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GENERAL-DATA PLOT PROGRAM FOR HEWLETT-PACKARD 9830 CALCULATOR

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PROGRAM DESCRIPTION AND USER INSTRUCTIONS

Description

This program plots data points (x, y) with the option of each axis being either rectangular or logarithmic scales. The data points may be entered from the keyboard or card reader or defined by a user-defined function, and may be plotted on a plotter-drafted grid or on graph paper. The program was written in the BASIC computer language for use on the Hewlett-Packard 9830 calculator[1/]; however, the program may be modified for use on other calculators.

Special considerations

For plotter-drafted grids, the plot height and width includes the dimensions of the labeling area. Thus, if a specific size of grid is desired, the labeling dimensions should be added to the height and width. For plotting on preprinted graph paper, the plot height and width includes a 1/4-inch margin around the entire grid; this permits data symbols to be plotted at the grid limits. Thus, the plotter limits should be set 1/4-inch from the graph limits.

System specifications

9830 (4K R/W), Plotter ROM, and Extended I/O ROM.
9862 Plotter
9866 Printer
9869 Card Reader (Optional)

[1/] The use of the brand name in this report is for identification purposes only and does not imply endorsement by the U.S. Geological Survey.

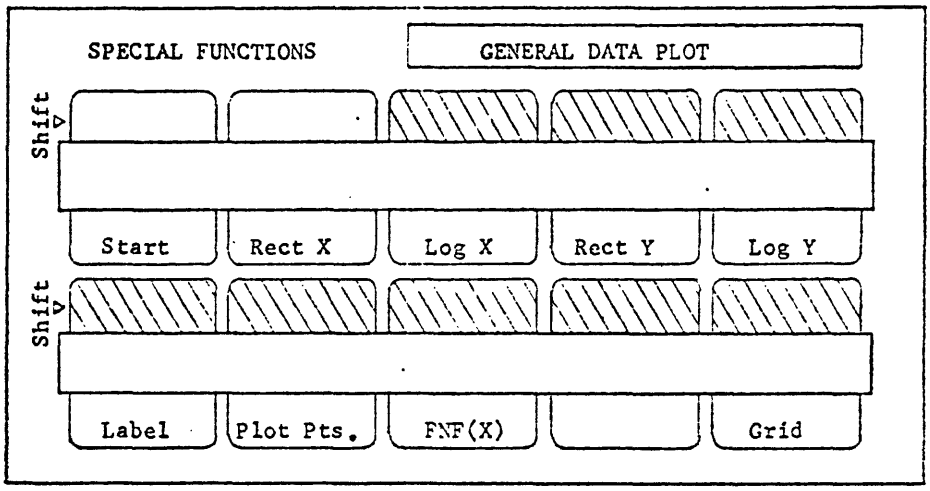

Figure 1.Special function key overlay for labeling keys used to run plot program.

Operation

1. Type LOADKEY 1 and press EXECUTE.

2. If data points are to be defined by a function, press FETCH and press FNF(X) [SF Key 7] (See figure 1). Define function and press END OF LINE.

3. Press RUN and START [SF Key 0]. The program will ask if plotting on graph paper, plot height, and plot width.

4. Press RECT X [SF Key 1] or LOG X [SF Key 2], then RECT Y [SF Key 3] or LOG Y [SF Key 4]. The rect. x and y axis programs will ask for minimum and maximum values. When not plotting on graph paper, they will also ask for tick increment and number of decimal places (0-4) in the axis label. The rect. x program also asks for maximum number of digits (including decimal) in x axis label. This value is used to center numbers under tick marks. The log x and y programs will ask for starting values of first log cycle and number of log cycles. The program (when not plotting on graph paper) will then plot a grid by calling subrouting FNG(Z) on SF Key 11 and display PUSH F5 (LABEL) OR F6 (PLOT) KEY. After pressing LABEL Key, the pen will move into position to label the x axis and then the y axis as shown in figure 2. The calculator/ plotter system is in the typewriter mode.

5. Pressing PLOT PTS [SF Key 6] initiates the plotting of data points. The program will ask for line dash length between data points (0=none, 9=solid line, or dash length in inches), symbol (push space bar for none), and options for automatic x increment, Y=F(X), and data on cards. Card data is read in by program subroutine FNC(Z) on SF Key 8. Ten values (10F8.0) are entered per card - either 5 pairs of x,y values, of 10 y values for automatic x increment, or 10 x values for Y=F(X). The data points are plotted and connected by program subroutine FNP(Z) on SF Key 10. If x or y values fall outside grid, an error message is displayed. Push CONT and EXECUTE to enter new values.

6. Press PLOT PTS [SF KEY 6] to start new line (change symbol and or line dash length).

7. Pressing GRID [SF Key 9] allows the user to replot the previous grid.

SAMPLE RUN

The plot shown in figure 2 was produced by using the program steps listed below. The portion of each step line preceding the "?" shows the entry request, and the entered value follows.

```
RUN
PLOT ON GRAPH PAPER (YES OR NO)?  NO
ENTER PLOT LIMIT HEIGHT (INCHES)?  5
ENTER PLOT LIMIT WIDTH (INCHES)?  9
PUSH F1(RECT X) OR F2(LOG X) KEY

ENTER MIN X?  Ø
ENTER MAX X?  1ØØ
ENTER X TIC INCRN.?  2Ø
ENTER NO. DEC(Ø4) X LABEL?  Ø
NO. OF COLUMNS(17) X LABEL?  3
PUSH F3(RECT Y) OR F4(LOG Y) KEY

ENTER START Y FIRST LOG CYCLE?  1
ENTER NUMBER Y LOG CYCLES?  2
PUSH F5(LABEL) OR F6(PLOT) KEY

LABEL X AXIS & PUSH STOP
DONE
LABEL Y AXIS & PUSH STOP
DONE
PUSH F6(PLOT) KEY

ENTER DASH LENGTH Ø=NONE 9=SOLID?  9
ENTER SYMBOLSPACE BAR FOR NONE?  X
AUTOMATIC X (YES OR NO)?  NO
Y=F(X) ON KEY 7 (YES OR NO)?  NO
DATA ON CARDS (YES OR NO)?  NO
ENTER FIRST X VALUE?  Ø
ENTER FIRST Y VALUE?  1
ENTER NEXT X VALUE OR PUSH F6 KY?  25
ENTER NEXT Y VALUE?  9
ENTER NEXT X VALUE OR PUSH F6 KY?  55
ENTER NEXT Y VALUE?  4
ENTER NEXT X VALUE OR PUSH F6 KY?  75
ENTER NEXT Y VALUE?  9Ø
ENTER NEXT X VALUE OR PUSH F6 KY?  1ØØ
ENTER NEXT Y VALUE?  5Ø

ENTER DASH LENGTH Ø=NONE 9=SOLID?  Ø.2
ENTER SYMBOLSPACE BAR FOR NONE?  H
AUTOMATIC X (YES OR NO)?  YES
X INCREMENT?  2Ø
Y=F(X) ON KEY 7 (YES OR NO)?  NO
DATA ON CARDS (YES OR NO)?  NO
```

(Sample Run Continued)

```
ENTER FIRST X VALUE?  Ø
ENTER FIRST Y VALUE?  4
ENTER NEXT Y VALUE?  2Ø
ENTER NEXT Y VALUE?  5Ø
ENTER NEXT Y VALUE?  1Ø
ENTER NEXT Y VALUE?  5
ENTER NEXT Y VALUE?  1Ø
END AUTO X OR CARD DATA
```

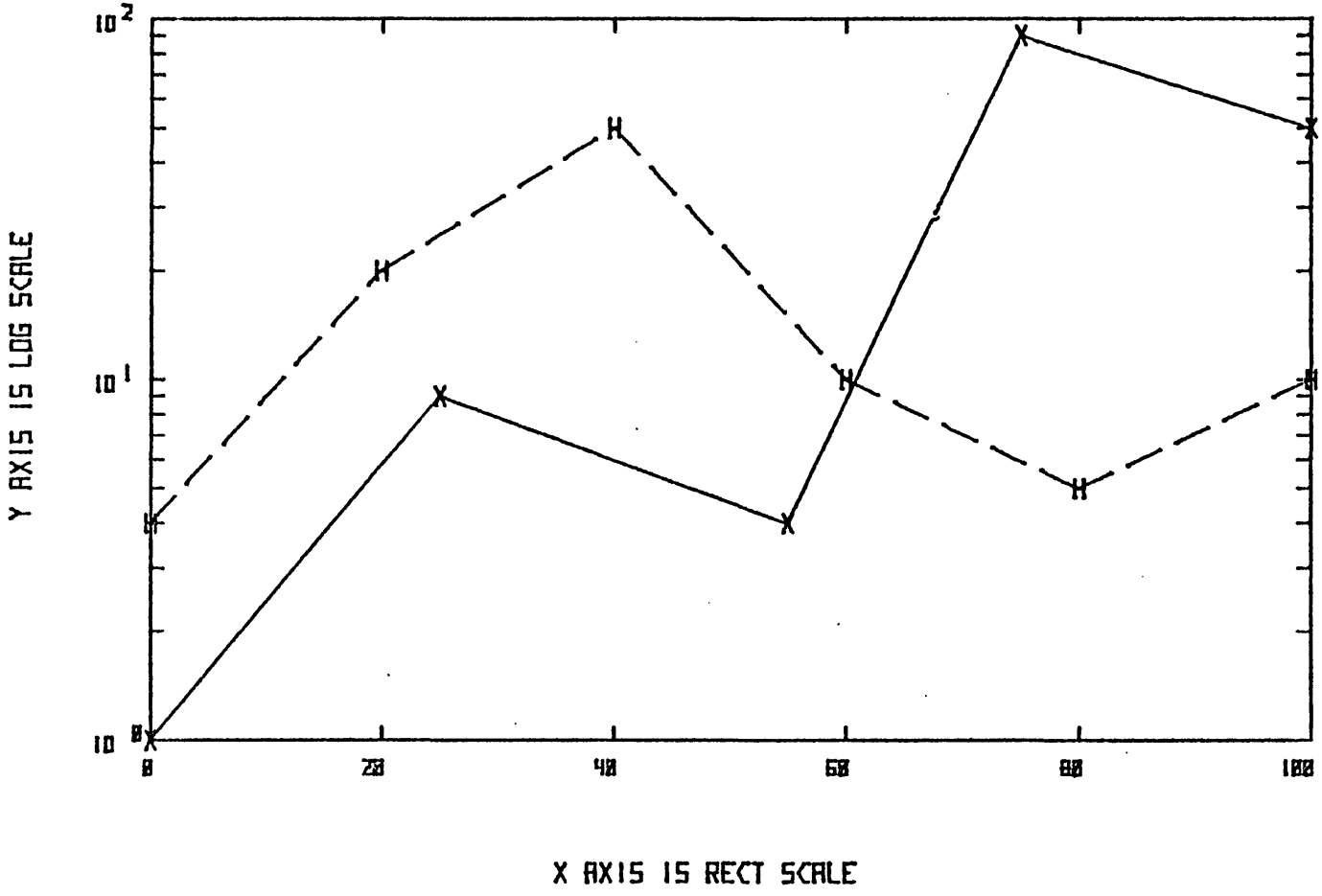

Figure 2. Sample plot

PROGRAM LISTING

```
5 REM KEY Ø (STARTING POINT FOR PROGRAM TO DRAW & LABEL GRID
1Ø REM          AND PLOT DATA OR PLOT DATA ON GRAPH PAPER)
15 DIM A$[ 3],B$[ 3],C$[ 3],D$[ 3],S$[ 1],T[ 1Ø]
2Ø DEG
22 REWIND
25 DISP "PLOT ON GRAPH PAPER (YES OR NO)";
3Ø INPUT A$
35 DISP "ENTER PLOT LIMIT HEIGHT (INCHES)";
4Ø INPUT H
45 DISP "ENTER PLOT LIMIT WIDTH (INCHES)";
5Ø INPUT W
55 X=Ø.2*H
6Ø DISP "PUSH F1(RECT X) OR F2(LOG X) KEY"
65 END

1Ø REM KEY F1 (RECT X)
15 G1=2
2Ø DISP "ENTER MIN X";
25 INPUT A1
3Ø DISP "ENTER MAX X";
35 INPUT B1
4Ø X7=B1
45 1F AS="YES" THEN 1Ø5
5Ø DISP "ENTER X TICK INCRM.";
55 INPUT C1
6Ø DISP "ENTER NO. DEC. (Ø-4) X LABEL";
65 INPUT D1
7Ø DISP "NO. OF COLUMNS(1-7) X LABEL";
75 INPUT D3
8Ø I=(B1-A1)/W*X
85 X4=(B1-A1)/(W-1)
9Ø S1=A1-I
95 S2=B1+I/3
1ØØ GOTO 12Ø
1Ø5 X4=(B1-A1)/(W-Ø.5)
11Ø S1=A1-X4*Ø.25
115 S2=B1+X4*Ø.25
12Ø DISP "PUSH F3(RECT Y) OR F4(LOG Y) KEY"
125 END

1Ø REM KEY F2 (LOG X)
15 G1=1
2Ø DISP "ENTER START X FIRST LOG CYCLE";
25 INPUT A1
3Ø A1=LGTA1
35 DISP "ENTER NUMBER X LOG CYCLES";
4Ø INPUT N1
45 B1=N1+A1
5Ø X7-10↑B1
55 IF A$="YES" THEN 85
6Ø I=N1/W*X
```

```
65 X4=N1/(W-1)
7Ø S1=A1-I
75 S2=B1+I/3
8Ø GOTO 1ØØ
85 X4=N1/(W-Ø.5)
9Ø S1=A1-X4*Ø.25
95 S2=B1+X4*Ø.25
1ØØ DISP "PUSH F3(RECT Y) OR F4(LOG Y) KEY"
1Ø5 END

1Ø REM KEY F3 (RECT Y)
15 G2=2
2Ø DISP "ENTER MIN Y";
25 INPUT A2
3Ø DISP "ENTER MAX Y";
35 INPUT B2
4Ø IF A$="YES" THEN 1ØØ
45 DISP "ENTER Y TICK INCRM.";
5Ø INPUT C2
55 DISP "ENTER NO. DEC.(Ø-4) Y LABEL";
6Ø INPUT D2
65 J=(B2-A2)/H*X
7Ø Y4=(B2-A2)/(H-1)
75 S3=A2-J
8Ø S4-B2+J/3
85 Z=FNGØ
9Ø DISP "PUSH F5(LABEL) OR F6(PLOT) KEY"
95 GOTO 12Ø
1ØØ Y4=(B2-A2)/(H-Ø.5)
1Ø5 S3=A2-Y4*Ø.25
11Ø S4=B2+Y4*Ø.25
115 DISP "PUSH F6(PLOT) KEY"
12Ø END

1Ø REM KEY F4(LOG Y)
15 G2=1
2Ø DISP "ENTER START Y FIRST LOG CYCLE";
25 INPUT A2
3Ø A2=LGTA2
35 DISP "ENTER NUMBER Y LOG CYCLES";
4Ø INPUT N2
45 B2=N2+A2
5Ø IF A$="YES" THEN 155
55 J=N2/H*X
6Ø Y4=N2/(H-1)
65 S3=A2-J
7Ø S4=B2+J/3
75 IF G1=2 THEN 14Ø
80 U=(S4-S3)/H
85 L=(H-1.33*J/U)/N2
```

```
9Ø Y=I*W/(S2-S1)
95 N=L*N1+Y*1.4
1ØØ IF N <= W THEN 125
1Ø5 DISP "COMP. WIDTH = "N;">INPUT W"
11Ø WAIT 8ØØØ
115 DISP "PUSH KEY FØ(START) & USE NEW W"
12Ø STOP
125 S1=A1-U*Y
13Ø S2=S1+W*U
135 X4=Y4
14Ø Z=FNGØ
145 DISP "PUSH F5(LABEL) OR F6(PLOT) KEY"
15Ø GOTO 175
155 Y4=N2/(H-Ø.5)
16Ø S3=A2-Y4*Ø.25
165 S4=B2+Y4*Ø.25
17Ø DISP "PUSH F6(PLOT) KEY"
175 END

1Ø REM KEY F5 (LABEL)
15 Y=Ø.1
2Ø S$="X"
25 FOR Z=Ø TO 1
3Ø LABEL (*,2,2,Z*9Ø,H/W)
35 PLOT S1,S3,1
4Ø CPLOT 1Ø,Y
45 DISP "LABEL"S$;" AXIS & PUSH STOP"
5Ø LETTER
55 DISP
6Ø DISP "DONE"
65 Y=1.1
7Ø S$="Y"
75 NEXT Z
8Ø LABEL (*,1.5,2,Ø,H/W)
85 DISP "PUSH F6(PLOT) KEY"
9Ø END

1Ø REM KEY F6 (PLOT DATA POINTS)
15 LABEL (*,2,2,Ø,H/W)
2Ø SCALE S1,S2,S3,S4
25 DISP "ENTER DASH LENGTH Ø=NONE 9=SOLID";
3Ø INPUT L1
35 DISP "ENTER SYMBOL--SPACE BAR FOR NONE";
4Ø INPUT S$
45 DISP "AUTOMATIC X (YES OR NO)";
5Ø INPUT B$
55 IF B$="NO" THEN 7Ø
6Ø DISP "X INCREMENT";
65 INPUT X5
7Ø DISP "Y=F(X) ON KEY 7 (YES OR NO)";
75 INPUT C$
```

```
8Ø DISP "DATA ON CARDS (YES OR NO)";
85 INPUT D$
9Ø IF D$="NO" THEN 1Ø5
95 Z1=FNC1
1ØØ GOTO 145
1Ø5 DISP "ENTER FIRST X VALUE";
11Ø INPUT X1
115 X6=X1
12Ø IF C$="NO" THEN 135
125 Y1=FNFX1
13Ø GOTO 145
135 DISP "ENTER FIRST Y VALUE";
14Ø INPUT Y1
145 GOTO G1 OF 15Ø,155
15Ø X1=LGT(X1)
155 GOTO G2 OF 16Ø,165
16Ø Y1=LGT(Y1)
165 Z-FNPØ
17Ø IF D$="NO" THEN 185
175 Z1=FNCØ
18Ø GOTO 195
185 IF B$="NO" THEN 21Ø
19Ø X2=X6=X6+X5
195 IF X2>X7 THEN 285
2ØØ IF D$="YES" THEN 245
2Ø5 GOTO 22Ø
21Ø DISP "ENTER NEXT X VALUE OR PUSH F6 KY";
215 INPUT X2
22Ø IF C$="NO" THEN 235
225 Y2=FNFX2
23Ø GOTO 245
235 DISP "ENTER NEXT Y VALUE";
24Ø INPUT Y2
245 GOTO G1 OF 25Ø,255
25Ø X2=LGT(X2)
255 GOTO G2 OF 26Ø,265
26Ø Y2=LGT(Y2)
265 IF X2< A1 OR X2>B1 THEN 295
27Ø IF Y2< A2 OR Y2>B2 THEN 325
275 Z=FNP1
28Ø GOTO 17Ø
285 DISP "END AUTO X OR CARD DATA"
29Ø STOP
295 GOTO G1 OF 31Ø,3ØØ
3ØØ DISP "X = "X2" OUTSIDE GRID"
3Ø5 GOTO 315
31Ø DISP "X = "(1Ø+X2)" OUTSIDE GRID"
315 STOP
```

```
32Ø GOTO 17Ø
325 GOTO G2 OF 34Ø,33Ø
33Ø DISP "Y = "Y2"OUTSIDE GRID"
335 GOTO 35Ø
34Ø X2=1Ø↑X2
345 DISP "Y = "(1O↑Y2)"OUSTIDE GRID"
35Ø STOP
355 IF B$="YES" THEN 235
36Ø GOTO 17Ø
365 END

1Ø DEF FNF(X)=X↑2/1Ø
2Ø REM DEFINE Y=F(X) (KEY 7)

1Ø DEF FNC(Z)
15 REM READ DATA CARDS (KEY 8)
2Ø IF B$="YES" THEN 1ØØ
25 IF C$="YES" THEN 18Ø
3Ø IF Z THEN 4Ø
35 IF J< 9 THEN 6Ø
4Ø J=-1
45 WRITE (1,*)"D"
5Ø ENTER (1,55)(FORI=1TO1Ø,T[ I])
55 FORMAT 1ØF8.Ø
6Ø J=J+2
65 IF Z THEN 85
7Ø X2=T[ J]
75 Y2=T[ J+1]
8Ø RETURN Ø
85 X1=T[ J]
9Ø Y1-T[ J+1]
95 RETURN Ø
1ØØ IF Z THEN 11Ø
1Ø5 IF J< 1Ø THEN 13Ø
11Ø J=Ø
115 WRITE (1,*)"D"
12Ø ENTER (1,125)(FORI-1TO1Ø,T[ I])
125 FORMAT 1ØF8.Ø
13Ø J=J+1
135 IF Z THEN 155
14Ø X2=X6=X6+X5
145 Y2=T[ J]
150 RETURN Ø
155 DISP "ENTER FIRST X VALUE";
16Ø INPUT X1
165 X6=X1
17Ø Y1=T[ J]
175 RETURN Ø
```

```
18Ø IF Z THEN 19Ø
185 IF J<1Ø THEN 21Ø
19Ø J=Ø
195 WRITE (1,*)"D"
2ØØ ENTER (1,2Ø5)(FORI=1TO1Ø.T[ I])
2Ø5 FORMAT 1ØF8.Ø
21Ø J=J+1
215 IF Z THEN 235
22Ø X2=T[ J]
225 Y2=FNFX2
23Ø RETURN Ø
235 X1=T[ J]
24Ø Y1=FNFX1
245 RETURN Ø

1Ø REM REPLOT PREVIOUS GRID (KEY 9)
15 Z=FNGØ
2Ø DISP "PUSH F5(LABEL) OR F6(PLOT) KEY"
25 END

1Ø DEF FNP(Z)
15 REM ROUTINE TO PLOT DASHED LINE (LENGTH L1), SOLID LINE (L1=9)
2Ø REM     OR NO LINE (L1=Ø) BETWEEN DATA POINTS
25 REM     (SPECIFIED SYMBOL S$). (KEY 1Ø)
3Ø IF Z THEN 65
35 PLOT X1,Y1,1
4Ø IF S$=" " THEN 6Ø
45 CPLOT -Ø.3,-Ø.3
5Ø LABEL (*)S$
55 IPLOT Ø,Ø,1
6Ø RETURN Ø
65 A=2
7Ø IF L1=Ø THEN 165
75 IF L1=9 THEN 17Ø
8Ø X3=(X2-X1)/X4
85 Y3=(Y2-Y1)/X4
9Ø L2=(X3↑2+Y3↑2)↑Ø.5
95 L3=Ø
1ØØ L3=L3+L1
1Ø5 IF L3 >= L2 THEN 17Ø
11Ø P=L3/L2
115 X=X1+P*X3*X4
12Ø Y=Y1+P*Y3*Y4
125 PLOT X,Y,2
13Ø L3=L3+Ø.1
135 IF L3 >= L2 THEN 17Ø
14Ø P=L3/L2
145 X=X1+P*X3*X4
15Ø Y=Y1+P*Y3*Y4
155 PLOT X,Y,1
16Ø GOTO 1ØØ
```

```
165 A=1
17Ø X1=X2
175 Y1=Y2
18Ø PLOT X1,Y1,A
185 IF S$=" " THEN 2ØØ
19Ø CPLOT -Ø.3,-Ø.3
195 LABEL (*)S$
2ØØ IPLOT Ø,Ø,1
205 RETURN Ø

1Ø DEF FNG(Z)
15 REM PLOT GRID (F11 KEY)
2Ø SCALE S1,S2,S3,S4
25 LABEL (*,1.5,2,Ø,H/W)
3Ø X1=A1
35 X2=X1+X4*Ø.Ø7
4Ø Y1=B2
45 Y2=Y1-Y4*Ø.Ø7
5Ø PLOT A1,A2
55 K=1
6Ø X=X1
65 GOTO G2 OF 7Ø,15Ø
7Ø C=1Ø↑A2
75 B=1Ø*C
8Ø A=C*2
85 FOR J=1 TO N2
9Ø FOR I=A TO B STEP C
95 Y=LGTI
1ØØ PLOT X,Y
1Ø5 IF Y=B2 THEN 18Ø
11Ø PLOT X2,Y
115 PLOT X,Y
12Ø NEXT I
125 A=A*1Ø
13Ø B=B*1Ø
135 C=C*1Ø
14Ø NEXT J
145 GOTO 18Ø
15Ø FOR Y=A2+C2 TO B2 STEP C2
155 PLOT X,Y
16Ø IF Y-B2 THEN 18Ø
165 PLOT X2,Y
17Ø PLOT X,Y
175 NEXT Y
18Ø IF K=2 THEN 35Ø
185 Y-Y1
19Ø GOTO G1 OF 195,275
195 C=1Ø↑A1
2ØØ B=1Ø*C
2Ø5 A=C*2
```

```
21Ø FOR J=1 TO N1
215 FOR I=A TO B STEP C
22Ø X=LGTI
225 PLOT X,Y
23Ø IF X=B1 THEN 3Ø5
235 PLOT X,Y2
24Ø PLOT X,Y
245 NEXT I
25Ø A=A*1Ø
255 B=B*1Ø
26Ø C=C*1Ø
265 NEXT J
27Ø GOTO 3Ø5
275 FOR X=A1+C1 TO B1 STEP C1
28Ø PLOT X,Y
285 IF X=B1 THEN 3Ø5
29Ø PLOT X,Y2
295 PLOT X,Y
3ØØ NEXT X
3Ø5 IF K=2 THEN 6Ø
31Ø X1=B1
315 X2=X1-X4*Ø.Ø7
32Ø Y1=A2
325 Y2=Y1+Y4*Ø.Ø7
33Ø PEN
335 PLOT A1,A2
34Ø K=K+1
345 GOTO 185
35Ø PEN
355 GOTO G2 OF 36Ø,42Ø
36Ø FOR I=A2 TO B2
365 PLOT A1,I,1
37Ø CPLOT -5,-Ø.5
375 LABEL (*)"1Ø"
38Ø IF I <=Ø THEN 395
385 CPLOT Ø.5,1.5
39Ø GOTO 4ØØ
395 CPLOT 1.5,1.5
4ØØ LABEL (4Ø5)I
4Ø5 FORMAT F3.Ø
41Ø NEXT I
415 GOTO 45Ø
42Ø D=D2+1
425 FOR I=A2 TO B2 STEP C2
43Ø PLOT A1,I,1
435 CPLOT -8,-Ø.3
44Ø Z=FND(Ø)
445 NEXT I
45Ø GOTO G1 OF 455,51Ø
455 FOR I=A1 TO B1
46Ø PLOT I,A2,1
465 CPLOT -2,-2
47Ø LABEL (*)"1Ø"
```

```
475 IF I< Ø THEN 49Ø
48Ø CPLOT Ø.5,1.5
485 GOTO 495
49Ø CPLOT 1.5,1.5
495 LABEL (4Ø5)I
5ØØ NEXT I
5Ø5 RETURN Ø
51Ø D=D1+1
515 FOR I=A1 to B1 STEP C1
52Ø PLOT I,A2,1
525 A=8-D3*Ø.5
53Ø CPLOT -A,-1.5
535 Z=FND(Ø)
54Ø NEXT I
545 RETURN Ø
55Ø END
555 DEF FND(Z)
56Ø FORMAT F7.Ø
565 FORMAT F7.1
57Ø FORMAT F7.2
575 FORMAT 2F7.3
58Ø FORMAT 2F7.4
585 GOTO D OF 59Ø,6ØØ,61Ø,62Ø,63Ø
59Ø LABEL (56Ø)I
595 GOTO 635
6ØØ LABEL (565)I
6Ø5 GOTO 635
61Ø LABEL (57Ø)I
615 GOTO 635
62Ø LABEL (575)I
625 GOTO 635
63Ø LABEL (58Ø)I
635 RETURN Ø
```