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SUMMARY

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A general program has been written to plot curves on the Oracle Curve Plotter. A description of the code and complete instructions for preparation of input tapes and operation of the code are given. The code tape is available from the Mathematics Panel or from the author.

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CURVE PLOTTING ROUTINE FOR THE ORACLE

M. P. Lietzke

Description

This program has been written to plot curves from data stored on magnetic tape. The routine requires that the numbers to be plotted be stored in succession on magnetic tape as 8-32 floating point numbers. The first number must be an x (abscissa), followed by its corresponding y value (ordinate), and this pattern (x, y) must be followed for all numbers to be plotted. The order in which the x values appear is not important, and multi-valued functions may be plotted by writing (x_1, y_1) , (x_1, y_2) , etc. All blocks except the last must contain 128 words.

It is not necessary to know the values of the numbers, but they must be within the range of 8-32 floating point. The routine finds the maximum and minimum values for x and y, and establishes the range as $n_1 \times 10^p$, then establishes an interval, setting Δx and $\Delta y = n_2 \times 10^{p-1}$. The maximum and minimum values are then rounded off to the nearest even interval as follows:

$$R_x = x_{\text{Max}} - x_{\text{min}} = n_1 \times 10^p \quad (0 \leq n_1 < 1.0)$$

$$\Delta x = n_2 \times 10^{p-1} \quad \left\{ \begin{array}{l} \text{for } n_1 < .5, n_2 = .25 \\ \text{for } n_1 \geq .5, n_2 = .5 \end{array} \right\}$$

$$q_x = \frac{x_M}{\Delta x} = \text{Integer} + (\text{fraction})$$

$$q'_x = \frac{x_m}{\Delta x} = \text{Integer} + (\text{fraction})$$

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If fractions exist:

for positive numbers $q_x \equiv \text{Integer} + 1$

$q'_x \equiv \text{Integer}$

for negative numbers $q_x \equiv \text{Integer}$

$q'_x \equiv \text{Integer} + 1$

If there is no fraction q_x or q'_x is used unchanged.

$$X_M = q_x \Delta x$$

$$X_m = q'_x \Delta x$$

Similar formulae are used to establish Y_M and Y_m from y_M and y_m .

Then:

$$X_M - X_m = R'_x$$

$$Y_M - Y_m = R'_y$$

$$\frac{R'_x}{\Delta x} = q_{R'_x}$$

$$\frac{R'_y}{\Delta y} = q_{R'_y}$$

$$\frac{1024}{q_{R'_x}} = x \text{ interval size}$$

$$\frac{960}{q_{R'_y}} = y \text{ interval size}$$

The axes are then plotted around the four sides of the graph area, using the intervals determined by the code.

The x and y values are normalized and plotted as follows:

$$\frac{X_m - x}{X_m - X_M} \times 1024 \times 2^{-39} = x \text{ curve plot address}$$

$$\left(\frac{Y_m - y}{Y_m - Y_M} \times 960 \times 2^{-39} \right) + 32 = y \text{ curve plot address}$$

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X_M , X_m , Y_M , and Y_m are printed in this order across the bottom of the graph, and the heading across the top.

Limits

Number of different x (abscissa) values ≤ 1024

Number of y (ordinate) values/ x value ≤ 960

Number of characters in heading ≤ 33 (21 hex)

Range of numbers same as for Floating Point Subroutine 005

Memory Cells Used

000-041	Floating Point Subroutine
050-07B	Dummy Words
080-0B2	Conversion Routine (Hex to decimal, memory to memory)
0E0-2D8	Program
300-3FF	Numbers received from Magnetic Tape
400-43D	Conversion Routine (Decimal to hex, memory to memory)
450-49D	Curve Plot Q words for alphanumeric characters (Oracle Memo No. 4)
500-53B	Program
700-794	Temporary Storage
7FA-7FF	Universal Constants

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Input

The input for this program consists of two tapes, the first to set up the name and any other information which is to be used unchanged for several graphs, the second to set up a case number, number of words to be plotted, number of drive on which numbers are stored, and information in the heading which may vary on succeeding graphs. The date is inserted in the first six hex bits of the Q register on a stop in 2B2 after the first tape has read in. Q = $\underbrace{m\ m}_{\text{month}} \underbrace{d\ d}_{\text{day}} \underbrace{y\ y}_{\text{year}} \underbrace{xxxx\ \dots}_{\text{irrelevant}}$

Any Tape I may be followed by as many copies of Tape II as necessary to complete a series of curves.

A sample heading might read:

<u>LIETZKE PROB 336</u>	<u>x = MDT Y = Ø</u>	05 01 57	<u>AAAAAAAA25</u>
Tape I	Tape II		Tape II

Tape I

N_1 n_1 n_2 $\cdot$ $\cdot$ n_{N_1}	$N_1 =$ starred number (hex) representing number of characters in first part of heading + 1 $n_i =$ starred number representing key word as listed in Oracle Memo No. 4 e.g. 1 = 01* F = 0F* space = 37*
--	--

Sp
CR

$n_{N_1} = 37^*$

Tape II

Case No. (ten hex digits)

No. words (hex * = no. x's + no. y's)

Drive No. *

N_2 N_2 = starred number (hex) representing number of characters in second part of heading excluding case No.

 n_1

:

 n_{N_2}

$$N_1 + N_2 \leq 21 \text{ (hex)}$$

Sp

CR

N_2 may = 0, in which case it must be followed by 37*, Sp, CR.

In preparing the input tapes, it is not necessary to type the zeros preceding the starred numbers, since Q is cleared after each insertion.

Tapes for the sample heading above would appear as follows.

Assume 100 points to plot are stored on Drive 1.

Tape I

N_1^*	011
L	015
l	012
E	00E
T	01D
Z	023
K	014
E	00E
Space	037
P	019
R	01B
O	018
B	00B
Space	037
3	003
3	003
6	006
Space	037
Sp, CR	

Tape II

Case No.	AAAAAAAA25
No. words	0C8
Drive	001
N_2	009
x	021
=	03C
M	016
D	00D
T	01D
Space	037
Y	022
=	03C
ϕ	035
Sp, CR	

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Operating Instructions

1. Position magnetic tape at beginning of first block of information to be plotted.
2. Advance film manually
3. With code tape under reader
 - 90 - 7FA
 - 90 - 400
4. Input tape I under reader
 - 43 - 2B0
5. At stop in 2B2 insert in Q

$$Q = \underbrace{m \ m}_{\text{month}} \quad \underbrace{d \ d}_{\text{day}} \quad \underbrace{y \ y}_{\text{year}} \quad \underbrace{XX \dots X}_{\text{irrelevant}}$$
6. Input tape II under reader, then back on continuous
7. Code will plot curve, advance film, and stop on B. P. in 2AE, ready for the next Tape II. The magnetic tape will be at the beginning of the block following the information which has just been plotted. If the next information is in position to be plotted, it is only necessary to place the next Tape II under the reader and go through the B. P.
8. If a new Tape I is to be used, position the tapes as in step 1, and repeat procedure from step 4.

The time required for each graph will depend on the number of points to be plotted, but in general will be less than two minutes per case.

CODE

Cell		
OEO	50961EF219	-10^{24}
1	0000000000	
2	0000000000	
3	0000000002	2*
4	0000000100	256*
5	0000000000	Words remaining
6	0000000000	Times through Routine
7	0000000000	No. Blocks used
8	0000000081	129*
9	0000000101	257*
A	0000000000	Total words to be used
B	0000000000	Words to be read each time
C	0000000000	X Max
D	0000000000	X min
E	0000000000	Y Max
F	0000000000	Y min
OFO	0020000000	
1	0000000000	Counter cell
2	30040ECOC0	restore 139 and 13A
3	30140EEOC2	restore 13B and 13C
4	4913F24300	restore 13E and 141
5	4000024301	restore 144 and 147
6	0000000000	stop word
7	5069E10DE7	10^{24}
8	8000000000	
9	0000000000	RX (8-32 F.P.)
A	0000000000	RY(8-32 F.P.)
B	0000000000	RX (Decimal)
C	0000000000	RY (Decimal)
D	207FB5410D	} set exits
E	5411054116	
F	5411C5411F	

CODE

Cell		
100	54125247FD	} set exits
1	5FOE75FOE6	
2	5FOE543107	
3	240F75FOEF	} set Max, Min
4	5FOED240EO	
5	5FOEC5FOEE	
6	4312F40000	cells
7	240EA220E9	No. Words - 257
8	4A111240EA	Tr if + No. Words
9	5FOEB240EA	→ OEB No. words
A	220E84A10E	- 129 Tr if +
B	247FF5FOE7	1 → Block counter
C	5FOE640000	1 → Times through
D	43 [000] 40000	
E	247FF5FOE6	1 → Times through
F	240E35FOE7	2 → Block counter
110	43 [000] 40000	
1	207FF5FOE5	No. W-257 + 1 → Remainder
2	240E6200E3	2 → Times
3	5FOE640000	through
4	240E45FOEB	256 → OEB
5	240E35FOE7	2 → Block counter
6	43 [000] 40000	
7	240E5220E9	Re-enter here remainder - 257
8	4A120240E5	Tr if + Remainder
9	5FOEB220E8	→ OEB - 127
A	4811C240E7	Tr if + add
B	207FF5FOE7	1 to Block counter
C	43 [000] 240E7	add
D	200E35FOE7	2 → Block counter
E	247FD5FOE5	0 → Remainder
F	43 [000] 40000	

CODE

Cell		
120	207FF5FOE5	Remainder $-257 + 1 \rightarrow$ Remainder
1	240E45FOEB	256 $\rightarrow$ OEB
2	240E7200E3	Add 2 to
3	5FOE7240E6	Block counter
4	207FF5FOE6	Add 1 to times through
5	43[000] 40000	
6	0500000000	.5 (dec)
7	0250000000	.25 (dec)
8	0000000F01	$\times 10^{-1}$ (dec)
9	0000000020	32*
A	0140000000	F.P. 1
B	0B40000000	F.P. 1024
C	0A78000000	F.P. 960
D	0000000027	39*
E	4310340000	$\rightarrow$ set Max, Min
F	247FD5F0F1	0 $\rightarrow$ counter
130	24130430FD	$\rightarrow$ Read in control Routine
1	240F1220E6	Counter-Times through
2	4A15C40000	Tr if +
3	240F1207FF	add 1 to counter
4	5F0F1240F5	} set stop word
5	200EB5F0F6	
6	40000600EB	No. Words to Q
7	B(0)30043138	Read from drive (x)
8	2413843000	$\rightarrow$ F.P.
9	30040EC0C0	$x - x_M$
A	30040ED0C1	$x - x_m$
B	30140EE0C2	$y - y_M$
C	B0140EFOC3	$y - y_m$
D	240C012009	test $x - x_M$
E	4913F24300	Tr if $x < x_M$ if $x > x_M$
F	5FOEC240C1	$x \rightarrow x_M$

CODE

Cell			
140	1200948142	Test $x - x_m$	Tr if $x > x_m$
1	4000024300	if $x < x_m$	
2	5F0ED240C2	$x \rightarrow x_m$	
3	1200949145	Test $y - y_M$	Tr if $y < y_M$
4	4000024301	$y \rightarrow y_M$ if $y > y_M$	
5	5F0EE240C3		
6	1200948148	Test $y - y_m$	Tr if $y > y_m$
7	4000024301	$y \rightarrow y_m$ if $y < y_m$	
8	5F0EF40000		
9	24139200F0	change addresses	
A	5F1395C13A		
B	2413B200F0		
C	5F13B200F8		
D	5C13C40000		
E	2413E200E3		
F	5F13E51141		
150	24144200E3		
1	5F1445F147		
2	220F64A154	Through ?	Tr if +
3	4313840000	back if -	
4	240F25C139	reset addresses	
5	5C13A240F3		
6	5C13B200F8		
7	5C13C40000		
8	240F45F13E		
9	51141240F5		
A	5F1445F147		
B	4311740000	Re-enter	
C	240E7227FF	Read-in control	
D	5F0E743160	Correct Block	
E	0000000000	counter	
F	0000000000		

CODE

Cell		No. Blocks	
160	600E740000		
1	A [0] 00040000	Hunt Back Drive (x)	
2	2416243000	→ F.P. Routine	
3	0EC40ED0F9	$x_M - x_m = RX$	
4	8EE40EFOFA	$y_M - y_m = RY$	
5	4000040000		
6	240F95F0FB	$RX(F.P.) \rightarrow RX(dec)$	
7	240FA5F0FC	$RY(F.P.) \rightarrow RY(dec)$	
8	2416843080	→ F.P. → dec conversion	
9	000FB000FC	(RX)	(RY)
A	160007F70D	0 → 70D	
B	4317000000		
C	0000000000		
D	0000000000		
E	0000000000		
F	0000000000		
170	247FD5F700	0 → 700	
1	5F701240FB	0 → 701	$R_x \rightarrow A$
2	5E70051701	Store RX	Store RX
		Decimal	Power
3	2470022126	$RX(Dec) - .5$	
4	4A17624127	Tr if +	if $RX(Dec) < .5$
5	5F70243177	store .25	
6	241265F702	if $RX(Dec) \geq .5$ store .5	
7	247011201D	Test exponent	
8	4B17D24701	Tr if -	
9	227FF4B17B	exp. - 1	Tr if ≤ 0
A	517024317F	Δx stored if $(exp-1) \geq 0$	
B	2412851702	Δx stored if $(exp-1) = -1$	
C	4317F40000		
D	24701207FF		
E	5170240000	Δx stored if $(exp-1) < -1$	
F	247FD5F700	0 → 700	

CODE

Cell			
180	5F701240FC	0 → 701	
1	5E70051701	Store RY Decimal	Store RY Power
2	2470022126	RY(Dec) - .5	
3	4A18524127	Tr if +	if RY(Dec) < .5
4	5F70343186	store .25	
5	241265F703	if RY(Dec) ≥ .5, store .5	
6	247011201D	Test exponent	
7	4B18C24701	Tr if -	
8	227FF4B18A	exp - 1	Tr if < 0
9	517034118D	ΔY stored if (exp - 1) ≥ 0	
A	2412851703	Δy stored if (exp - 1) = -1	
B	4118D40000		
C	24701207FF	Δx stored	
D	51703247FD	if (exp - 1) < - 1	
E	5F7095F708	0 → 709	0 → 708
F	2418F43400	→ Dec → F.P. conversion	
190	0070200703	(Δx)	(Δy)
1	2419143000	→ F.P.	
2	0EF1703707	yM/Δy = q'y	
3	0EE1703706	yM/Δy = qy	
4	0ED1702705	xM/Δx = q'x	
5	0EC1702704	xM/Δx = qx	
6	7040000704	qx	
7	F050000705	q'x	
8	160007F70C	0 → 70C	
9	247044819B	qx → A	Tr if exp +
A	247FD5F70B	if qx < 1 store 0	
B	431AB58708	to q'x calc store exp qx	
C	1E0085F709	shift and store dec qx	
D	7119F2419F	store exp qx	
E	207FF5F19F	(exp + 1) → 19F	
F	247091F [000]	shift integer → Q	

CODE

Cell

1A0	5F70A7F70B	Store fraction	Store integer
1	2419F5170C	store (exp qx) + 1	
2	241292270C	32* - (exp qx) + 1	
3	511A440000	$\hookrightarrow 1A^4$	
4	2470B12 [000]	Shift integer to 8-32 pos.	
5	5F70B24708	and store	exp qx
6	5870B2770A	Integral	- fraction
7	4A1AD240EC	qx stored	
8	120094B1AB	out if no fraction	XM $\rightarrow$ A
9	241A943000	out if XM < 0	
A	FOB812A70B	$\rightarrow$ F.P.	
B	4000040000	qx + 1	
C	4000040000		
D	24705481AF		
E	247FD5F70C	set q' x = 0 if q'x < 1	
F	431C058708		store exp
1B0	1E0085F709	shift and store decimal	
1	711B3241B3		
2	207FF5F1B3	exp + 1 $\rightarrow$ 1B3	
3	247091F [000]	shift integer $\rightarrow$ Q	
4	7F70C5F70A	store integer	store fraction
5	247FD5F70D	0 $\rightarrow$ 70D	
6	241B35170D	store (exp q'x) + 1	
7	241292270D	32 - (exp q'x) + 1	
8	511B940000	$\hookrightarrow$ 1B9	
9	2470C12 [000]	shift integer to 8-32 pos	
A	5F70C24708	and store	
B	5870C2770A	integral q'x stored	- fraction
C	4A1C0240ED	out if no fraction	X _m $\rightarrow$ A
D	120094A1C0	out if X _m $\geq$ 0	
E	241BE43000	$\rightarrow$ F.P.	
F	FOC812A70C	q'x + 1	

CODE

Cell		
1C0	241C043000	→ F.P.
1	7060000706	$ qy $
2	F070000707	$ q'y $
3	24706481C5	
4	247FD5F70D	set $qy = 0$ if $qy < 1$
5	431D658708	store exp.
6	1E0085F709	store dec.
7	711C9241C9	
8	207FF5F1C9	$exp + 1 \rightarrow 1C9$
9	247091F [000]	shift integer → Q
A	5F70A7F70D	store fraction store integer
B	247FD5F70E	$0 \rightarrow 70E$
C	241C95170E	store $(exp \ qy) + 1$
D	241292270E	$32* - (exp \ qy) + 1$
E	511CF40000	$\hookrightarrow 1CF$
F	2470D12 [000]	shift integer → 8-32 pos
ID0	5F70D24708	and store
1	5870D2770A	integral qy stored $- fraction $
2	4A1D6240EE	out if no fraction
3	120094B1D6	out if $Y_M < 0$
4	241D443000	→ F.P.
5	F0D812A70D	$qy + 1$
6	4000040000	
7	4350040000	Tr to calculate $q'y$
8	4000040000	
9	4000040000	
A	241DA43000	→ F.P.
B	12B1710712	$1024 / q \ RX $
C	92C1711713	$960 / q \ RY $
D	4000040000	
E	247121E008	X intervals
F	7F7145F715	store exp store decimal

CODE

Cell		
1E0	2412D22714	39* - Exp *
1	511E240000	
2	2471514 [000]	X intervals x 2^{-39}
3	5F71624713	stored
4	1E0087F714	Y intervals
5	5F7152412D	Store exponent
6	2271451E7	store decimal
7	2471514 [000]	39* - Exp*
8	5F71740000	Y intervals x 2^{39}
9	4000040000	stored
A	4000040000	
B	4000040000	
C	4000040000	
D	240505F1F0	} set addresses
E	240515F1F1	
F	4000040000	
1F0	40000C1 [020]	} plot axis
1	40000C2 [000]	
2	241F022052	and intervals
3	4A [1F6] 241F0	Test for end of
4	20 [054] 5F1F0	axis
5	431F040000	change address
6	4000040000	and return
7	240505F1F0	} change addresses
8	241F120054	
9	5F1F124058	
A	541F324056	
B	12014541F4	to plot intervals
C	431F040000	and return
D	241F120054	} change addresses
E	5F1F124058	
F	12014541F3	

CODE

Cell		
200	240505F1F0	
1	431F040000	and return
2	4000040000	
3	240505F1F0	} reset addresses
4	240515F1F1	
5	241FD12014	
6	541F424059	
7	5F1F340000	
8	40000C1 [020]	} Plot axis
9	40000C2 [3FE]	
A	2420822052	Test for end of
B	4A [20E] 24208	axis
C	20 [054] 5F208	change addresses
D	4320840000	and return
E	240505F208	} change addresses
F	2420922054	
210	5F2092405A	
1	5420B24056	
2	120145420C	and return
3	4320840000	
4	240505F208	} change addresses
5	2420922054	
6	5F2092405A	
7	120145420B	
8	4320840000	and return
9	240505F208	} reset
A	240535F209	
B	2405D5420B	
C	2405712014	
D	5420C40000	addresses
E	4000040000	
F	40000C1 [020]	

CODE

Cell					
220	40000C2 [000]	Plot axis and intervals			
1	2422022053	Test for end of			
2	4A [225] 24220	axis			
3	20 [054] 5F220	change addresses			
4	4321F40000	and return			
5	240515F220	}	change addresses		
6	2421F20054				
7	5F21F24055				
8	1201454223				
9	2405C54222				
A	4321F40000	}	Change addresses		
B	240515F220				
C	2421F20054				
D	5F21F2405B				
E	1201454222				
F	4321F40000	}	and return		
230	4000040000				
1	240505F21F			}	reset addresses
2	2405B54122				
3	2422612014				
4	5422324051				
5	5F22040000				
6	40000C1 [3DF]	}	Plot axis and		
7	40000C2 [000]			intervals	
8	2423722053	Test for end of			
9	4A [23C] 24237	axis			
A	20 [054] 5F237	change address			
B	4323640000	and return			
C	240515F237	}	change addresses		
D	2423622054				
E	5F2362405D				
F	120145423A				
				and return	

CODE

Cell		
240	2405C12014	}
1	5423943236	
2	4000040000	
3	240515F237	}
4	2423622054	
5	5F2362405D	
6	1201454239	
7	4323640000	
8	240525F236	}
9	240515F237	
A	2405E54239	
B	2424412014	
C	5423A40000	
D	2424D43000	→ F.P.
E	0ED40EC700	$X_m - X_M$
F	8EF40EE701	$Y_m - Y_M$
250	247FD5F0F1	0 → counter
1	24251430FD	→ Read-in control routine
2	240F1220E6	Through ?
3	4A27940000	out if +
4	240F1207FF	add 1 to counter
5	5F0F1240EB	
6	1200C20060	set stop word
7	5F0F6600EB	
8	B(0)30043259	Read from Dr (x)
9	2425943000	→ F.P.
A	0ED4 [300] 702	$X_m - x$
B	0EF4 [301] 703	$Y_m - y$
C	7021700704	$X_m - x$
		$\frac{X_m - x}{X_m - X_M}$ ①
D	7031701705	$Y_m - y/Y_m - Y_M$ ②
E	704212B706	① . 1024
F	F05212C707	② . 960

CODE

Cell			
260	247061E008	x ratio	shift
1	7F7085F709	store exponent	store decimal
2	2412D22708	39* - exponent	
3	5126440000		
4	2470914[000]	$x \text{ ratio} \times 2^{-39} =$	
5	5F70E24707	x-coordinate	Y ratio
6	1E0087F708	shift	store exponent
7	5F7092412D		
8	2270851269		
9	2470914[000]	$y \text{ ratio} \times 2^{-39} =$	
A	5F70F40000	y- coordinate - 32*	
B	2470F20129	y - coord + 32*	
C	5126E2470E		
D	5126F40000		
E	40000C1000	plot (x, y)	
F	40000C2000		
270	2425A20061	change addresses	Test
1	5F25A2425B		
2	200615F25B		
3	2425A220F6		
4	4A27543259	out if + return	
5	4000040000		
6	240605F25A	reset addresses	
7	240625F25B		
8	4311740000	→ Read-in control	
9	240EC5F710	Max and Min to storage	
A	240ED5F711		
B	240EE5F712		
C	240EF5F713		
D	2427D43080	→ Convers. Hex → Dec	
E	0071000713		
F	247101E004	Shift off digits	

CODE

Cell			
280	7F7205F710	and store as *Nos.	
1	24280207FB	change	
2	5428022063	addresses	
3	4B27F2427F	back for next digit	
4	207FB5427F		
5	24282207FB		
6	5128224280	change addresses	
7	207FB5F280	and go back for	
8	2428222067	next No.	
9	4B27F24068		
A	5F27F24069		
B	5F2802406A	reset addresses	
C	5F2822406B		
D	5F72A5F735	insert space between	
E	5F74040000	Nos.	
F	4000040000		
290	247202006C		
1	5129240000		
2	C100060[000]	Set x - coord.	bring in Q word
3	40000C3[000]	Print digit	
4	3800024290		
5	207FB54290		
6	242932006D	change address	
7	5F29324290	and back for next	
8	2206E4B290	digit	
9	400002406F		
A	5F290247FD	reset addresses	
B	5129340000		
C	4000040000		
D	4000040000		
E	4000040000		
F	4000040000		

CODE

Cell			
2A0	2407020(794)	set stop word	
1	5F07140000		
2	2406C20751		
3	512A440000		
4	C13FD60 [000]	} Print Heading	
5	40000C3 [000]		
6	38000242A2	} change addresses	
7	207FF5F2A2		
8	242A52006D		
9	5F2A5242A2		
A	220714B2A2		
B	4000040000		
C	240705F2A2	} reset addresses	
D	247FD512A5		
E	C800043 [ABE]		
F	0000000000	Case No.	
2B0	90750432B1	Read in first tape	
1	2407020750	set address to read	
2	512BC00000	next tape	insert date in Q
3	7F29324293		
4	1E0047F780	} set up date for printing	
5	1E0047F781		
6	1E0047F783		
7	1E0047F784		
8	1E0047F786		
9	1E0047F787		
A	2406B5F782		
B	5F7855F788		
C	242BC40 [000]		
D	12014542C6	address → Read order	
E	942AF940EA	Read in Case No.	Read in No. words
F	9470024073	Read in Drive No.	

CODE

Cell		
2C0	2070012020 }	set up hunt
1	5816124074 }	order
2	2070012020 }	set up read
3	5813758258 }	orders
4	9470024700	N_2^*
5	207505F794	$N_1 + N_2 \rightarrow 794$
6	90[000]432C7	Read n_i 2
7	242AF1E004 }	shift off and store
8	7F7895F2AF }	case No. for printing
9	242C8207FB }	
A	542C8242C8 }	change address
B	220774B2C7 }	and return
C	240785F2C8	reset address
D	2406C20780	
E	512CFC13FD	set y coordinate
F	4000060[000]	bring in Q word
2D0	40000C3(27C)	Print character
1	38000242CD }	
2	207FF5F2CD }	change
3	242D02006D }	addresses
4	5F2D0242CD }	
5	220794B2CD	return
6	2407A5F2CD }	reset addresses
7	2407B5F2D0 }	
8	4312E00000	$\rightarrow 123$

CODE

Cell		
500	2470748502	
1	247FD5F70E	set $q'y = 0$ if $q'y < 1$
2	4351358708	store exp
3	1E0085F709	store decimal
4	7150624506	$(\text{exp } q'y) + 1$
5	207FF5F506	$\rightarrow 506$
6	247091F [000]	shift integer $\rightarrow Q$
7	7F70E5F70A	Store integer store fraction
8	247FD5F70F	$0 \rightarrow 70F$
9	245065170F	$(\text{exp } q'y) + 1 \rightarrow 70F$
A	241292270F	$32* - (\text{exp } q'y) + 1$
B	5150C40000	$\rightarrow 50C$
C	2470E12 [000]	shift integer $\rightarrow 8-32$ pos.
D	5F70E24708	and store
E	5870E2770A	integral $q'y$ stored - fraction
F	4A513240EE	out if no fraction
510	120094A513	out if $Y_m > 0$
1	2451143000	$\rightarrow$ F.P.
2	FOE812A70E	$q'y + 1$
3	4000040000	
4	240EC12009	
5	4851B40000	Tr if $X_M \geq 0$
6	2451643000	$\rightarrow$ F.P.
7	702270B0EC	$\Delta x qx = X_M $
8	702270C0ED	$\Delta x q'x = X_m $
9	0EC207C0EC	$-1 X_M = X_M$
A	8ED207C0ED	$-1 X_m = X_m$
B	43525240ED	out
C	120094A522	
D	2451D43000	$\rightarrow$ F.P.
E	702270B0EC	$\Delta x qx = X_M$
F	702270C0ED	$\Delta x q'x = X_m $

Tr if $x_m \geq 0$

CODE

Cell		
520	8ED207COED	$-1 X_m = X_m$
1	4352540000	out
2	2452243000	$\rightarrow$ F.P.
3	702270BOEC	$\Delta x qx = X_M$
4	F02270COED	$\Delta x q'x = X_m$
5	240EE12009	
6	4852C40000	Tr if $y_M \geq 0$
7	2452743000	$\rightarrow$ F.P.
8	703270DOEE	$\Delta y qy = Y_M $
9	703270EOEF	$\Delta y q'y = Y_m $
A	0EE207COEE	$-1 Y_M = Y_M$
B	8EF207COEF	$-1 Y_m = Y_m$
C	4353624OEF	out
D	120094A533	Tr if $y_m \geq 0$
E	2452E43000	$\rightarrow$ F.P.
F	703270DOEE	$\Delta y qy = Y_M$
530	703270EOEF	$\Delta y q'y = Y_m $
1	8EF207COEF	$-1 Y_m = Y_m$
2	4353640000	out
3	2453343000	$\rightarrow$ F.P.
4	703270DOEE	$\Delta y qy = Y_M$
5	F03270EOEF	$\Delta y q'y = Y_m$
6	2453643000	$\rightarrow$ F.P.
7	OEC4OED710	$X_M - X_m = RX$
8	OEE4OEF711	$Y_M - Y_m = RY$
9	7101702710	$RX/\Delta X = qRX$
A	F111703711	$RY/\Delta y = qRY$
B	431DA00000	

DUMMY WORDS

Cell		Cell	
050	40000C1020	070	2406C20751
1	40000C2000	1	0000000000 stop word
2	40000C13DF	2	5F78A242B2
3	40000C23FF	3	00000000AC
4	0000000004	4	00000000B0
5	0000000716	5	4000071751
6	0000000717	6	0000000000 stop word
7	0000000054	7	7F7935F2AF
8	001FD00202	8	7F7895F2AF
9	001F600000	9	2406C20793
A	0021400219	A	2406C20780
B	0022500230	B	40000C327C
C	0022B00243	C	01C0000000 F... (-2)
D	0020E00248		
E	0023C00000		
F	0000000000		
060	0ED4300702		
1	0000002000		
2	0EF4301703		
3	7F72A5F710		
4	7F7355F711		
5	7F7405F712		
6	7F74B5F713		
7	5428022067		
8	247101E004		
9	7F7205F710		
A	5428022063		
B	0000000037		
C	0000000450		
D	0000000014		
E	2474B2006C		
F	247202006C		