Name of Routine. A/RECIPROOT. Date. 2.7.51.

Purpose.

To calculate square roots and reciprocal square roots.

Cues.

£ £ G A $\frac{1}{2}$ / @ /

Sub-routines.

Principal Lines.

$[/\ E]_0^{19}$ = D @ / J

$[/\ A]_0^{19}$ = V S T A

Tapes.

RECIPROOT ONE

RECIPROOT TWO

Magnetic Storage.

8 L and 8 R

Electronic Storage.

S 0 and S 1

Stores Altered.

/ C, E C, : C - U C B 5 and B 6

Effects.

Initially $2^{20} \leq 2^{\beta} \leq [/\ C]_+ < 2^{\beta+1} \leq 2^{40}$

Then $[/\ C]_+^1 = 2^{39-\beta}\ [/\ C]_{+\frac{1}{2}}$;

$[:\ C]_+^1 = 2^{39+\alpha}\ [/\ C]_{+\frac{1}{2}}^{-\frac{1}{2}}$; $[B\ 5]^1 = 2\alpha + 4$

$[I\ C]_+^1 = 2^{38-\alpha}\ [/\ C]_+^{\frac{1}{2}}$; $[B\ 6]^1 = 40 - 2\alpha$

where $\alpha = \{\beta/2\}$.

A table is attached to assist in 'unstandardizing' the results.

Method.

$[/\ C]_+^1 = 2^{39-\beta}\ [/\ C]_+$ ie. most significant digit now 2^{39}

$\varphi \doteqdot \{[/\ C]_+^1\}^{-\frac{1}{2}}$ is found from 16 entry table

$2^{40}\ (1+\varepsilon) = \frac{4\ [/\ C]^1}{2^{80}} \times \varphi^2$

$2^{40}\ (1+\varepsilon)^{-\frac{1}{2}}$ is found by expanding as a series.

$$\frac{\varphi \times 2^{40}\ (1+\varepsilon)^{\frac{1}{2}}}{2^{40}} = \frac{2^{60}}{2\{[/\ C]_+^1\}^{\frac{1}{2}}} = \frac{2^{40+\beta/2}}{\{2[/\ C]_+\}^{\frac{1}{2}}}$$

If β is odd, multiply by $\frac{1}{2}$ and then by $2\ [/\ C]_+^1$

If β is even, multiply by $\frac{1}{\sqrt{2}}$ and then by $[/\ C]_+^1$

giving in both cases $[:\ C]_+^1 = 2^{39+\alpha}\ [/\ C]_+^{-\frac{1}{2}}$;

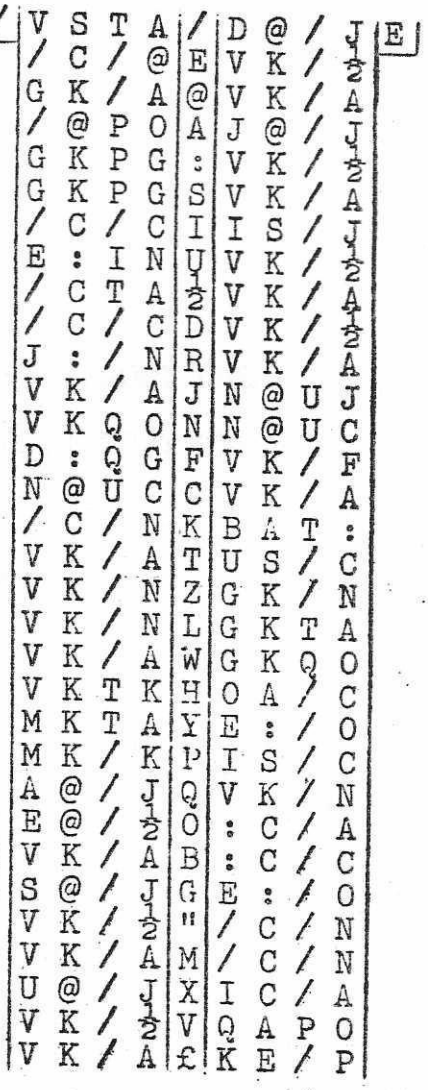
$[I\ C]^1 = 2^{38-\alpha}\ [/\ C]_+^{\frac{1}{2}}$.

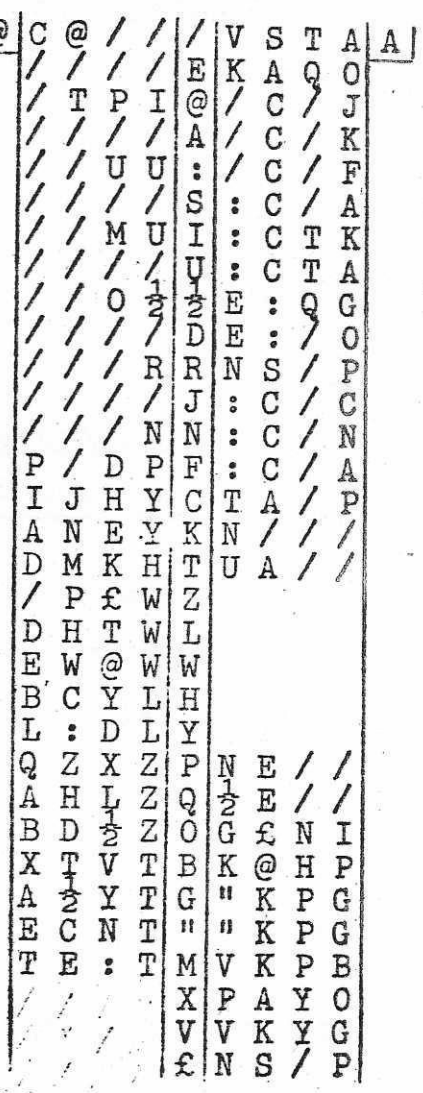
Time .075 secs.

MANCHESTER UNIVERSITY ELECTRONIC COMPUTER.

Programme Sheet 2.

ROUTINE. RECIPROOT.





Tape:- RECIPROOT ONE

Dest. Seq:- KAK@///$\frac{11}{22}$/@/

RECIPROOT TWO.

KAK@//E$\frac{11}{22}$/@/

Lines /A - TA belong to EXAPP.

Table (amended) for use in conjunction with RECIPROOT.

γ_0	γ_1		S	δ_0	δ_1	m		S′	δ_0'	δ_1'	m′
20	22		C:	37	38	27		TA	20	21	31
20	24		N:	36	38	26		LA	20	22	32
20	26		R:	35	38	25		HA	20	23	33
20	28		½:	34	38	24		PA	20	24	34
20	30		I:	33	38	23		OA	20	25	35
20	32		::	32	38	22		GA	20	26	36
20	34		@:	31	38	21		MA	20	27	37
20	36		/:	30	38	20		VA	20	28	38
20	38		VA	29	38	19		/:	20	29	39
20	40		MA	28	38	18		@:	20	30	40
20	40		GA	27	37	17		::	21	31	41
20	40		OA	26	36	16		I:	22	32	42
20	40		PA	25	35	15		½:	23	33	43
20	40		HA	24	34	14		R:	24	34	44
20	40		LA	23	33	13	*	N:	25	35	45
20	40		TA	22	32	12		C:	26	36	46
20	40		CA	21	31	11		T:	27	37	47
20	40		NA	20	30	10	*	L:	28	38	48
22	40		RA	20	29	9		H:	29	38	49
24	40		½A	20	28	8		P:	30	38	50
26	40		IA	20	27	7		O:	31	38	51
28	40		:A	20	26	6		G:	32	38	52
30	40		@A	20	25	5		M:	33	38	53
32	40		/A	20	24	4		V:	34	38	54
34	40		V@	20	23	3		/S	35	38	55
36	40		M@	20	22	2		@S	36	38	56
38	40		G@	20	21	1.		:S	37	38	57.

If initially $2^{\gamma_0} \leq [/C]_+ < 2^{\gamma_1}$ and we follow RECIPROOT by the instructions:-

```
      T A
  I C / C
    S S N
  M K / A
```

Then $[M\ K]_+' = 2^m \sqrt{[/\ C]_+}$

and $2^{\delta_0} \leq [M\ K]_+' < 2^{\delta_1}$.

If initially $2^{\gamma_0} \leq [/C]_+ < 2^{\delta_1}$ and we follow RECIPROOT by the instructions:-

```
      T A
  : C / C
   S' I N
  V K / A
```

Then $[V\ K]_+' = \dfrac{2^m}{\sqrt{[/\ C]_+}}$

and $2^{\delta_0'} < [V\ K]_+' \leq 2^{\delta_1'}$.

ie $2^{20-m} \sqrt{[/C]_{+f}}$