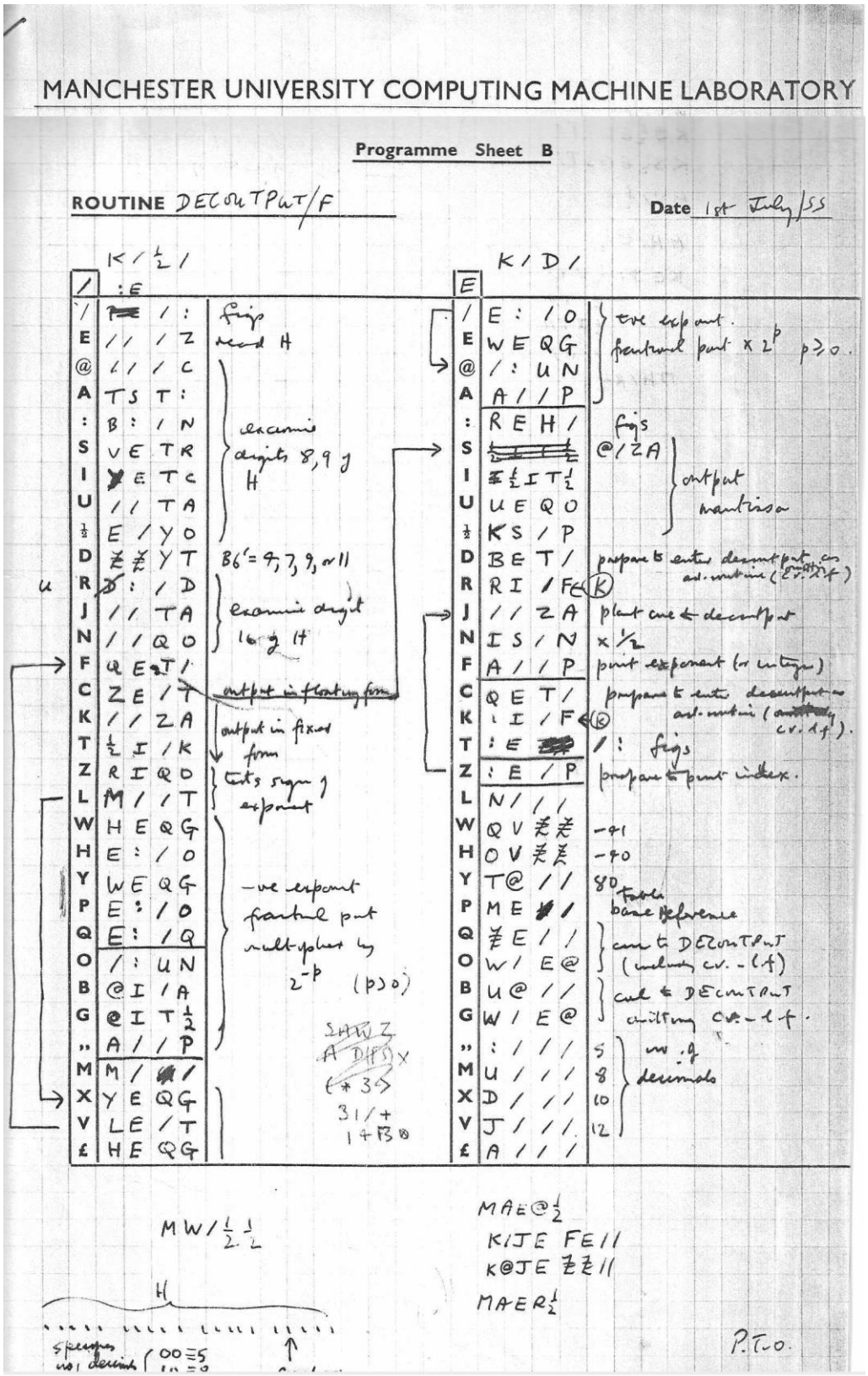
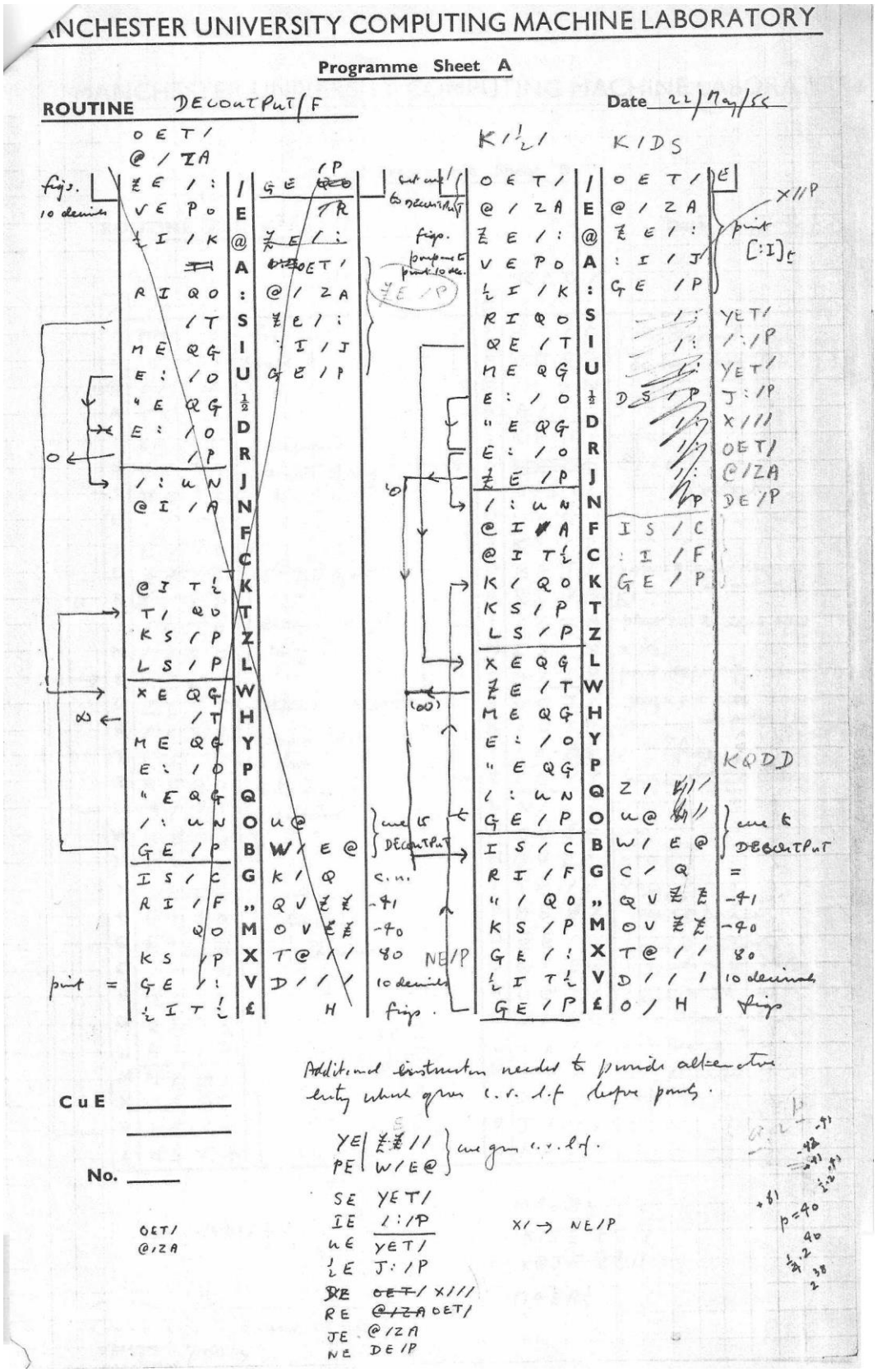
Index

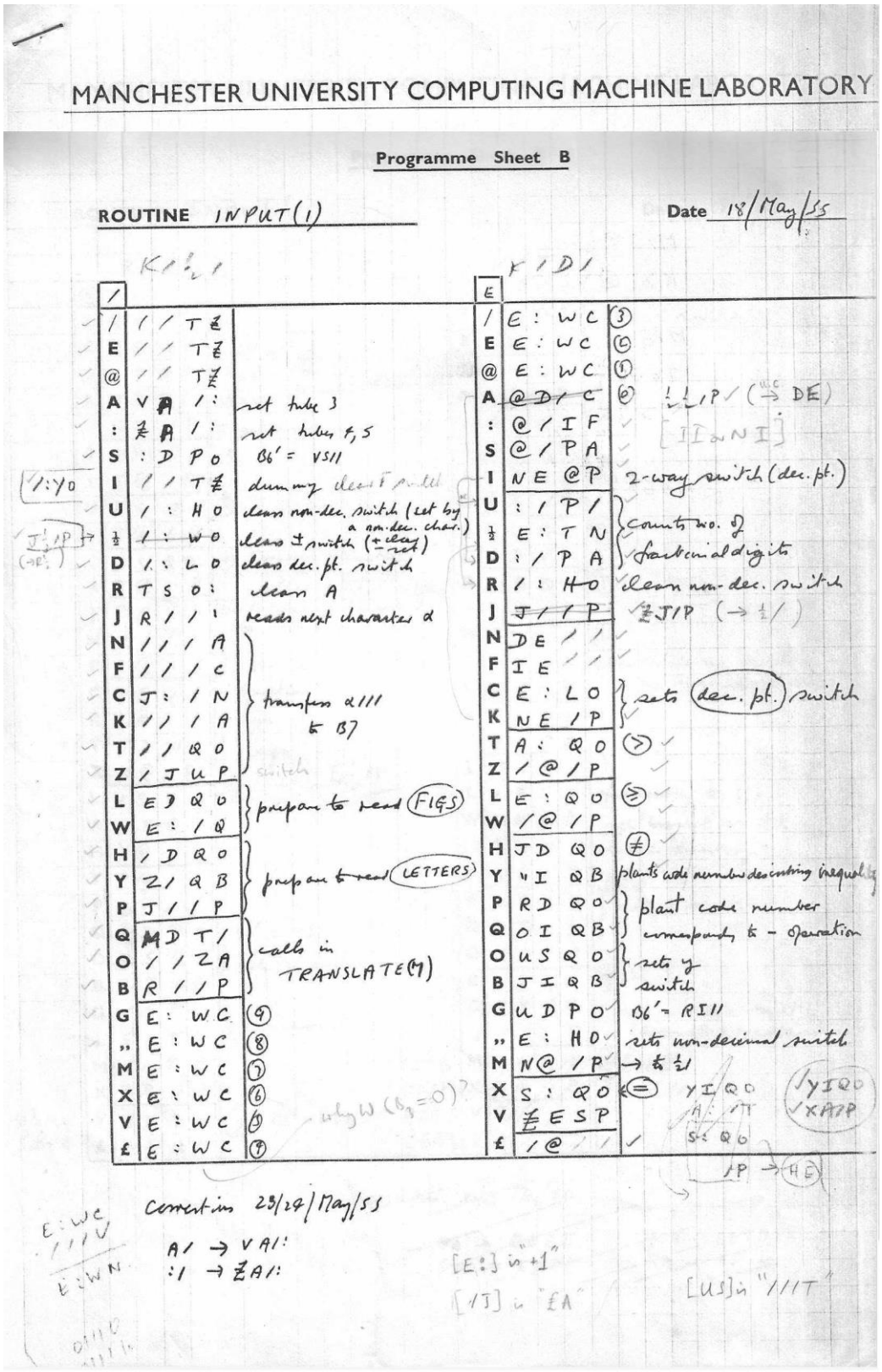
p1


MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY
Programme Sheet B
ROUTINE DECOUTPUT/F
Date 18th July/55
K/½/
K/D/
figs
need H
examine digits 8, 9 of H
B6' = 4, 7, 9, or 11
examine digit 16 of H
output in floating form
output in fixed form
sets sign of exponent
-ve exponent
fractional part
multiplied by
2^-p (p>0)
output mantissa
prepare to enter decoutput
plant cwe ← decoutput
x ½
print exponent (+ integer)
prepare to print index.
-41
-40
80
table base reference
cwe ← DECOUTPUT
(including cv. -(1+f)
cwe ← DECOUTPUT
omitting cv. -1-f.
5
8
10
12
no. of decimals
MAE@½
KIJE FE11
K@JE ZZ11
MAER½
MW/½ ½
H
P.T.O.

p3


ANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY
Programme Sheet A
ROUTINE DECOUTPUT/F
Date 22/May/55
KIDS
KQDD
Additional instruction needed to provide alternative entry when given c.r. d.f. before parts.
CuE
No.
OET/
@IZA

p4



MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE INPUT(1)

Date 18/May/55

/				
/	/ / T			
E	/ / T			
@	/ / T			
A	V A / :	set tube 3		
:	Z A / :	set tubes 4, 5		
S	: D P 0	06' = V511		
I	/ / T	dummy		
U	/ : H 0	clears non-dec. switch (set by a non-dec. char.)		
½	/ : W 0	clears ± switch (+ clear, − set)		
D	/ : L 0	clears dec. pt. switch		
R	T S 0 :	clears A		
J	R / / '	reads next character α		
N	/ / / A	transfers α111 to 87		
F	/ / / C			
C	J : / N			
K	/ / / A			
T	/ / Q 0			
Z	/ J U P	switch		
L	E J Q 0	prepare to read (FIGS)		
W	E : / Q			
H	/ D Q 0	prepare to read (LETTERS)		
Y	Z / Q B			
P	J / / P			
Q	M D T /	calls in TRANSLATE(7)		
O	/ / Z A			
B	R / / P			
G	E : W C	(4)		
„	E : W C	(8)		
M	E : W C	(7)		
X	E : W C	(6)		
V	E : W C	(5)		
£	E : W C	(3)		

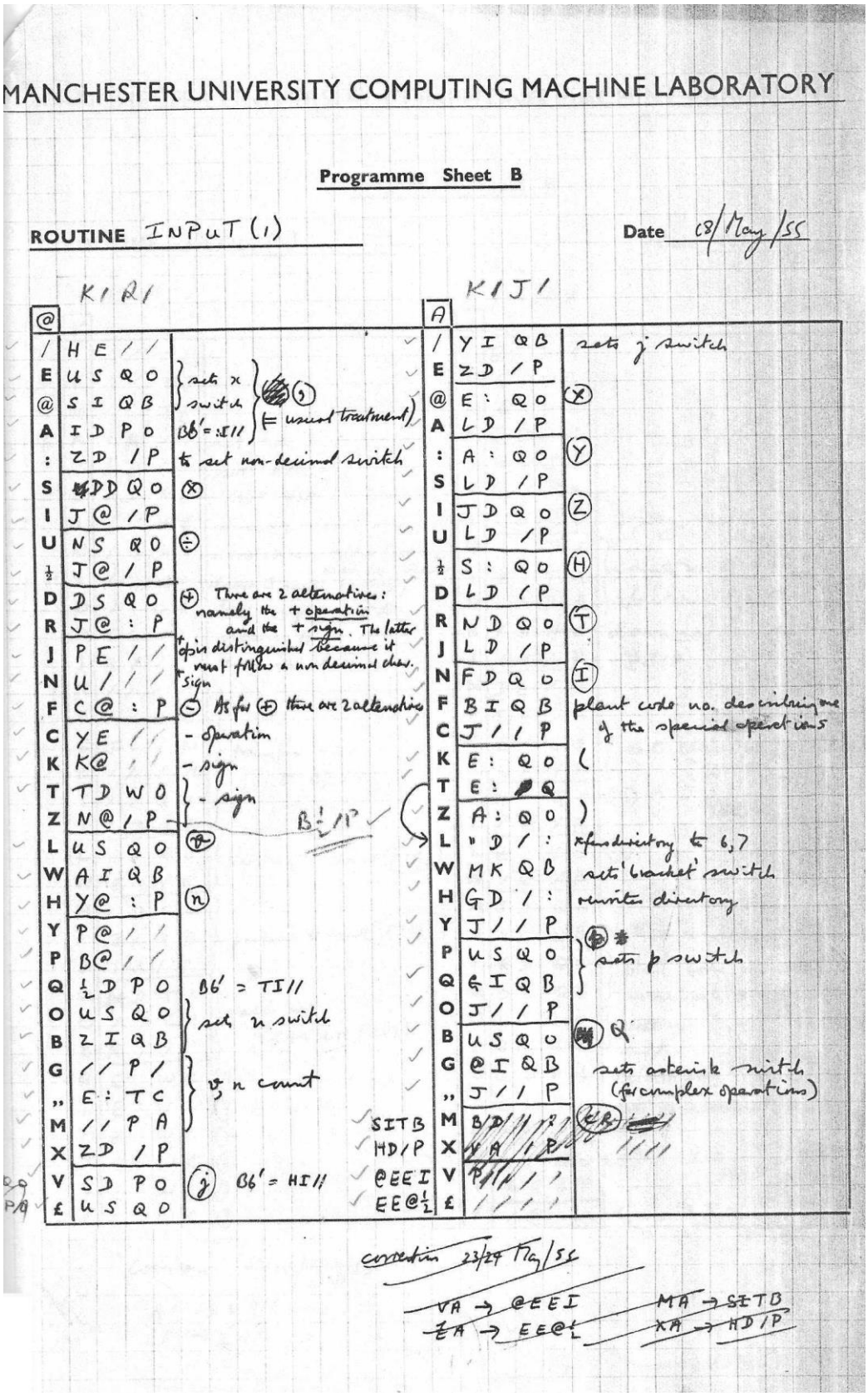
E				
/	E : W C	(3)		
E	E : W C	(2)		
@	E : W C	(1)		
A	@ D / C	(0)		
:	@ / I F			
S	@ / P A			
I	N E @ P	2-way switch (dec. pt.)		
U	: / P /	counts no. of fractional digits		
½	E : T N			
D	: / P A			
R	/ : H 0	clears non-dec. switch		
J	J / / P	ZJ/P (→ ½/)		
N	D E / /			
F	I E / /			
C	E : L 0	sets (dec. pt.) switch		
K	N E / P			
T	A : Q 0	(>)		
Z	/ @ / P			
L	E : Q 0	(≥)		
W	/ @ / P			
H	J D Q 0	(≠)		
Y	" I Q B	plants code number denoting inequality		
P	R D Q 0	plant code number corresponding to − operation		
Q	O I Q B			
O	U S Q 0	sets y switch		
B	J I Q B			
G	U D P 0	06' = R11		
„	E : H 0	sets non-decimal switch		
M	N @ / P	→ to ½/		
X	S : Q 0	(=)		
V	Z E S P			
£	/ @ / /			

Corrections 23/24/May/55

A/ → VA/:

:/ → ZA/:

p5



MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE INPUT (1)

Date 08/May/55

K1R1

@		
/	H E / /	
E	U S Q O	} sets x switch (5) (= usual treatment)
@	S I Q B	
A	I D P O	BB' = :II
:	Z D / P	to set non-decimal switch
S	ΦD D Q O	(x)
I	J @ / P	
U	N S Q O	(÷)
½	J @ / P	
D	D S Q O	(+) There are 2 alternatives: namely the + operation and the + sign. The latter
R	J @ : P	*spin distinguished because it must follow a non decimal char.
J	P E / /	
N	U / / /	*sign
F	C @ : P	(-) As for (+) there are 2 alternatives
C	Y E / /	- operation
K	K @ / /	- sign
T	T D W O	} - sign
Z	N @ / P	
L	U S Q O	(n)
W	A I Q B	
H	Y @ : P	(n)
Y	P @ / /	
P	B @ / /	
Q	½ D P O	BB' = TI//
O	U S Q O	} set n switch
B	Z I Q B	
G	/ / P /	} if n count
,,	E : T C	
M	/ / P A	
X	Z D / P	
V	S D P O	(j) BB' = HI//
£	U S Q O	

K1J1

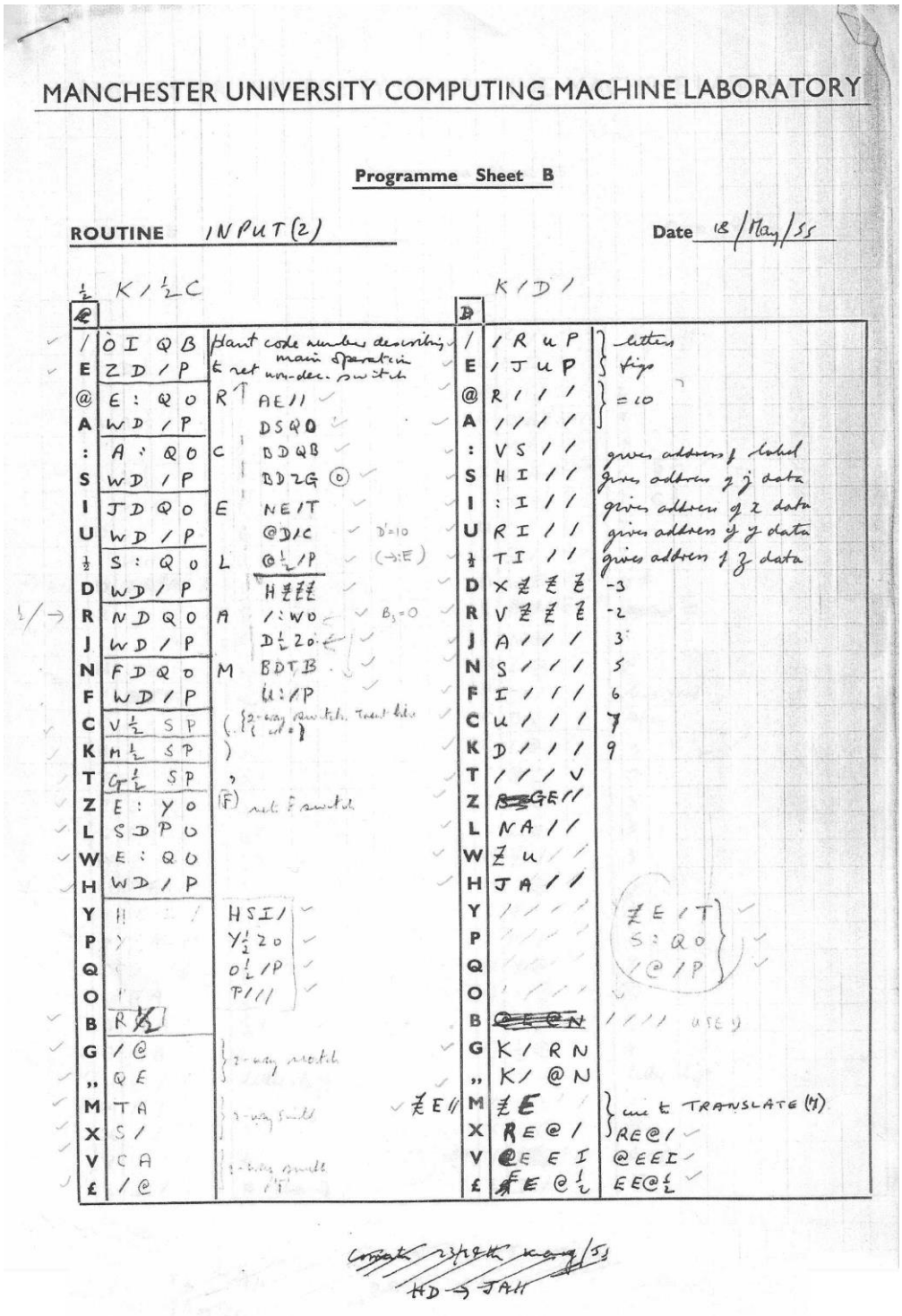
A		
/	Y I Q B	sets j switch
E	Z D / P	
@	E : Q O	(X)
A	L D / P	
:	A : Q O	(Y)
S	L D / P	
I	J D Q O	(Z)
U	L D / P	
½	S : Q O	(H)
D	L D / P	
R	N D Q O	(T)
J	L D / P	
N	F D Q O	(I)
F	B I Q B	plant code no. describing one of the special operations
C	J / / P	
K	E : Q O	(
T	E : Q Q	
Z	A : Q O	)
L	" D / :	x fun directory to 6,7
W	M K Q B	sets 'bracket' switch
H	G D / :	rewrites directory
Y	J / / P	
P	U S Q O	(p) * sets p switch
Q	¢ I Q B	
O	J / / P	
B	U S Q O	(*) Q
G	@ I Q B	sets asterisk switch (for complex operations)
,,	J / / P	
M	B D // //	(ER)
X	V A / P	
V	P // / /	
£	/ / / /	

SITB
HD/P
@EEI
EE@½

correction 23/24 May/55

VA → @EEI
£A → EE@½
MA → SITB
XA → HD/P

p6



MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE INPUT (2)

Date 18/May/55

½ K/½C

€					
/	Ò I Q B	plant code number describing main Sparatron & ret non-dec. switch			
E	Z D / P				
@	E : Q O	R	AE11		
A	W D / P		DSQO		
:	A : Q O	C	BDQB		
S	W D / P		BDZG ⓪		
I	J D Q O	E	NE/T		
U	W D / P		@D/C		D'=10
½	S : Q O	L	@½/P		(→:E)
D	W D / P		H ≠ ≠ ≠		
R	N D Q O	A	/:WO		B_3=0
J	W D / P		D½20		
N	F D Q O	M	BDTB		
F	W D / P		U:/P		
C	V ½ S P	(2-way switch. Treat like ( )			
K	M ½ S P	)			
T	G ½ S P	,			
Z	E : Y O	(F)	not F switch		
L	S D P U				
W	E : Q O				
H	W D / P				
Y	H		HSI/		
P	)		Y½20		
Q			O½/P		
O	'		T///		
B	R ½				
G	/@	2-way switch			
,,	Q E				
M	T A	2-way switch			≠ E //
X	S /				
V	C A	2-way switch			
£	/@		/T		

K/D/

£					
/	/ R U P	letters			
E	/ J U P	figs			
@	R / / /	=10			
A	/ / / /				
:	V S / /	gives address of label			
S	H I / /	gives address of j data			
I	: I / /	gives address of z data			
U	R I / /	gives address of y data			
½	T I / /	gives address of Z data			
D	X ≠ ≠ ≠	-3			
R	V ≠ ≠ ≠	-2			
J	A / / /	3			
N	S / / /	5			
F	I / / /	6			
C	U / / /	7			
K	D / / /	9			
T	/ / / V				
Z	~~B~~ G E //				
L	N A / /				
W	≠ U				
H	J A / /				
Y	/ / / /	≠ E / T			
P		S : Q O			
Q		/ @ / P			
O					
B	~~Q E @ N~~	/ / / / USED			
G	K / R N				
,,	K / @ N				
M	≠ E	use t TRANSLATE (4)			
X	R E @ /	RE@/			
V	@ E E I	@EEI			
£	≠ E @ ½	EE@½			

Corrects 23/May/55

HD → JAH

p7

MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE INPUT(2) **Date** 18/May/55

K1R1

R		
/	Z /	Fig. Shift
E	D ½	A
@	/	B
A	A ½	C
:	/	D
S	S ½	E
I	/	F
U	/	G
½	U A	H
"A//	D ~~"A//~~	I
R	/	J
J	/	K
N	U ½	L
F	~~J~~ ½	M
C	/	N
K	/	O
T	)	P
Z	0 A	Q
L	E ½	R
W	/	S
H	D A	T
Y	/	U
P	Y A	V
Q	/	W
O	E A	X
B	A A	Y
G	S A	Z
,,	W /	letter shift
M	F E	.
X	/	?
V	/	≠
£	D /	(erase)

K1J1

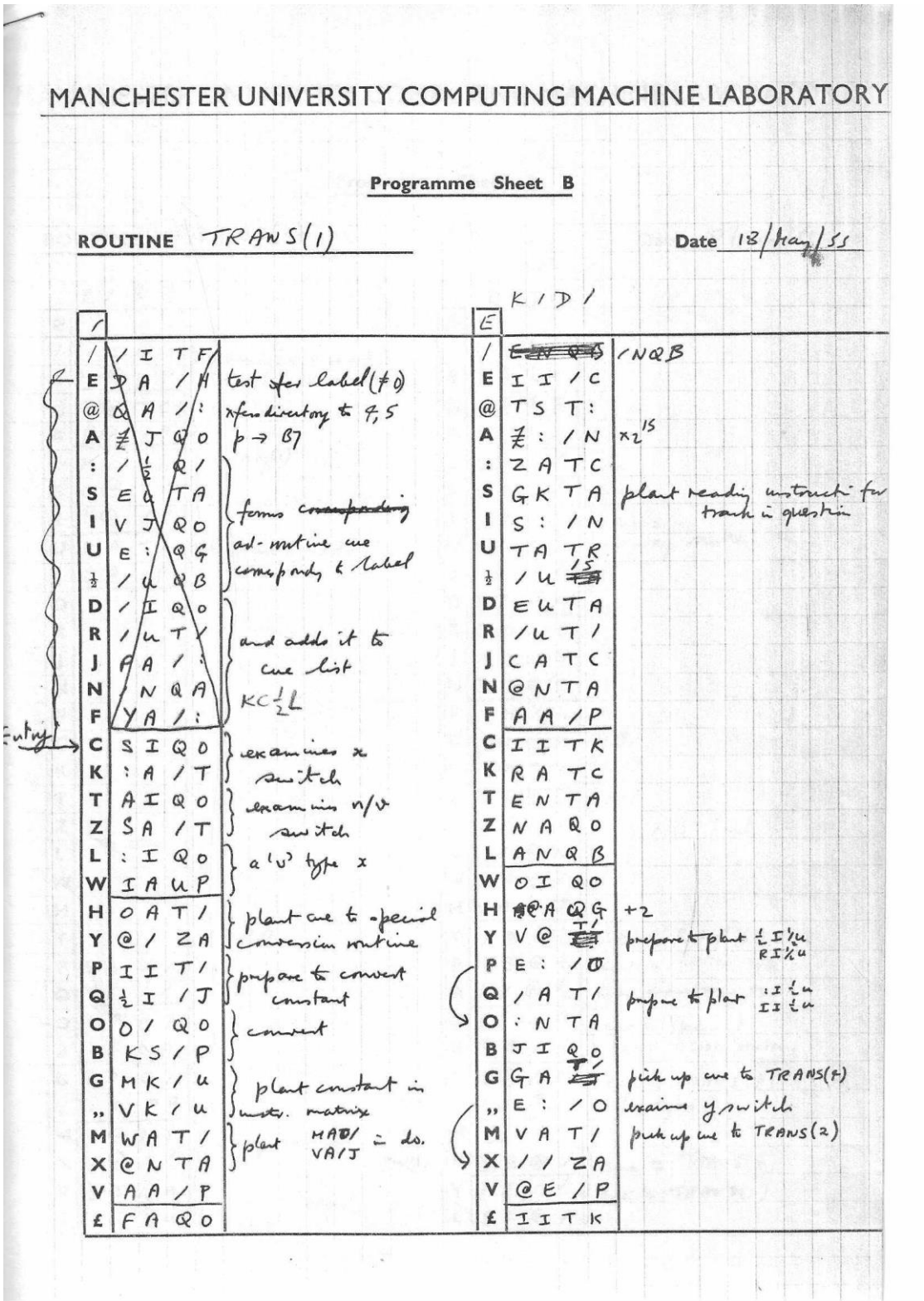
J		
/	Z /	Fig. Shift
E	E E	1
@	/ E	2
A	~~A~~ Y A//	*
:	V /	+
S	C A	(~~F~~ ½
I	~~F~~ A	) C ½
U	" /	7
½	G /	8
D	W E	≠
R	~~R~~ ME	~~=~~ =
J	N @	-
N	Z @	v
F	D /	Line feed
C	D /	Space
K	/ @	, K ½
T	@ E	0
Z	K E	>
L	Z E	≥
W	~~2~~ /	3
H	X @	j (→)
Y	X /	5
P	M /	6
Q	I @	%
O	: @	⊗
B	B /	9
G	½ @	+
,,	W /	letter shift
M	F E	.
X	W @	~~?~~ n
V	~~=~~ P /	~~≠~~ CR
£	D /	

TR → Y A//
PR → 1//+

Correction 23/[illegible] May/55
DR → "A//

Line 2R has yet to be corrected. (1/6/55)

p8



MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE TRANS(1)

Date 18/May/55

K / D /

/	/ I T F	
E	D A / H	test for label (≠0)
@	Q A / :	xfer to directory to 4, 5
A	≠ J Q 0	p → B7
:	/ ½ Q /	
S	E Q T A	forms corresponding
I	V J Q 0	sub-routine cue
U	E : Q G	corresponding to label
½	/ U Q B	
D	/ I Q 0	
R	/ U T /	and adds it to
J	A A / :	cue list
N	/ N Q A	KC½L
F	Y A / :	
C	S I Q 0	examines x
K	: A / T	switch
T	A I Q 0	examines n/v
Z	S A / T	switch
L	: I Q 0	a 'v' type x
W	I A U P	
H	0 A T /	plant cue to special
Y	@ / Z A	conversion routine
P	I I T /	prepare to convert
Q	½ I / J	constant
O	0 / Q 0	convert
B	K S / P	
G	M K / U	plant constant in
,,	V K / U	instr. matrix
M	W A T /	plant MADD/ = do.
X	@ N T A	VAIJ
V	A A / P	
£	F A Q 0	

/	~~E N Q S~~	/NQB
E	I I / C	
@	T S T :	
A	≠ : / N	x2^15
:	Z A T C	
S	G K T A	plant reading instruction for
I	S : / N	track in question
U	T A T R	
½	/ U ~~S~~ 15	
D	E U T A	
R	/ U T /	
J	C A T C	
N	@ N T A	
F	A A / P	
C	I I T K	
K	R A T C	
T	E N T A	
Z	N A Q 0	
L	A N Q B	
W	0 I Q 0	
H	~~@~~ A Q G	+2
Y	V @ T/	prepare to plant ½ I ½ U
P	E : / 0	R I ½ U
Q	/ A T /	prepare to plant : I ½ U
O	: N T A	I I ½ U
B	J I Q 0	
G	G A ~~T~~ /	pick up cue to TRANS(1)
,,	E : / O	examine y switch
M	V A T /	pick up cue to TRANS(2)
X	/ / Z A	
V	@ E / P	
£	I I T K	

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE TRANS(1) **Date** 10/May/55

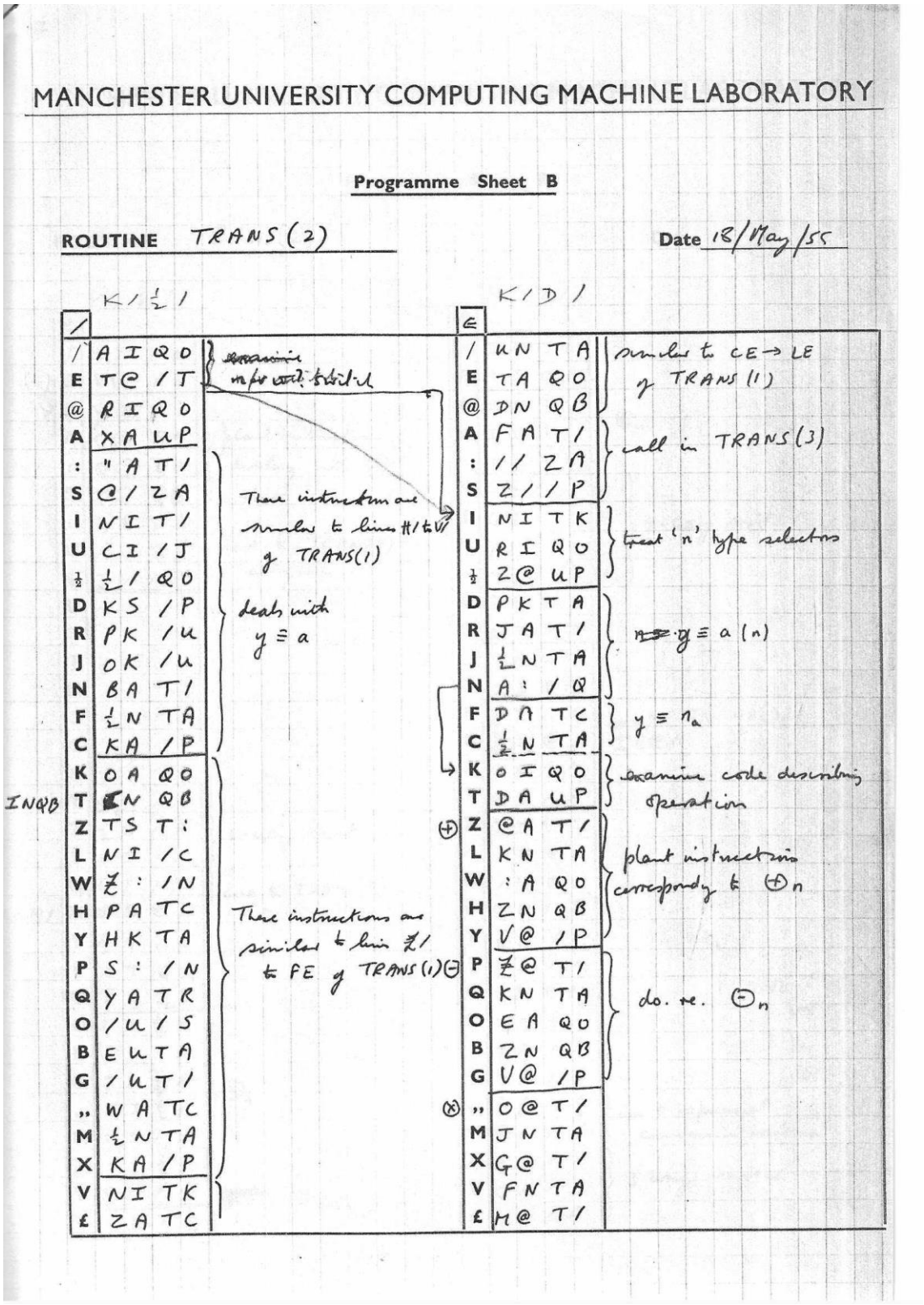
K/R/D

@		
/	: I Q O	examine n, v count (o or / in this case)
E	M @ u P	
@	G @ T C	n_a
A	P @ / P	
:	M K T A	a (n type)
S	O @ T /	
I	P @ / P	
U	M A T /	pick up cue to TRANS(6)
½	Q @ / P	
D		
R		
J		
N		
F		
C		
K		
T		
Z		
L		
W		
H		
Y		KPRR
P	Q E / /	
Q	M E / /	
O	M A O /	.
B	: I O A	.
G	G D O /	.
,,	: I O A	.
M	A @ / /	2 way switch
X	E @ / /	
V	½ I ½ u	.
£	R I ½ u	.

K/I/J

A		
/	: I ½ u	.
E	I I ½ u	.
@	V ≠ ≠ ≠	
A	L E / /	c.n
:	I @ / /	c.n
S	V E / /	c.n
I	W / / /	c.n.s 3-way switch
U	V / / /	
½	F E / /	
D	F / / /	c.n
R	G D ½ C	.
J	/ T Q O	
N	@ J £ / P	.
F	" A ½ :	.
C	~~" A / :~~	IN@/.
K	~~/ N T /~~	@NIJ
T	~~@ N / J~~	≠AII
Z	/ / / /	data block
L	/ ß @ N	
W	M A @ /	.
H	V A / J	
Y	/ @ R ½	write cue list from 9,5
P	/ @ @ ½	read " " to 9,5
Q	K / @ ½	read directory 9,5
O	≠ ≠ / /	cue to special CONVERSION routine
B	@ E / /	
G	≠ E / /	cue to TRANS(4) (entry no. 1)
,,	UE @ /	UE@/
M	≠ ≠ / /	cue to TRANS(6)
X	D E @ /	DE@/
V	≠ ≠ / /	cue to TRANS(2)
£	S E @ /	

p10



MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

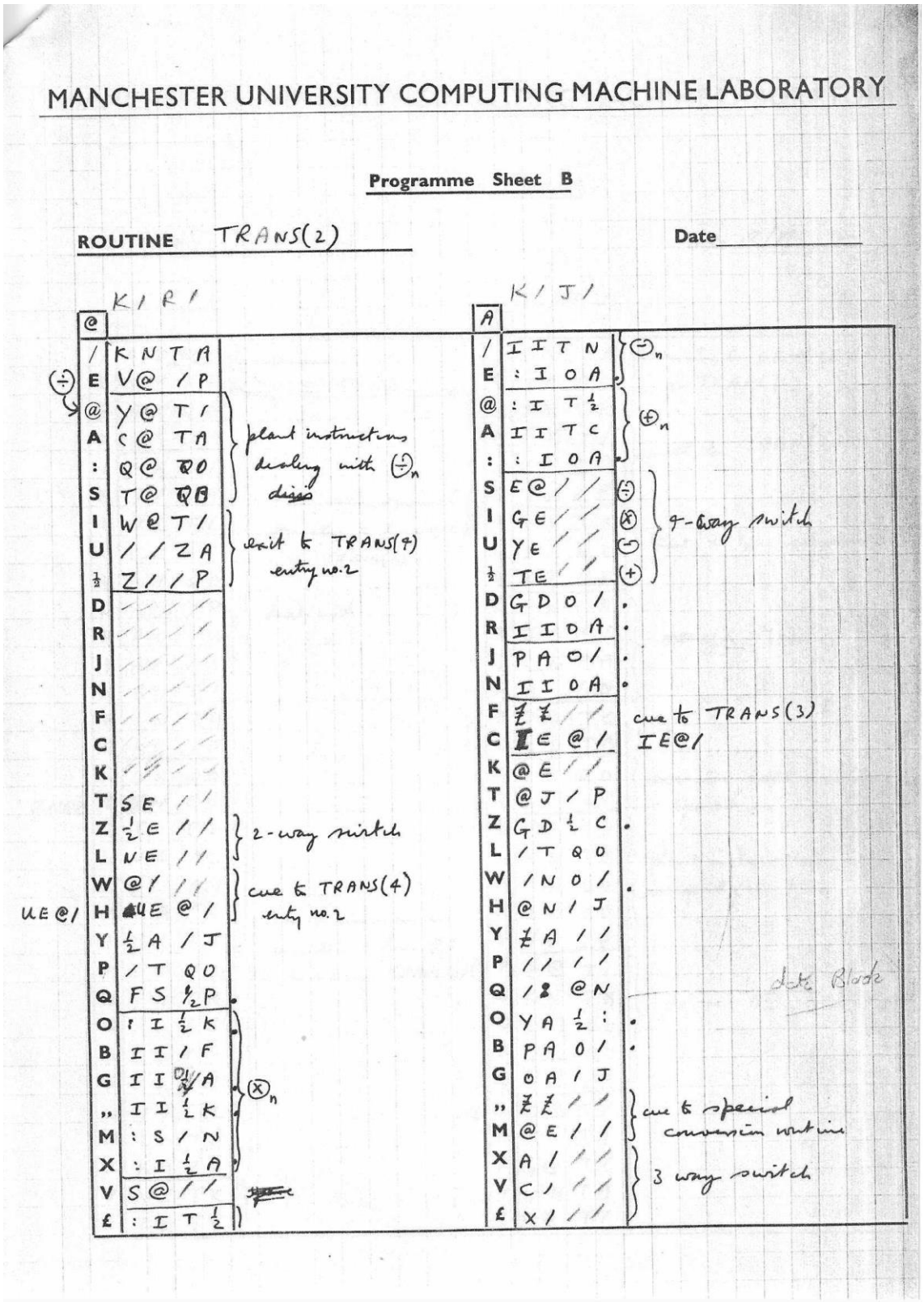
Programme Sheet B

ROUTINE TRANS (2) **Date** 18/May/55

K/½/ K/D/

/	A I Q O		/	U N T A	similar to CE → LE of TRANS (1)
E	T @ / T	examine m for coded symbol	E	T A Q O	
@	R I Q O		@	D N Q B	
A	X A U P		A	F A T /	call in TRANS (3)
:	" A T /		:	/ / Z A	
S	@ / Z A		S	Z / / P	
I	N I T /	These instructions are similar to lines #1 to #V of TRANS (1)	I	N I T K	treat 'n' type selectors
U	C I / J		U	R I Q O	
½	½ / Q O		½	Z @ U P	
D	K S / P	deals with y ≡ a	D	P K T A	y ≡ a (n)
R	P K / U		R	J A T /	
J	O K / U		J	½ N T A	
N	B A T /		N	A : / Q	
F	½ N T A		F	D A T C	y ≡ n_a
C	K A / P		C	½ N T A	
K	O A Q O		K	O I Q O	examine code describing operation
INQB T	[illegible] N Q B		T	D A U P	
Z	T S T :	⊕	Z	@ A T /	plant instructions corresponding to ⊕n
L	N I / C		L	K N T A	
W	Ƶ : / N		W	: A Q O	
H	P A T C		H	Z N Q B	
Y	H K T A		Y	V @ / P	
P	S : / N	These instructions are similar to line Ƶ/ to FE of TRANS (1) ⊖	P	Ƶ @ T /	do. re. ⊖n
Q	Y A T R		Q	K N T A	
O	/ U / S		O	E A Q O	
B	E U T A		B	Z N Q B	
G	/ U T /		G	V @ / P	
,,	W A T C	⊗	,,	O @ T /	
M	½ N T A		M	J N T A	
X	K A / P		X	G @ T /	
V	N I T K		V	F N T A	
£	Z A T C		£	M @ T /	

p11


MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY
Programme Sheet B
ROUTINE TRANS(2)
Date
K/R/
K/J/
plant instructions dealing with ÷n
exit to TRANS(9) entry no.2
2-way switch
cue to TRANS(4) entry no.2
UE@/
cue to TRANS(3)
IE@/
4-way switch
cue to special conversion routine
3 way switch

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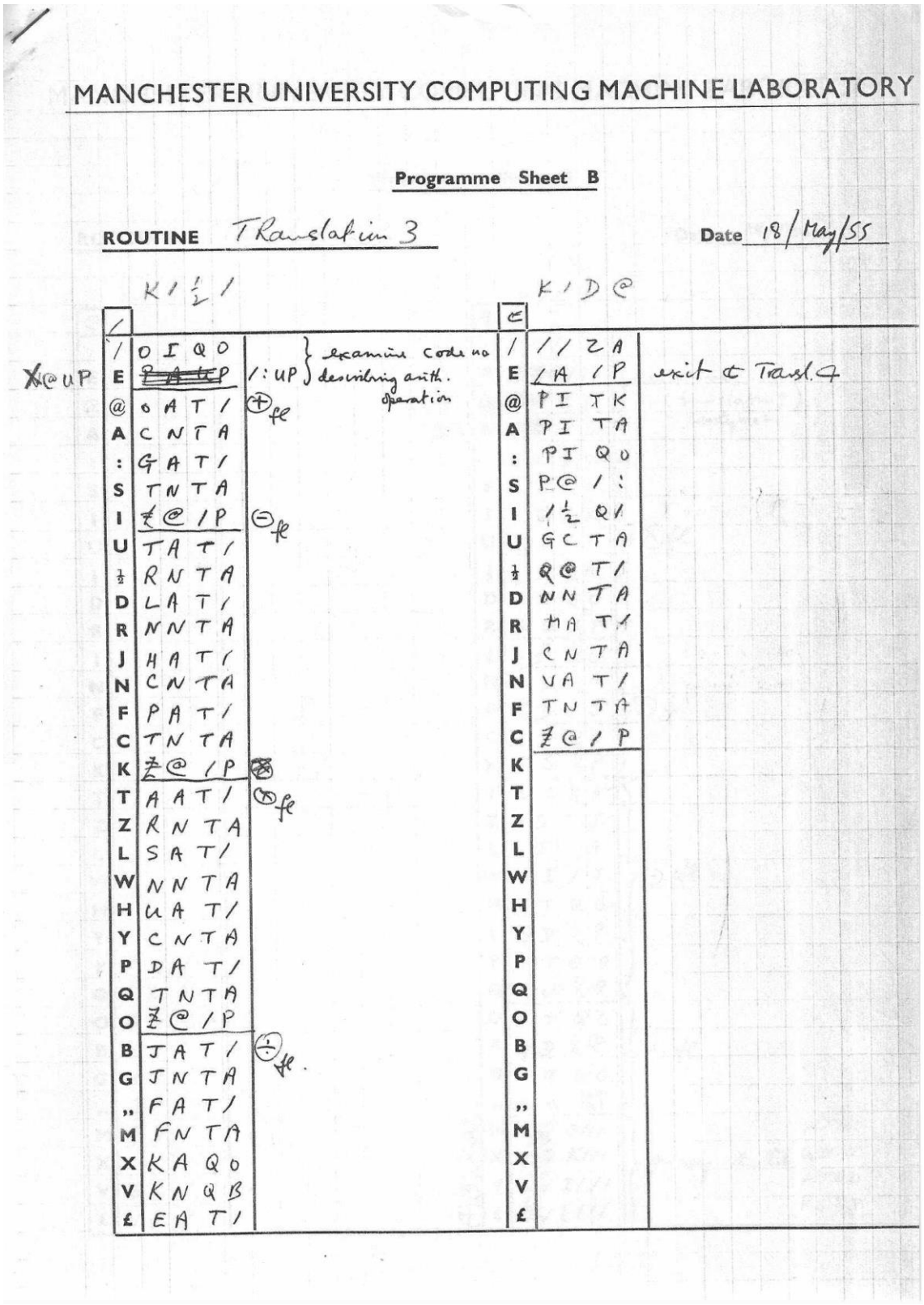

MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE Translation 3 Date 18/May/55

K1½/ K1D@

/	0 I Q 0	} examine code no describing arith. operation
E	~~P A U P~~	/: UP
@	0 A T /	⊕ fe
A	C N T A	
:	G A T /	
S	T N T A	
I	£ @ / P	⊖ fe
U	T A T /	
½	R N T A	
D	L A T /	
R	N N T A	
J	H A T /	
N	C N T A	
F	P A T /	
C	T N T A	
K	£ @ / P	⊗
T	A A T /	⊗ fe
Z	R N T A	
L	S A T /	
W	N N T A	
H	U A T /	
Y	C N T A	
P	D A T /	
Q	T N T A	
O	£ @ / P	
B	J A T /	÷ fe.
G	J N T A	
,,	F A T /	
M	F N T A	
X	K A Q 0	
V	K N Q B	
£	E A T /	

/	/ / Z A	
E	/ A / P	exit to Transl. 4
@	P I T K	
A	P I T A	
:	P I Q 0	
S	P @ / :	
I	/½ Q /	
U	G C T A	
½	Q @ T /	
D	N N T A	
R	M A T /	
J	C N T A	
N	V A T /	
F	T N T A	
C	£ @ / P	
K		
T		
Z		
L		
W		
H		
Y		
P		
Q		
O		
B		
G		
,,		
M		
X		
V		
£		

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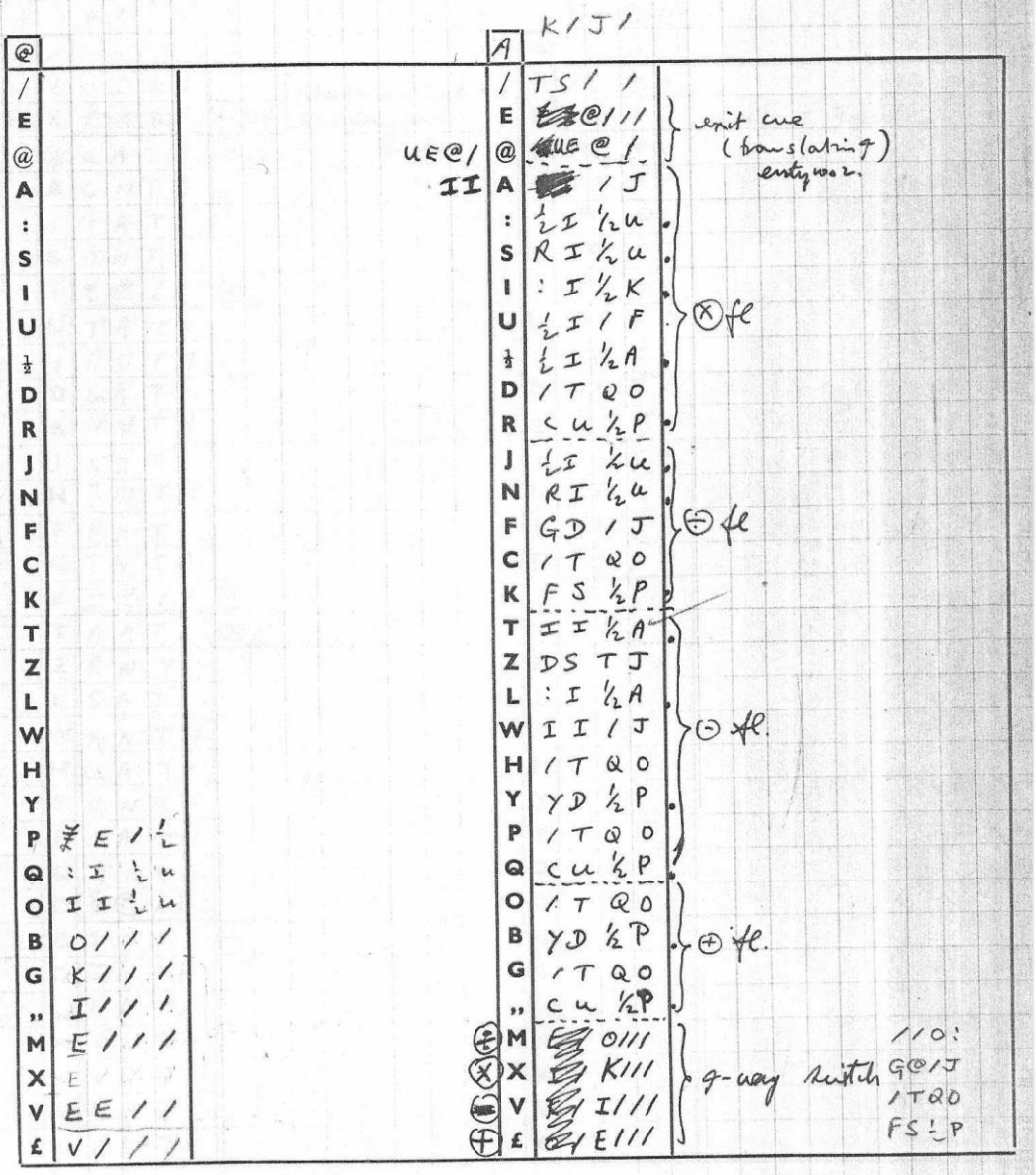
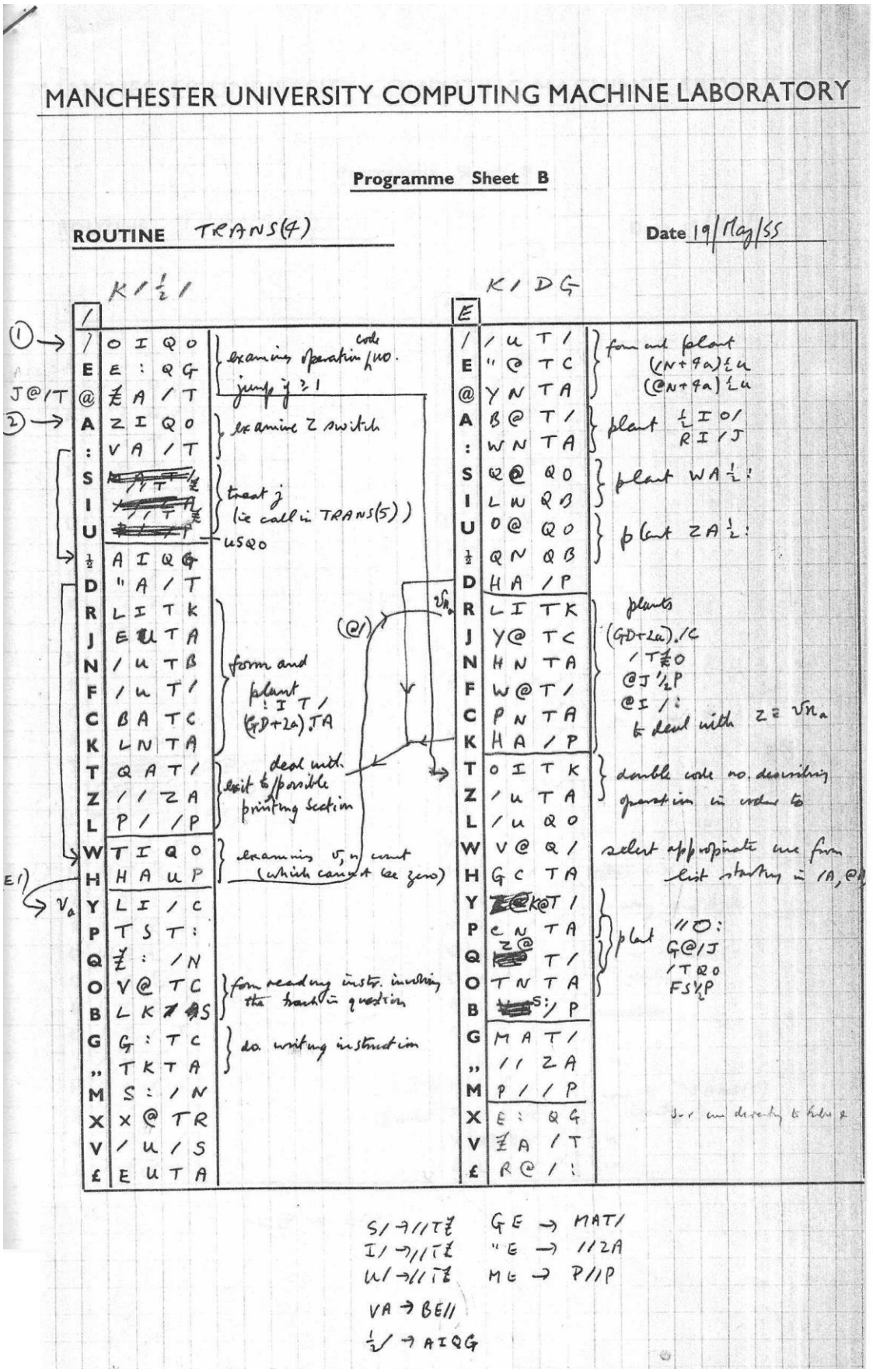
MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE Translation 3 **Date** 18/May/55



p14


MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY
Programme Sheet B
ROUTINE TRANS(4)
Date 19/May/55
examining operation code no.
jump if j ≥ 1
examine Z switch
treat j (ie call in TRANS(5))
use Q0
form and plant ! I T / (GD+2a) JA
deal with exit & possible printing section
examine v, n count (which cannot be zero)
form reading instr. involving the track in question
do writing instruction
form and plant (N+9a)£u (@N+9a)£u
plant ½I 0/ RI/J
plant WA ½:
plant ZA ½:
plants (GD+2a).1C / T≠0 @J ½P @I /: & deal with Z ≥ vn
double code no. describing operation in order to
select appropriate one from list starting in 1A, @A
plant 11 0: G@1J /T R0 FS½P
S/ → 11 T≠
I/ → 11 T≠
U/ → 11 T≠
VA → BE11
½/ → AIQG
GE → MAT/
"E → 11ZA
ME → P11P

p15

MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE TRANS(9) **Date** 19/May/55

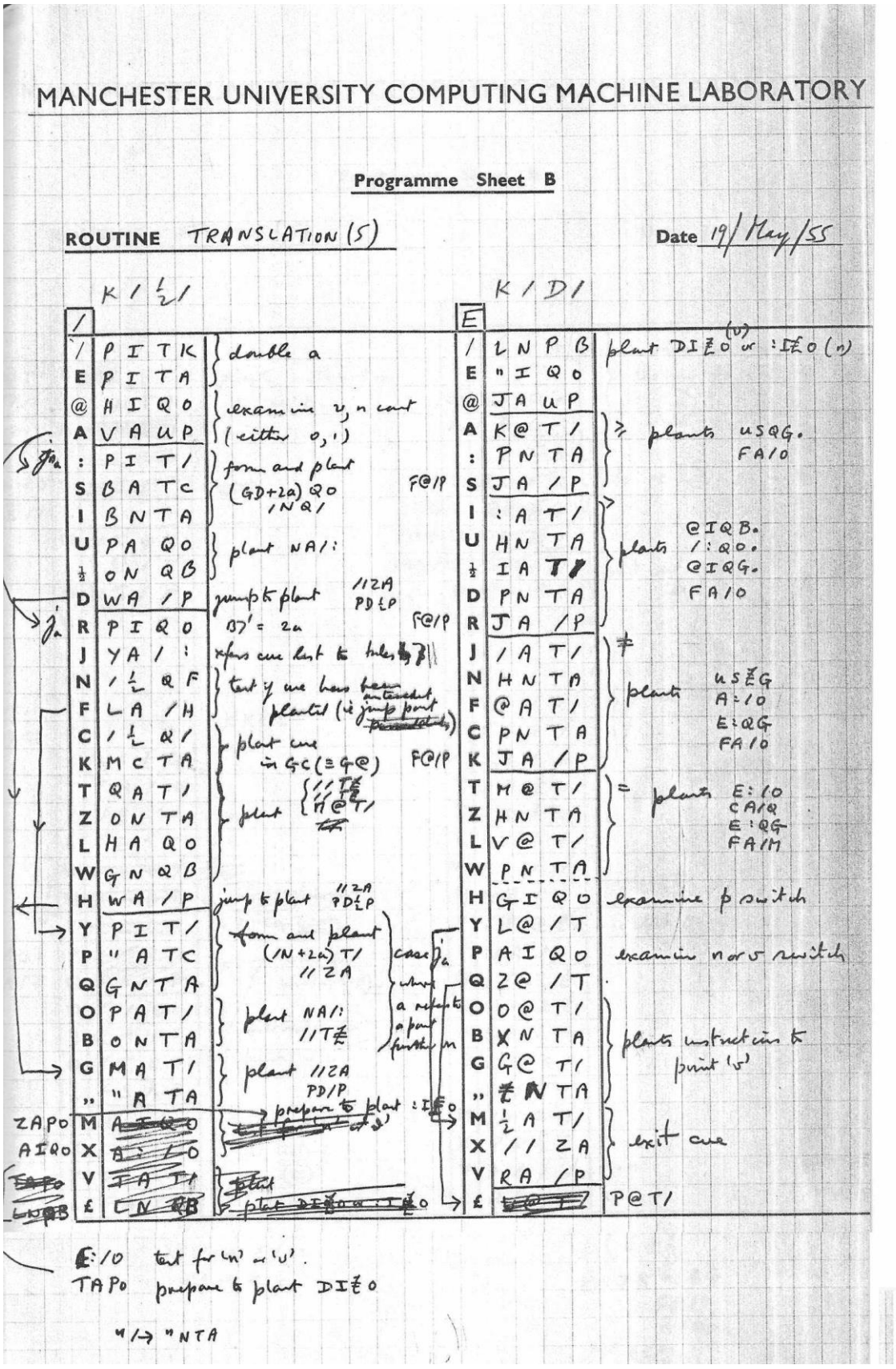
K / J /

@			A		
/	P I T K		/	≠ ≠ / /	} function no 1
E	P I T A		E	P / @ /	
@	P I Q O		@	≠ ≠ / /	} " " 2
A	/ ½ Q /		A	Q / @ /	
:	G C T A		:	≠ ≠ / /	} " " 3
S	K @ T /		S	O / @ /	
I	C N T A		I	≠ ≠ / /	} " " 4
U	Z @ T /		U	B / @ /	
½	T N T A		½	≠ ≠ / /	} " " 5
D	S : / P		D	G / @ /	
R	≠ E / ½	‖ ≠≠ //	R	/ / / /	} " " 6
J	M E	≠ ///	J	/ / / /	
N			N	/ / / /	} " " 7
F			F	/ / / /	
C		K K R Z	C	/ / / /	} " " 8
K	/ / @ :	.	K	/ / / /	
T	[redacted]	G @ I J	T	/ / / /	} " " 9
Z	[redacted]	/ T Q O	Z	/ / / /	
L	[redacted]	F S ½ P .	L	/ / / /	} " " 10
W	@ J ½ P	.	W	/ / / /	
AI½: H	[redacted] I ½ :	.	H	K / / /	[redacted] c.n.
Y	G D ½ C	.	Y	H / / /	} 2-way switch
P	/ T ≠ O		P	D E / /	
Q	W A ½ :		Q	W E	} use to TRANS(5) (entry 2)
O	Z A ½ :		½E@/ O	[redacted] ½ E @ /	
B	½ I O /		B	: I O /	} [redacted]
G	R I / J		G	G D O A	
„	/ N ½ u	.	„	L / / /	c.n.
M	@ N ½ u	.	I@// M	≠ ≠ / /	} use to TRANS(5) (entry 1)
X	≠ A / /		½E@/ X	[redacted] ½ E @ /	
V	/ / / /		V	[redacted] B E / /	c.n
£	/ [redacted] @ N		£	K E / /	c.n.

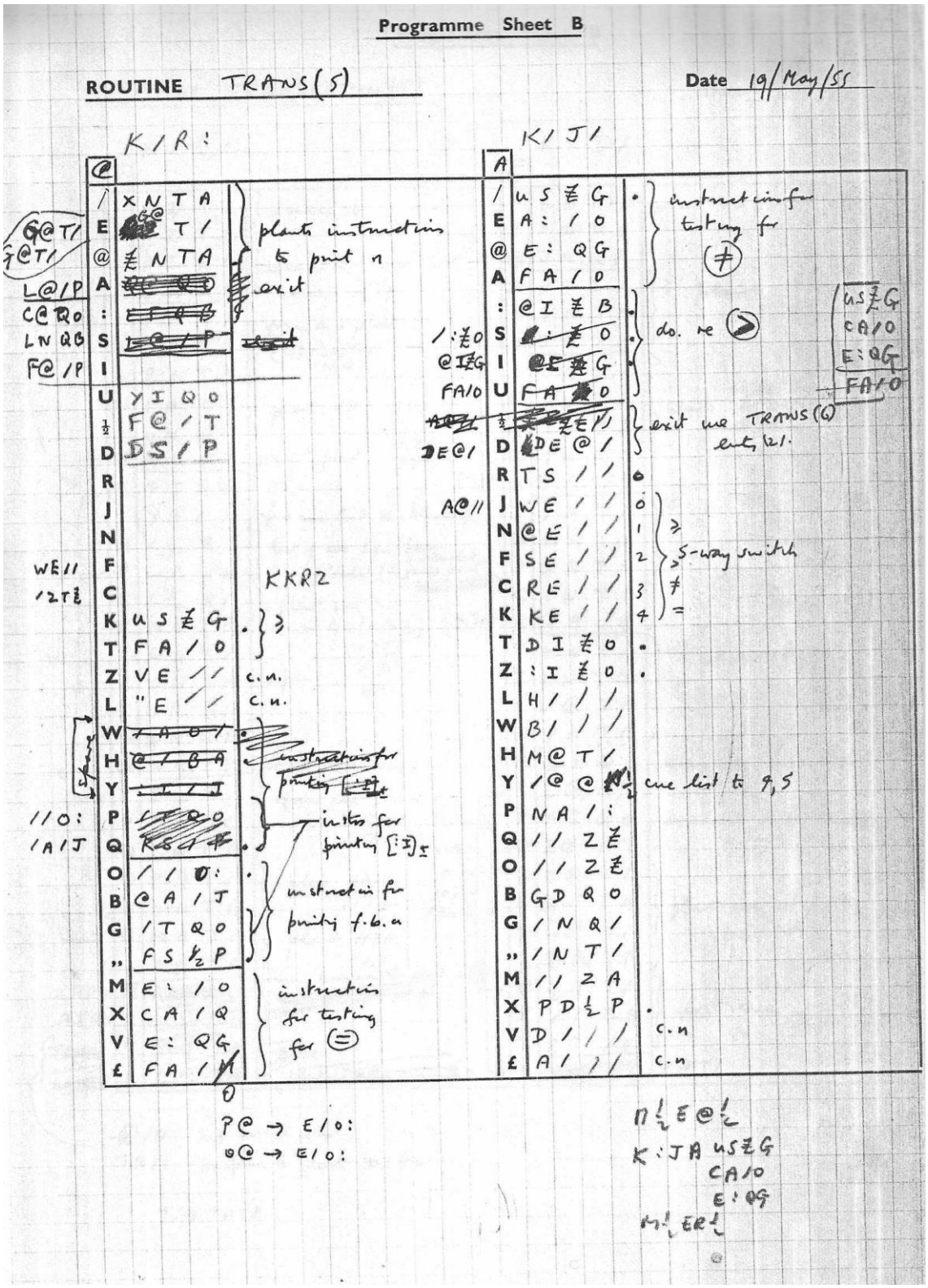
K@ → E10:

data
block

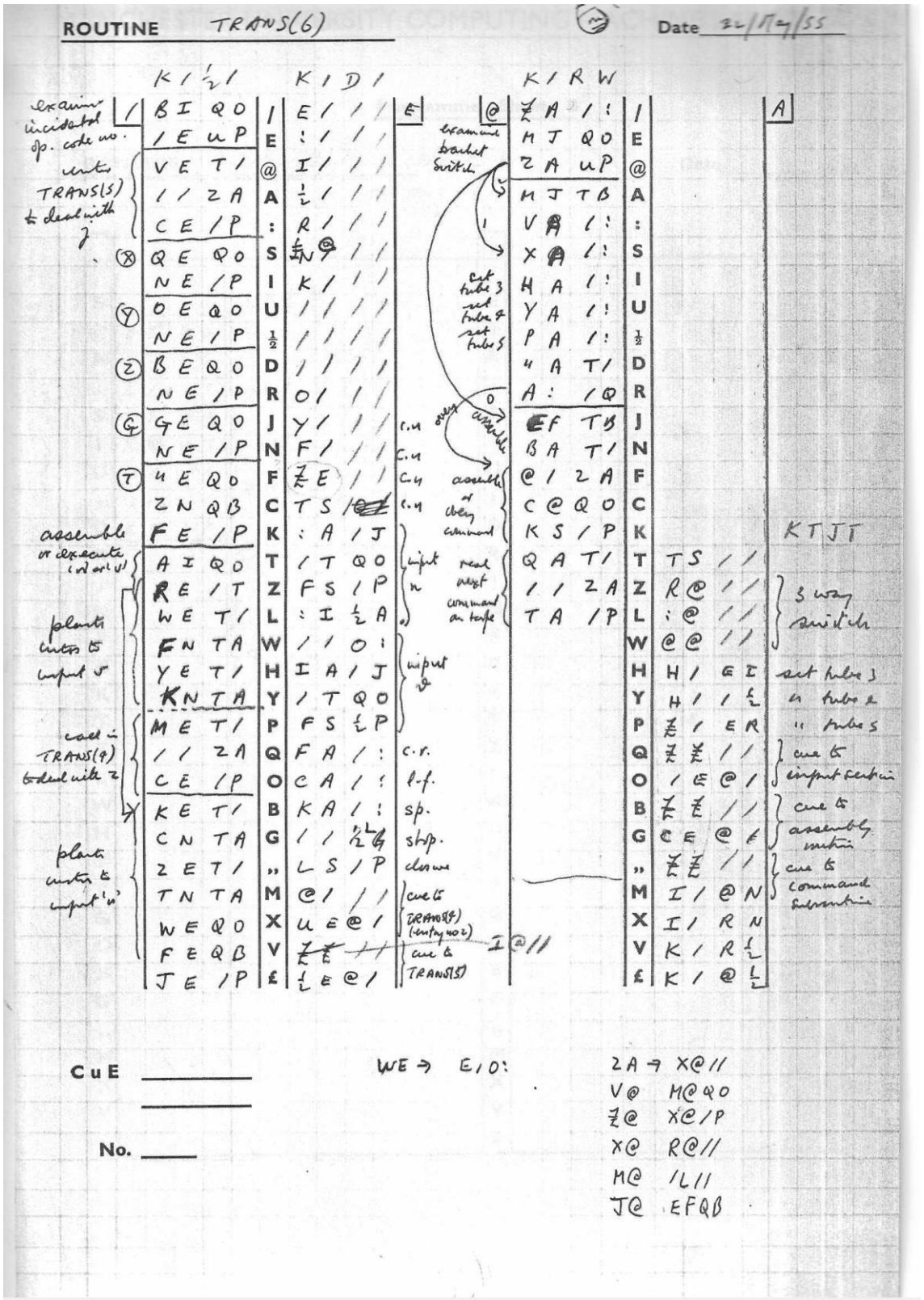
p16


MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY
Programme Sheet B
ROUTINE TRANSLATION (5)
Date 19/May/55
K / ½ /
K / D /
double a
examine v, n cont (either 0, 1)
form and plant (GD+2a) Q0 / N Q /
plant NA /:
jump to plant 1/2A PD LP
x fers one last to tube
test if one has been inserted, plant (i.e. jump point
plant one in GC (= G@)
plant
jump to plant 1/2A PD LP
form and plant (/N+2a) T / 1/2A
plant NA /: 1/T
plant 1/2A PD/P
prepare to plant : I E 0
plant DI E 0 (v) or : I E 0 (n)
plants U S Q G. F A / 0
plants @ I Q B. / : Q 0. @ I Q G. F A / 0
plants U S E G A : / 0 E : Q G F A / 0
plants E : / 0 C A / Q E : Q G F A / M
examine p switch
examine n or v switch
plants instructions to print 'v'
exit cue
E : / 0 test for 'n' or 'v'.
TA P0 prepare to plant DI E 0
" / → " N T A

p17


Programme Sheet B
ROUTINE TRANS(5)
Date 19/May/55
K/R:
K/J/
plants instructions to print n
exit
KKR2
instructions for printing
instructions for printing f.b.a
instructions for testing for (=)
instructions for testing for (≠)
do. ne (>)
exit via TRANS(6) ent, 121.
5-way switch
cue list to 4,5
c.n.
c.n.
P@ → E/0:
0@ → E/0:
n!E@!
K:JA USŹG
CA/0
E:QG
m!ER!

p18


ROUTINE TRANS(6)
Date 22/11/55
examine incidental op. code no.
enters TRANS(5) to deal with
assemble or execute (w or v)
plants enters to input s
calls in TRANS(4) to deal with z
plants enters to input 'w'
examine basket switch
set tube 3 set tube 4 set tube 5
assemble or obey command
read next command on tape
input n
input y
c.r.
l.f.
sp.
stop.
clear w
enter to input 'w'
enter to TRANS(4) (entry no 2)
enter to TRANS(5)
3 way switch
set tube 3
" tube 4
" tube 5
enter to input section
enter to assembly section
enter to command subroutine
CuE
No.
WE → E/O:
2A → X@//
V@ M@QO
Z@ X@/P
X@ R@//
M@ /L//
J@ EFQB

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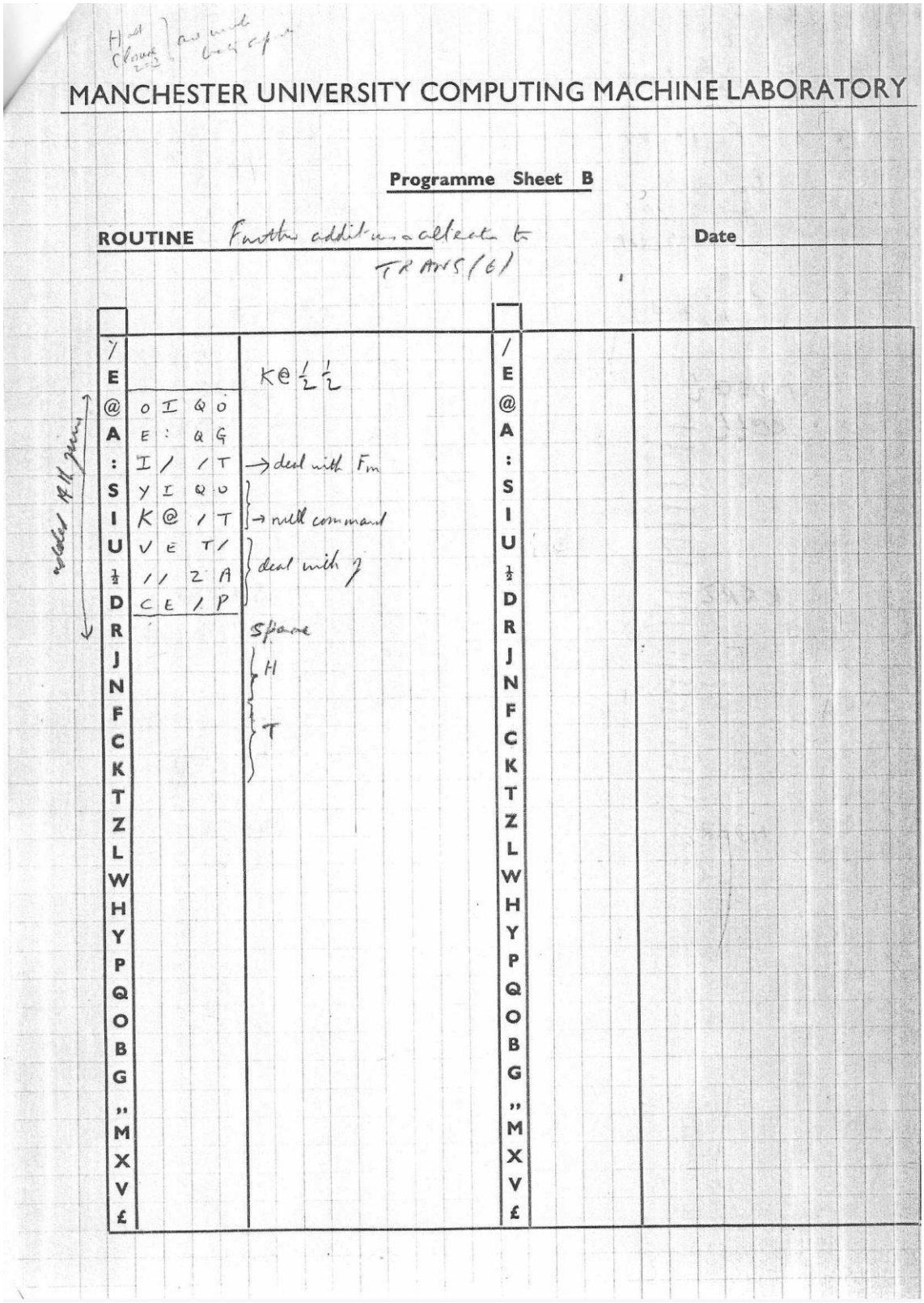


MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

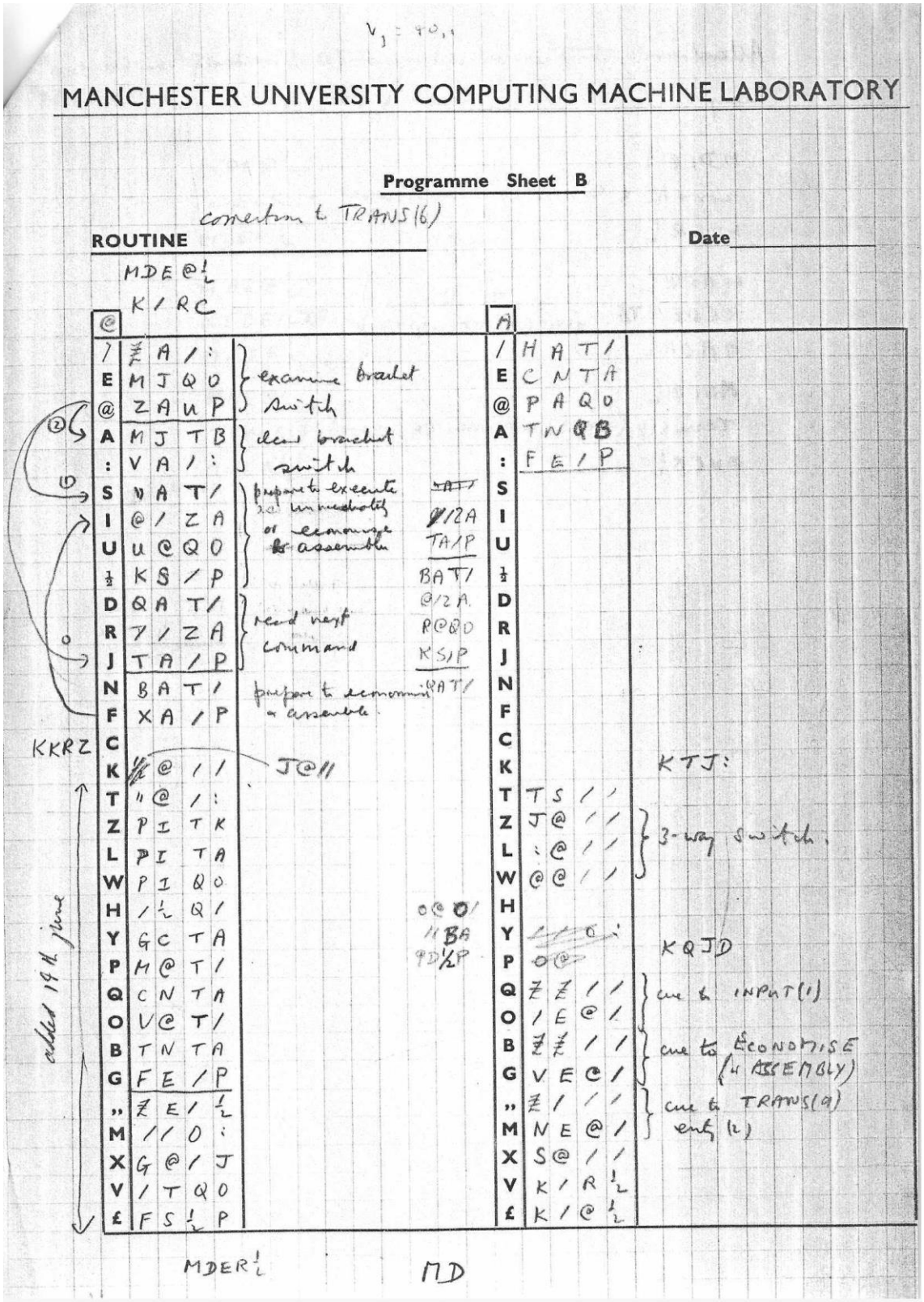
ROUTINE Further additional adder to TRANS(6)

Date

/					/
E				K@½½	E
@	O	I	Q	O	@
A	E	:	Q	G	A
:	I	/	/	T	: → deal with Fm
S	Y	I	Q	O	S
I	K	@	/	T	I → null command
U	V	E	T	/	U
½	/	/	Z	A	½ deal with /
D	C	E	/	P	D
R					R Space
J					J H
N					N
F					F T
C					C
K					K
T					T
Z					Z
L					L
W					W
H					H
Y					Y
P					P
Q					Q
O					O
B					B
G					G
"					"
M					M
X					X
V					V
£					£

"selected" H & T pairs

p21



MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE correction to TRANS(6) Date

MDE@½
K/RC

examine bracket switch
clear bracket switch
prepare to execute at once immediately or economize by assembly
need next command
prepare to economize & assemble
KKRZ
J@11
KTJ:
3-way switch.
KQJD
cue to INPUT(1)
cue to ECONOMISE (& ASSEMBLY)
cue to TRANS(9) enf (2)
ended 19 H June
MDER½
MD

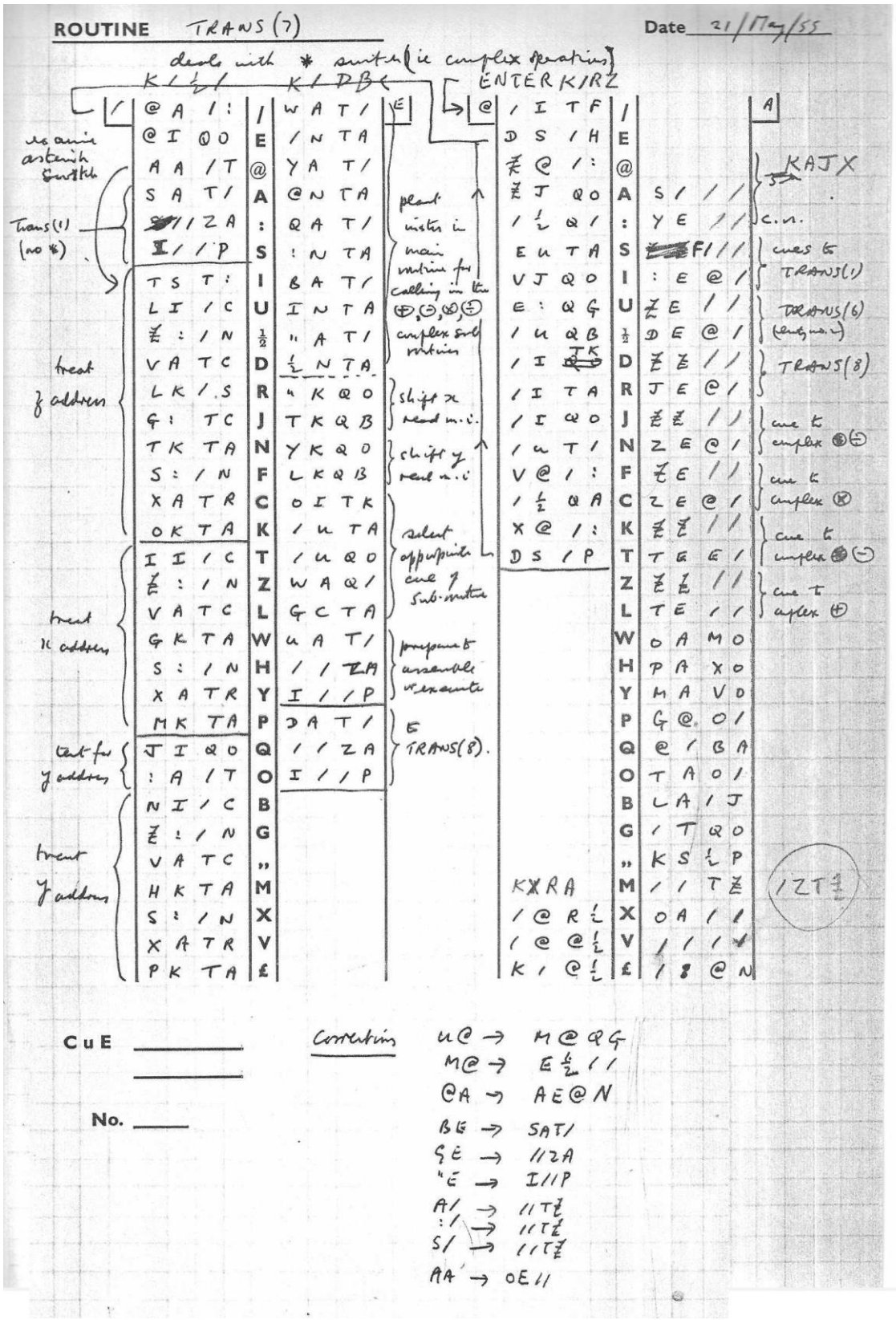
Alterations necessary to ensure that branches in instruction may include sub-routines.

MDE@!L
correction to TRANS(6)
MDER!L

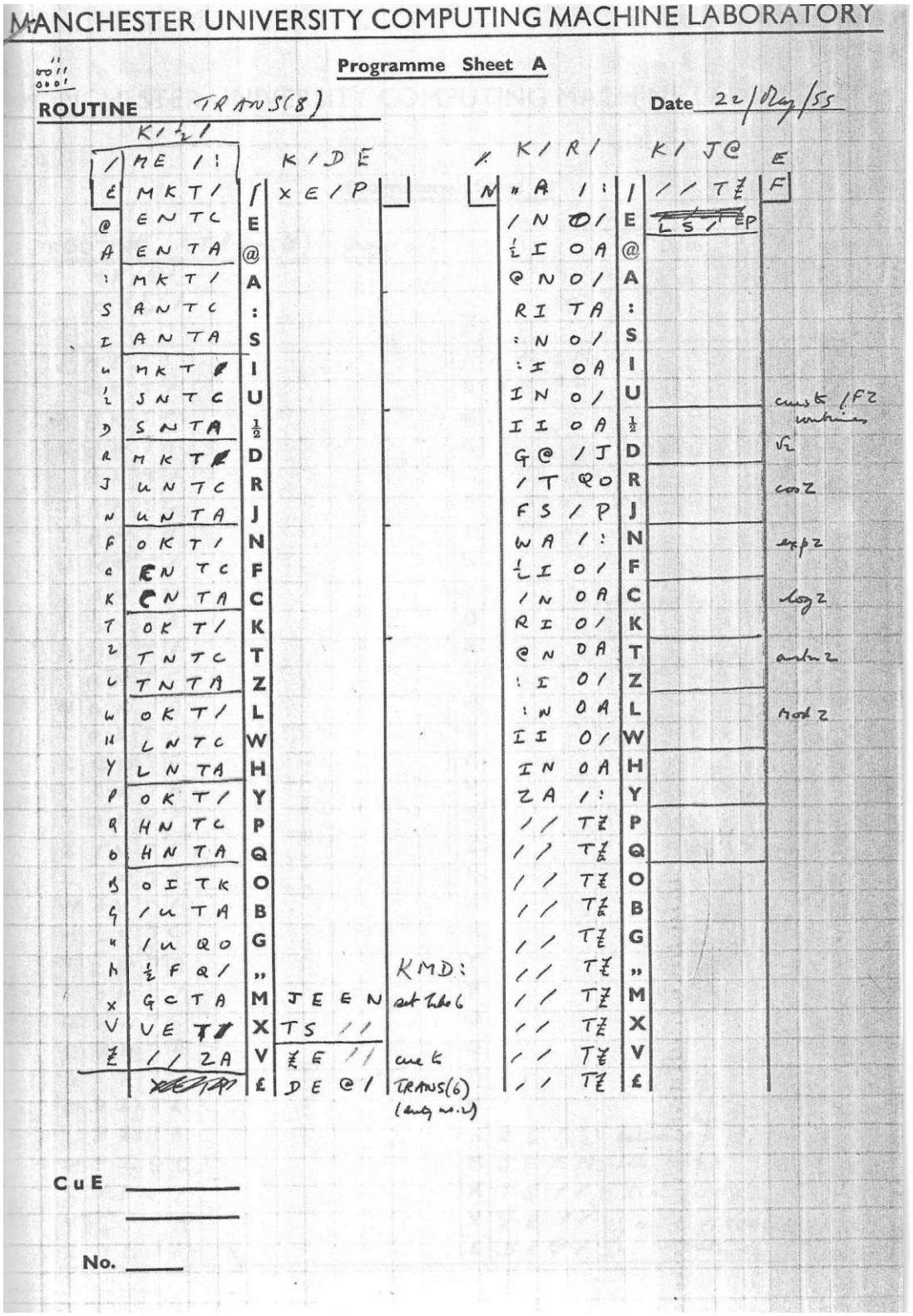
MAE@!L
KEDEILTE
MAER!L
} correction to INSTR. MATRIX.

MNE@!L
TRANS(9) (punch the whole thing again).
MNER!L

p23


ROUTINE TRANS (7)
Date 21/May/55
deals with * entries (ie complex operations)
K/½/ K/DB/
ENTER K/RZ
require asterisk switch
Trans(1) (no *)
treat ʃ address
treat ıc address
test for y address
treat y address
plant exits in main routine for calling in the ⊕,⊖,⊗,⊘ complex sub routines
shift x read m.c.
shift y read m.c.
select appropriate exit ʃ sub-routine
prepare to assemble or examine
E TRANS(8).
A
KAJX
c.n.
exits to TRANS(1)
TRANS(6) (beg, m.c.)
TRANS(8)
exit to complex ⊗⊖
exit to complex ⊗
exit to complex ⊗⊖
exit to complex ⊕
1ZT½
CuE
No.
Corrections
u@ → M@QG
M@ → E½//
@A → AE@N
BG → SAT/
ʂE → //2A
"E → I//P
A/ → //T½
:/ → //T½
S/ → //T½
AA → 0E//

p24


MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY
Programme Sheet A
ROUTINE TRANS(8)
Date 22/May/55
K1½1
K1DE
K1R1
K1J@
KMD:
CuE
No.

p25

MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE TRANS(8) page 0 Date 25/8/55

M K / @ ½
K / ½ /

K / D E

/					E				
/	M	E	/	:	/	/	/	Z	A
E	M	K	T	/	E	X	E	/	P
@	E	N	T	C	@				
A	E	N	T	A	A				
:	M	K	T	/	:				
S	A	N	T	C	S				
I	A	N	T	A	I				
U	M	K	T	/	U				
½	S	N	T	C	½				
D	S	N	T	A	D				
R	M	K	T	/	R				
J	W	N	T	C	J				
N	W	N	T	A	N				
F	O	K	T	/	F				
C	C	N	T	C	C				
K	C	N	T	A	K				
T	O	K	T	/	T				
Z	T	N	T	C	Z				
L	T	N	T	A	L				
W	O	K	T	/	W				
H	L	N	T	C	H				
Y	L	N	T	A	Y				
P	O	K	T	/	P				
Q	H	N	T	C	Q				
O	H	N	T	A	O				
B	"	E	/	:	B				
G	P	I	T	K	G				
"	P	I	T	A	"	Z	E	/	½
M	P	I	Q	O	M	J	E	E	N
X	/	D	Q	/	X	T	S	/	/
V	G	C	T	A	V	~~Z~~	E	/	/
£	V	E	T	/	£	D	E	@	/

K II D S

use density
~~data tube 6~~ → tube 4

Lets tube 6

C.N. for R.C.S.

use 6 TRANS(6)
Entry 02

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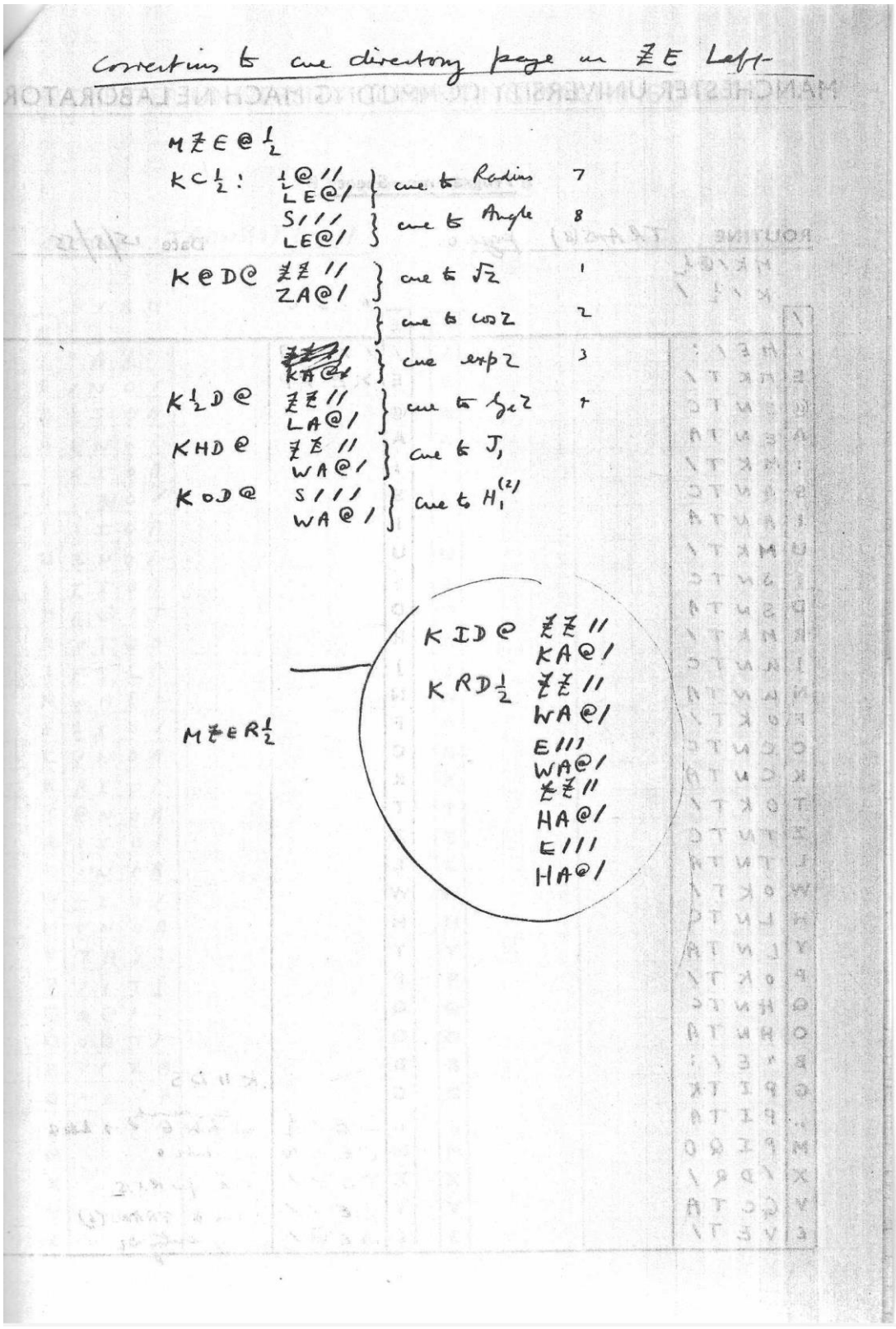
Corrections to one directory page in ZE Left-
MZE@½
KC½: ½@// LE@/ } one to Radius 7
S/// LE@/ } one to Angle 8
K@D@ ZZ// ZA@/ } one to √2 1
} one to cos 2 2
} one exp 2 3
K½D@ ZZ// LA@/ } one to sin 2 4
KHD@ ZZ// WA@/ } one to J1
KoD@ S/// WA@/ } one to H1(2)
MZER½
KID@ ZZ// KA@/
KRD½ ZZ// WA@/
E///
WA@/
ZZ//
HA@/
E///
HA@/

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

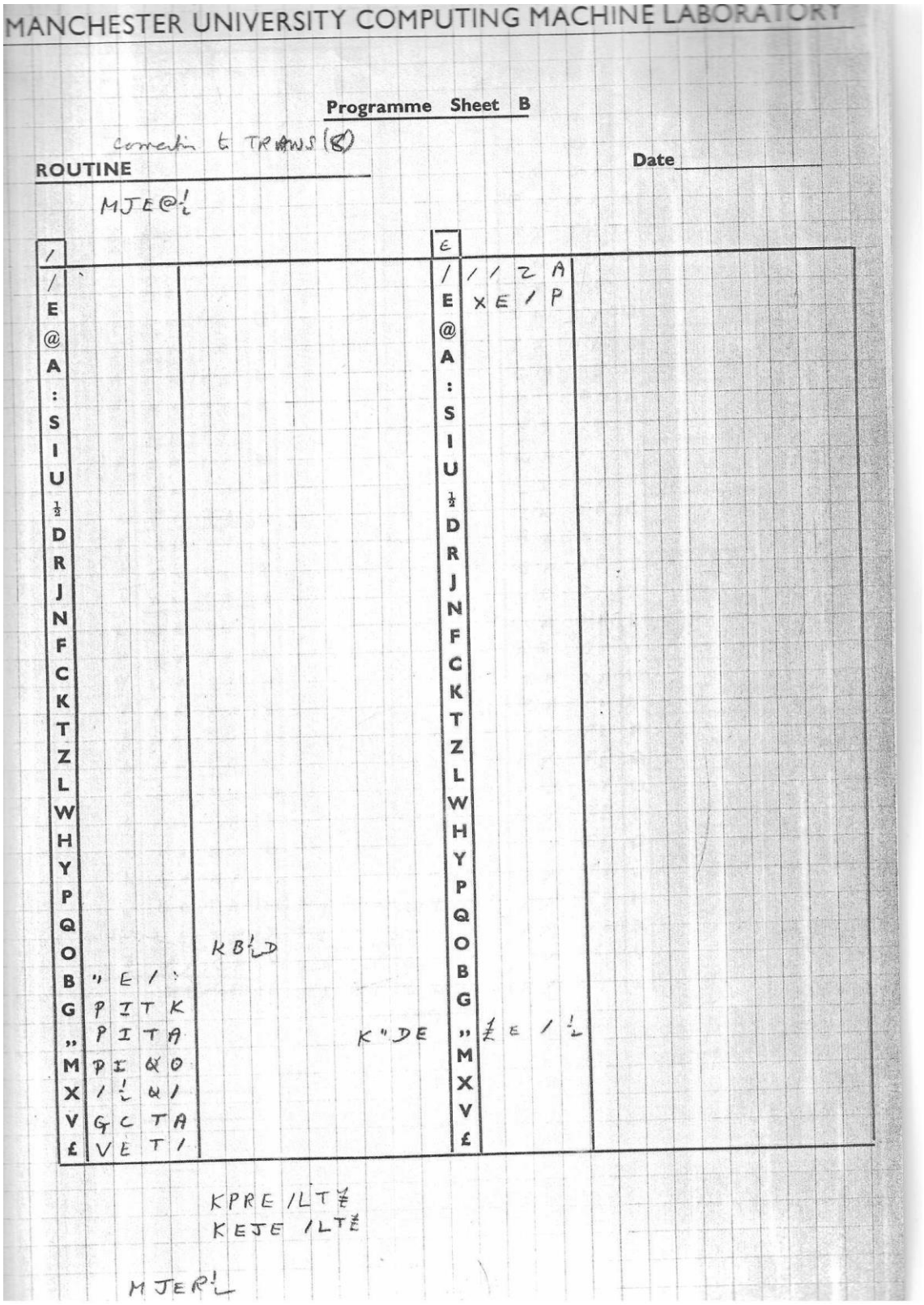
Programme Sheet B

ROUTINE TRANS(8) page 1 Date 25/8/55

N	K	R	M		F
/	"	A	½	:	/
E	/	N	0	/	E
@	½	I	0	A	@
A	@	N	0	/	A
:	R	I	0	A	:
S	:	N	0	/	S
I	:	I	0	A	I
U	I	N	0	/	U
½	I	I	0	A	½
D	G	@	/	J	D
R	/	T	Q	0	R
J	F	S	½	P	J
N	W	A	½	:	N
F	½	I	0	/	F
C	/	N	0	A	C
K	R	I	0	/	K
T	@	N	0	A	T
Z	:	I	0	/	Z
L	:	N	0	A	L
W	I	I	0	/	W
H	I	N	0	A	H
Y	Z	A	½	:	Y
P	/	L	T	½	P
Q	Q	@	/	:	Q
O	0	@	T	/	O
B	/	/	Z	A	B
G	↳	E	/	P	G
,,	T	S	/	/	,,
M					M
X					X
V					V
£					£

MJER½

p28



MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

Correction to TRANS (8)

ROUTINE

Date

MJE@!

/	/	E	@	A	:	S	I	U	½	D	R	J	N	F	C	K	T	Z	L	W	H	Y	P	Q	O	B	G	"	M	X	V	£
	"	E	/	:																												
	P	I	T	K																												
	P	I	T	A																												
	P	I	Q	O																												
	/	!	Q	/																												
	G	C	T	A																												
	V	E	T	/																												

KB!D

K"DE

/	E	@	A	:	S	I	U	½	D	R	J	N	F	C	K	T	Z	L	W	H	Y	P	Q	O	B	G	"	M	X	V	£
/	/	2	A																												
E	X	E	/	P																												

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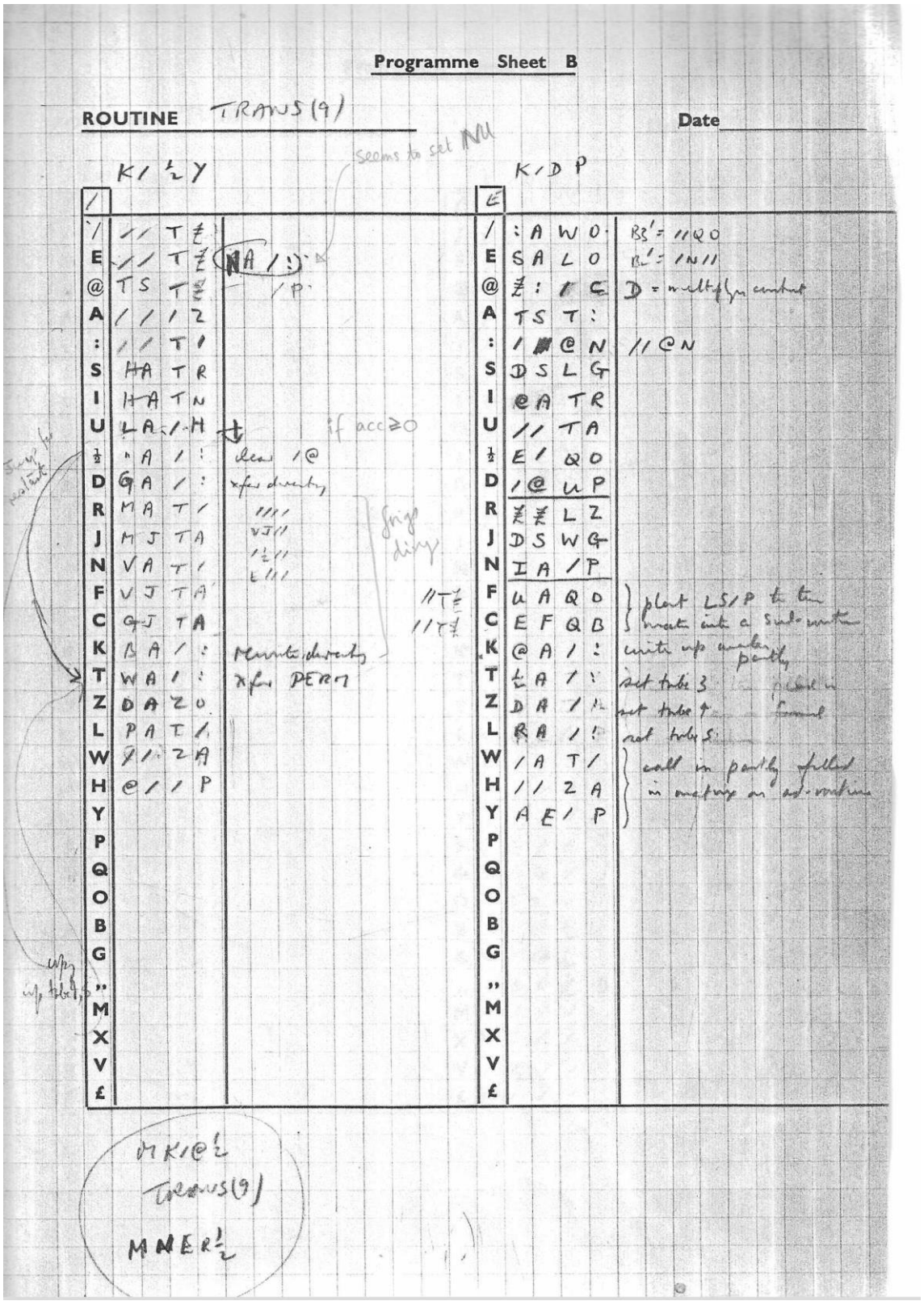
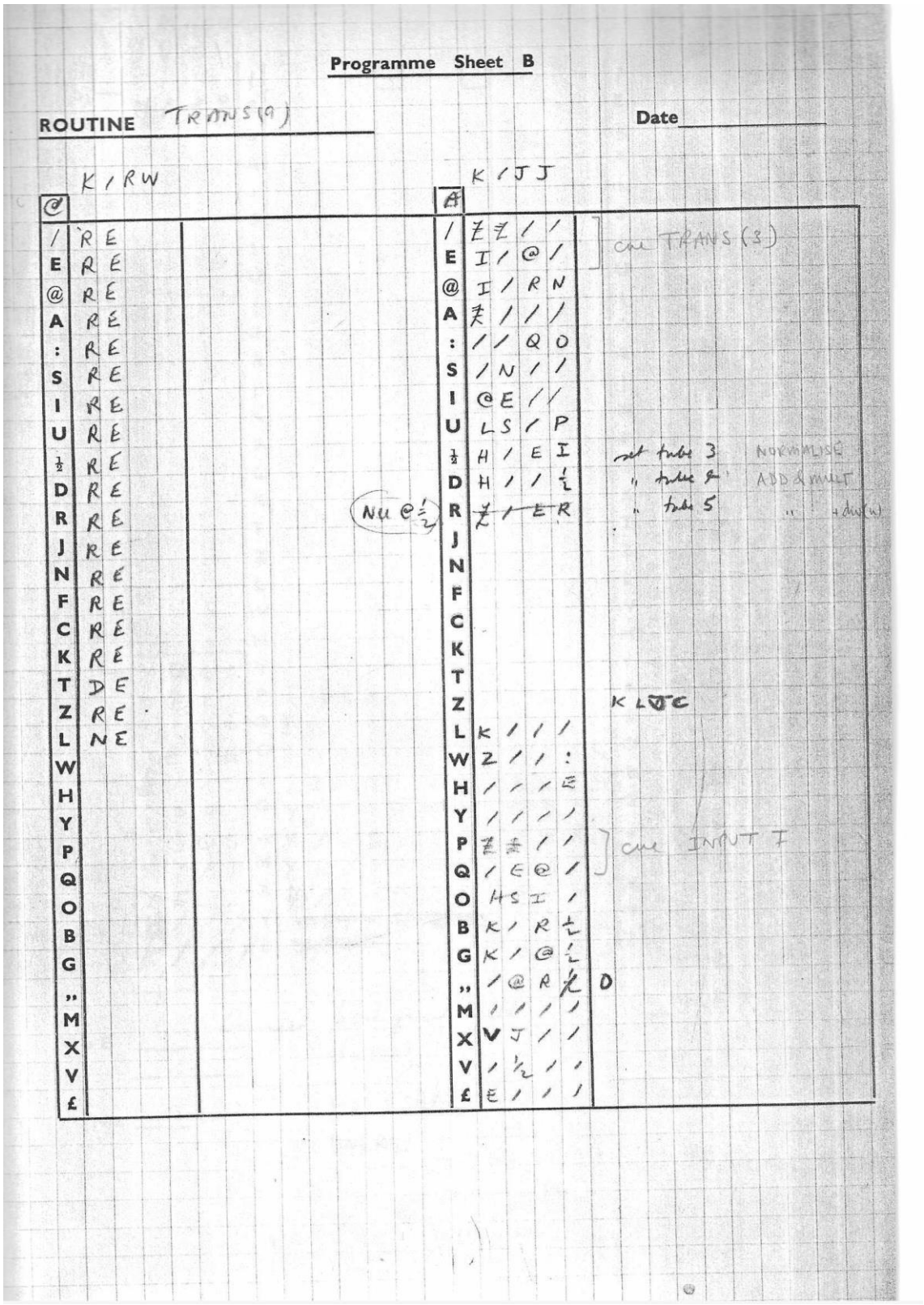

Programme Sheet B
ROUTINE TRANS(9)
Date
K/½Y
K/D P
seems to set NN
if acc≥0
clear 1@
xfer directly
Insert directly
xfer PERM
plant LS/P to turn
insert into a sub-routine
write up number
partly
set tube 3
set tube 4
set tube 5
call in partly filled
in one way or another
MK/@½
TRANS(9)
MNER½

p30



Programme Sheet B

ROUTINE TRANS(9)

Date

@	K / R W
/	R E
E	R E
@	R E
A	R E
:	R E
S	R E
I	R E
U	R E
½	R E
D	R E
R	R E
J	R E
N	R E
F	R E
C	R E
K	R E
T	D E
Z	R E
L	N E
W	
H	
Y	
P	
Q	
O	
B	
G	
"	
M	
X	
V	
£	

A	K / J J	
/	≠ ≠ / /	] cal TRANS (3)
E	I / @ /	
@	I / R N	
A	≠ / / /	
:	/ / Q O	
S	/ N / /	
I	@ E / /	
U	L S / P	
½	H / E I	set tube 3 NORMALISE
D	H / / ½	" tube 4 ADD & MULT
R	≠ / E R	" tube 5 " + div(+)
J		
N		
F		
C		
K		
T		
Z		K L O C
L	K / / /	
W	Z / / :	
H	/ / / ≤	
Y	/ / / /	
P	≠ ≠ / /	] cal INPUT I
Q	/ ∈ @ /	
O	H S I /	
B	K / R ½	
G	K / @ ½	
"	/ @ R ≠	D
M	/ / / /	
X	V J / /	
V	/ ½ / /	
£	E / / /	

Nu @ = ½

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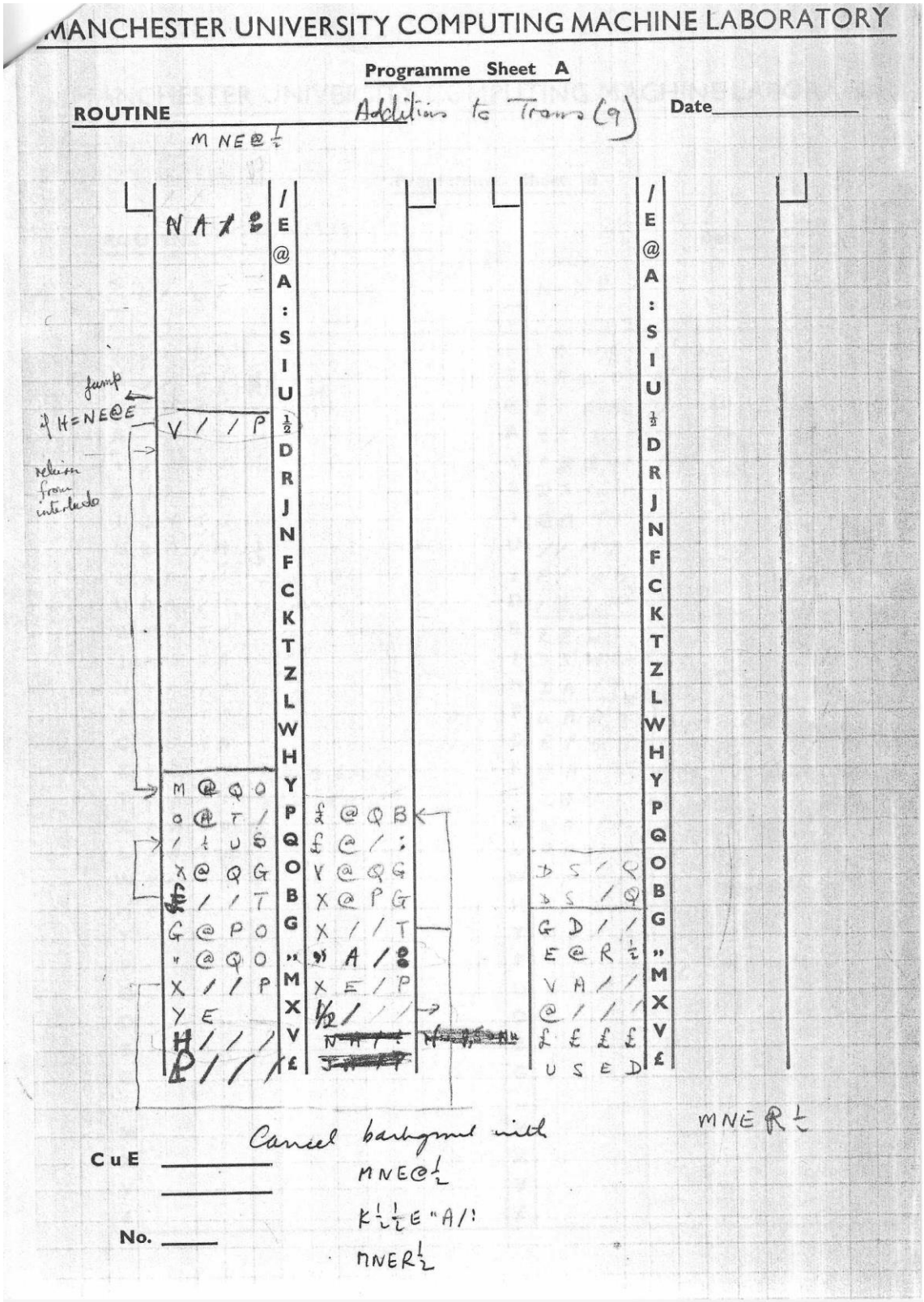
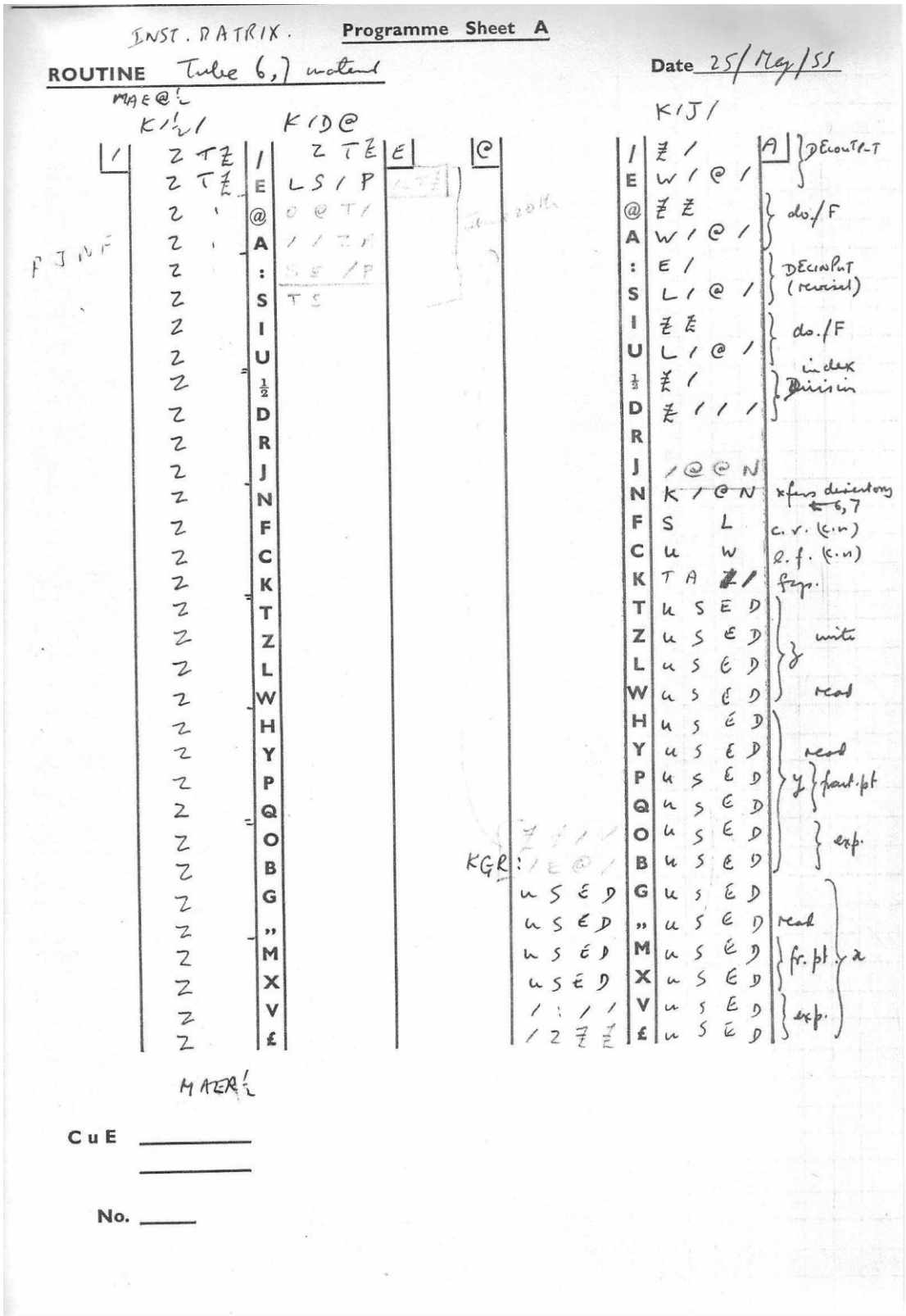

MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY
Programme Sheet A
ROUTINE
Addition to Trans (9)
Date
MNE@½
/E@A:SIU½DRJNFCKTZLWHYPQOBG„MXV£
jump
if H=NE@E
return from interlude
Cancel background with
MNE@½
K½½E"A/:
ΠNER½
MNER½
CuE
No.

p32


INST. MATRIX.
Programme Sheet A
ROUTINE Tube 6,7 material
Date 25/May/55
DECOUPLT
do./F
DECINPUT (reversed)
do./F
index
Digits in
xfers directions ← 6,7
c.r. (c.n)
l.f. (c.n)
fixp.
units
read
read
y fixed pt
exp.
read
fr. pt. x
exp.
CuE
No.

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE CONVERTER(SPECIAL) **Date** 19/May/55

K1½Z

/			E		
/	G E / u		/		
E	M E / u		E		
@	Y E T /	set m & CONVERTER	@		
A	/ / Z A		A		
:	V E / C	$D' = \frac{D}{10}$	:		
S	M E Q 0	set BJ = decimal exponent	S		
I	W E / T		I		
U	I S T /		U		
½	0 E / N		½		
D	0 E / u	multiply by $\frac{1}{10}$ the appropriate no. of times	D		
R	G E / F		R		
J	0 E / S		J		
N	G E / A		N		
F	D S Q G		F		
C	Q E / P		C		
K	G E / J	converter entered as	K		
T	H E / P	convert to floating	T		
Z	~~S T / P~~	~~bring [illegible] and add~~	Z		
L			L		KWDF
W		convert exponent	W	C / / /	
H			H	T S / /	
Y		$\left(\frac{2^3}{10}\right)^{\beta} \times 2^{3\beta}$	Y	Z Z / /	} m & CONVERTER
P			P	Z / E /	
Q		by adding β to exponent	Q	S / /	c.m.
O			O	/ / / /	
B			B	/ / / /	
G			G	u S E D	} integral part
,,			,,	u S E D	
M			M	u S E D	} decimal exponent (-w)
X			X	u S E D	
V			V	G N I W	} $\frac{1}{10}$
£			£	B N I A	

On entry $x = n.10^{-\beta}$ where $n = L_{\pm}$ $\beta = M_{\pm}$

On exit $x = a.2^{-\beta}$ " $a = L_{\pm f}$ $2\beta = M_{\pm}$

~~$\frac{1}{2} \leq a < 1$~~ $\frac{1}{2} \leq |a| < 1$

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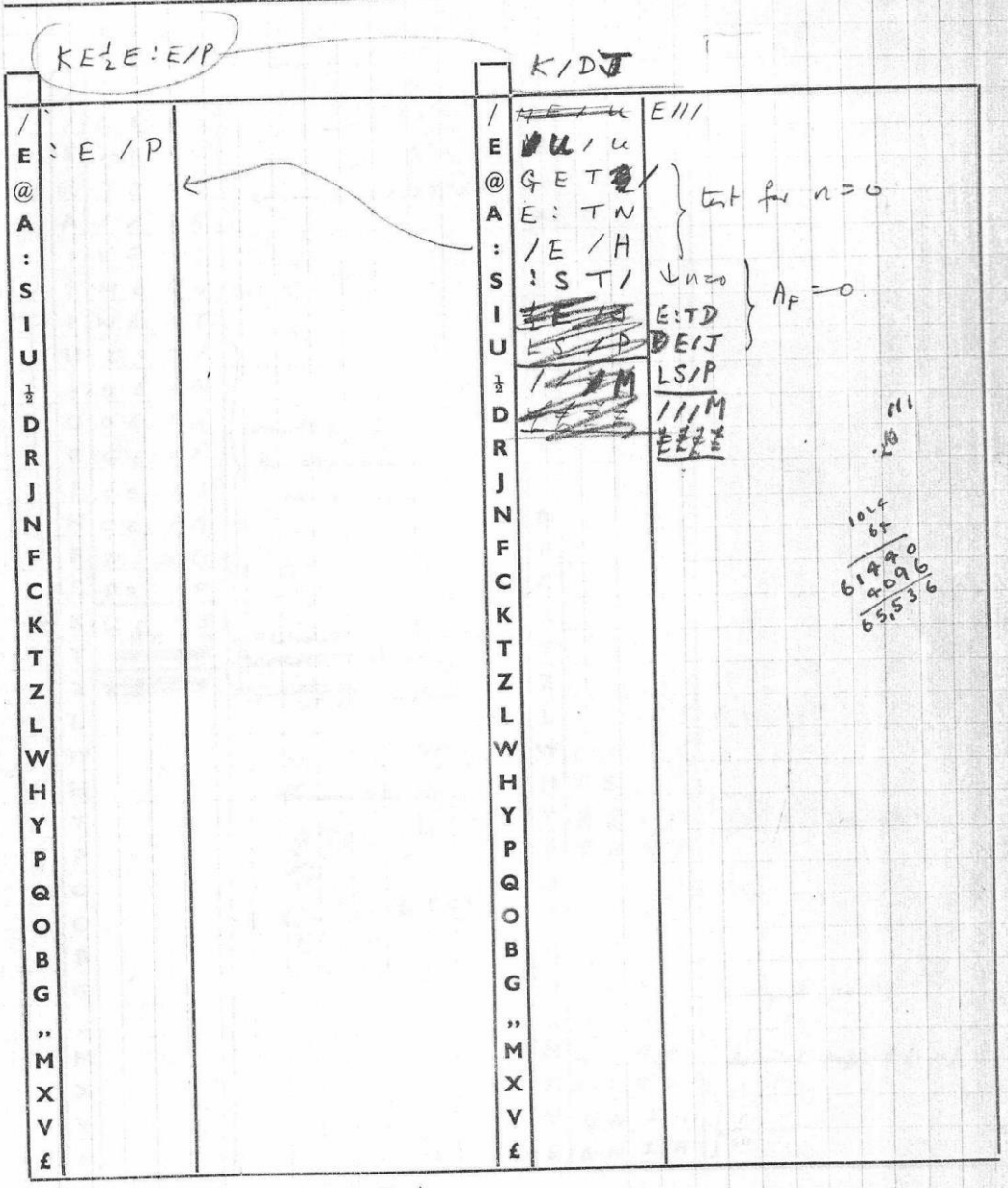
MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

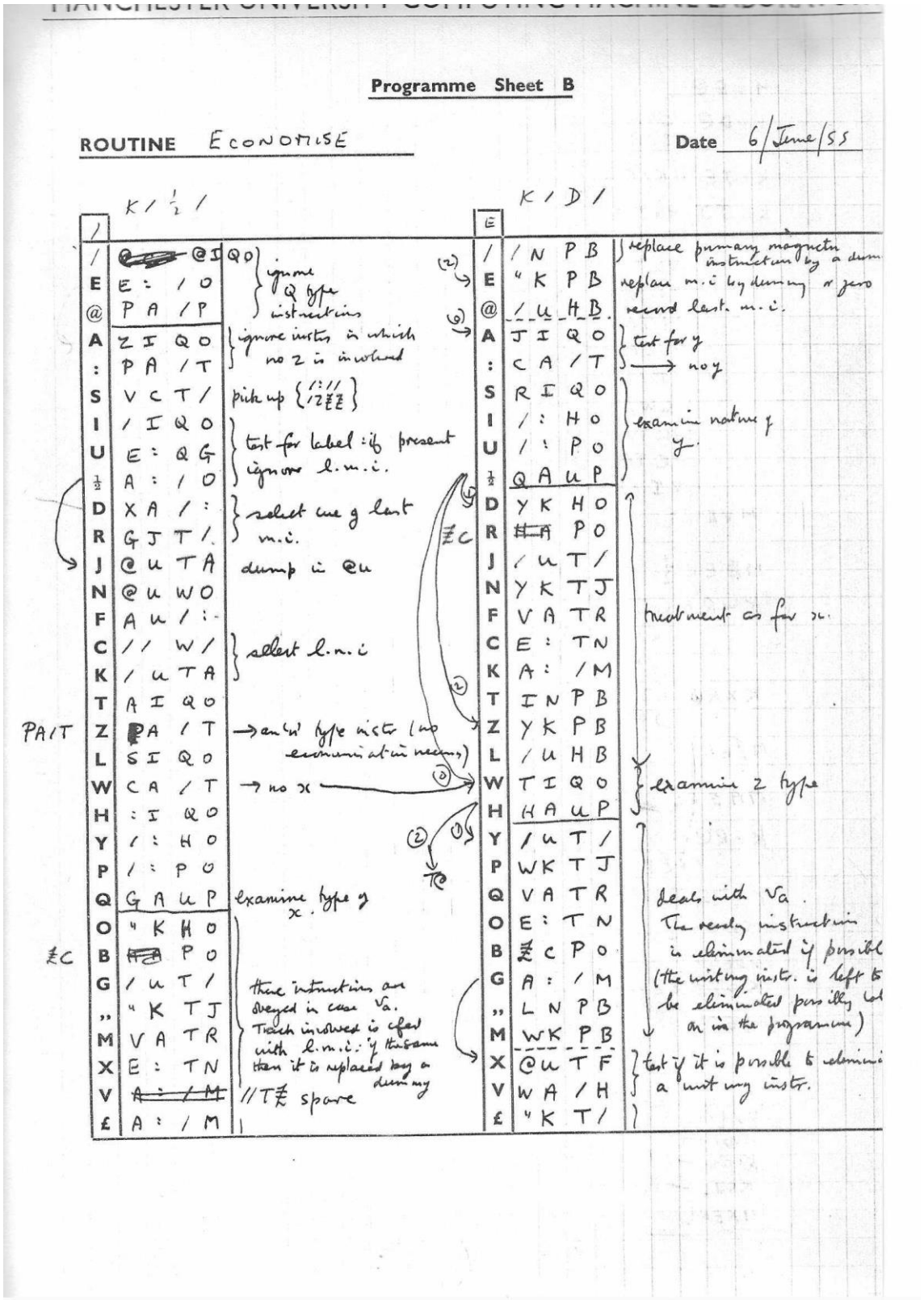
Correct to CONVTR(SPECIME)

ROUTINE

Date 18/July/55



p35


Programme Sheet B
ROUTINE ECONOMISE
Date 6/June/55
K/½/
K/D/
ignore Q type instructions
ignore instrs in which no Z is involved
pick up
test for label : if present ignore l.m.i.
select use g last m.i.
dump in Qu
select l.m.i
examine type g x.
these instructions are obeyed in case Va. Each involved is after with l.m.i. if the same then it is replaced by a dummy
// TZ spare
PAIT
ZC
replace primary magnetic instructions by a dum
replace m.i by dummy or zero
record last m.i.
test for g
→ no g
examine nature of g.
treatment as for x.
examine z type
deals with Va.
The wanted instruction is eliminated if possible
(the existing instr. is left to be eliminated possibly lat or in the programme)
test if it is possible to eliminate a existing instr.

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Programme Sheet B

ROUTINE ECONOMISE **Date** 6/June/55

K / R W

@					A				
/	Y	K	T	R	/				
E	W	K	T	R	E				
@	U	S	T	R	@				
A	U	S	T	N	A				
:	E	:	/	M	:				
S	W	A	/	P	S				
I	@	U	T	/	I				
U	G	:	T	C	U				
½	/	U	T	A	½				
D	D	S	H	O	D				
R	D	S	W	G	R				
J	£	£	W	Z	J				
N	E	U	/	:	N				
F	Z	A	T	/	F				
C	/	/	Z	A	C	L	E	/	/
K	T	A	/	P	K	/	/	/	/
T	H	A	Q	O	T	T	S	/	/
Z	K	K	Q	B	Z	£	£	/	/
L	W	A	/	P	L	V	E	@	/
W					W	[redacted]		N@	//
H					H	½	@	/	/
Y					Y	[redacted]	H	@	//
P					P	K	@	/	/
Q					Q	L	E	/	/
O					O	½	E	/	/
B					B	T	E	/	/
G					G	@	E	/	/
,,					,,	Q	/	/	/
M					M	/	E	/	/
X					X	K	/	@	½
V					V	£	£	/	/
£					£	/	/	/	/

y all reading m.i's between two writing instructions are dummies, then the 1st writing instr is unnecessary

replace the writing instruction by a dummy

assembly

sets a switch so that assembly routine need not bother to look for a writing instr.

K C J L

C.n

[redacted] space

} use to ASSEMBLY

} 2-way switch HE11

} 3-way switch

} 3-way switch

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/

MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE Sub-routine cue directory **Date**

K@½N

/		
/		
E		
@	Z Z	cue to SQ.RT/F
A	P / @ /	
:	Z Z	" " COSINE/F
S	Q / @ /	
I	Z Z	" " EXP/F
U	O / @ /	
½	Z Z	" " LOGE/F
D	B / @ /	
R	Z Z	" " ARCTAN/F
J	G / @ /	
N	Z Z	" ordinal
F	Z / / /	
C		
K		
T		
Z		
L		
W		
H		
Y		
P		
Q		
O		
B		
G		
"		
M		
X		
V		
£		

E		
/		
E		
@	1	$\sqrt{z}$ ✓
A		
:	2	$\cos z$
S		
I	3	e^z
U		
½	4	$\log_e(z)$ ✓
D		
R	5	
J		
N	6	
F		
C	7	
K		
T	8	
Z		
L	9	
W		
H	10	$J_1(z)$ ✓
Y		
P	11	$H_1^{(1)}(z)$
Q		
O	12	$H_1^{(2)}(z)$ ✓
B		
G		
"		
M		
X		
V		
£		

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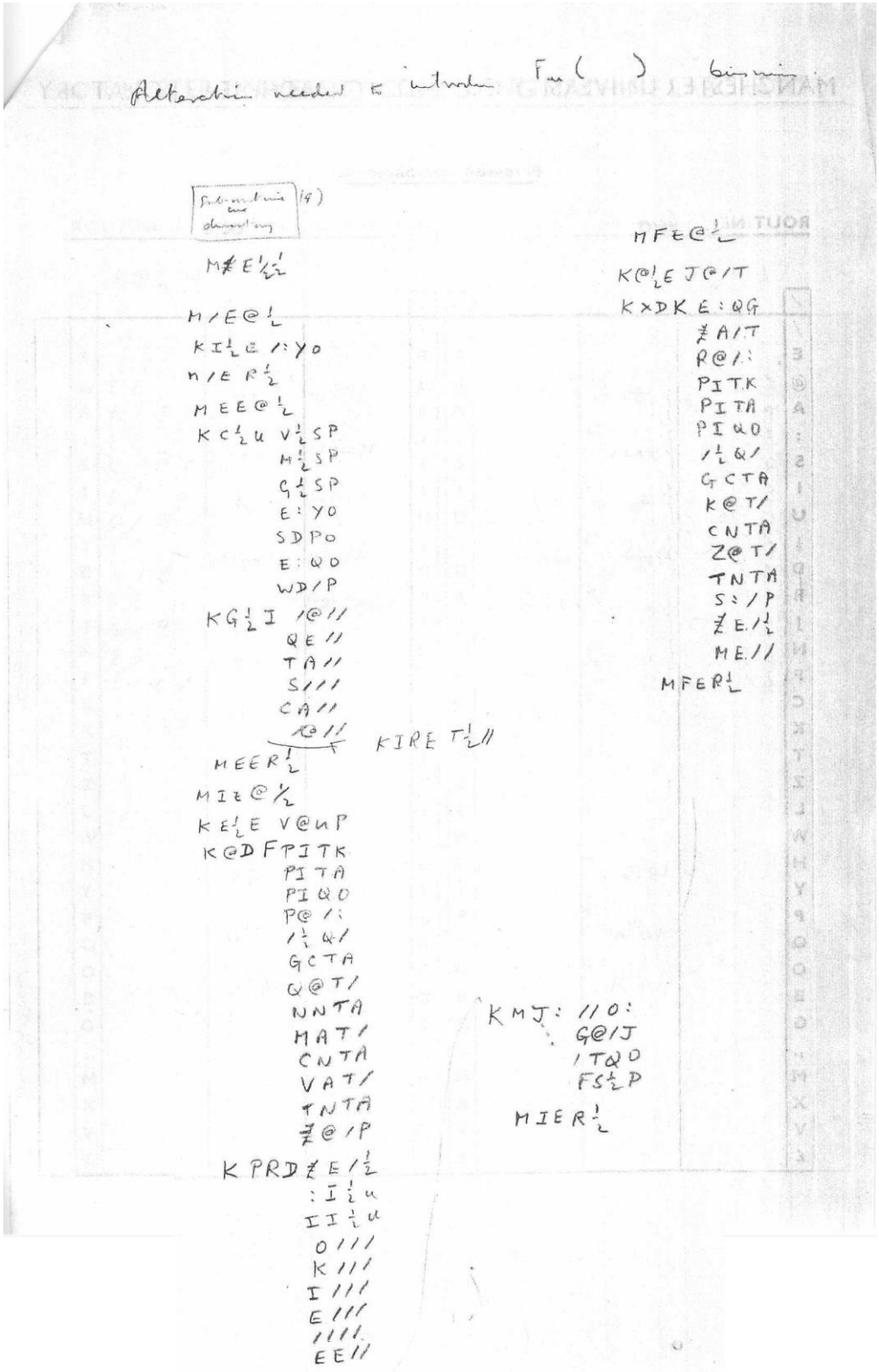

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE functions and derivatives (↑E left) goes on main autocode tape. **Date**

	Real		Complex	
K@½L / K@D½	/		/	
	E		E	
	@	cosine sq. root x	@	√z
	A		A	
	:	sine 2π x	:	cos z
	S		S	
	I	exp. x	I	exp z
	U		U	
	½	$\log_e x$	½	$\log_e z$
	D		D	
	R	$\frac{\arctan x}{\pi}$	R	
	J		J	
	N	|x|	N	
	F		F	
	C	$\sqrt{x^2+y^2}$	C	
	K		K	
	T	$\arctan(\frac{y}{x})$	T	
	Z		Z	
	L	Runge Kutta	L	
	W		W	
	H		H	
	Y		Y	
	P		P	
	Q		Q	
	O		O	
	B		B	
	G		G	
	"		"	
	M		M	
	X		X	
	V		V	
	£		£	

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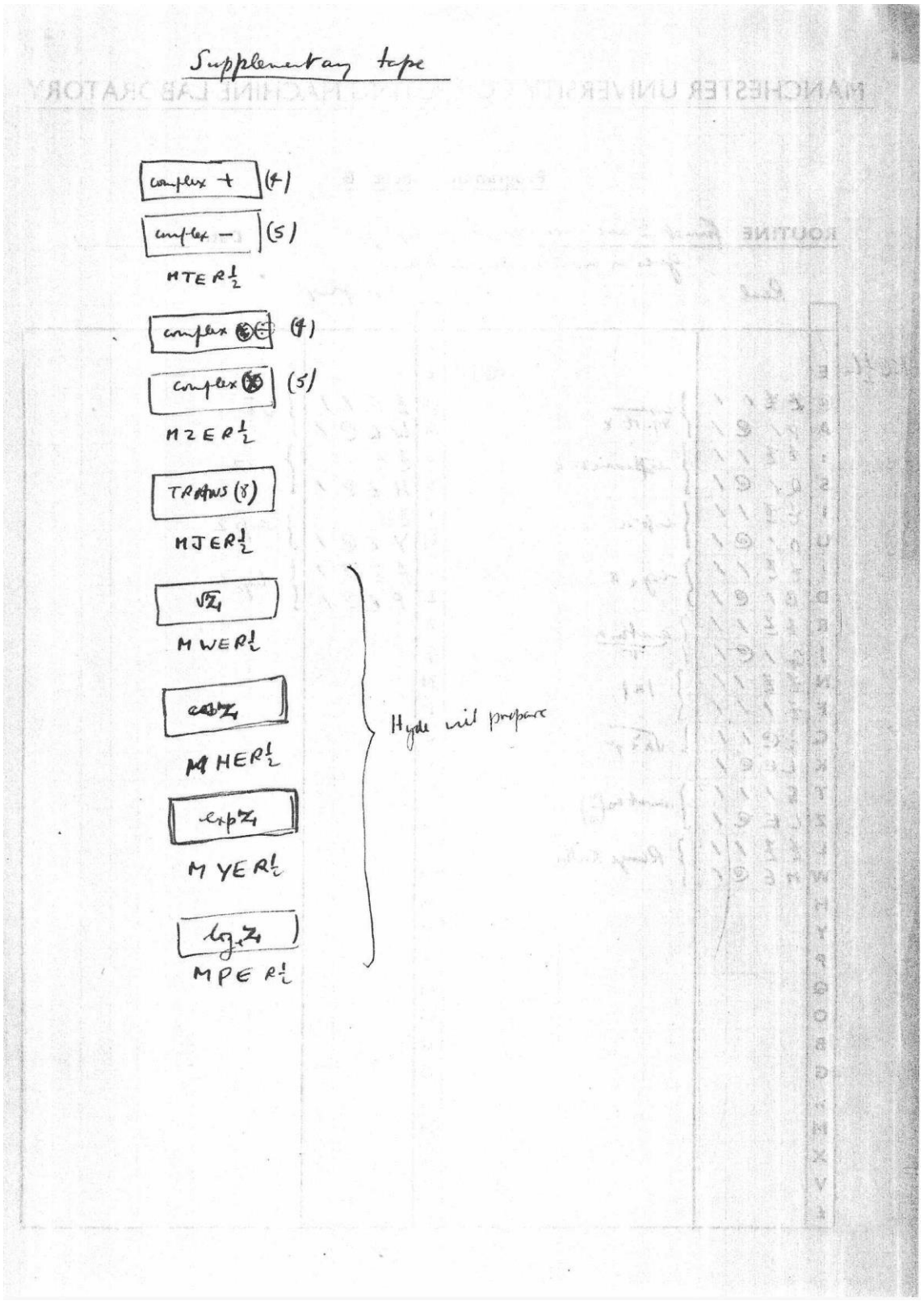
Supplementary tape
complex + (4)
complex − (5)
MTER½
complex × (4)
complex ÷ (5)
MZER½
TRANS (8)
MJER½
√Z1
MWER½
cosZ1
MHER½
expZ1
MYER½
log10Z1
MPER½
Hyde will prepare

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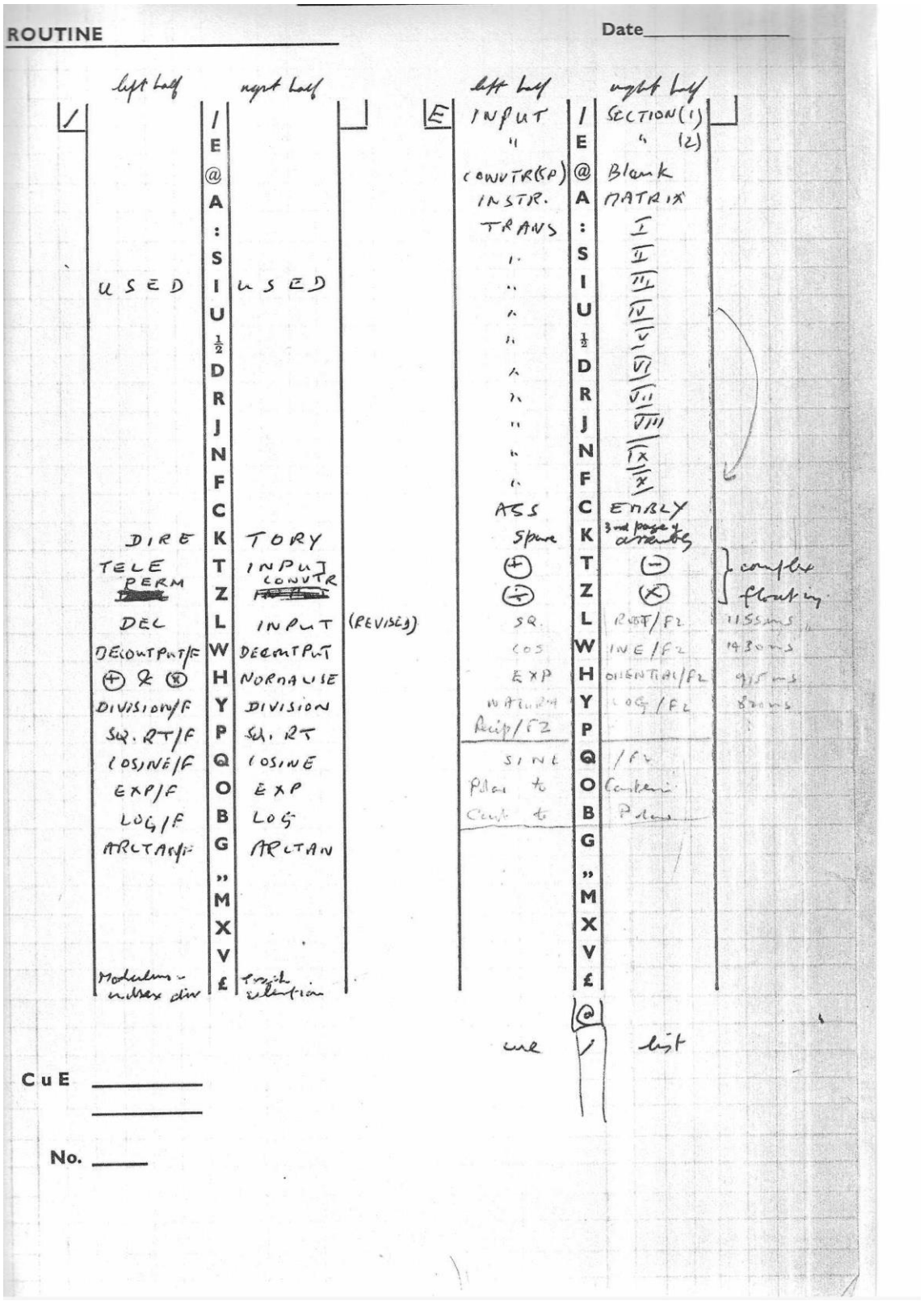
ROUTINE
Date
left half
right half
USED
USED
DIRE
TORY
TELE
PERM
INPUT
CONVTR
DEL
INPUT
(REVISED)
DECOUTPUT/F
DECOUTPUT
⊕ & ⊗
NORMALISE
DIVISION/F
DIVISION
SQ. RT/F
SQ. RT
COSINE/F
COSINE
EXP/F
EXP
LOG/F
LOG
ARCTAN/F
ARCTAN
Modulus - integer division
Fixed point
left half
right half
INPUT
SECTION (1)
" (2)
CONVTR(SP)
Blank
INSTR.
MATRIX
TRANS
I
II
III
IV
V
VI
VII
VIII
IX
X
ASS
ENTRY
Spare
3rd page of assembly
⊕
⊖
⊗
complex floating
SQ.
ROOT/F2
1155 m/s
COS
INE/F2
1930 m/s
EXP
ONENTIAL/F2
915 m/s
LOG/F2
820 m/s
Recip/F2
SINE
/F2
Plan to
Conkeni
Cent to
Plan
use
list
CuE
No.

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE Assembly (Tube 3) **Date** 25/May/55

I			u		
/	Ò /		/	u S Ē D	u_0
E	O /		E	u S E D	l_0+1
@	B E		@	u S Ē D	u
A	B E		A	u S Ē D	$l+1$
:	O /		:	u S E D	r_0
S	O /		S	U @	3-way switch
I	O /		I	W @	
U	O /		U	/ A	
½	O /		½	/ N T /	
D	O /		D	/ / W A	
R	O /		R	/ N H O	
J	O /		J	Ƶ Ƶ W Z	
N	O /		N	u S Ē D	
F	O /		F	u S E D	
C	O /		C	A / / /	
K	O /		K	V J / /	
T	P E	n, Q0 n, Ƶ0 dummy	T	/ ½ / /	
Z	Z /		Z	B D / P	
L	T E	finish	L	G @	
W	G J T A		W	Ƶ / / /	
H	X A / ;		H	/ / Ƶ Ƶ	
Y	L S / P		Y	Ƶ Ƶ / /	
P	Y I T :		P	/ / / /	
Q	V I / P		Q	B /	
O			O	½ A	2 way switch (55)
B			B	Z /	
G			G	u S E D	
,,			,,	u S E D	
M			M	u S E D	
X	L I		X	u S E D	
V	D @		V	~~D~~ ½ @	2 way switch (55)
£	G /		£	K @	

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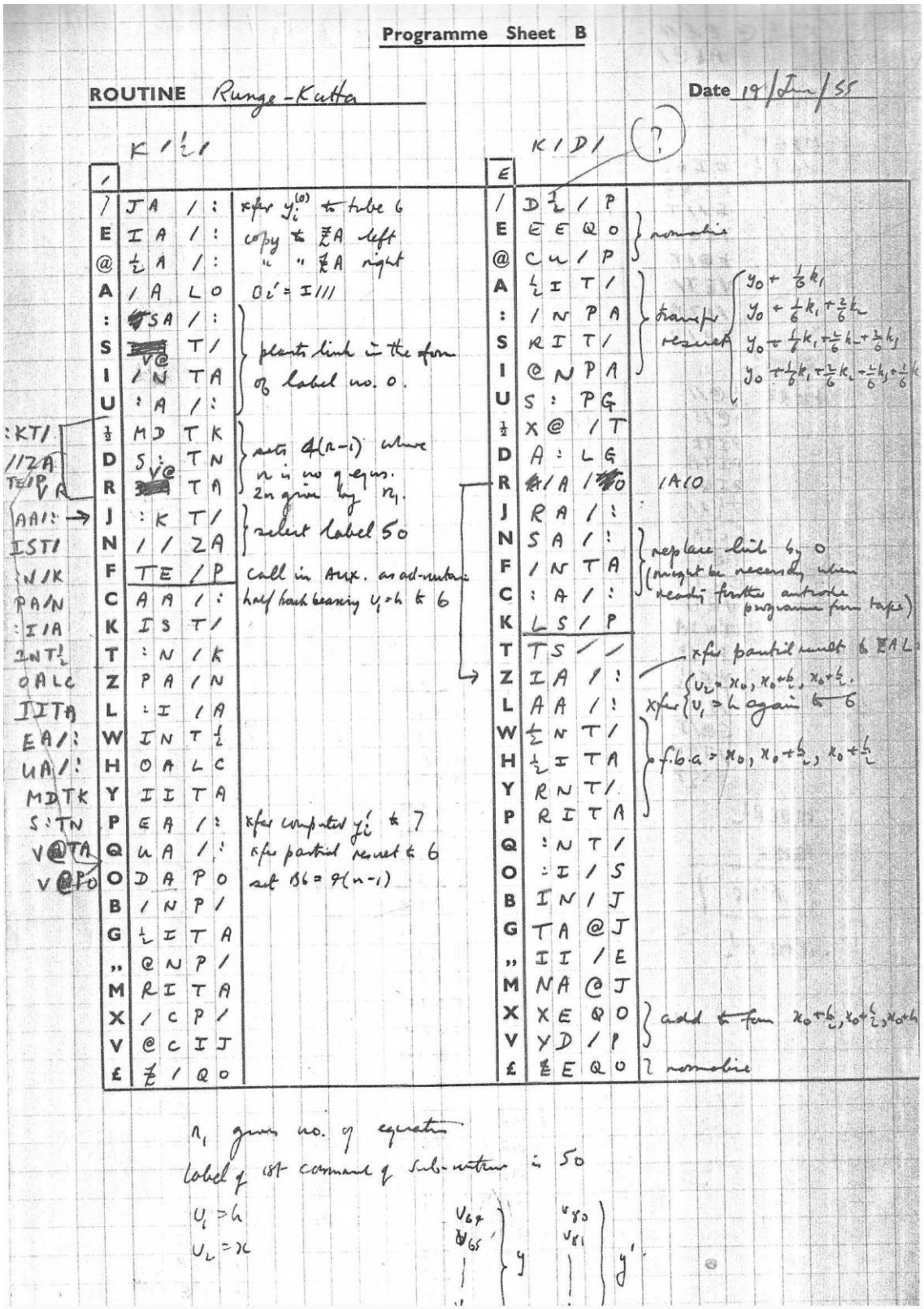
Programme Sheet B
ROUTINE Runge-Kutta
Date 19/Jun/55
K/½/
K/D/
(?)
/ JA / : xfer $y_i^{(0)}$ to tube 6
E IA / : copy to ½A left
@ ½A / : " " ½A right
A / A L 0 0i' = I///
: SA / :
S VC T /
I / N T A plants link in the form
U : A / : of label no. 0.
½ MD T K
D S : T N sets 4(n-1) where
R T A n is no of eqns.
2n given by n_1.
J : K T / select label 50
N / / ZA
F TE / P call in Aux. as sub-routine
C A A / : half back bearing $U_1 = h$ to 6
K I S T /
T : N / K
Z P A / N
L : I / A
W I N T ½
H O A L C
Y I I T A
P E A / : xfer computed y_i' to 7
Q U A / : xfer partial result to 6
O D A P 0 set 86 = 4(n-1)
B / N P /
G ½ I T A
„ @ N P /
M R I T A
X / C P /
V @ C I J
£ £ / Q 0
/ D ½ / P
E E Q 0 } nonsense
@ C U / P
A ½ I T / } transfer required
: / N P A
S R I T /
I @ N P A
U S : P G
½ X @ / T
D A : L G
R A / 0 1A10
J R A / :
N S A / : } replace link by 0
F / N T A (might be necessary when
C : A / : reading further instructions
K L S / P from tape)
T T S / / xfer partial result to EAL
Z I A / : xfer {$U_2 = x_0, x_0+h_2, x_0+\frac{h}{2}$.
L A A / : {$U_1 = h$ again to 6
W ½ N T /
H ½ I T A } f.b.a = $x_0, x_0+\frac{h}{2}, x_0+h$
Y R N T /
P R I T A
Q : N T /
O : I / S
B I N / J
G T A @ J
„ I I / E
M N A @ J
X X E Q 0 } add to form $x_0+h_2, x_0+\frac{h}{2}, x_0+h$
V Y D / !
£ £ E Q 0 ? nonsense
:KT/
//ZA
TE/P
VA
AA/: →
IST/
:N/K
PA/N
:I/A
INT½
OALC
IITA
EA/:
UA/:
MDTK
S:TN
V@TA
V@PO
n_1 gives no. of equations
label of 1st command of sub-routine = 50
$U_1 = h$
$U_2 = x$
V_{67} V_{68} V_{69} } y
V_{80} V_{81} } y'

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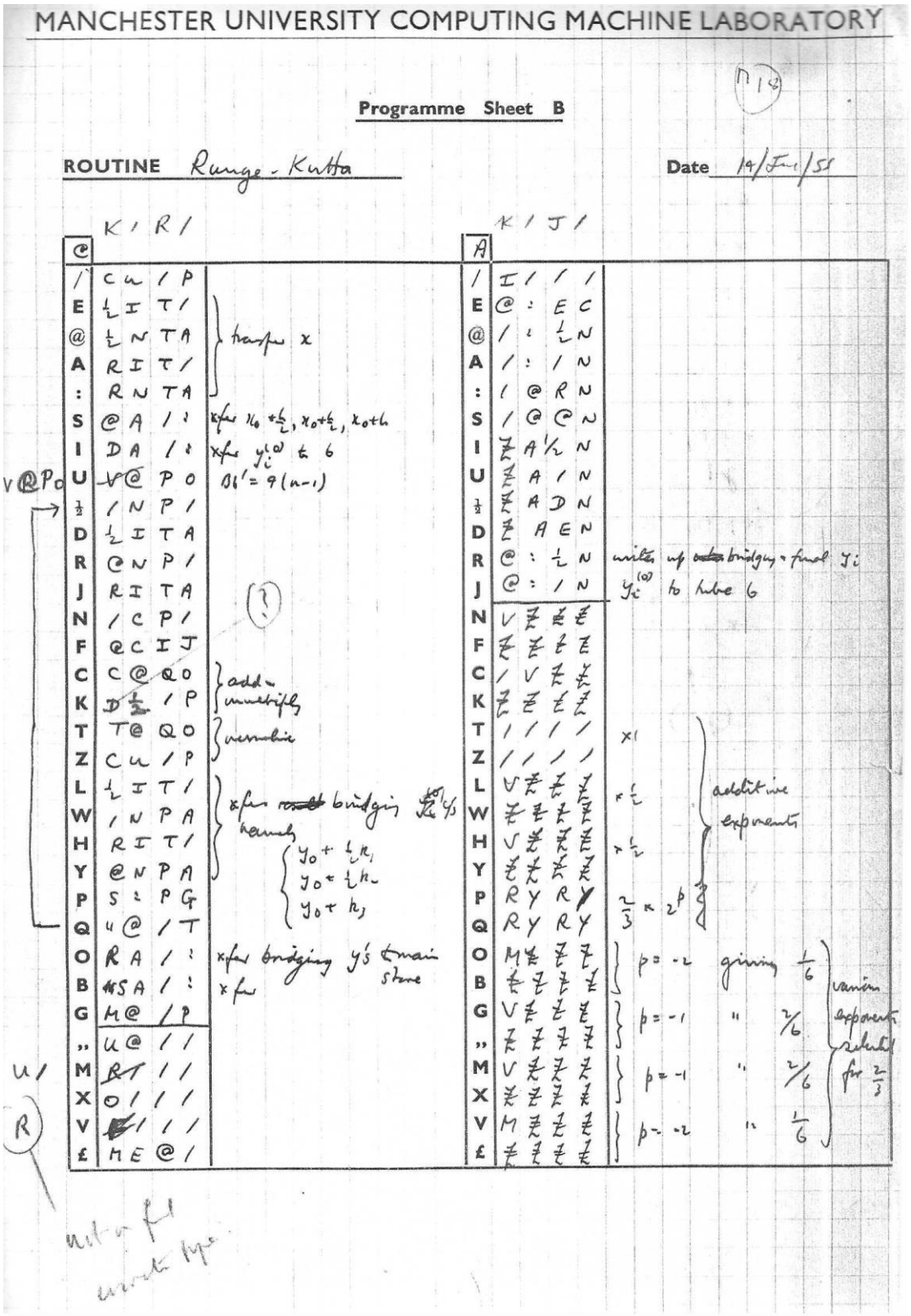
MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY
Programme Sheet B
ROUTINE Runge-Kutta
Date 19/Jun/55
transfer x
xfer y_i^(0) & 6
writes up bridging + final y_i
y_i^(0) to tube 6
add + multiply
variable
bridging
main
store
adolitive exponents
p = -2 giving 1/6
p = -1 " 2/6
p = -1 " 2/6
p = -2 " 1/6
variable exponent subroutine for 2/3

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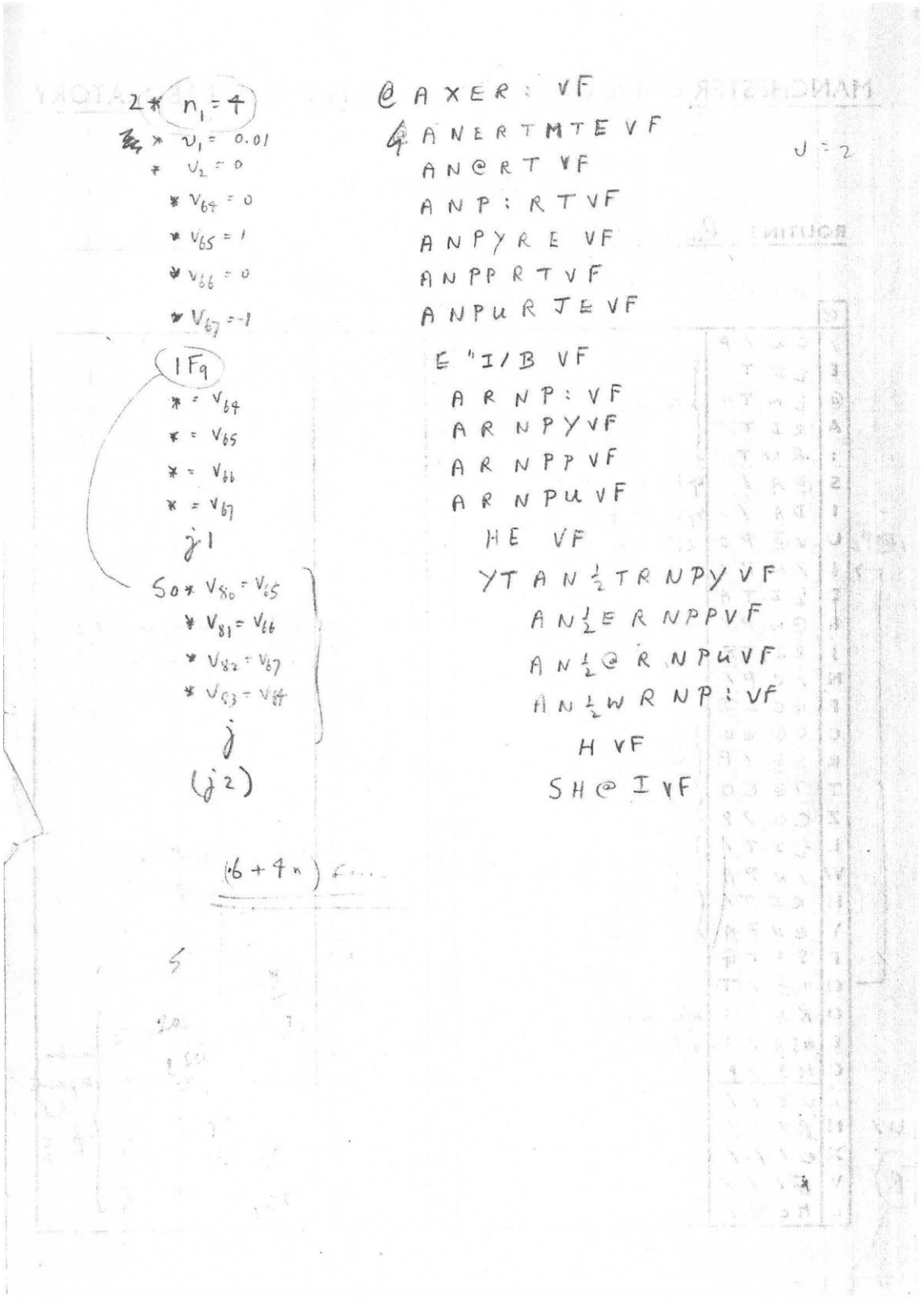
2* n1 = 4
* v1 = 0.01
* v2 = 0
* v64 = 0
* v65 = 1
* v66 = 0
* v67 = -1
IFq
* = v64
* = v65
* = v66
* = v67
j1
So* v80 = v65
* v81 = v66
* v82 = v67
* v83 = v68
j
(j2)
(6 + 4n)
@ A X E R : VF
4 A N E R T M T E V F
A N @ R T VF
A N P : R T VF
A N P Y R E VF
A N P P R T V F
A N P u R J E VF
E "I/B VF
A R N P : VF
A R N P Y VF
A R N P P VF
A R N P u VF
H E VF
YT A N ½ T R N P Y V F
A N ½ E R N P P V F
A N ½ @ R N P u V F
A N ½ W R N P : VF
H VF
S H @ I VF
J = 2

Components of Autocode

	# of Tubes	action	req'd
Translator	I		
	II		
	III		
	IV		
	V		
	VI		
	VII		
	VIII	complex of.	
	IX		
	X		
Input	I	bootstrap read of instr.	✓
"	II		✓
Instr Matrix			✓
Economizer		eliminate unec. nogo's.	✓
Magnetic location		jumps – part of prog.	✓
Main assembly			✓

/Z (S' = H) needs fixing.

Simplest program 1 * n = 1 cr lf
(j 1) cr lf

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Material in Brookes Notes on Autocode.

INPUT (1) 18 May 55
(2) "

CONVERTER (special) 19 May 55 correction 18/July/55

DIRECTORY 23 May 55

DEC OUTPUT/F 22 May 55, 1st July

DECINPUT (REVISED) 20 May 55

DIVISION/F 19 May 55

TRANS (1) 18 May 55
TRANS (2) "
(3) "
(4) 19 May 55
(5) "
(6) 22 May 55
(7) 21 May 55 / 22 May 55
TRANS (8) 25 May 55
(9) redated

ASSEMBLY 25 May 55

ECONOMISE 6 June 55

Runge Kutta 14 June 55
Complex Mult 21 May 55 corrected 2 June 55
" Div "
Sub "
Addn "
Inst. Matrix 21 May 55

Tubes Material checked 23 May 55

"First set of corrections & during night 23rd May"

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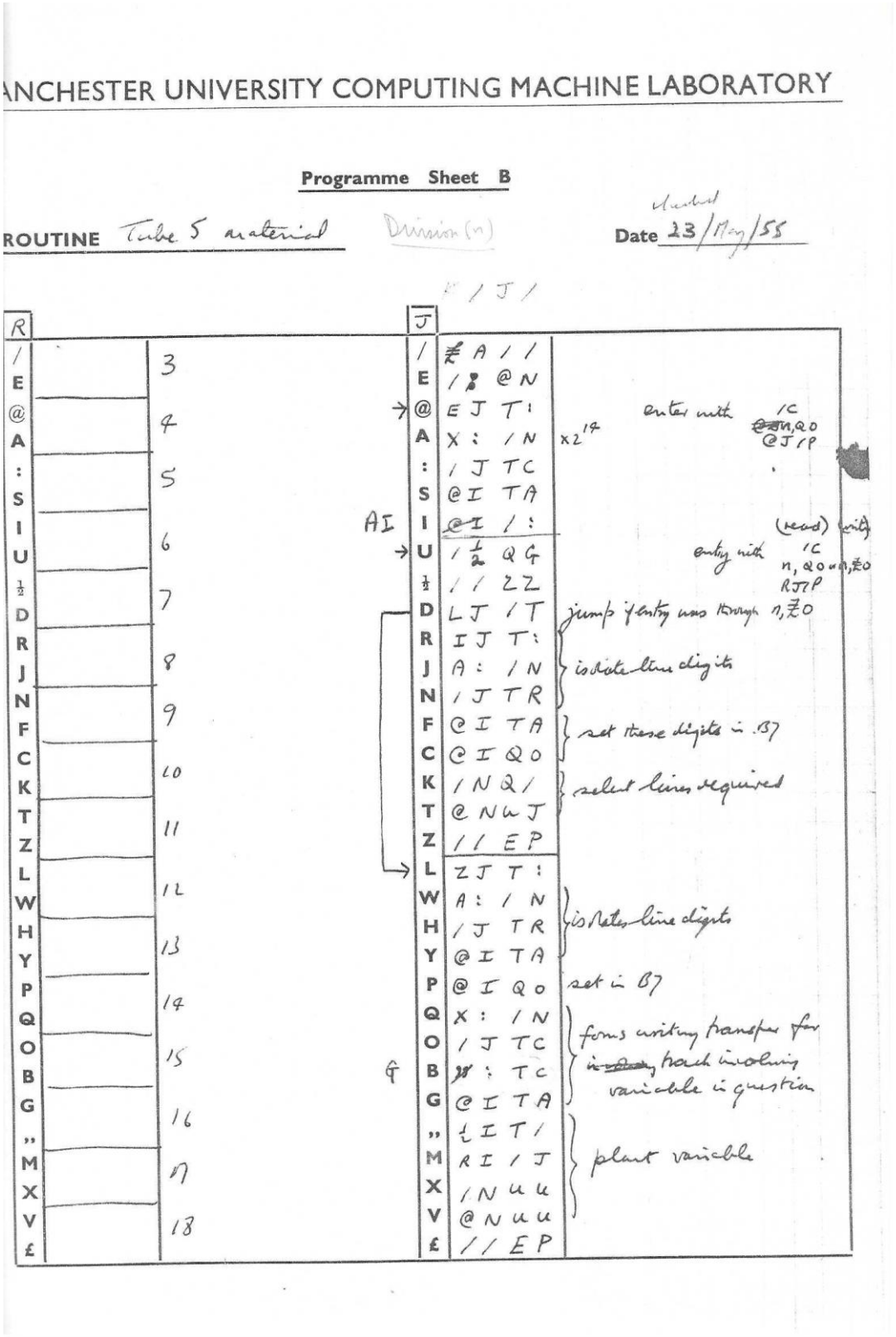

ANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE Tube 5 material Division (n) Date 23/May/55

R | J

R			J		
/		3	/	≠ A / /	
E			E	/ 8 @ N	
@		4	@	E J T :	enter with 1C [illegible] n, Q 0 @ J 1 P
A			A	X : / N	x2^17
:		5	:	/ J T C	
S			S	@ I T A	
I		6	I	@ I / :	AI (read) with
U			U	/ ½ Q G	entry with 1C n, Q 0 = n, ≠ 0 R J 7 P
½		7	½	/ / Z Z	
D			D	L J / T	jump if entry was through n, ≠ 0
R		8	R	I J T :	is data-line digits
J			J	A : / N	
N		9	N	/ J T R	
F			F	@ I T A	set these digits in B7
C		10	C	@ I Q 0	
K			K	/ N Q /	select lines required
T		11	T	@ N u J	
Z			Z	/ / E P	
L		12	L	Z J T :	
W			W	A : / N	is Nets-line digits
H		13	H	/ J T R	
Y			Y	@ I T A	
P		14	P	@ I Q 0	set in B7
Q			Q	X : / N	forms writing transfer for
O		15	O	/ J T C	is ~~data~~ track involving
B			B	[illegible] : T C	variable in question
G		16	G	@ I T A	
„			„	½ I T /	plant variable
M		17	M	R I / J	
X			X	/ N u u	
V		18	V	@ N u u	
£			£	/ / E P	

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ANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet A

ROUTINE DIRECTORY **Date** 23/May/55

K / ½ / K / D /

/	/ @ @ /	/	/ A @ /	E	@	/	1
	E @ @ /	E	E A @ /			E	
	@ @ @ /	@	@ A @ /			@	
	A @ @ /	A	A A @ /			A	
	: @ @ /	:	: A @ /			:	
	S @ @ /	S	S A @ /			S	
	I @ @ /	I	I A @ /			I	
	U @ @ /	U	U A @ /			U	
	½ @ @ /	½	½ A @ /			½	
	D @ @ /	D	D A @ /			D	
	R @ @ /	R	R A @ /			R	
	J @ @ /	J	J A @ /			J	
	N @ @ /	N	N A @ /			N	
	F @ @ /	F	F A @ /			F	
	C @ @ /	C	C A @ /			C	
	K @ @ /	K	K A @ /			K	
	T @ @ /	T	T A @ /			T	
	Z @ @ /	Z	Z A @ /			Z	
	L @ @ /	L	L A @ /			L	
	W @ @ /	W	W A @ /			W	
	H @ @ /	H	H A @ /			H	
	Y @ @ /	Y	Y A @ /			Y	
	P @ @ /	P	P A @ /			P	
	Q @ @ /	Q	Q A @ /			Q	
	O @ @ /	O	O A @ /			O	
	B @ @ /	B	B A @ /			B	
	G @ @ /	G	G A @ /			G	
	" @ @ /	"	" A @ /			"	KMJ:
	M @ @ /	M	M A @ /	/ / / /		M	
	X @ @ /	X	X A @ /	V T / /		X	
	V @ @ /	V	V A @ /	/ ½ / /		V	
	£ @ @ /	£	£ A @ /	£ / / /		£	

C u E _____

_____

No. ____

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE COMPLEX ADDITION **Date** 21/May/55

$(e+if) = (a+ib) + (c+id)$

/	K / K /					E	K / D J				
/	M	E	/	u		/	G	u	/	J	$A_p = d$
E	V	E	/	u		E	E	E	Q	O	b+d
@	M	E	/	:		@	Y	D	/	P	
A	/	N	P	▮		A	A	E	Q	O	normalise b+d
:	½	I	T	A	xfers a to f.b.a	:	C	u	/	P	
S	@	N	P	/		S	½	I	T	/	
I	R	I	T	A		I	:	N	H	A	record imag. part y
U	:	N	P	/		U	R	I	T	/	result
½	M	u	T	A	xfers b to Mu, Vu.	½	I	N	H	A	
D	I	N	P	/		D	X	E	/	:	write up result.
R	V	u	T	A		R	L	S	/	P	
J	V	E	/	:		J					
N	:	N	Y	/		N					
F	O	u	T	A	xfers d to Ou, Gu	F					
C	I	N	Y	/		C					
K	G	u	T	A		K					
T	/	N	Y	/	$A_p = C$	T					
Z	@	N	S	J		Z					
L	L	/	Q	O	a+c	L					
W	Y	D	/	P		W					
H	H	/	Q	O	normalise (a+c)	H					
Y	C	u	/	P		Y					
P	X	E	/	:		P					
Q	½	I	T	/		Q					
O	/	N	H	A	record real part	O					
B	R	I	T	/	of sum	B					
G	@	N	H	A		G					
„	M	u	T	/		„					KMD:
M	½	I	T	A	xfers b to f.b.a	M	u	S	E	D	read x
X	V	u	T	/		X	u	S	E	D	write z
V	R	I	T	A		V	u	S	E	D	read y
£	O	u	T	/		£	u	S	E	D	write read z

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE COMPLEX SUBTRACTION **Date** 21/May/55

$(e+if) = (a+ib) - (c+id)$

	K / ½ /			E	K / D J	
/	M E / u			/	G u / J	$A_F = b$
E	V E / u			E	E E Q o	b − d
@	V E / :	(c+id) hank		@	Y D / P	
A	/ N Y F	xfers − c to f.b.a		A	A E Q o	normalise (b − d)
:	½ I T A			:	C u / P	
S	@ N Y /			S	½ I T /	records imaginary part of result
I	R I T A			I	: N H A	
U	: N Y F	xfers −d to mu, vu.		U	R I T /	
½	M u T A			½	I N H A	
D	I N Y /			D	X E / :	
R	V u T A			R	L S / P	clear
J	M E / :	(a+ib) hank		J		
N	S N P /	xfers b to ou, Gu		N		
F	o u T A			F		
C	I N P /			C		
K	G u T A			K		
T	/ N P /	$A_F = a$		T		
Z	@ N I J			Z		
L	L / Q o	a − c		L		
W	Y D / P			W		
H	H / Q o	normalise (a − c)		H		
Y	C u / P			Y		
P	X E / :			P		
Q	½ I T /	record real part of sum		Q		
O	/ N H A			O		
B	R I T /			B		
G	@ N H A			G		
,,	M u T /			,,		K M D :
M	½ I T A	xfers d to f.b.a		M	u S E D	read x
X	V u T /			X	u S E D	~~read~~ unity
V	R I T A			V	u S E D	read y
£	o u T /			£	u S E D	~~read~~ read y

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE COMPLEX MULTIPLICATION **Date** 21/May/55

$(e+if)=(a+ib)\otimes(c+id)$

	@	K / R /			A	K / J /	
ME	/	` / u			/	/ A Q O	ac − bd
VE	E	/ u			E	Y D / P	
ME	@	/ :			@	@ A Q O	normalise
	A	/ N P /	xfer a		A	C u / P	✓
Mu	:	T A		ΣE	:	E/ :	
	S	@ N P /			S	½ I T /	record real part
Vu	I	T A			I	/ N H A	reset
	U	: N P /	xfer b		U	R I T /	
Ou	½	T A			½	@ N H A	
	D	I N P /			D		Put ½
Gu	R	T A			R	G u T C	
XE	J	/ :			J	R I T A	f.b.a = ad
	N	/ N Y /	xfer c		N	I S T /	
Hu	F	T A			F	H u / K	
	C	@ N Y /			C	O u / F	
Pu	K	T A			K	½ I / A	
	T	: N Y /	xfer d		T	: I / K	
:I	Z	T A			Z	H u / F	$A_P = bc$
	L	I N Y /			L	@ I / u	
II	W	T A			W	I I / J	
→	H	I I T ½	f.b.a = −bd		H	V u / J	
	Y	G u T C			Y	Y A Q O	bc + ad
	P	R I T A			P	Y D / P	
	Q	I S T /			Q	Q A Q O	normalise reset
	O	: I / K			O	C u / P	
	B	O u / D			B	½ I T /	imag part 1
	G	½ I / A		:NHA	G	: N H A	record/reset
	„	H u / K			„	R I T /	
	M	H u / F		INHA	M	I NH A	
	X	@ I / u	$A_F = ac$	VE	X	VE/ :	write up reset
	V	P u / J			V	L S / P	close
	£	V u / J			£	/ / / /	

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE complex ⊗ (1st corrected version) **Date** 2/6/53

K/R/

@	
/	Mu TA
E	@N P/
@	Vu TA
A	:N P/
:	Ou TA
S	IN P/
I	Gu TA
U	~~XA/:~~ ‡ VA/:
½	/N Y/
D	Hu TA
R	@N Y/
J	Pu TA
N	:N Y/
F	:I TA
C	IN Y/
K	II TA
T	II T½
Z	Gu TC
L	RI TA
W	IS T/
H	:I /K
Y	Ou /D
P	½I /A
Q	Hu /K
O	Mu /F
B	@I /u
G	Pu /J
,,	Vu /J
M	M@ Q O
X	YD /P
V	V@ Q O
£	Cu /P

K/J/

A		
/	~~£~~ A/:	
E	½ IT/	
@	/N HA	
A	RI T/	
:	@N HA	
S	Pu T½	
I	Gu TC	
U	RI TA	
½	IS T/	
D	Hu /K	
R	Ou /F	
J	½I /A	
N	:I /K	
F	Mu /F	
C	@I /u	
K	II /J	
T	Vu /J	
Z	ZA Q O	
L	YD /P	
W	WA Q O	
H	Cu /P	
Y	½ IT/	
P	:N HA	
Q	RI T/	
O	IN HA	
B	~~VA/:~~	XA/:
G	~~£E/~~	LS/P
,,	~~V///~~	////
M	~~MA/u~~	USED
X	~~VA/u~~	USED
V	~~MA/:~~	USED
£	~~AP/~~	USED

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE Complex ⊕ (1st corrected version) Date 2/6/55

K/½/

/	M	A	/	u
E	V	A	/	u
@	M	A	/	:
A	/	N	P	/
:	M	u	T	A
S	@	N	P	/
I	V	u	T	A
U	:	N	P	/
½	0	u	T	A
D	I	N	P	/
R	G	u	T	A
J	V	A	/	:
N	/	N	Y	/
F	H	u	T	A
C	@	N	Y	/
K	P	u	T	A
T	:	N	Y	/
Z	:	I	T	A
L	I	N	Y	/
W	I	I	T	A
H	I	S	T	/
Y	H	u	/	K
P	H	u	/	F
Q	½	I	/	A
O	P	u	T	K
B	R	I	T	A
G	I	S	T	/
,,	:	I	/	K
M	:	I	/	F
X	@	I	/	u
V	I	I	/	J
£	I	I	/	J

YE/P

ZE11
HEQO
E/ZZ
AEQO
FS/P

K/D/

/	/	E	Q	O
E	Y	D	/	P
@	G	E	/	J
A	A	E	Q	O
:	F	S	/	P
S	I	S	T	/
I	½	I	/	K
U	:	I	/	D
½	:	I	/	A
D	H	u	/	F
R	H	u	/	A
J	R	I	T	½
N	I	I	T	C
F	I	I	T	A
C	R	I	T	½
K	P	u	T	C
T	P	u	T	A
Z	B	E	/	P
L	/	/	/	/
W	/	/	/	/
H	/	/	/	/
Y	/	/	/	/
P	/	/	/	/
Q	/	/	/	/
O	/	/	/	/
B	K	@	/	/
G	½	½	/	/
,,	Y	/	/	/
M	M	A	/	u
X	V	A	/	u
V	M	A	/	:
£	/	N	P	/

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE COMPLEX DIVISION · **Date** 2/1/May/55

$(e+if) = (a+ib)/(c+id)$

	/	K / ½ /	
	/	M E / u	
	E	V E / u	
	@	M E / :	
	A	/ N P /	
Mu	:	T A	xfr a
	S	@ N P /	
Vu	I	T A	✓
	U	: N P /	
Ou	½	T A	xfr b
	D	I N P /	
Gu	R	T A	✓
	J	E / :	
	N	/ N /	
Hu	F	T A	xfr c
	C	@ N /	✓
Pu	K	T A	
	T	: N /	
:I	Z	T A	xfr d.
	L	I N /	
II	W	T A	
	H	I S T /	
	Y	H u / K	
	P	H u / F	f.b.a = c^2
	Q	½ I / A	
	O	P u T K	
	B	R I T A	
	G	I S T /	
	,,	: I / K	
	M	: I / F	$A_F = d^2$
	X	@ I / u	
	V	I I / J	
£	I I / J		

	E	K / D L	
	/	/ E Q O	c^2+d^2
	E	Y D / P	
	@	G E / J	replaces f.b.a
	A	A E Q O	by $\frac{1}{c^2+d^2}$ ✓
	:	F S / P	
	S	I S T /	set word 1f
	I	½ I / K	
	U	: I / D	
	½	: I / A	replace d
	D	H u / F	by $\frac{-d}{c^2+d^2}$ ✓
	R	H u / A	
	J	R I T L	
	N	I I T C	
	F	I I T A	replace c
	C	R I T L	by $\frac{c}{c^2+d^2}$
	K	P u T C	
	T	P u T A	✓ final section 1
	Z	B E / P	→ t/ multiplicati
	L		~~Section~~ multiplie
	W		
	H		
	Y		
	P		
	Q		
	O		K B D U
	B	N @ / /	
	G	É É / /	cue t RECIPROCAL/F
	,,	Y / / /	
	M	U S E D	read x
	X	U S E D	~~read~~ write y
	V	U S E D	read j
£	U S E D	~~write~~ read y	

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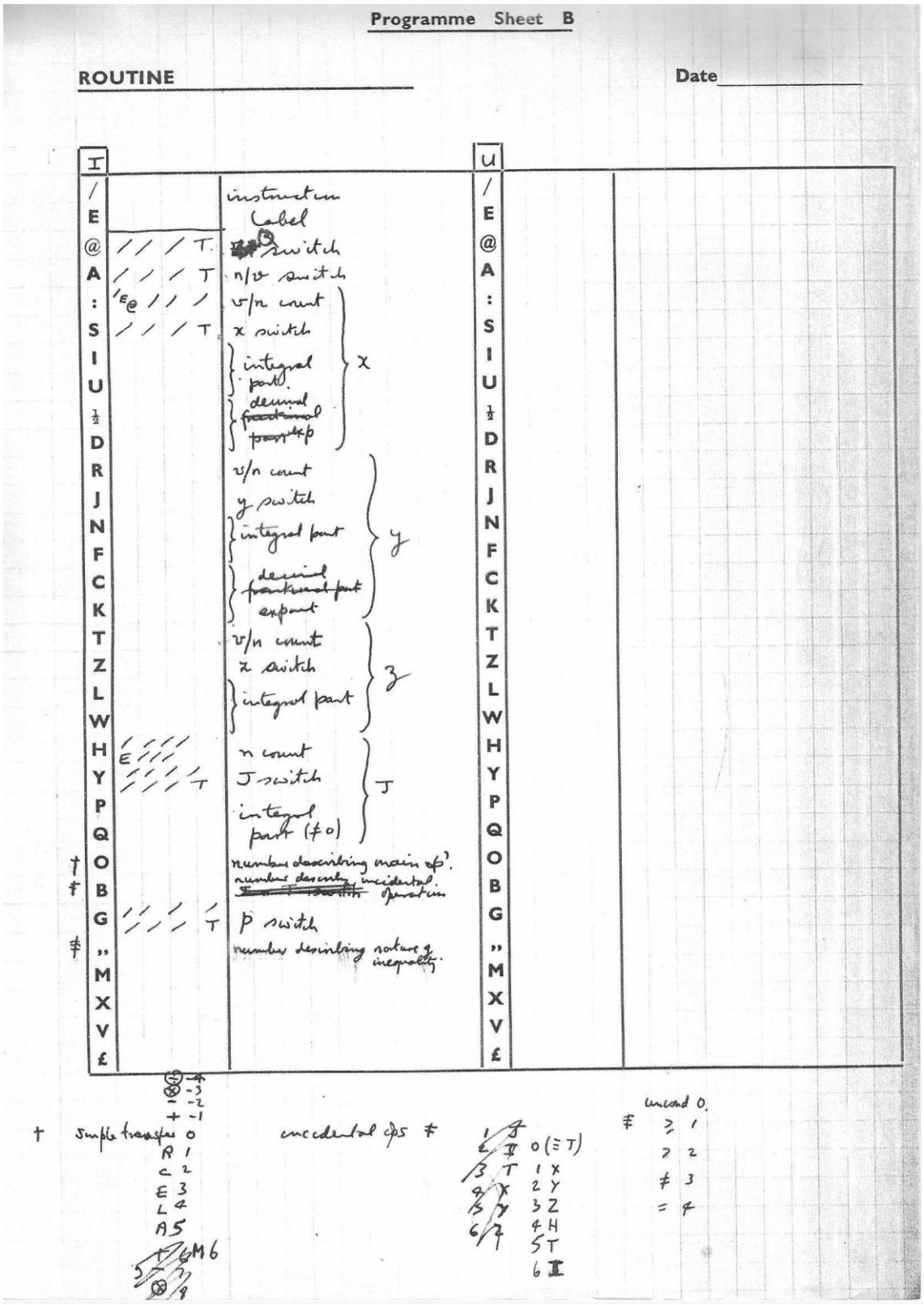
Programme Sheet B
ROUTINE
Date
I
U
instruction
Label
switch
n/v switch
v/n count
x switch
integral part
decimal fractional part
exponent
x
v/n count
y switch
integral part
decimal fractional part
exponent
y
v/n count
z switch
integral part
z
n count
J switch
integral part (≠0)
J
number describing main op'.
number describing incidental operation
p switch
number describing nature of inequality.
simple transfer
incidental ops
uncond 0.

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

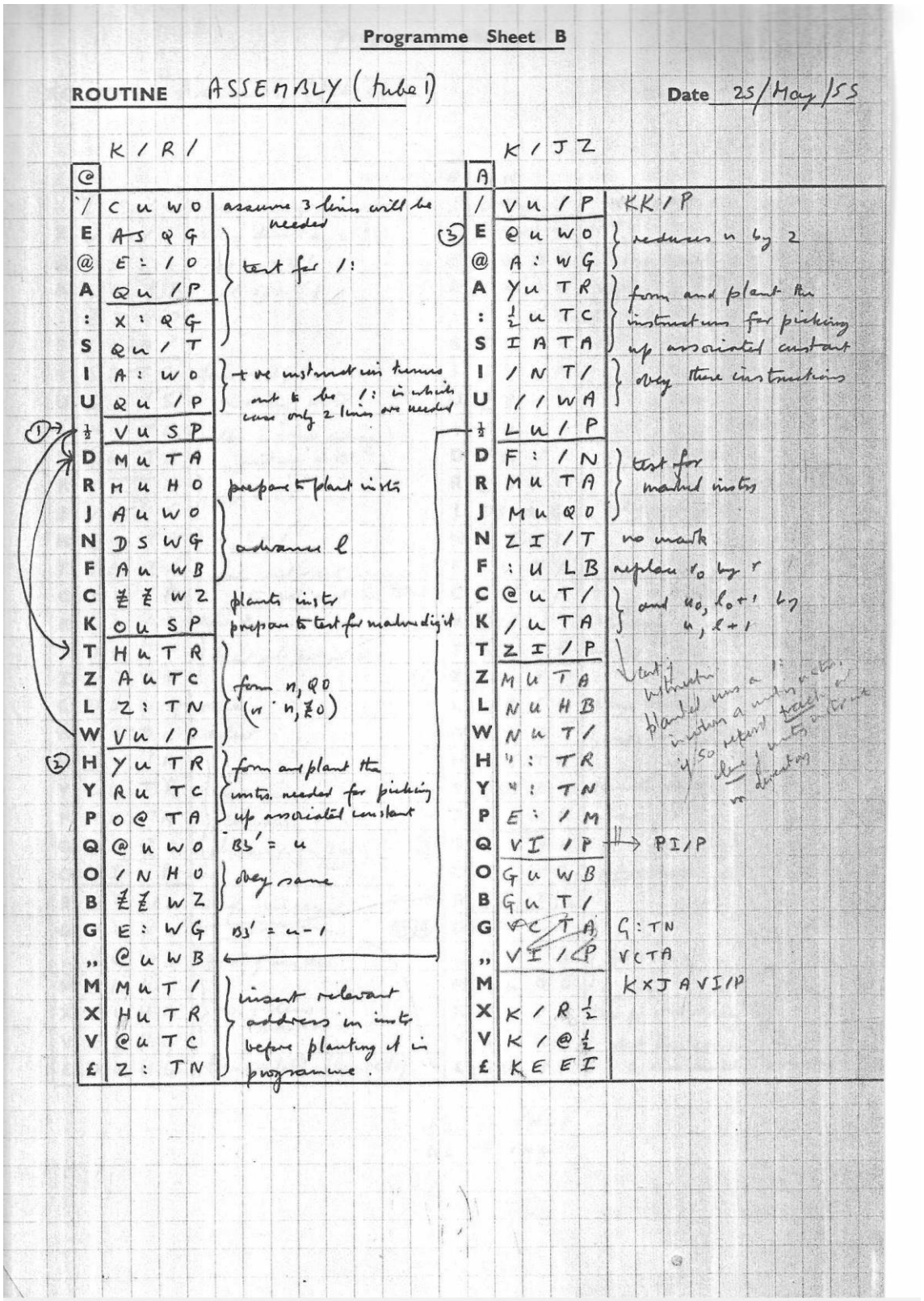
Programme Sheet B

ROUTINE Assembly (tube 0) **Date** 25/[illegible]/55

/										E	IN							
/	½	A	/	:					xfers 3rd page of routine	/	M	U	L	/				
E	V	A	/	:					xfers directory to 4, 5	E	M	U	/	5				// T ½
@	D	S	L	0					set r = ½ ½	@	:	U	A	T				3 way switch if There are enough lines available
A	:	U	L	B					set r_0 = ½ ½	A	:	U	L	0				replace r by r_0
:	½	J	Q	0						:	E	U	W	0				l_0+1 to B3
S	/	½	Q	/						S	Z	U	H	0				B4' = BD/P
I	S	S	T	C					form and plant reading instr.	I	D	S	W	G				plant BD/P as link
U	G	U	/	S						U	½	½	W	Z				
½	"	:	T	C					do. corresp. ending writing instr.	½	"	U	/	:				write current track
D	"	U	T	A						D	V	A	/	:				x fer directory
R	X	J	T	/					u_0, l_0+1	R	½	J	Q	0				advances p
J	/	U	/	S						J	D	S	Q	G				
N	@	U	T	A					u, l+1	N	½	J	Q	B				
F	E	½	Q	/					form and - write one to next writing track	F	K	U	T	/				reset u_0, l_0+1 = VJ11, 1½11
C	N	U	T	A						C	X	J	T	A				
K	G	U	/	:					x fer current track	K	½	X	A	/	:			rewrite directory
T	J	U	T	/					plant add. writing one	T	S	:	/	P				→ S/
Z	V	J	T	A						Z	"	U	/	:				
L	D	S	L	G					advance r	L	V	A	/	:				x fer directory
W	/	N	@	C					select	W	/	U	T	/				record u_0, l+1
H	½	:	/	N						H	X	J	T	A				
Y	L	U	T	R					examine	Y	½	X	A	/	:			rewrite directory
P	M	U	T	A					column	P	L	S	/	P				close
Q	X	U	Q	0					character (ie 2nd char.)	Q	E	:	Y	0				BS' = E111 set switch
O	/	I	U	P						O	E	:	W	0				B5' = E[illegible] enough lines needed
B	E	:	W	0					single line needed	B	½	I	/	P				
G	/	:	Y	0						G	M	U	L	/				
"	X	U	W	B					copy no. of lines reqd.	"	M	U	T	A				register ← B7
M	@	U	H	0						M	M	U	Q	0				
X	A	U	H	G					no. of lines available	X	A	:	/	0				start to test for short or long type
V	E	:	H	G						V	A	:	W	0				short line content
£	X	U	H	G					lines available - (lines reqd.)	£	Q	U	/	P				2 lines needed in programme

/E → /NL/

qE → /NL/


Programme Sheet B
ROUTINE ASSEMBLY (tube 1)
Date 25/May/55
K/R/
K/JZ
assume 3 lines will be needed
test for /:
+ve instruct can terminate but in the / : in which case only 2 lines are needed
prepare to plant instrs
advance ℓ
plants instr
prepare to test for makeup digit
form n, Q0 (n · n, ½0)
form and plant the instrs needed for picking up associated constant
B3' = u
obey same
B3' = u - 1
insert relevant addresses in instr before planting it in programme.
reduces n by 2
form and plant the instructions for picking up associated constant
obey these instructions
test for makeup instrs
no makeup
replace r0 by r
and u0, ℓ0+1 by u, ℓ+1
test if instruction planted was a jump back in which a makeup is required if so reset tracks and clear makeup counts to zero
KK/P
G:TN
VCTA
KXJAVI/P
PI/P

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Programme Sheet B

ROUTINE DECIN PUT (REVISED) **Date** 20/May/55

/	K / ½ /			
/	/	/	T Ξ	
E	D	S	T	G
@	K	@	T	B
A	/	:	T	O
:	Z	@	W	O
S	/	:	Y	O
I	/	:	P	O
U	F	E	T	:
½	G	@	T	A
D	M	@	T	A
R	V	@	T	A
J	P	E	O	:
N	J	/	/	:
F	O	@	/	A
C	J	:	/	C
K	O	@	/	N
T	O	@	/	A
Z	O	@	Q	O
L	/	A	U	P
W	E	:	P	C
H	E	:	P	C
Y	E	:	P	C
P	E	:	P	C
Q	E	:	P	C
O	E	:	P	C
B	E	:	P	C
G	E	:	P	C
,,	E	:	P	C
M	D	S	Q	O
X	G	@	Q	B
V	G	@	W	G
£	Ξ	A	/	T

① → E, ② → @ : set a 2-way switch

B0′ = 1111

B3′ = HΞΞΞ

B5′ = 1111

B6′ = 1111

clear working space

A′ = 0

J/ on any unit (input) DIYB

transfers 1111 to B7

multiway switch

9 8 7 6 5 4 3 2 1

× G@/u11

× 0@/u

× ½I T½

× RI/A

E	K / D /	
/	P @	/ C
E	V @	/ F
@	V @	T A
A	" @	Y G
:	Ξ A	/ P
S	E :	Q O
I	" @	Q B
U	Ξ A	/ P
½	T @	P O
D	Ξ A	/ P
R	L @	T /
J	@	/ Z A
N	H @	/ C
F	B @	Y B
C	J /	/ T
K	I S	T /
T	M @	/ N
Z	M @	/ u
L	V @	/ F
W	M @	/ S
H	V @	/ A
Y	D S	Y G
P	u /	/ P
Q	V @	/ J
O	E @	Q O
B	F @	u P
G	G E	Q O
,,	K S	/ P
M	½ I	/ u
X	R I	/ u
V	L S	/ P
£	/	/ /

① K@QO

D′ = 10

builds up integral part

counts no. of digit after dec. pt.

← ⊙

← —

sets cue to CONVERTER

D′ = 0.1 0.8

B sign flip-flop

2 way switch : in the course of entry ② the effect is to clear the number

convert to f.b. form and plant in f.b.a } entry no ①

spare

in the course of entry ① (c.n., Ξ½ or 11) the effect is read the no. on the tape, convert to f.b. form and store in f.b.a clearing A = 0.

F@ enters K511

C@ " B511

" " " entry ② (c.n., E1) the effect is to read the next no. on the tape and leave in A in the form M± + Lf.

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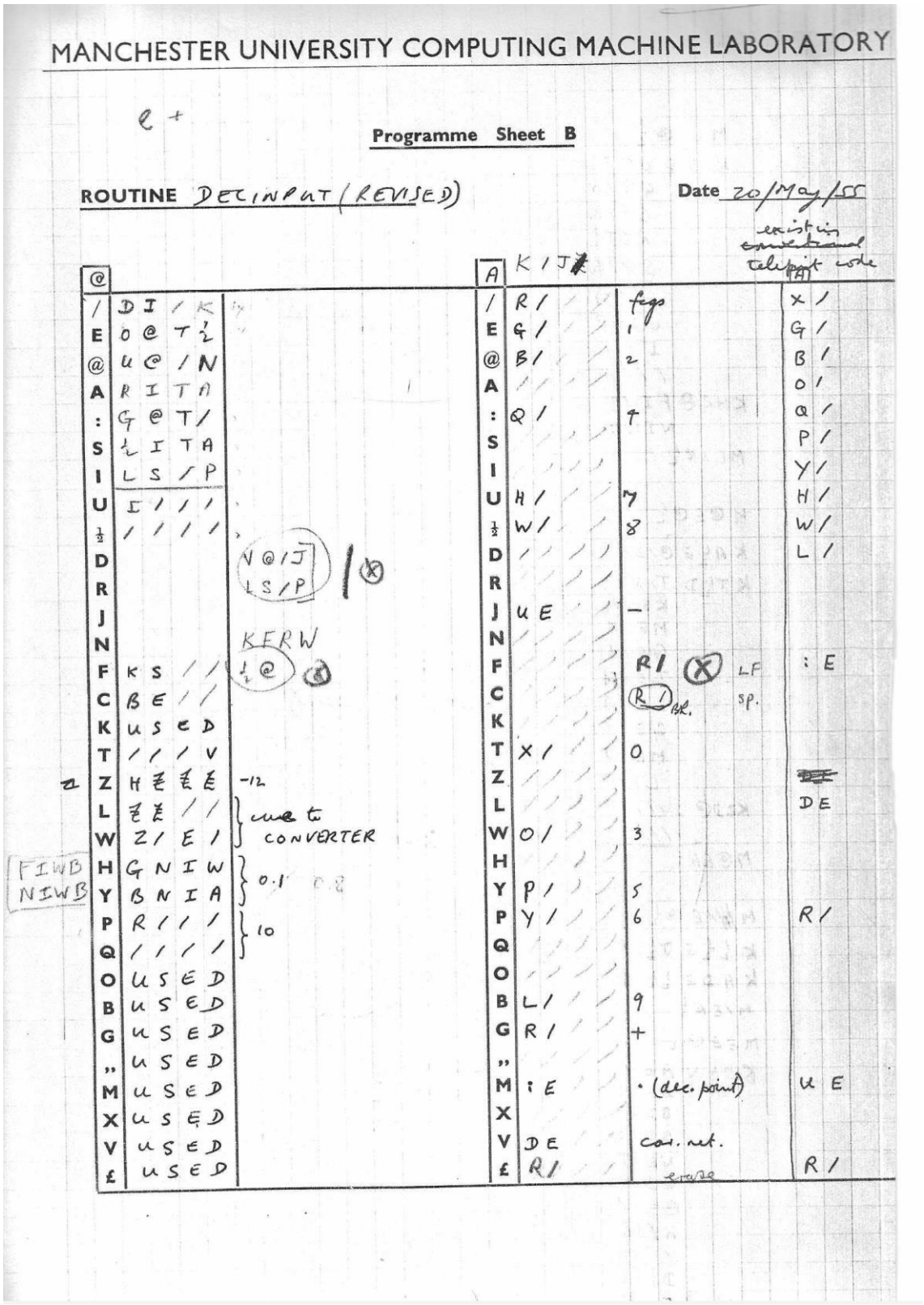

MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE DECINPUT (REVISED)

Date 20/May/55

existing convention teleprint code

@						A	K / J			[A]
/	DI	/	K			/	R /	figs		X /
E	0	@	T	½		E	G /	1		G /
@	U	C	/	N		@	B /	2		B /
A	R	I	T	A		A	/			O /
:	G	@	T	/		:	Q /	4		Q /
S	½	I	T	A		S				P /
I	L	S	/	P		I				Y /
U	Ξ	/	/	/		U	H /	7		H /
½	/	/	/	/		½	W /	8		W /
D					N Q / J	D	/			L /
R					L S / P	R				
J						J	U E	–		
N					KERW	N				
F	K	S	/	/	½ @	F		R / (X)	LF	: E
C	B	E	/	/		C		(R /)	BK. SP.	
K	U	S	E	D		K				
T	/	/	/	V		T	X /	0		
Z	H	Ξ	Ξ	Ξ	-12	Z				~~DE~~
L	Ξ	Ξ	/	/	} use to	L				DE
W	Z	/	E	/	} CONVERTER	W	O /	3		
H	G	N	I	W	} 0.1	H				
Y	B	N	I	A	}	Y	P /	5		
P	R	/	/	/	} 10	P	Y /	6		R /
Q	/	/	/	/		Q				
O	U	S	E	D		O				
B	U	S	E	D		B	L /	9		
G	U	S	E	D		G	R /	+		
,,	U	S	E	D		,,				
M	U	S	E	D		M	: E	. (dec. point)		U E
X	U	S	E	D		X				
V	U	S	E	D		V	D E	car. ret.		
£	U	S	E	D		£	R /	erase		R /

FIWB
NIWB

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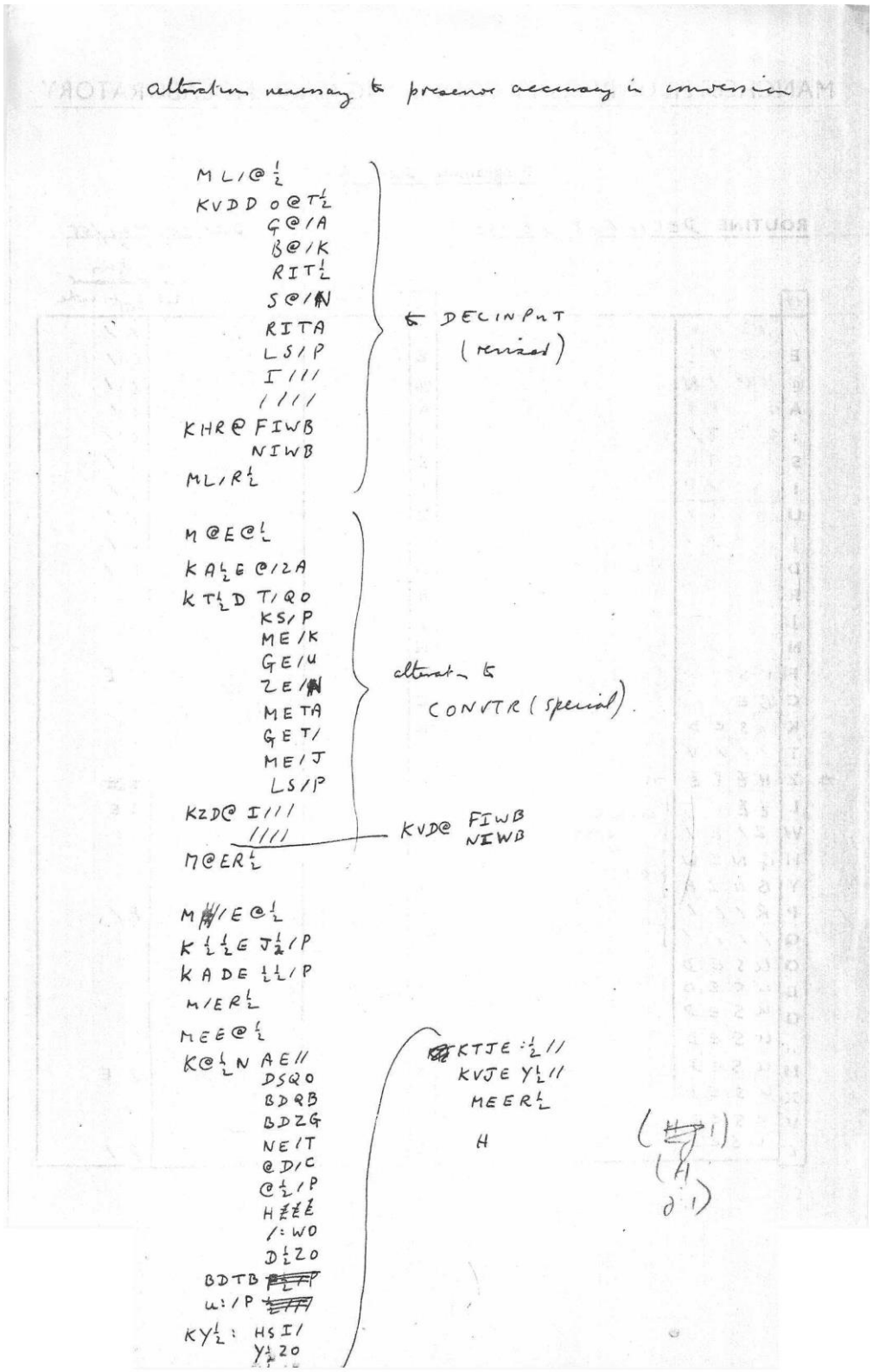
alteration necessary to preserve accuracy in conversion
ML/@½
KVDD O@T½
G@/A
B@/K
RIT½
S@/N
RITA
LS/P
I///
////
KHR@ FIWB
NIWB
ML/R½
← DECINPUT
(revised)
M@E@½
KA½E@/2A
KT½D T/QO
KS/P
ME/K
GE/U
ZE/N
META
GET/
ME/J
LS/P
KZD@ I///
////
KVD@ FIWB
NIWB
M@ER½
alterat_ ←
CONVTR (special).
M/E@½
K½½EJ½/P
KADE½½/P
M/ER½
MEE@½
K@½N AE//
DSQO
BDRB
BDZG
NE/T
@D/C
@½/P
HÉÉÉ
/:WO
D½ZO
BDTB
W:/P
KY½: HSI/
Y½ZO
KTJE:½//
KVJE Y½//
MEER½
H
(H 1)
(H
d 1)

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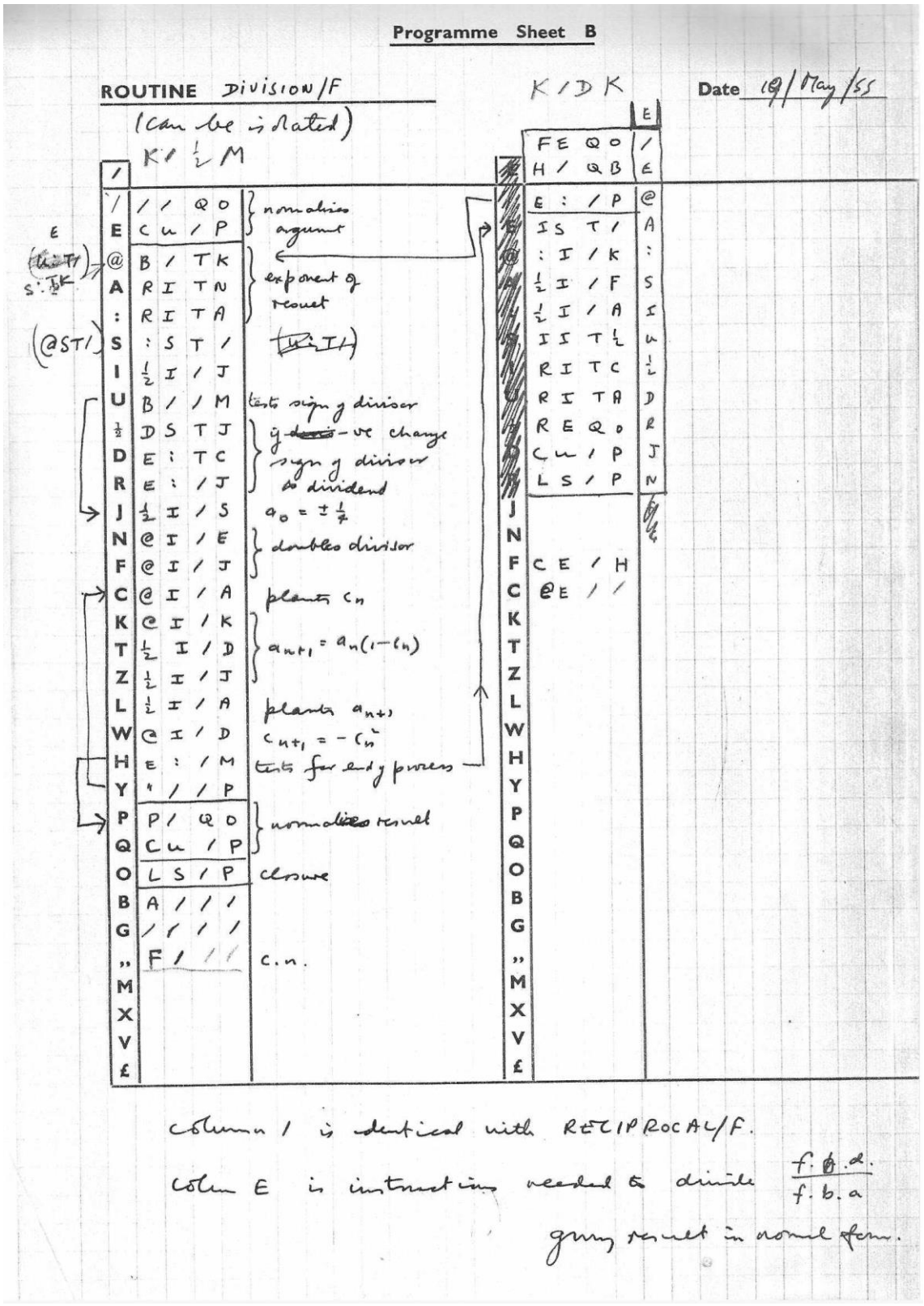
Programme Sheet B
ROUTINE DIVISION/F
K/DK
Date 19/May/55
(can be iterated)
K/½M
normalises argument
exponent of result
tests sign of divisor
if -ve change sign of divisor & dividend
$a_0 = \pm\frac{1}{4}$
doubles divisor
plants c_n
$a_{n+1} = a_n(1-c_n)$
plants a_{n+1}
$c_{n+1} = -c_n^2$
tests for end of powers
normalises result
closure
c.n.
column 1 is identical with RECIPROCAL/F.
Colm E is instructions needed to divide f.b.d. / f.b.a
giving result in normal form.

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MANCHESTER UNIVERSITY COMPUTING MACHINE LABORATORY

Programme Sheet B

ROUTINE Modulus & Division (n) **Date** 20/May/55

K/½D

/		
/	: I T ½L	from modulus $y\ [:I]_t$
E	E : / M	
@	: I T F	
A	: I T A	
:	½L I T ½L	take modulus $y\ [\overline{\tfrac{1}{2}L}\ I]_t$
S	E : / M	
I	½L I T F	
U	½L I T A	
½	L S / P	
D		
R		
J		
N		
F		
C		
K		
T		
Z		
L		
W		
H		
Y		
P		
Q		
O		
B		
G		
"		
M		
X		
V		
£		

K/DC

E		
/	: I T /	
E	" E TA	
@	I I T /	
A	V E TA	
:	Q E / K	$D_{\pm f} = 2n_1 \cdot 2^{-20}$
S	X E T /	$L_{\pm f} = 2n_2 \cdot 2^{-40}$
I	O E / J	$n_{\pm} \div L_f = \frac{n_1}{n_2} = n_3$
U	U E Q O	
½	F S / P	
D	I S T I	round off
R	: I / A	
J	: I T K	from $2n_3$
N	: I T A	
F	L S / P	close
C		
K		
T		
Z		
L		
W		
H		
Y		
P		
Q		K O D ½L
O	Z E / /	use to DIVISION
B	Y / E @	
G	/ / / /	
"	U S E D	
M	U S E D	
X	/ / / /	
V	U S E D	
£	U S E D	