RWKHU T

7KH ERDUG LV UHVSQRVLEOH IRU HQVXULQJ WKDW  
UHOHYDQW 8QGHUVWDQGLQJ WKDW LUU@IONHYDQW  
DSSH DUDQFH DQG SDVW VH[XDO KLVWRU\ DUH QR

5HOHYDQW TXHVWLRQV FDQ FRPH WKURXJK WKH E  
GHWDLOV RI HDFK SDUW\ UHJDUGLQJ WKH KRZ ZK

4XHVWLRQV"



$\rho_j \cdot \alpha_j^T \hat{u} \sim \hat{u}^T$   
 $N(\hat{u} \cdot \mathbf{1}, \hat{U})$



DXMN \ ^RN CS^VN 8G 6 \SN`JXL  
CRN 5SXJV A\_VN

1 \_ î

ǒ CS^VN 8G 5SXJV A\_VN 2RJXQN]  
ǒ D=2 0]RN`SVVN ?\YLMN\_\JV 8WZJL^]  
ǒ 7NJ\SXQ >NLN\ AYVN DXMN\ ^RN XNa A\_VN



1 = α T S Y ^ α À s ~ 8 ã = T T

ö 2 Y W Z V J S X ^ J X M = Y ^ S J L J ^ S Y X

Jö B \_ Z Z Y \ ^ S ` N < N J ] \_ \ N ] 2 Y W Z V J S X J X ^ J X M A N ] Z Y X M N X ^

Kö 8 X O Y \ W J V ? \ Y L N ] ]

Lö 5 Y \ W J V ? \ Y L N ] ]

j]•Tî = \_α î\_ sjα = Ý îα = j\_

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” B_ZZY\^S`N <NJ]_\N] βJZZVSNM ^Y KY^R
ZJ\^SN] OY\ SXOY\WJV JXM OY\WJV YZ^SYX]à
| 2Y_X]NVSXQ
| 2Y_\]N OMT_]^WNX^]
| 2VJ]] BLRNM_VN
| 4]LY\^]
| FY\U BLRNM_VN
| =Y 2YX^JL^ >\MN\]
|
```

' = ~ ] = ~ ~ ^ T \_ ^ T Ê ~ = ~

ě CS^VN 8G 2YY\MSXJ^Y\ \N[\_S\NM ^Y MY J MS]WS  
ě CRN C8GB7 KNRJ`SY\ W\_]^ WNN^ ^RN XJ\\YaNM M  
Jě 1NRJ`SY\ RJM ^Y YLL\_\ SX ^RN DXS^NM B^J^N]  
Kě 1NRJ`SY\ RJM ^Y WNN^ JVV ^R\NN ]^JXMJ\M]ò BN`N\Nó ?N\  
Lě 1NRJ`SY\ RJM ^Y ^JUN ZVJLN aS^RSX JX NM\_LJ^SYXJV Z\Y  
Sě >H LJWZ\_] ZJ\^SN] SX aRSLR JX S]]\_N YLL\_\ \NM aY\_VM  
SSě >X LJWZ\_] ZJ\^SN]>N`NX^]>JL^S`S^SN] SXLV\_MSXQ \N  
ě 3S]WS]]NM LYWZVJSX^] \_XMN\ CS^VN 8G LJX ]^S  
ZYVSLSN] VSUNVc JZZVSLJKVN ^Y 7\_WJX AN]Y  
2YWW\_XS^c B^JXMJ\M]  
ě ?J\UN\ ?YN CSWN]^JWZ ò ò F0C27

$$\tilde{A} = \tilde{j} \cdot \alpha_j T$$

" HY\_ W\_] ^ SXLV\_ MN JM`S]Y\] JXM NX]\_ \N ^RNS\ ZJ

" 0M`S]Y\ 5Y\W

" 0M`S]Y\] ?VJc J KJLUQ\Y\_XM \YVN SX ^RN]N LJ]N

| HY\_ aYX ^ KN SX^N\`SNaNM

| HY\_ aYX ^ ^N]^SOc

| HY\_ \ ]Z NJUSXQ \YVN J^ ^RN RNJ\ SXQ aSVV KN VSWS^NM ^Y  
YO ^RN ZJ\^c cY\_ J\N ]\_ZZY\^SXQ

| HY\_ J\N XY^ NXLY\_ \JQNM XY\ aSVV cY\_ KN J]UNM ^Y ]RJ\N c  
aRSLR cY\_ JXM cY\_ \]NVO \NZ\N]NX^SXQ J ZJ\^SL\_VJ\ ZJ\^c

| HY\_ J\N YXVc JM`S]SXQ ]^\_MNX^]ó cY\_ aSVV XY^ JM`S]N JXc  
Z\YLN]]

| HY\_ J\N ^RN\N ^Y ]\_ZZY\^ JXM JM`YLJ^N KNLJ\_]N cY\_ LJ\N J  
cY\_ JQ\NN aS^R N`N\c JL^SYX ^RN ZJ\^c cY\_ J\N ]\_ZZY\^SXQ

S\_Ã ~ α = 1 î α = j \_

” DXKSJ]NM JXM 8WZJ\^SJV ^Y KY^R ZJ\^SN]

” SX`N]^SQJ^Y\ WYMNV

” 0M`JXLN a\S^^NX XY^SLN YO ^RN SX^N\`SNa JXM ]L

” 3\_\SXQ ^RN SX^N\`SNa

| 0M`S]Y\] LJX ^JUN XY^N] ^Y J]U ^RNS\ ZJ\^c JKY\_^ VJ^N\

| 0M`S]Y\] LJXXY^ KN MS]\\_Z^S`N Y\ SX^N\]\\_Z^ ^RN SX^N\`SNa

| 0M`S]Y\] LJXXY^ JX]aN\ YX KNRJVO YO ^RN ZJ\^c

| CRN]N SX^N\`SNa] J\N Ô JKY\_^ ^RN ZJ\^SN] `XY^ ^RN JM`S]Y\

| 1N Z\NZJ\NM OY\ ^RN SX^N\`SNa] ^Y SXLV\_MN JXM LY`N\ `N\c Nb

KN \_XLYWOY\^JKVN

| 8X`N]^SQJ^Y\] aSVV JV]Y LYVVNL^ N`SMNXLN O\YW ^RN ZJ\^SN]

MYL\_WNX^J^SYX JL\Y]] WJXc ZVJ^OY\W]ô JXM `N\KJV JLLY\_X^] C

” 4JLR ZJ\^c WJc Z\N]NX^ N`SMNXLN YX ^RNS\ KNRJVO

| 4JLR ZJ\^c RJ] J LRJXLN ^Y \N]ZYXM ^Y ^RN N`SMNXLN LYVVNL^

| 8X`N]^SQJ^Y\ \NZY\^ WJc JV]Y KN \N]ZYXMNM ^Y SX a\S^SXQ Kc

| HY\_ WJc RNVZ cY\_\ ZJ\^c aS^R ^RN]N a\S^^NX \N]ZYX]N] SO ^RN

K\_^ ^RNC LJX MNXc cY\_\ RNVZ aS^R XY [\_N]^SYX] J]UNM



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"Öi4 i "K Á"ù K !"? mvÖ?e ÓİõÔ∅

i î • œ ã j ] • T œ

>X 5\SMJcò

” 7NJ\SXQ >NLN\ AYVN SX 8XOY\WJV ?\YLN]]

” 7NJ\SXQ >NLN\ AYVN SX 5Y\WJV ?\YLN]]

” BLNXJ\SY A\_X ^R\Y\_QR

N î• = \_ 1 ~ • α = j \_ 6 S \_ 0 j • ] î T i • j

” CS^VN 8G 2YY\MSXJ^Y\ SJ VNJM 2YY\MSXJ^Y\ OY  
Z\YLN]] \_Z \_X^SV ^RN RNJ\SXQ SJ JLRNM\_VNMđ  
” 7NJ\SXQ >NLN\] J\N VNJM MNLS]SYX WJUN\] OY\  
| FN VSUNX ^RS] ^Y 0MWSXS]^\J^S`N AN]YV\_^SYX] Y\ <NMSJ^  
| 3SHN\NXLN]đ  
v <\_^\_JV JQ\NNWNX^ ^Y NXQJQN SX ^RS] ^cZN YO RNJ\SX  
v <\_^\_JV JQ\NNWNX^ ^Y SMNX^SJNM JJXL^SYX]  
v CRN RNJ\SXQ W\_]^ KN VS`N aS^R ^RN ZJ\^SN] JXM ^RN  
v CRN RNJ\SXQ YNLN\ W\_]^ JVVYa L\Y]] [\_N]^SYXSXQ ^R\Y  
v >XVc 4M\_LJ^SYXJV BJXL^SYX] J\N ZN\WS^^NM XY ]\_]Z  
LYX]SMN\NM  
v 58XJV Y\_^LYWN]ó aS^R \J^SYXJVN W\_]^ KN MYL\_WNX^NM  
v =Y 0ZZNJV YZ^SYX OY\ NS^RN\ ZJ\^c  
v >XLN ^RN LJ]N SJ \N]YV`NMó ^RN\N SJ XY ]^JXMSXQ \NL

α 7 \_ \_ = \_ 1 î \_ S \_ 0 j • ] î T g = Ñ N î • =

8XS^SJV B^NZ] ß2YWZVN^NM Kc C8G2à

j \_ ø = \_ 7

7NJ\SXQ

- " DJN ^RN RNJ\SXQ jL\SZ^ ^Y WJUN SX^\YM\_L^Y\c \NWJ\U] JXM NbZVJSX RNJ\SXQ V
- " 0]U NJLR ZJ^\c aRJ^ Y\_^LYWN ^RNc J\N RYZSXQ OY\ Kc NXQJQSQ SX ^RN SXOY
- " 0VVYa KY^R ZJ^\SN] ^Y \NLY\_X^ ^RNS\ j^Y\SN]ó J]U cY\_\ Z\NZJ\NM Y\ OYVVYa \_Z
- " 0VVYa OY\ L\Y]] [\_N]^SYXSXQ Kc ^RN ZJ^\SN] JM`S]Y\]đ
- " 0O^N\ NJLR L\Y]] [\_N]^SYX ZY]NM Kc J ZJ^\c ] JM`S]Y\ó MN^N\WSXN aRN^RN\ ^Y J  
OY\ JXc NbLV\_]SYXđ

?Y]^ 7NJ\SXQ CJ]U]

RN  
SYX



j \_ ø = \_ 7

” CS^VN 8G 2YY\MSXJ^Y\ S] VNJM LYY\MSXJ^Y\ YO  
8X`N]^SQJ^SYXđ 0X SX`N]^SQJ^S`N \NZY\^ aSVV I  
” 7NJ\SXQ >NLN\] JL^ J] VNJM LYXM\_L^>RNJ\SXQ Y  
YO ^RN Bnb\_JV <S]LYXM\_L^ 1YJ\M OY\ J VS`N RN  
C8G2 S] ^RN\N ^Y ]\_ZZY\^ JXM Q\_SMNó K\_^ VN^^M  
MYL\_WNX^J^SYX LYWN] O\YW ^RN 7NJ\SXQ >NLN\  
\N]YV`N LJ]N] ^R\Y\_QR ^RN OY\WJV LYWZVJSX^ Z  
” 5Y\WJV  
| ;S`N RNJ\SXQ \N[\_S\NM SX ^RN]N LJ]N]  
| 0M`S]Y\] \N[\_S\NM OY\ NJLR ZJ\^c J^ ^RN RNJ\SXQ  
| 4M ]JXL^SYX] ZV\_] ]\_]ZNX]SYX JXM NbZ\_V]SYX JVVYaNM RN  
| >\_^LYWN] MNVS`N\NM ^Y KY^R ZJ\^SN] SX a\S^SXQ <Y\N M  
|

α 7 \_\_ = \_ 1 î Fj•]îT g=Ã N î•=\_ 1

8XS^SJV B^NZ] ß2YWZVN^NM Kc ^RN C8G2à

8XS^SJV B^NZ] ß2YWZVN^NM Kc ^RN 7>à

8XS^SJV B^NZ] ß2YWZVN^NM Kc ^RN B<71à

” DJN NVNWNX^] YO ^RN Z\YRSKS^NM LYXM\_L^ MNJXS^SYXß]à ^Y Q\_SMN cY\_\ Z\NZ



j \_ ø = \_ 7

? \ N 7 N J \ S X Q ß 7 > à

j \_ ø = \_ 7

7NJ\SXQ ß7>à

SXQ

j \_ ø = \_ 7

?Y] ^ 7NJ \SXQ ß7 > à

" 1N J`JSVJKVN ^Y Z\Y`SMN jJXL^SYX LYX]\_V^J^SYX ^Y ^RN B<71 aRNX JZZVSLJJKV  
" ANLNS`N ^RN MYL\_WNX^ L\JO^NM Kc ^RN B<71 ^RJ^ Z\Y`SMN] ^RN \J^SYXJVN OY  
" 2\JO^ ^RN JXJV Y\_^LYWN VN^^N\ KJJNM YX ^B SQ YMYN`SMNa6  
" >XLN \N`SNaNMó jNXM ^RN 5SXJV >\_^LYWN ;N^^N\ó aS^R JZZNVVJ^N SXOY\WJ^SY

?Y] ^ 7NJ \SXQ ßB<71 à

j î • x S S S ¬ \_ î • = j

?J\UN\ ?YN

CSWN]^JWZ

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q = ~ TTî\_ j¬~

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” 0^^Y\XNc 5Y\W 1NSXQ _ZMJ^NM  
” 54A?0 5Y\W 1NSXQ _ZMJ^NM  
” B<8?E ?YVSLc DZMJ^NM Kc BZ\SXQ BNWN]^N\  
” 0ZZNJV]
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@\_N]^SYX]ú

þ j ¬ • ø j T î ~ î  
N î • = \_ 1 ~ Û •



DXMN\ ^RN CS^VN 8G 6\SN`JXL  
CRN 5SXJV A\_VN

B < 7 1

1 \_ î

ǒ CS^VN 8G 5SXJV A\_VN 2RJXQN]





1 = α T S Y î α À s ~ 8 ã = T T

ö 2 Y W Z V J S X ^ J X M = Y ^ S J L J ^ S Y X

Jö B \_ Z Z Y \ ^ S ` N < N J ] \_ \ N ] 2 Y W Z V J S X J X ^ J X M A N ] Z Y X M N X ^

Kö 8 X O Y \ W J V ? \ Y L N ] ]

Lö 5 Y \ W J V ? \ Y L N ] ]

j]•Tî = \_α î\_ sjα = Ý îα = j\_

```
” B_ZZY\^S`N <NJ]_\N] βJZZVSNM ^Y KY^R
ZJ\^SN] OY\ SXOY\WJV JXM OY\WJV YZ^SYX]à
| 2Y_X]NVSXQ
| 2Y_\]N OMT_]^WNX^]
| 2VJ]] BLRNM_VN
| 4]LY\^]
| FY\U BLRNM_VN
| =Y 2YX^JL^ >\MN\]
|
```

' = ~ ] = ~ ~ ^ T \_ ^ T Ê ~ = ~

ě CS^VN 8G 2YY\MSXJ^Y\ \N[\_S\NM ^Y MY J MS]WS  
ě CRN C8GB7 KNRJ`SY\ W\_] ^ WNN^ ^RN XJ\\YaNM M  
Jě 1NRJ`SY\ RJM ^Y YLL\_\ SX ^RN DXS^NM B^J^N]  
Kě 1NRJ`SY\ RJM ^Y WNN^ JVV ^R\NN ]^JXMJ\M]ò BN`N\Nó ?N\  
Lě 1NRJ`SY\ RJM ^Y ^JUN ZVJLN aS^RSX JX NM\_LJ^SYXJV Z\Y  
Sě >H LJWZ\_] ZJ\^SN] SX aRSLR JX S]]\_N YLL\_\ \NM aY\_VM  
SSě >X LJWZ\_] ZJ\^SN]>N`NX^]>JL^S`S^SN] SXLV\_MSXQ \N  
ě 3S]WS]]NM LYWZVJSX^] \_XMN\ CS^VN 8G LJX ]^S  
ZYVSLSN] VSUNVc JZZVSLJKVN ^Y 7\_WJX AN]Y  
2YWW\_XS^c B^JXMJ\M]  
ě ?J\UN\ ?YN CSWN]^JWZ ò ò F0C27

$$\tilde{A} = \tilde{j} \cdot \alpha_j T$$

" HY\_ W\_] ^ SXLV\_ MN JM`S]Y\] JXM NX]\_ \N ^RNS\ ZJ

" 0M`S]Y\ 5Y\W

" 0M`S]Y\] ?VJc J KJLUQ\Y\_XM \YVN SX ^RN]N LJ]N

| HY\_ aYX ^ KN SX^N\`SNaNM

| HY\_ aYX ^ ^N]^SOc

| HY\_ \ ]Z NJUSXQ \YVN J^ ^RN RNJ\SXQ aSVV KN VSWS^NM ^Y  
YO ^RN ZJ\^c cY\_ J\N ]\_ZZY\^SXQ

| HY\_ J\N XY^ NXLY\_ \JQNM XY\ aSVV cY\_ KN J]UNM ^Y ]RJ\N c  
aRSLR cY\_ JXM cY\_ \]NVO \NZ\N]NX^SXQ J ZJ\^SL\_VJ\ ZJ\^c

| HY\_ J\N YXVc JM`S]SXQ ]^\_MNX^]ó cY\_ aSVV XY^ JM`S]N JXc  
Z\YLN]]

| HY\_ J\N ^RN\N ^Y ]\_ZZY\^ JXM JM`YLJ^N KNLJ\_]N cY\_ LJ\N J  
cY\_ JQ\NN aS^R N`N\c JL^SYX ^RN ZJ\^c cY\_ J\N ]\_ZZY\^SXQ

S\_Ã ~ α = 1 î α = j \_

” DXKSJ]NM JXM 8WZJ\^SJV ^Y KY^R ZJ\^SN]

” SX`N]^SQJ^Y\ WYMNV

” 0M`JXLN a\S^^NX XY^SLN YO ^RN SX^N\`SNa JXM ]L

” 3\_\SXQ ^RN SX^N\`SNa

| 0M`S]Y\] LJX ^JUN XY^N] ^Y J]U ^RNS\ ZJ\^c JKY\_^ VJ^N\

| 0M`S]Y\] LJXXY^ KN MS]\\_Z^S`N Y\ SX^N\]\\_Z^ ^RN SX^N\`SNa

| 0M`S]Y\] LJXXY^ JX]aN\ YX KNRJVO YO ^RN ZJ\^c

| CRN]N SX^N\`SNa] J\N Ô JKY\_^ ^RN ZJ\^SN] `XY^ ^RN JM`S]Y\

| 1N Z\NZJ\NM OY\ ^RN SX^N\`SNa] ^Y SXLV\_MN JXM LY`N\ `N\c Nb

KN \_XLYWOY\^JKVN

| 8X`N]^SQJ^Y\] aSVV JV]Y LYVVNL^ N`SMNXLN O\YW ^RN ZJ\^SN]

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$$\begin{aligned}
 \hat{E}^{-1} \hat{T} q &= \tilde{j}_- \alpha \hat{i}_- S_- \alpha \dots \tilde{j}_- \\
 x &= jT \quad ijT = \hat{E}
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v <\_^\_JV JQ\NNWNX^ ^Y NXQJQN SX ^RS] ^cZN YO RNJ\SX  
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v CRN RNJ\SXQ W\_]^ KN VS`N aS^R ^RN ZJ\^SN] JXM ^RN  
v CRN RNJ\SXQ YNLN\ W\_]^ JVVYa L\Y]] [\_N]^SYXSXQ ^R\Y  
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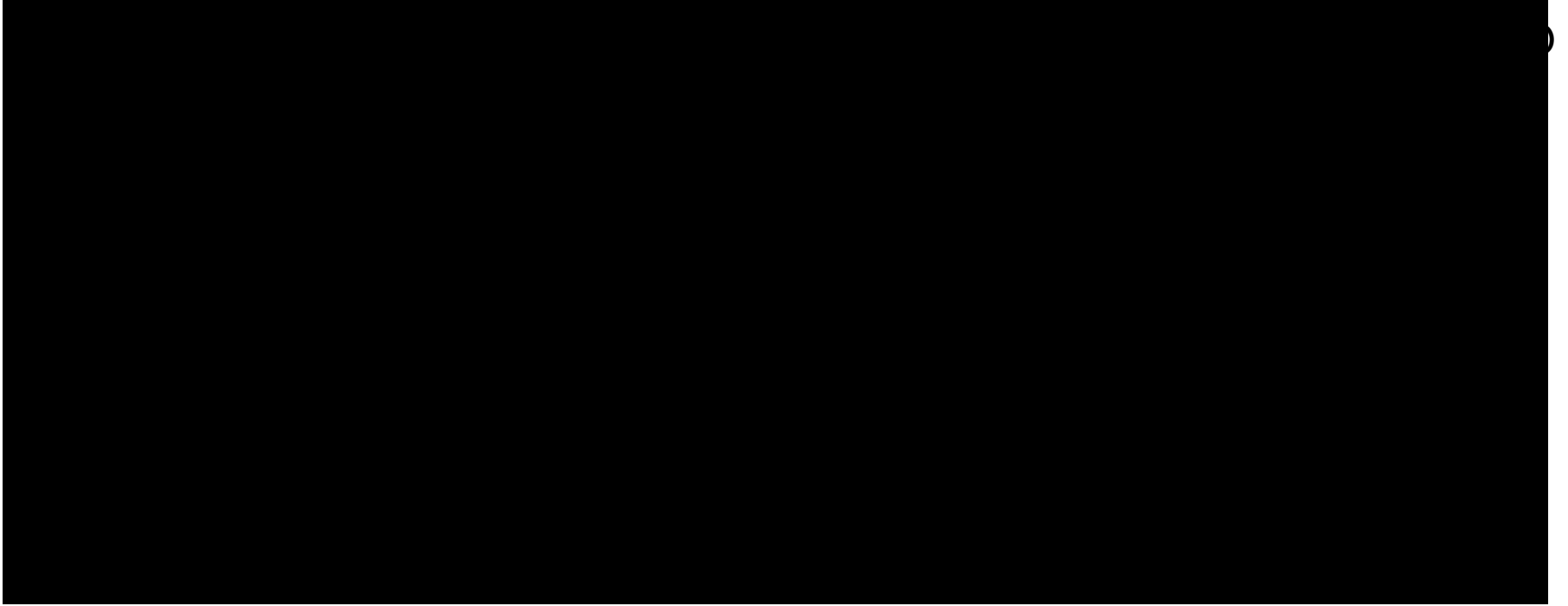
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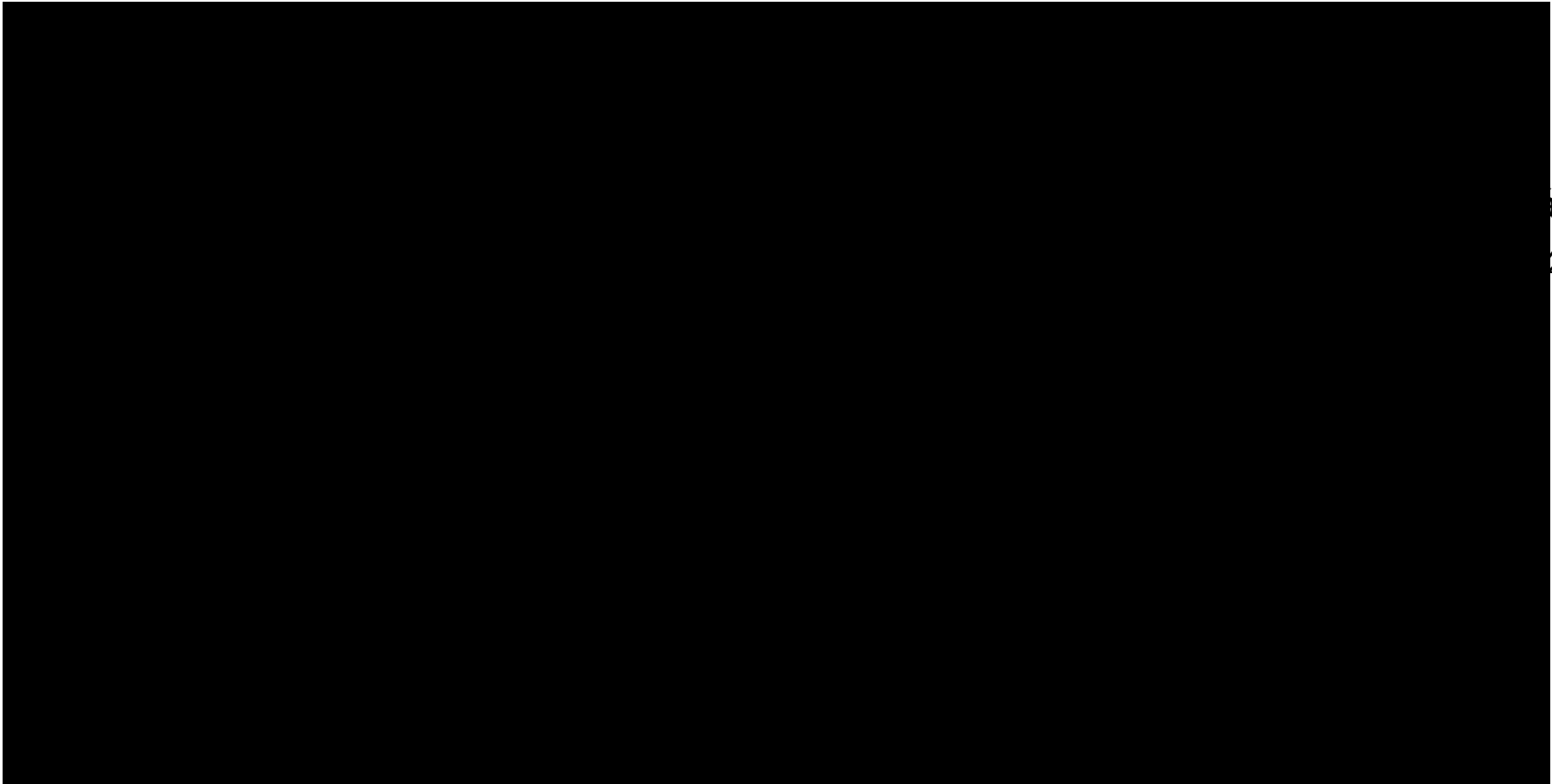
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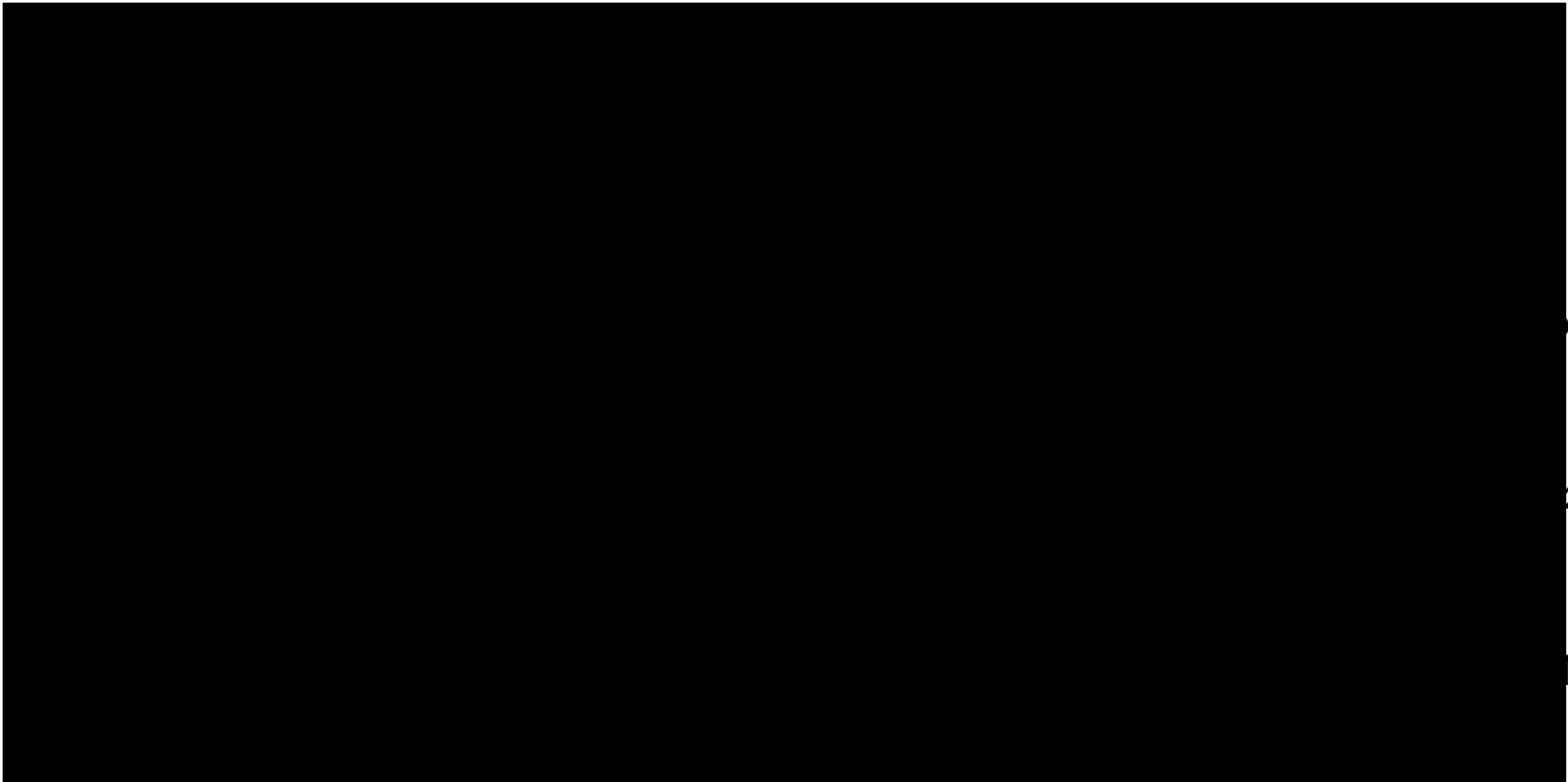
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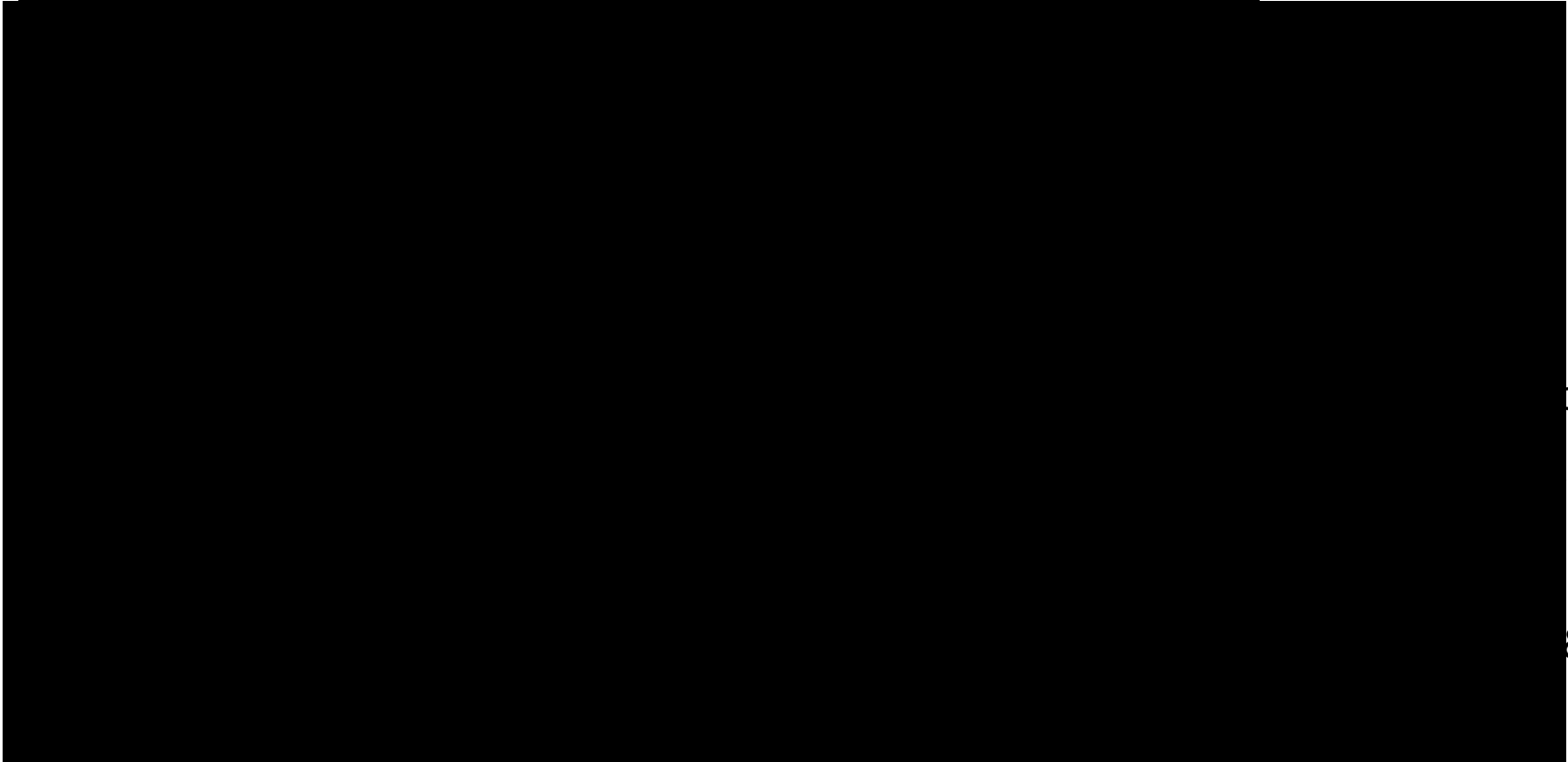
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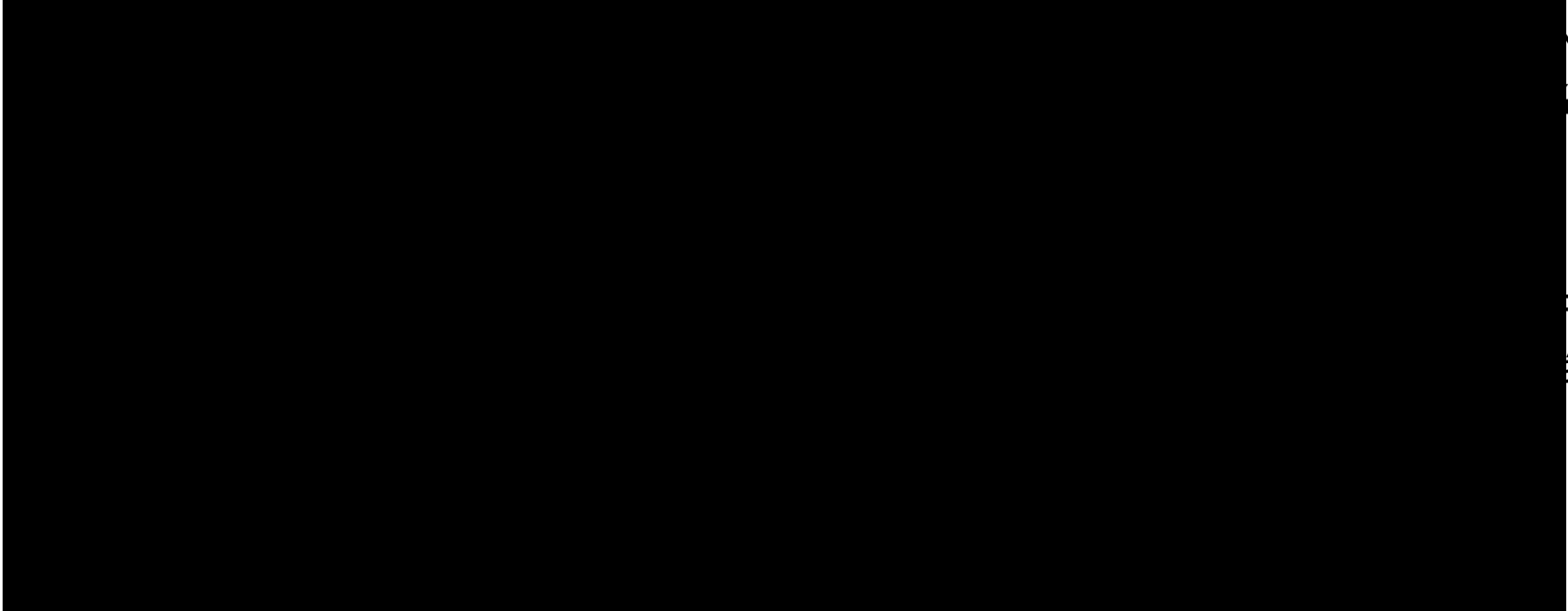
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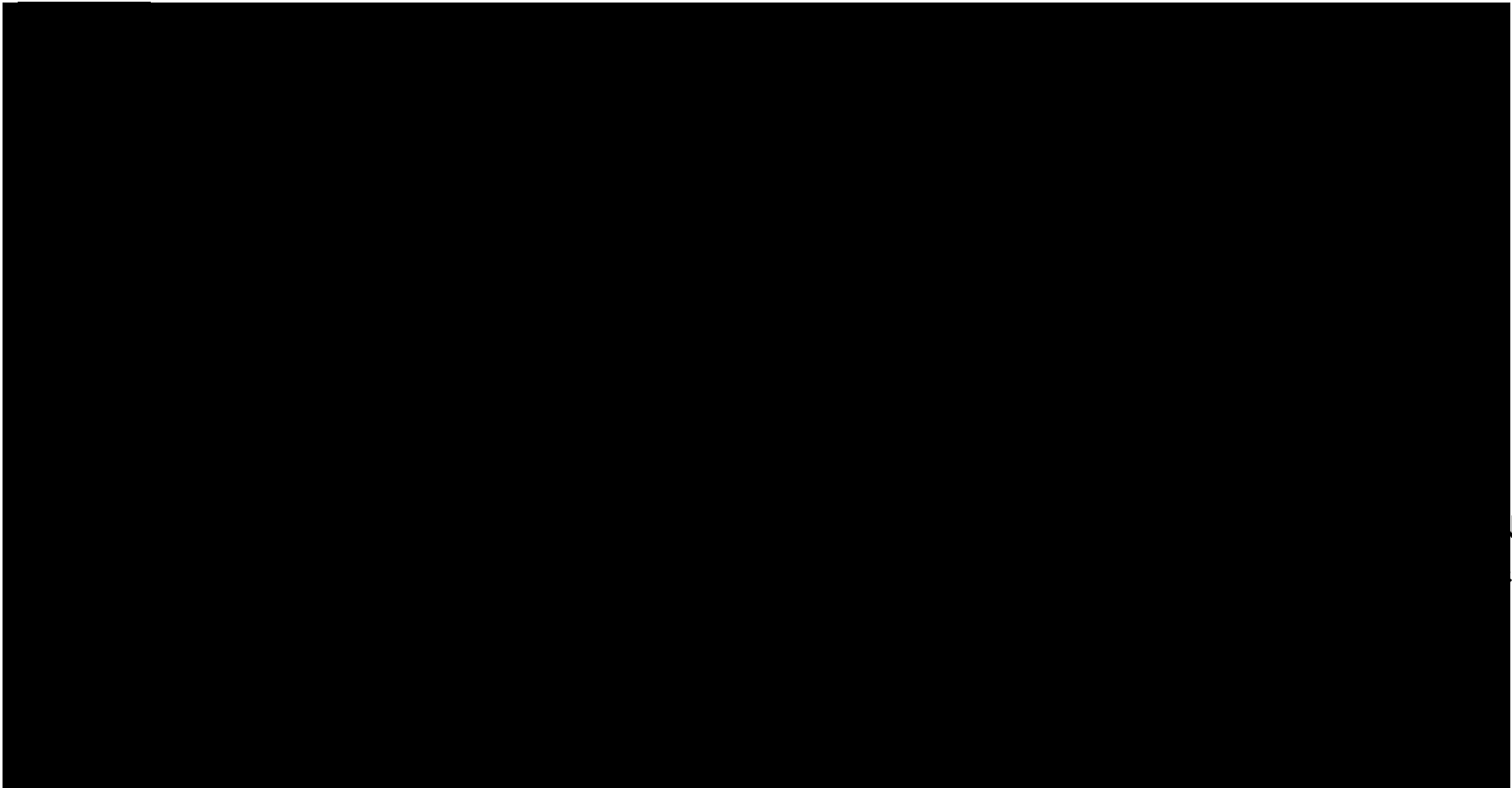
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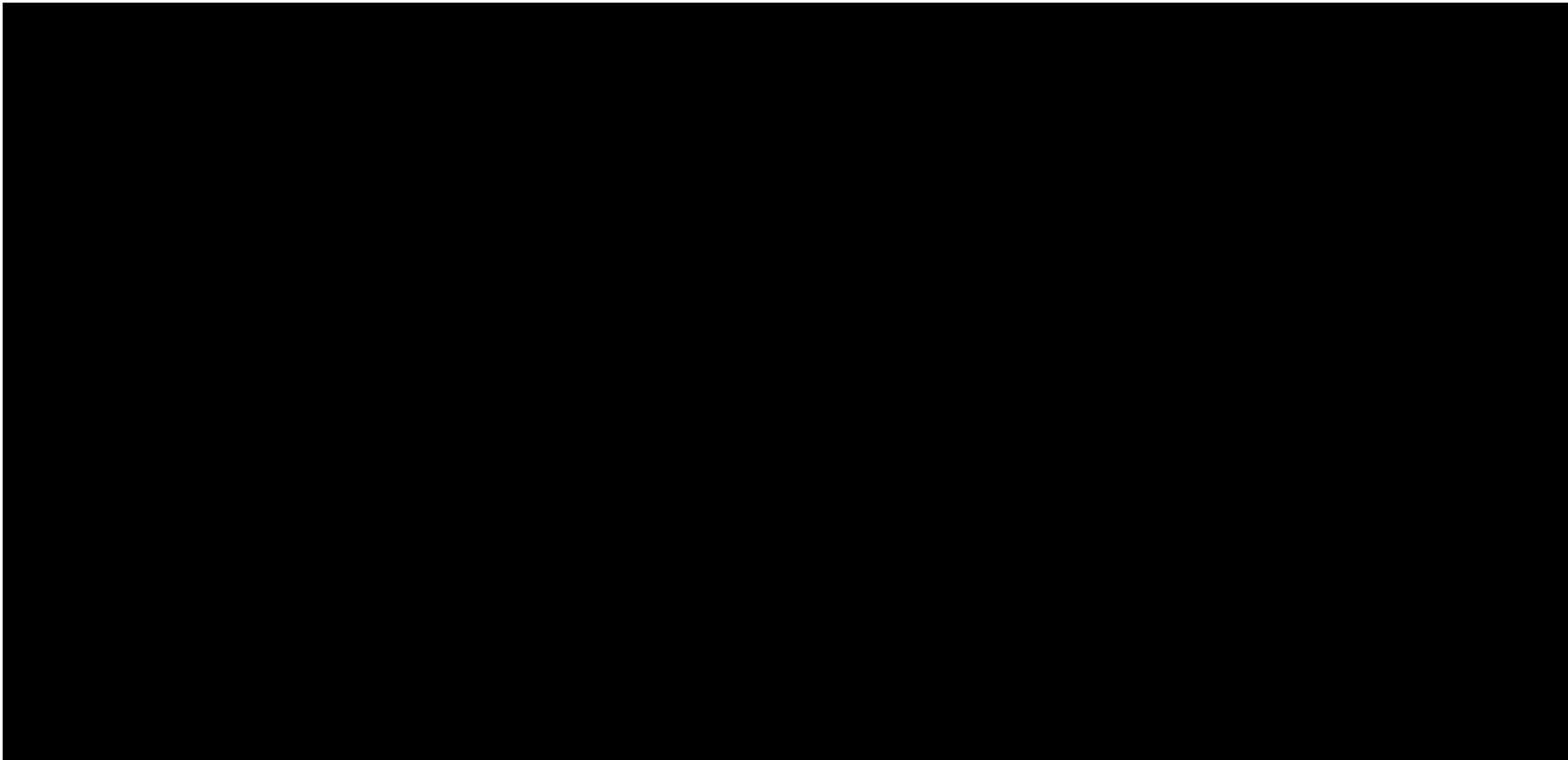
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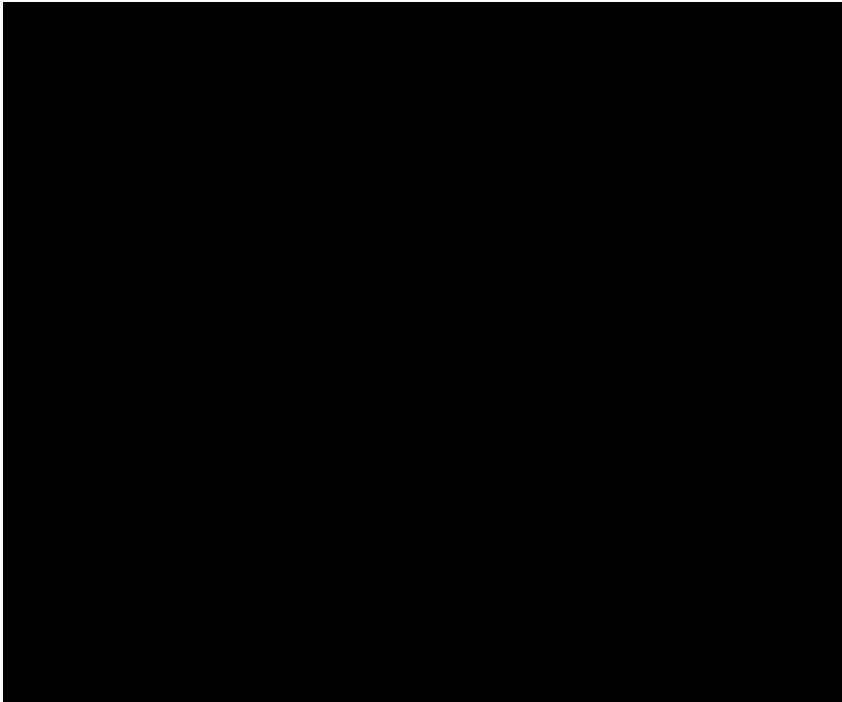
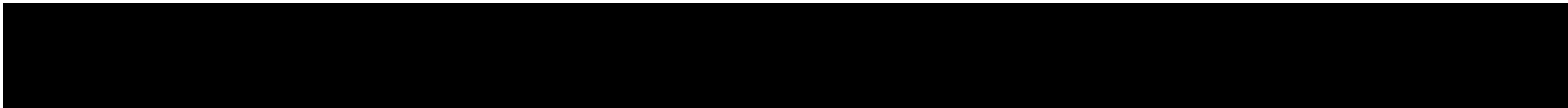
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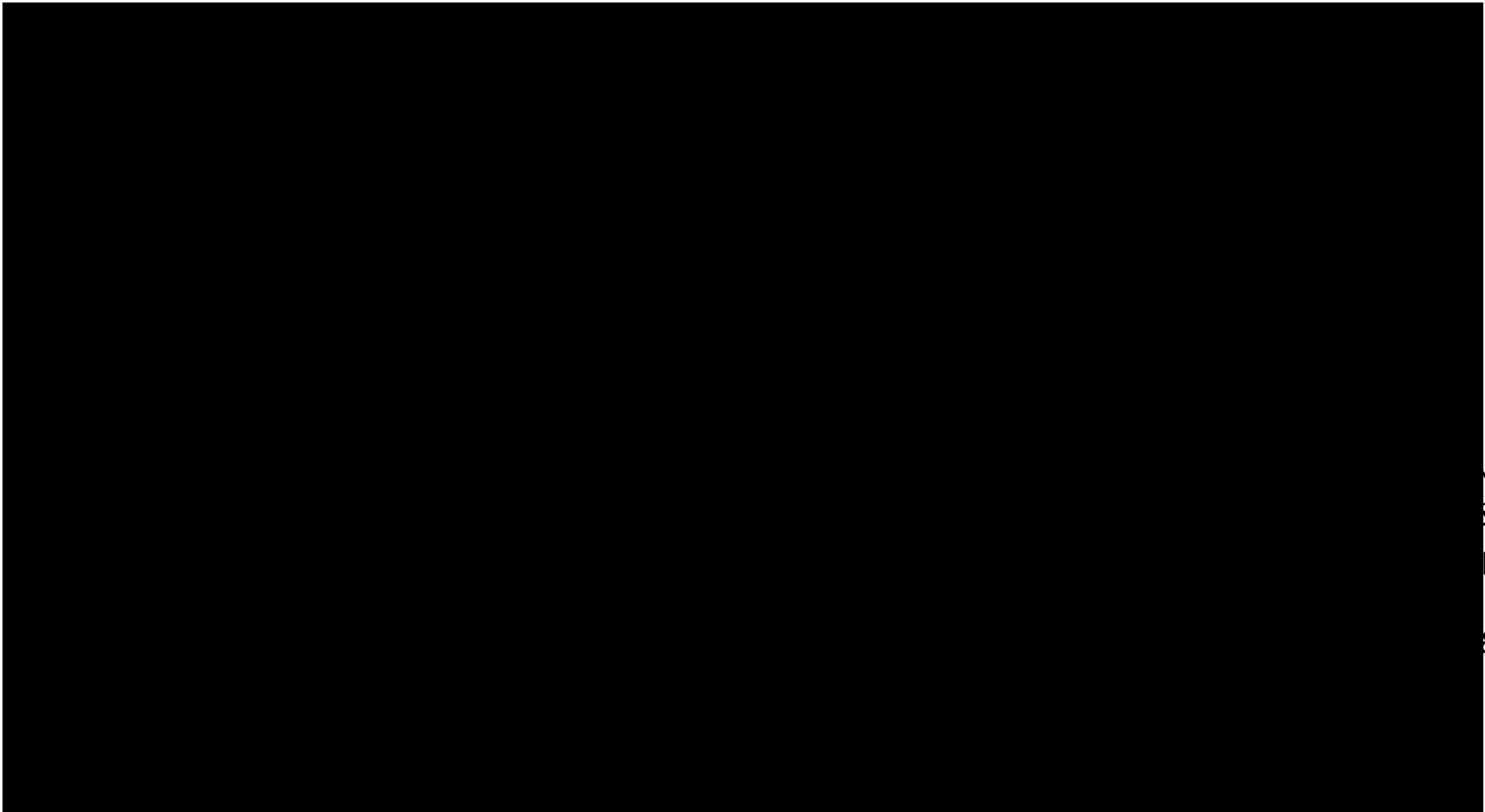
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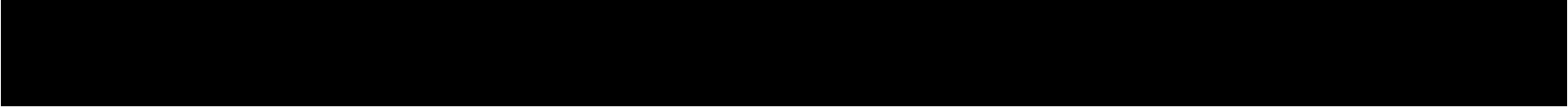
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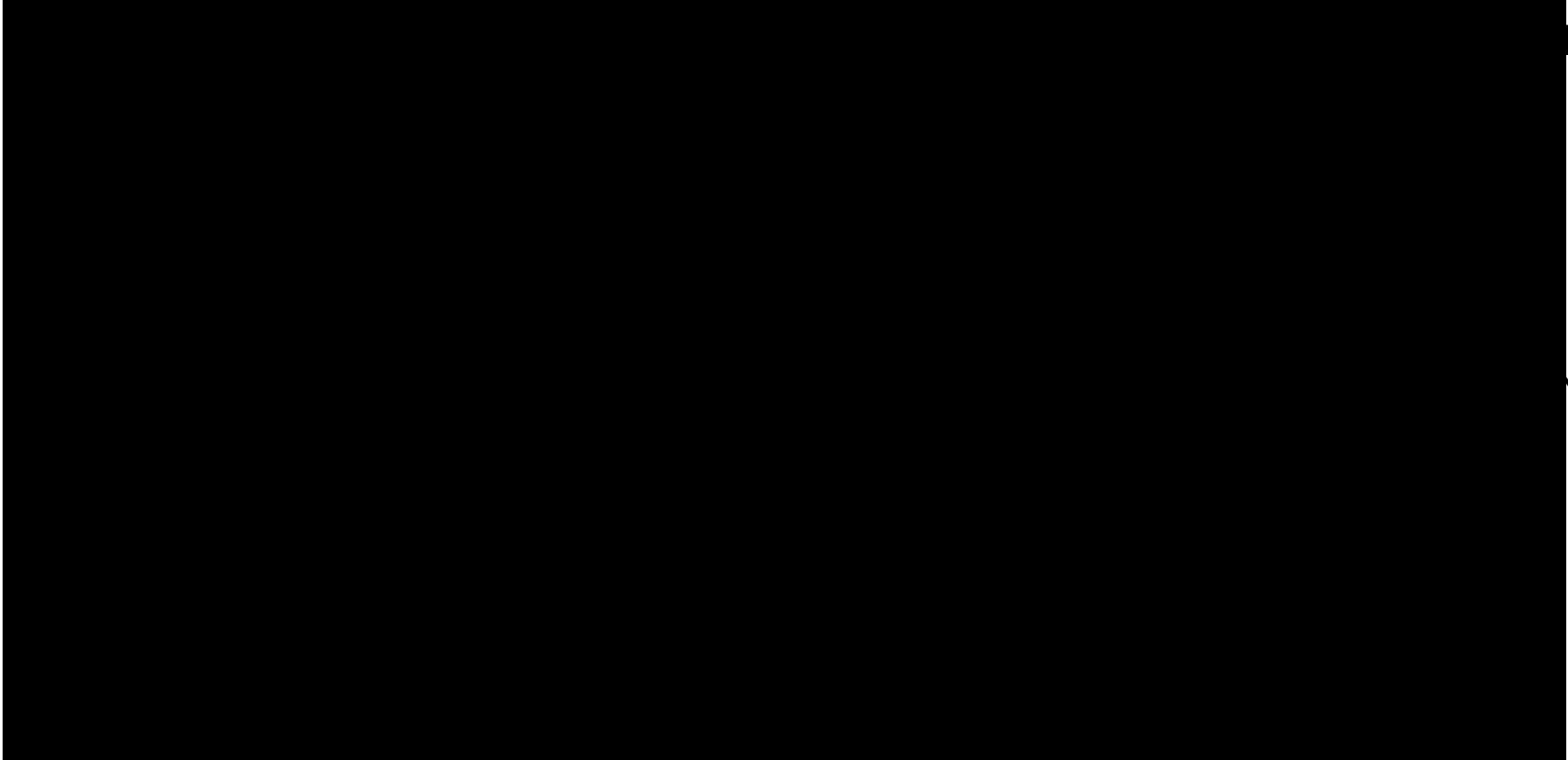
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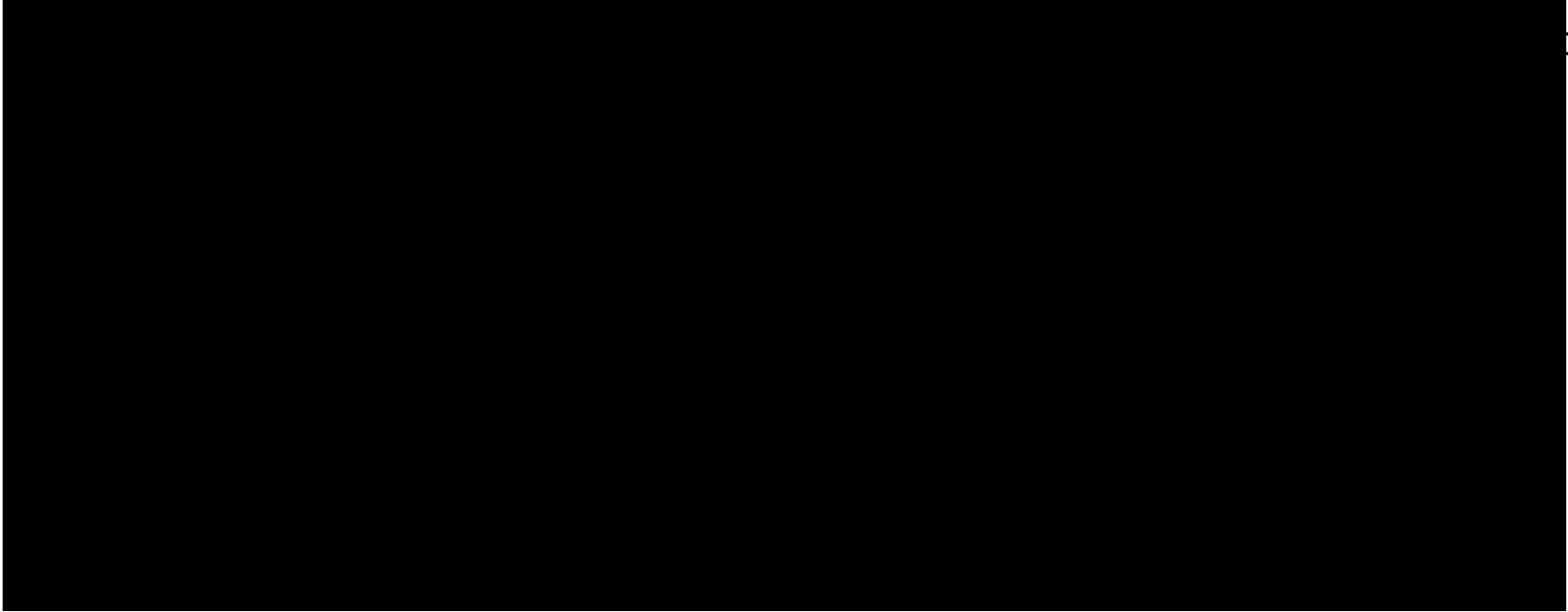
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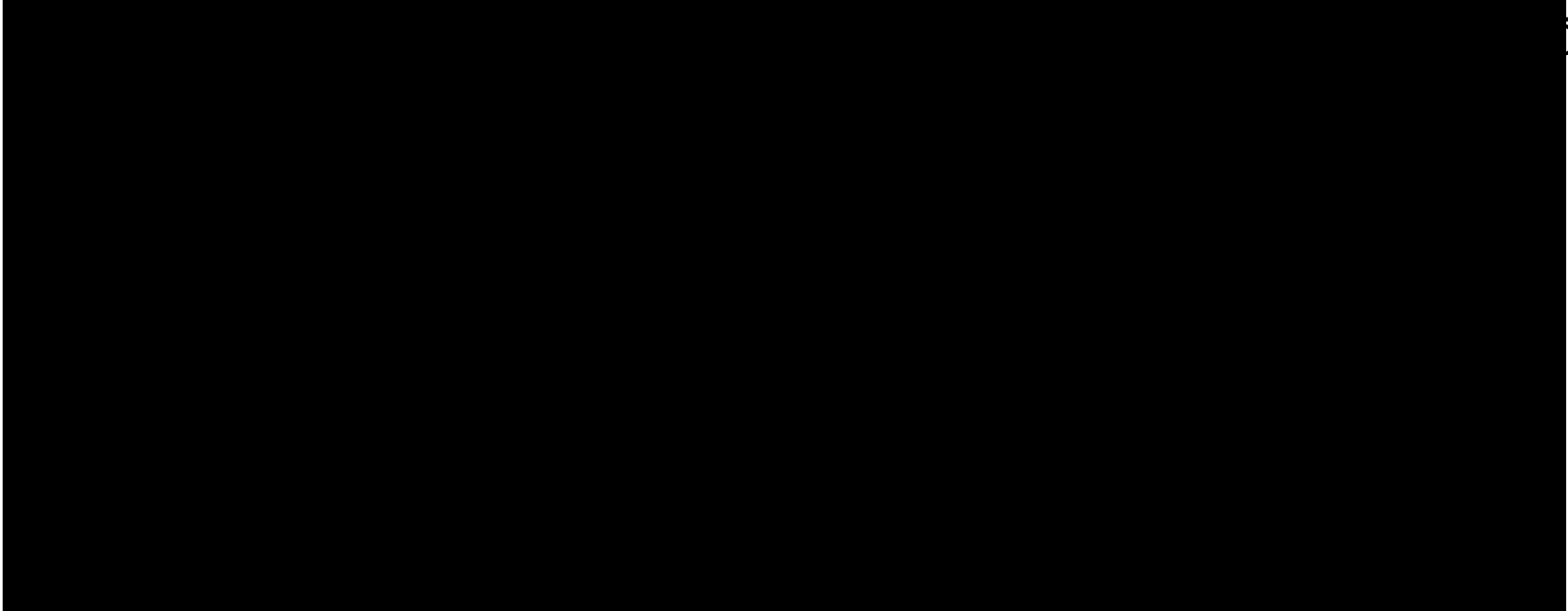


Ú



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DB

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” , QWURGXFWLRQ WR 7UDXPD  
” , PSDFW RI 7UDXPD  
” &RQVLGHUDWLRQV  
” 8QLTXH &RQVLGHUDWLRQV  
” &DVH VWXG\

! ÿ ¾ N p F p Œ B ¾ S ¾

([SRVXUH WR DQ HYHQW RU HYHQWV WKDW FUHDW  
RU VHQVH RI ZHOO EHLQJ DQG ERGLO\ LQWHJULW\

” :DU

” 1DWXUDO 'LVDVWHUV

” 6H[XDO 9LROHQFH

” 5HODWLRQVKLS 9LROHQFH

” 6WDONLQJ

} á B x á g á Ý p Œ ÿ B á ¾ N

:KHQ WKH \$P\JGDOD VHQVHV D WkuHDW LQ WKH IR  
+\SRWkdODPXV ZKLFK VLJQDOV WKH SLWXLWDU\ J  
ZKLFK UHOHDVHV KRUPRQH V RU FKHP LFDOV WKURX  
WkuHDW DQG OLNHO\ WUDXPd

” 7KH \$P\JGDOD GRHV QRW GLVWLQJXLVK EHWZHH  
VWUDQJHU RU DFTXDLQWDQFH EXW LQWHUSUHV

” 7KH SK\VLRO RJLFDO UHVS RQH RI WKH EUDLQ W  
DFFRXQWV IRU WKH EHKDYLRUV WKDW DUH FRP  
WUDXPd

A & B & ¾ p 8 & & Ý

&DWHFKRODPLQHV DGUHQDOLQH UHVSQRQVLEOH  
PRELOL]DWLRQ LPPRELOL]DWLRQ EXW LPSDLU UD

2SLRLGV UHOHDVHG WR GHDO ZLWK SDLQ FUHDW

&RUWLVRO HIIHFWV HQUJ\ DYDLODELWL\

2[\WRFLQ SURPRWHV JRRG IHHOLQJV WR FRXQWHU

” 9LFWLPV WDNH GD\V WR JHW WR D FRKHUHQV  
KDYH WR EH FRPSOHWHG IURP VWDUW WR QLVK

8 & & Ý ÷

7KH KRUPRQDO RRG PD\ ODVW IRU KRXUV DQG P  
HYHQW

+RUPRQHV DUH UHOHDVHG LQ YDU\LQJ DPRXQWV D  
DPRQJ YLFWLPV

" )LJKW )OLJKW )UHH]H UHDFWLRQV DUH QRW  
WKDW LPSDLUV WKHLU DELOLW\ WR UDWLRQDOO

" OD\ SUHVHQW WR \RX DV FRQIXVHG ODXJKLQJ

Œ & x p E & Ö N n p X 8 B á á v á Y

+RUPRQDO RRG DQG G\VUHJXODWLRQ RI WKH DXW  
ERG\ WR VKXW GRZQ

5DSH LQGXFHG SDUDO\VLV

8S WR • RI WKRVH ZKR H[SHULHQFH D VH[XDO DVVD  
LPPRELOLW\ ZKHUH WKH\ NQRZ ZKDW LV KDSSHQLC  
UHVSRQVH EDVHG RQ VXUYLYDO

] á & B n p ¾ Ý p „ á m S ¾ p F F ¾ S N

+LSSRFDP SXV LV WKH êPHPRU\ PDNHUë SURFHVVHV  
0HPRU\ LV IRUPHG LQ VWHSV

” (QFRGLQJ RUJDQLJLQJ VHQVRU\ LQIRUPDWLRQ

” &RQVROLGDWLRQ JURXSLQJ LQWR PHPRULHV D

7KH KRUPRQDO RRG GRHVQèW LQWHUIHUH ZLWK W  
DFFXUDF\ EXW GRHV LPSDLU WKH DELOLW\ RI WKH

” 0D\ FUHDWH IUDJPHQWHG PHPRULHV

” 5HFDOO FDQ EH VORZ DQG GLI FXOW

” \$OFRKRO ZLOO LQWHUIHUH ZLWK HQFRGLQJ WK



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¥ × N p B á F ? & F á p N & p N B ¾ S ¾

” 3 H U V R Q D O L W \

” & R S L Q J 6 W U D W H J L H V

” \$ Y D L O D E O H V X S S R U W V \ V W H P V D Q G U H V R X U F H V

” \* H Q H U D O U H V L O L H Q F H

” 3 D V W K L V W R U \ R I W U D X P D W L F H [ S H U L H Q F H V

”



# • S á F N & ÷

" %H DZDUH RI ZK\ YLFWLPV UHVSQRQVHV ZLOO YD  
" %H PLQGIXO WKDW UHFDOO LV RIWHQ GLI FXOW  
WUDXPD  
" &ODULI\ GRQèW SDUDSKUDVH  
" 'R QRW MXGJH RU EODPH ODQJXDJH PDWWHUUV  
" \$YRLG UH WUDXPDWLJDWLRQ  
"

Œ B ¾ S ¾ p E ö & B á Ý p € á F ? & F á

” 3URPRWHV VDIHW\

” 5HFRJQLJHV WKH LPSDFW RI WUDXPD RQ FRJQLV

¥ × N F p ÷ ÿ N p F ÿ S N p Ý & h p ö l l

" <RX JLYH XQVXSSRUWLYH UHVSQRQVHV  
" <RX WDNH FRQWURO RI FRQYHUVDWLRQ PRUH W  
" <RX HVFDODWH WKH VLWXDWLRQ  
" <RX GH QH RU ODEHO WKHLU H[SHULHQFH  
" <RX DVN ê:K\ë TXHVWLRQV  
" <RX YHUEDOLJH MXGJHPHQW  
" <RX LQVLVW WKDW WKH\ PXVW SUHVW FKDUJHV

‘ A S á p x & F Ý á B  $\frac{3}{4}$  N & F

3RSXODWLRQV

” 0DOH 9LFWLPV  
” /\*%74, 9LFWLPV  
” ,QWHUQDWLRQDO YLFWLPV  
” 9LFWLPV ZLWK GLVDELQV  
” 9LFWLPV ZLWK PHQWDO KH  
” 9LFWLPV RI GUXJ IDFLQV  
” 9LFWLPV RI UHSHDW DVVD

# $\frac{3}{4}$ F á p „ N S Ý n

'U 5R JHUV DQG +HOHQ

” +HDULQJ 2I FHU V 6SHFL F



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” ” ” ”

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" ,QLWLDO 6WHSV  
| 5HSRUW (YLGHQFH 5HYLHZ  
| (OHPHQWV RI 3URKLELWHG &R  
" 3UH +HDULQJ  
| &UHDWH UHYLHZ DQG SUDFW  
| 3UHSDUH GLUHFH H[DPLQDWLR  
" +HDULQJ  
| 8VH WKH VFULSW  
| 'HWHUPLQH LI RIIHUG FURVV  
TXHVWLRQV DUH SHUPLVVLEOH  
| \$VN ERDUG TXHVWLRQV  
| 0RGHUDWRU 5ROH  
" 3RVW +HDULQJ  
| 3UHRSRQGHUHQFH RI (YLGHQFH  
| 6DQFWLRQV  
| 'RFXPHQDWLRQ DQG 5DWLRQDOH

'HFLVLRQ 0DNHU &KHFNOLVW  
" 5ROH RI 7LWOH ,;  
" 5ROH RI +HDULQJ 2I FHU  
" 5ROH RI 60+%  
&KHFNOLVW

Œ & p F ? á ¾ p & B p & N p N & p F ? á ¾

:ULWH D VFULSWđ

3UDFWLFH WKH VFULSWđ

&RPH EDFN DQG VKDUH WKH VFUL

%UHDNRXW 5RRPV

PLQXWHV

6DUDK &DWH -RUGDQ

6WDQ 5REHUW

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\$WWRUQH\ V 6FKRRO \$VVLJQH G 3

3DUHQWV \*XDUGLDQV DQG )ULHC

” )(53\$ 5HOHDVH 5HTXLUHG

” &DQQRW DQVZHU IRU VWXGH

” ,V WKHUH WR VXSSRUW

” &DQ UHTXHVW D EUHDN

” &DQQRW EH DVNHG TXHVWLR

” 0XVW EH UHVSHFWIXO DQG Q

RWKHU SDUW\ GLUHFWO\

” 6HUYHV DV WKH SHUVRQ WR

EHKDOI RI WKH SDUW\ WKH\

” &DQQRW UHVSRQG RQ EHKDC

” &DQ DGYLVH WKH VWXGHQW

TXHVWLRQV

” &DQ UHTXHVW D EUHDN

” &DQQRW EH DVNHG TXHVWLR

” 0XVW EH UHVSHFWIXO DQG Q

RWKHU SDUW\ GLUHFWO\

” \$WWRUQH\ 5HOHDVH DQG 1R

UHOHDVH PXVW EH FRPSOHW

FKRLFH

” )(53\$ 5HOHDVH PXVW EH FRP

\$GYLVRU RI &KRLFH

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'HWHUPLQDWLRQ

" 'HWHUPLQDWLRQ RI 5HVSQRQV  
UDWLRQDOH EDVHG RQ SURKL  
| RI WKH PHPEHUV PXVW DJU

" 'HWHUPLQH VDQFWLRQV  
| \$OO PHPEHUV PXVW DJUHH W

&KHFNOLVW

2XWFRPH /HWWHU

" 5DWLRQDOH IRU GHWHUPLQ  
LV FOHDUO\ GRFXPHQWHG D  
DOO PHPEHUV RI WKH ERDU

" 2XWFRPH OHWWHU OLVWV D  
WDNHQ IURP WKH WLPH WKH  
LVVXHG

| 8VH WKH KHDULQJ RI FHU UR  
WKLV DQG HQVXUH LW LV FR  
UXOH

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5H D G W K H R X W F R P H O H W W H U

, G H Q W L I \ L V V X H V

, G H Q W L I \ Z K D W L V P L V V L Q J

& R P H E D F N D Q G V K D U H

6 W D Q D Q G - R U G D Q

5 R E H U W 6 D U D K & D W H

P L Q X W H V L Q % 2 5 R R P V



] ^ } B ¾ x N x á

C8G2 LJX T\_^SOc cY\_\ jN\`SLN aS^  
CYY j^SLUc SX \NQJ\M] ^Y ^RN \N]Z

?Y^NX^SJVvc \NL\_]NM O\YW LJ]Nđ

" ,V WKHUH D &RQ LFW RI ,QWHUHVW %LDV&" +RZ Z

" 3ROLF\ DQG 3URFHGXUH UHYI H7 SODO TXHVWLR

| :KDW SDUW RI WKH SROLF\ GR WKH DOOHJDWLRQ 2VN\c BAJ

| :KDW TXHVWLRQV GR \RX KDYH UHODWHG WR WKDW SROLF

" 5HYLHZ RI FRPSODLQW DQG RWL EH RI DOOHJDWLRQ

| 'R WKH DOOHJDWLRQV PDMF 5Y\ ^RN KNXNJ^ YO jYWNyXN Y^RN\ ^R

| \$UH WKHLU OLQJHULQJ TXHVWLRQV DERXW WKH G&VPLVVD

" (OHPHQWV RI DOOHJDWLRQV VKRXOG EH VHHQ L

| :KDW DUH WKH HOHPHQWV WKH LQYHVWLJDWLRQ ZLOO SXU

4bZVYS^J^SYXó 2YX]NX^ó 1NXNJ^ YO Y^RN\]ó \Nó]M&]K\SM&XJY  
NHNL^



] p ^ p } B 3/4 x N x á p

+HUH LV ZKDW \RX NQRZ

" SDUWLHV WKDW DWWHQGHG WKH YLHZLQJ GLG QRW WKLQN LW ZDV  
WKHLU SODFH WR WHOO WKH UHSRUWLQJ SDUW\ WKDW WKH YLGHR  
H[LVWHG WKH\ GLG QRW NQRZ LI WKH YLGHR ZYXSRQVHWRXW WKH GL  
WR E\ ERWK SDUWLHV DOO KDYH VDPH VWRIW  
" 7KH UHVSRRGLQJ SDUW\ VD\ DOO VWHŠV ZHUH FRQVHQRWHG WR  
E\ WKH UHSRUWLQJ SDUW\  
" 7KH UHSRUWLQJ SDUW\ VD\ VKH MXVW OHDUQHG WKDW WKHLU VH[  
DFW ZDV UHFRUGHG DQG VKH GLG QRW JLYH SHUPLVVLRQ DQG  
VKH GLG QRW JLYH SHUPLVVLRQ WR KDYH LW YLHZHG  
" 7KH YLGHR ZDV PDGH \HDU DJR EDVHG" RQ\ WKDW LW DSHOHDQW" 'LUHF  
" 7KH YLGHR ZDV VKRZQ WR RWKHUV PRV DJR DFRUGLQJ WR  
ZLWQHVV VWDWHPHQWV  
" 5HSRUWLQJ SDUW\ VD\ UHVSRRGLQJ SDUW\ LV PDQLSXODWLYH  
DQG LV FXUUHQWO\ DEXVLQJ KLV JLUOIULHQG E\ @\$@ \$€ À0 p

,Q WKH KHDULQJ

" 'R \RX DVN WKH ZLWQHVVH  
VWRULHV"  
R ZYXSRQVHWRXW WKH GL  
KHDULQJ ZLWK WKH SDUW  
ZHUH FRQVHQRWHG WR  
R \RX YLHZ WKH YLGHR"

KDW LW DSHOHDQW" 'LUHF  
SHODWHG

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-HQQ\ DQG %HQ

” :KDW DUH WKH DOOHJHG SRO

” :KDW IDFWV ZLOO \RX EH ORR  
LQYHVWLJDWRUV”

” +RZ ZLOO \RX DVVHV V FUHGLE

” ,V WKHUH DQ LVVXH RI FRQVH  
GH QHG”

” ,V WKHUH DQ LVVXH RI LQFDS

-R\FH DQG 'U 5ROOLQV

” :KDW DUH WKH DOOHJHG SR

” :KDW IDFWV ZLOO \RX EH OR  
LQYHVWLJDWRUV”

” +RZ ZLOO \RX DVVHV V FUHGLE

” ,V WKHUH DQ LVVXH RI FRQVH  
GH QHG”

” ,V WKHUH DQ LVVXH RI LQFDS

UV DQC

! ÿ ¾ N p A S á F N & F p h p n & S p ¾ F

^ á h p E ö & B ¾ N &

-R\FH DQG 'U 5ROOLQV

-R\FH UHSRUWHG D VLPLODU FRPSODLQW DJDLQVW D  
GLIIHUHQW SURIHVVRU RQH \H DU DJR 7KH  
GHWDLOV RI WKH FRPSODLQW KDYH WKH IROORZLQJ  
LQ FRPPRQ

D -R\FH GUDQN WRR PXFK DOFRKRO

E -R\FH èV PHPRU\ ODSVHG

F -R\FH LQVWLJDWHG PHHWLQJV ZLWK PDOH

SURIHVVRUV LQ FRXUVHV VKH ZDV QRW GRLQJ ZHOO

LQ

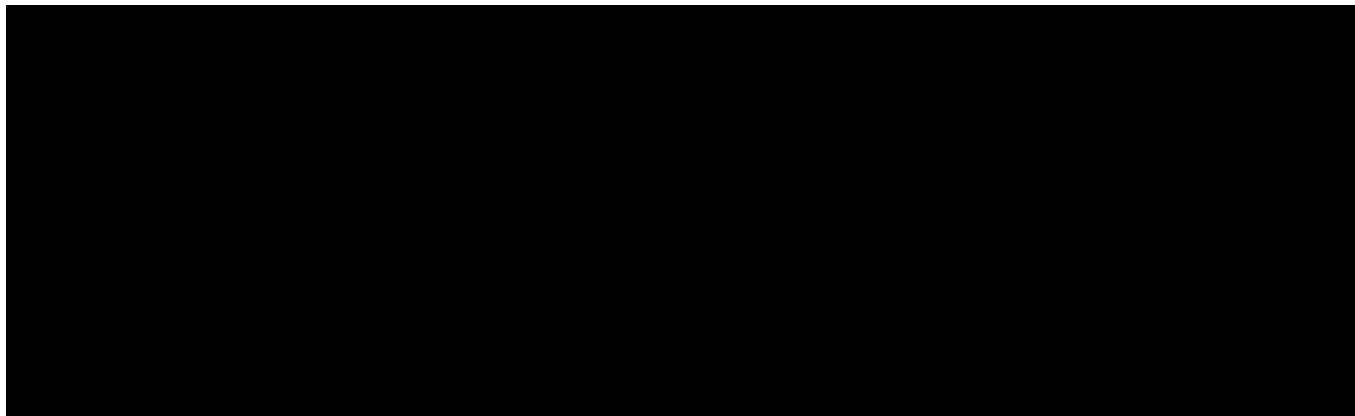
'U 5ROOLQV ZDV UHSRUWHG IRU VH[XDO

KDUDVVPHQW \H DU DJR E\ D IHPDOH

FROOHDJXH ZKR DOOHJHG WKDW KH DVNHG KHU W€P•W€P'7@ T

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\$ U H \ R X U H D G \ I R U \ R X U U V W K H D U L Q J "

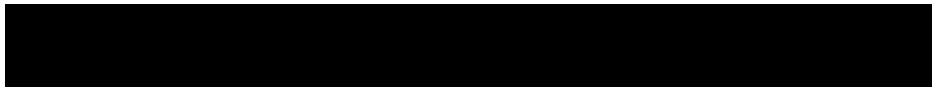


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Y K N \ à

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& U H G L E L

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€ á F & S N & p 8  $\frac{3}{4}$  x

% O D F N R X W V

# & F á N

" ßxb¼m'öžÛL

" 0m'D¼!Jö!J R>x!J'JÔ!L

" „m<xJm<L

" !öml'x ¼ž ŌJ'D kJmxž!L

" !öml'x ¼ž ŌD!m Jm ö>ö J'ö'! L

" yx' !'ö¼<D' Jm 'D! m!<ö'JÔ!L

" §öž'x; ö >x!J'JÔ! J! ¼!!JxmL

" !b!öžG öm jmxŌJm<G öm ßxb¼m'öžÛ [xž ö;ěžkö'JÔ!G xml Jx¼!G örr<J(x!b¼





& ö S F ÷ p f E g p h & B Ý F

” , Q XH QFH WKH PRPHQW VRPHRQH FRQVXPHV D  
” , PSDLUPHQW UHODWHV WR WKH DOFRKRO LQ W  
” , QWR[LFDWLRQ &RQGLWLRQ RI EHLQJ GUXQN  
” , QHEULDWLRQ &RQGLWLRQ RI EHLQJ GUXQN

7KRVH OLVWHG DERYH DUH QRW , QFDSDFLWDWLRQ  
XQGHUVWDQG WKH ZKR ZKDW ZK\ ZKHUH DQG KP  
DOFRKRO WKRXJK D SHUVRQ FDQ EH LQFDSFLWDW

E x  $\frac{3}{4}$  ?  $\frac{3}{4}$  x N n p pđ“0 €

$\frac{3}{4} \times$  & S N F p

%ODFNRXW \$PQHVLDIRU SODFHV SHRSOH ZHQW  
FDQ LQYROYH VSRWW\ PHPRU\ IUDJPHQWU\ EODF  
HQ EORF EODFNRXW

%ODFNLQJ 2XW YV 3DVVLQJ 2XW

" %ODFNLQJ RXW IURP DOFRKRO LPSOLHV WKDW D  
XQDEOH WR FUHDWH PHPRULHV IRU HYHQWV DQ  
" 3DVVLQJ RXW LPSOLHV D SHUVRQ LV DVOHHS RU  
" 7KH WZR VWDWHV DUH TXLWH GLIIHUHQW

& N S á Ý

ê7KH PRVW FRPPRQ IRUP RI EODFNRXW LQYROYHV

& & p  $\frac{3}{4}$  x & S N F

ê'XULQJ D EODFNRXW WKH DELOLW\ WR UHPHPEHU

\$ p & x p  $\frac{3}{4}x$  & S N F

ê(Q EORFë EODFNRXWV DUH VWUHWFKHV RI WLPH Z  
PHPRU\ DW DOO %ODFNRXWV GR QRW LQYROYH D

” ÷ F

” \*URVV PRWRU LPSDLUPHQW  
” /DFN RI SK\VLFDQ FRQWURO  
” %OXUUHG 9LVLRQ  
” /RVV RI EDODQFH  
” )HHOLQJV RI (XSKRULD WXUQ WR XQSOHDVDQW  
” -XGJHPHQW DQG SHUFHSWLRQ LV VHYHUHO\ LPS  
” 2QH PD\ EHFRPH DJJUHVVLYH  
” 7KHUH LV DQ LQFUHDVH ULVN RI LQMXU\ WR VHO





B á Ý Ö N n

6HUYHV DQ DLG LQ \RXU DVVHV VPHQW DQG DQDO\W  
HYLGHQWLDU\ SHUVSHFWLYH

# & N S á Ý

\$V \RX ZHLJK HYLGHQFH WR GHWHUPLQH ZKHWKHU  
VXSSRUWV D QGLQJ RI UHVSQRVLELOLW\ HDFK DO  
EH HYDOXDWHG IRU LWV FUHGLELOLW\

” ,I D SLHFH RI HYLGHQFH LV PRUH FUHGLEOH WK  
DQG FDQ LQ XHGFH WR VRPH GHJUHH WKH EURD

” ,I HYLGHQFH LV QRW FUHGLEOH OHVV WKDQ  
SUHSRQGHUHQFH VFDOH LQ IDYRU RI WKDW HYL

” ,PSRUWDQWO\ UHJDUGLQJ D SLHFH RI HYLGHQFH  
HYLGHQFH KDV QR LPSDFW RQ WKH QGLQJ

” (YLGHQFH WKDW LV QRW FUHGLEOH PD\ WLS WK  
XQGHUPLQHV WKH FUHGLELOLW\ RI RWKHU HYL

\$ m <sup>3</sup>/<sub>4</sub> ? á

3DUW\ \$ LQWURGXFHV D ZLWQHVV ZKR SURYLGHV V  
GSHQGLQJ RQ KRZ IDU DORQJ WKH FRQWLQXXP W  
SHUFHQW WKDW ZLWQHVVèV WHVWLPRQ\ PD\ DOVF  
RI WKH SDUW\ ZKR SURYLGHG WKH ZLWQHVV 3DUW

” (YLGHQFH LV LQWHUOLQNLQJ WR IRUP FRPSOH[  
SLÀ`W@ L LH FUHGLELO@H LPSDFQ WKH FUHGLEL  
SLÀ`UWQ•ì€ pp À0 pđ€0 Àp €Àp€ 00P YLXfURYLGH

\$ FN ¾ Ö Fÿ ÷ p B á Ý Ö N n

&RUURERUDWLRQ %HVW HVWDEOLVKHV FUHGLELOLW\ ZI  
HYLGHQFH VXSSRUWLQJ IDFWV

0XOWLGLPHQVLRQDO /RFDWLRQ DQG SRVLWLRQ FDQ LP

1HXWUDOLW\ ZLWQHVVHV ZLWK QR OR\DOWLHV WR WKH

,PSDUWLDOLW\ 2EMHFWLYLW\ WKH PRUH OR\DO D ZLWQ  
WKHLU WHVWLPRQ\ PD\ EH 5HODWLRQVKLSV RI WKH SDU

3UR[LPLW\ :KDW VRPHRQH ZLWQHVVHV LQ SHUVRQ LV P  
DIWHU WKH IDFW LV OHVV YDOXDEOH ZKDW WKH\ KHDUG

,QKHUHQW 3ODXVLELOLW\ \*LYHQ ZKDW \RX NQRZ GRHV

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\$FFRXQWV WROG WR WKHVH IRON  
KDYH WKH LQIRUPDWLRQ XQ OWHU  
ELDV

%L 0XVW EH FRQVLGHUHG L H YLFWLP EODPLQJ

:LWQHVV ZKR ZHUH WROG LPPH  
LQFLGHQW EXW QRW LQYROYHG

\$QDO\VLV RI PLFURDJJUHVVLRQV

\$GGLWLRQDO DOOHJDLRQV LUD  
6KRXOGQèW EH U  
DQG PDA LPSDFW

,QFRQVL\

([DPLQH DQG UHPHPEHU PHPRULHV  
FDQ QDWXUDOO\ HYROYH

\$FWV WKDW ZHUH FRQ... DO  
1R ,PSDFW

/\LQ

3HRSOH FDQ OLH LQ RQH DUHD DQG WHOO WUXWK LQ DQRWKHU VR LW V QRW D  
WRWDO NLOOHU GHWHUPLQH LI WKH OLS \$ SHUVRQ GWG WR WHOO DW RQH

\$ SHUVRQ GWG WR WHOO DW RQH

'HOD\ LQ UHSRUWLQJ

WLPH RI WKH... LRU

'RHV QRW DIIHFV FUHGLELQW\ FRPPRQ

&KDQJHV LQ EHKDYLRU

([SODLQLQJ ZK\ WKH PLVFRQGX

OD\ DGG WR FUHGLELQW\ RU QRW  
DQG WKDW LV RND\

IRONV UHDFW GLIIHUHQ' 'R QRW DGG WR  
" , GLGQèW NQRZ  
" 6KHèV D LUW  
" ,W ZDVQèW D ELJ GHDO

B á Ý Ö N n p E N á F p Ö n p } ¾ B N n

5HSRUWLQJ 3DUW\ 'R QRW DGG

" &ORWKLQJ  
" \$SSHDUDQFH  
" )OLUWLQJ %HKDYLRU  
" 0DOH 9LFWLPV  
" 6H[XDO 2ULHQWDWLRQ

5HVSRQGLQJ 3DUW\ 7KHVH DU

" &KDUDFWHU ZLWQHVVHV DQ  
" HYLGHQFH WKH\ SURYLGH  
" 3RSXODULW\ ZLWK VWDII DQ  
" 1R KLVWRU\ RI SDVW SUREO  
" \$FDGHPLF SHUIRUPDQFH  
" ,PSRUWDQFH WR D WHDP RU

# • S á F N & F p N & p x & F Ý á B K

" +RZ PLJKW D UHDVRQDEOH SHUVRQ UHDFW WR WKH LQFLC  
" :KDW ZDV WKH HIIHFW RI WKH EHKDYLRU RQ WKH UHSRUW  
" 'LG WKH LQGLYLGXDO KDYH D SDUWLFXODU UHDVRQ QRW  
" ,V WKH HYLGHQFH RIIHUG LQKHUHQWO\ SODXVLEOH"  
" ,V WKHUH HYLGHQFH FRUURERUDWLQJ WKH LQIRUPDWLRQ  
" ,V WKHUH DQ\WKLQJ PLVVLRQ IURP WKH WHVWLPRQ\ WKDW  
" 'LG WKH LQGLYLGXDO KDYH WKH RSSRUWXQLW\ DQG DELC  
" ,V WKHUH UHOHYDQW SDVW FRQGXFW WKDW QHHGV WR E  
" :DV WKH ZLWQHVV SDUW\ XQGHU WKH LQ XHQFH RI DQ\ VX  
WKHLU WHVWLPRQ\"

}  $B^{3/4} \times N$   $\times$  á p  $\mathcal{O}E$  á



& R Q V H Q W D Q G

2 F W R E H U

+ H D U L Q J 2 I F H



$p \} B^{3/4} \times N \quad \times^{3/4} \quad p B S \ddot{O} B \quad \times M P$

} & x n p á f N & F

1 R Q & R Q V H Q V X D O 6 H [ X D O & R Q W D F W L V

" \$ Q \ L Q W H Q W L R Q D O V H [ X D O W R X F K L Q J

" + R Z H Y H U V O L J K W

" : L W K D Q \ R E M H F W

" % \ D S H U V R Q X S R Q D Q R W K H U S H U V R Q

" 7 K D W L V Z L W K R X W F R Q V H Q W D Q G R U E \ I R U F H

6 H [ X D O F R Q W D F W L Q F O X G H V L Q W H Q W L R Q D O F R Q V

J H Q L W D O V R U W R X F K L Q J D Q R W K H U Z L W K D Q R I \ R

W R X F K \ R X R U W K H P V H O Y H V Z L W K R U R Q D Q \ R I W

L Q W H U Q D W L R Q D O E R G L O \ F R Q W D F W L Q D V H [ X D O F



] & Ý á p & ö p } B & & ö

,V WKH GH QLWLRQV LQ WKH SROLF\ LWVHOI 7KHV  
ZLWK QRQ FRQVHQVXDO VH[XDO WRXFKLQJ WKHU  
H[LWV LQ QRQ FRQVHQVXDO LQWHUFRXUVH

” 6RPHRQH FDQ DFFLGHQWO\ EUXVK VRPHRQHèV E  
” ,W LV KDUG WR LPDJLQH WKDW VRPHRQH GRHV  
VRPHRQH HOVH

1RQ FRQVHQVXDO ,QWHUFRXUVH LV D W\SH RI QRQ  
ZK\ WKH GH QLWLRQV RYHUODS KRZHYHU ZLWK LQ  
VHULRXV FRQGXFW ZKLFK UHTXLUHV D PRXQVHQVHQ  
VXVSHQVLRQ LQ PDQ\ FDVHV

á N á B ÷ p ö p & ^ x & F á F S <sup>3</sup>/<sub>4</sub>  
& x x S B B á Y I I I

```
:DV WKHUH VH[XDO FRQWDFW E\ RQH SHUVRQ XS  
GH QHG LQ WKH SROLF\ " , ) <(6  
:DV LW LQWHQWLRQDO " , ) <(6  
:DV LW E\ IRUFH " , ) <(6 SROLF\ ZDV YLRODWHG  
:DV LW ZLWKRXW FRQVHqw DV FRQVHqw LV GH  
SROLF\ YLRODWLRQ , I 12 WKHUH LV QR SROLF\
```





! ÿ ¾ N p F p N ÿ á p € S Ö B x p N ÿ á P

7KH 5XEULF LQWHQGV WR DQVZHU GHHSU LVVXHV  
DQG FRQVHQW WKDW VWLOO QHHG WR EH DGGUHV

8 & B x á J p x ¾ ? ¾ x N n J p ¾ Ý p x &

, QFDSDFLW\ LV D IRUP RI QRQ FRQVHQW EXW WKH  
ZLOO JHW LQWR LQ D IXWXUH PHHWLQJ

<RX VKRXOG DQDO\]H ERWK IRUFH DQG FRQVHQW F  
YLRODWHG EXW LQ DQ DOOHJDWLRQ FRQZKHXU WR  
ZKDWHYHU \RX ZDQW LW LV WKH IRUFH DQDO\VLV  
6RPHWLPHV IRUFH UHVXOWV LQ FRQVHQW DV ZLWK  
%HFDXVH WKLV FRQVHQW LV QRW YROXQWU\ LW  
WKH RQH WKDW PDWWHUV ,W LV EHVW WR DQDO\

” )RUFH

” , QFDSDFLW\

” &RQVHQW

$\frac{3}{4}$  n v ÷ p 8 d € \$

,I IRUFH LV SUHVHQW LQ DQ\ IDFWV RI D FDVH WK  
EH DVVHVVG ,I VRPHRQH LV QW LQ •0` 0€ \$0 KXSDI  
DUUHO\ LHUHO\$ DQPG OWKH IRUFH LV WKQW FL DV

T

" 1RW DOO IRUFH RI YLROHQFH LV QRQ FRQVHQVX

" .LQN UHODWLRQVKLSV WHQG WR YDOXH FRQVHQ

D ORW RI FRPPXQLFDWLRQ DERXW LW IDU PRU

" :KHQ IRUFH LV EHLQJ DQDO\JHG LQ .LQN HQFRX

FRQVHQW H[LVWHG RU ZKHWKHU XVH RI IRUFH

RU ZKHWKHU IRUFH FRQWLQXHG GHVSLWH WKH

RWKHU QHJRWLDWHG ERXQGDUHV

| 7KXVH ZRXOG EH SROLF\ YLRODWLRQV

| (YHQ LI VRPRHRQH LV KDUPHG LQ WKH VHX[DO LQWHUDFW

EHLQJ KDUPHG WKHUH LV QR EDVLV IRU D SROLF\ YLROD

2XWVLGH RI .LQN WKH IRUFH SDUDGLJP LV RQH ZI

DQG RU DJDLQVW WKH ZLOO RI WKH UHSRUWLQJ S

IRUPV 3K\VLFDQ 9LROHQFH 7KUHDWV ,QWLPLGDV

} ÿ n F x ¾ p ¥ & á x á

” 1R PDWWHU KRZ VOLJKW WKH LQWHQWLRQDO S  
SK\VLFDU UHVWUDLQW RU WKH SUHVHQFH RI D  
FRQVWLWXWH WKH XVH RI IRUFH

| 3K\VLFDU 3UHVXUH YV 3K\VLFDU 9LROHQFH 7KH DQDO\  
LQWLPDF\ ZKLFK RIWHQ KDV VRPH SK\VLFDU HOHPHQWV W  
v 6RPHRQH XVHV SK\VLFDU SUHVXUH WRKHOS IDFLOLWD  
v 6RPHRQH SODFHV WKHLU KDQGV RQ VRPHRQHèV KHDG  
v 2U VRPHRQH SUHVVLQJ GRZQ RQ VRPHRQH LQ PLVVLRO

” 7KH NH\ TXHVWLRQ LV LI VRPHRQH XVHG SK\VLFDU  
WR JDLQ VH[XDO DFFHVV

# Œ ÿ B á ¾ N F

” , I D W K U H D W L V X V H G W R R E W D L Q V H [ I R U F H L Y  
W K U H D W L V X S W R W K H X Q L Y H U V L W \ L Q Y H V W L J

” \$ Q \ W K U H D W W K D W F D X V H V V R P H R Q H W R G R V R  
D E V H Q W W K H W K U H D W F R X O G E H H Q R X J K W R S U

” 7 K L V L V H V S H F L D O O \ W U X H Z K H Q W K H S H U V R Q E  
W K U H D W H Q H U K D G W K H Z L O O D Q G F D S D F L W \ W R

” 7 K L V F R Q V W U X F W G R H V Q R W D S S O \ W R Q H J R W L  
R X U F R H U L F L R Q G L V F X V V L R Q / H Y H U D J H D Q G S R  
W K U H D W V

| , I \ R X G R Q R W K D Y H V H [ Z L W K P H , Z L O O N L O O \ R X

| , I \ R X G R Q R W K D Y H V H [ Z L W K P H , Z L O O K D U P V R P H R Q H \

| , I \ R X G R Q R W K D Y H V H [ Z L W K P H , Z L O O W H O O S H R S O H \

| , I \ R X G R Q R W K D Y H V H [ Z L W K P H , Z L O O I D L O \ R X L Q P \ F









} B  $\frac{3}{4}$  x N x á p Œ á

5XEULF

&DVH 6WXG\ \$ 5REHUW 6WDQ %ODLU

&DVH 6WXG\ % -RUGDQ DQG 6DUDK

& R H U F L R Q Y V 6  
1 R Y H P E H U  
+ H D U L Q J 2 I F H

# & á B x &

WK DQG QDO HOHPHQW RI )25&(

" ,QFOXGHV HOHPHQWV RI SUHVXUH GXUHVV FD

" 7KH PRVW FRPPRQ W\SH RI )RUFH VHHQ RQ FRO

" ,Q DVH[XDO FRQWH[W FRHUFLRQ LV DQ 815(\$62

HQJDJH LQ VH[XDO DFWLYLW\

" ,W LV KHOSIXO WKHQ WR FRQWUDVW FRHUFLRQ

GLVWLQFWLRQ LV NH\ LQ FDVHV RI DOOHJDWLRO

" %RWK LQYROYH FRQLQFLQJ VRPHRQH WR GR V

GR WKH\ WUXO\ GLIIHU"

& á F p N ÿ á p ? á B F & p Ö á ÷ p ? B á F

Ö á p x & g x á Ý

6HGXFWRQ  
" 6H[XDO DGYDQFHV DUH XOWI  
" 2QH ZDQWV WR GR VRPH FRQ  
SHUVRQ ZKR LV WKH REMHFV  
DWWHQWLRQ ZDQWV WR EH F  
" 6HHN WR SHUVXDGH RQH DQ  
ZLOOLQJ WR JR DORQJ  
" 7ZR SHRSOH DUH SOD\LQJ W  
" 6HGXFWRQ FDQ EHFRPH FR  
PXFK SUHVXUH FURVVHV W

&RHUFLRQ  
" 2QH ZDQWV WR FRQYLQFH V  
SHUVRQ PDNHV LW FOHDU W  
WR EH FRQYLQFHG  
" 7KH\ GR QRW ZDQW WR SODV  
" 7KH\ GR QRW ZDQW WR EH S  
" &RHUFLRQ EHJLQV QRW ZKH  
VH[XDO DGYDQFHV %87 ZKH  
WKH RWKHU GRHV QRW ZDQV  
\$1' WKH SHUVRQ SUHVXULC  
DFWLYLW\ SXVKHV SDVW WK  
" &RHUFLRQ LV D PDWWHU RI  
RQ RII VZLWFK WKH PLQXWH

WKH SRLQW RI ZKDW LV ZHO

A & h p Ý & p h á p & h p h ÿ <sup>3</sup>/<sub>4</sub> N p × B & F F

# E N á F N n

:HèUH DW WKH EDU DQG ,èP WU\LQJ WR FRQYLQFH  
KDOI KRXU WHOOLQJ \RX DOO WKH UHDVRQV ZK\ \R  
GRLQJ D JUHDW VHOO MRE DV , NQRZ P\ SURGXFW  
EHVW ORYHU \RXèOO HYHU KDYH , FKDOOHQJH \RX  
YRXXFK IRU P\ SURZHVV , WHOO \RX WKDW \RX RZH  
LV RQH UROOHU FRDVWHU ULGH \RX MXVW GRQèW  
/LJDUG DFW 1RW EX\LQJ LW" , NQRZ ZK\ 7KH SURE  
ZRXOG MXPS RQ WKH H[SHULHQFH , DP RIIHULQJ 7  
6R , FKDQJH WDFWLFVě

# E N á F N n p & N S á Ý

, WHOO \RX YDULRXV LWHUDWLRQV RI WKH IROORZ

<RX FRPH LQWR D EDU GUHVHVG WR NLOO LUW Z  
DQG VD\ QR" <RXèUH MXVW D WHDVH <RX OLNH WF

<RXèUH SUREDEO\ IULJLG <RX VKRXOG WDNH D FK  
VRPH VRUW RI UHOLJLRXV IUHDN" \*RG ZRQèW NQRZ

:KDW DUH \RX WKH ODVW YLUJLQ LQ FDSWLYLW\ ( (ZD\ RYHUUDWHG

\$UH \RX DIUDLG \RXU SDUHQWV DUH JRLQJ WR QG  
XS 5HOD[



# & p n & S p F á á p N y á p N á F N n p Y

, FDQ W DON P \ V H O I X S W R \ R X X  
I D F H D Q G , K D Y H D ) L U V W \$ P H Q  
\ R X K R Z J U H D W , D P L Q W K H V D F  
L W è V R E Q R [ L R X V

% 8 7 L I , W X U Q R Q \ R X D Q G V W D  
U D W K H U W K D Q V H O O P \ V H O I W K  
G L I I H U H Q F H

, I , D V V D L O \ R X U F R U H Y D O X H V  
U H O L J L R Q , Y H U \ Z H O O P D \ E H V  
F R P P X Q L W \ V W D Q G D U G R Q L Q W H

, Q V X P P D U \ R Q F H \ R X G U D Z D C  
\ R X G R Q è W Z D Q W W R S O D \ P \ J D  
\ R X E H \ R Q G W K D W S R L Q W V H G X  
F R H U F L Y H

: K D W D P R X Q W R I S U H V V X U H L V  
I X Q F W L R Q R I W K H G X U D W L R Q I  
L Q W H Q V L W \ R I P \ S U H V V X U H

2 Q F H R X U F R P P X Q L W \ V W D Q G D U  
D S S U R S U L D W H I R U \ R X W R O D E I

# EBB $\frac{3}{4}$ N & $\frac{3}{4}$ p á f N & Fp & ö p &

ê&RHULFLRQ LV WKH XVH RI HPRV  
WR SHUVXDGH VRPQRQH WR GR V  
QRW ZDQW WR GR OLNH EHLQJ  
FHUWDLQ VH[XDO DFWV ([DPSOH  
VWDWHPHQWV LQFOXGH

- ” ,I \RX ORYH PH \RX ZRXOG KD
- ” ,I \RX GRQèW KDYH VH[ ZLWK  
VRPQRQH ZKR ZLOO
- ” ,èP QRW VXUH , FDQ EH ZLWK  
GRHVQèW ZDQW WR KDYH VH[

ê&RHULFLRQ FDQ DOVR WDNH W  
KDYH VH[ ZLWK PH ,èP EUHDNL  
LI LWèV QRW DV H[SLFLW OLNH  
UHODWLRQVKLS KDV FUHDWHG  
ZKHU H\RX IHHO OLNH \RX KDYH  
WKHP WR NHHS WKHP LQ WKDW  
GH QDWHO\ EH D IRUP RI FRHUF  
VD\ \RXèUH QRW JLYLQJ FRQVH  
SROLF\ FRQVHQVXDO XQZDQWH  
FRQVLGHHG FRQVHQVXDO VH[ D  
WKURXJK D IRUPDO VH[XDO PLV

€ á ¾ N n

:H GR QRW KDYH DQ HVWDEOLVKH  
SROLF\ DV WKH SUHYLRXV GH QI  
VWDQGDUG IRU QHJRWLDWLRQ LQ

7KHUH LV VXFK D WKLQJ DV XQZD  
EXW DV WKH GHVFULSWRU LQGLF

7KLV LV LPSRUWDQW

,W LV QRW VH[XDO PLVFRQGXF  
RXU SROLFLHV RU EHOLHIV DERX

,Q HYHU\ JHQHUDWLRQ WKHUH KI  
EHKDYLURV WKDW GRQèW FURVV  
PLVFRQGXFW EXW DUH VWLOO G

\$Q LQGLYLGXDO PD\ UH HFW RQ  
DQG ZLVK WKH\ KDG DFWHG GLI  
HPEDUUDVVHG E\ WKHLU RZQ S  
GRHV QRW ZLWKRXW DGGLWLR  
FULWHULD IRU 1RQFRQVHQVXDQ

6WXGHQWV KDYH FDOOHG LW è  
VH[ë èUDSH\ë DQG èXQZDQWHQ

'HFLVLRQ PDNHUV DUH WKH UDV  
ZDONLQJ WKLV DGPLWWHGO\ Q  
HYHU\WKLQJ LV GLVFULPLQDWR  
GLVFULPPLQDWLRQ PHDQV QRW

:KHQ WKH DVVHVPHQW RI ERX  
EHKDYLURV KRQRUV WKH VXEMHI  
UHSRUWLQJ SDUW\ RYHU WKH R  
D UHDVRQDEOH SHUVRQ ZH VV  
VORSH



& F á N p F p ? á B ö á x N

# ¾ F á p „ N S Ý n

/L] DQG | HYHDK

” %UHDNRXW \*URXSV

| %ODLU 3DWULFN 6DUDK

| -RUGDQ 6WDQ 5REHUW 0HODQLH

” 'LVFXVLRQ

| 'RHV WKH WRWDOLW\ RI WKH HYLGHQFH VR IDU VXJJHVW

| 'R \RX KDYH HYLGHQFH WKDW 1HYHDK ZDV WU\LQJ WR JUR

| 'RHV WKH EHKDYLRU FURVV WKH OLQH RI VHGXFWLRQ LQW

FRQVHQW DQG RXU SROLF\”

| :KDW LV \RXU QGLQJ” 6DQFWLRQV”