

Program Title CYCLIC PATTERNS

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Program-Description, Equations, Variables FIGURES ARE DRAWN BY JOINING POINTS DESCRIBED BY ORDERED PAIRS OF NUMBERS DERIVED FROM THE EQUATIONS GIVEN BELOW. EITHER CARTESIAN (X,Y) OR POLAR (R,θ) COORDINATE PAIRS MAY BE OUTPUT. ANY DEGREE OF RESOLUTION CAN BE SPECIFIED SO THAT STRAIGHT EDGED FIGURES, e.g. REGULAR POLYGONS, MAY BE EASILY DRAWN. EACH RUN OF POINTS MAY BE SUBJECTED TO ENLARGEMENT, ROTATION AND TRANSLATION; IT IS THUS SIMPLE TO PRODUCE REPEATING PATTERNS. IN -MANUAL- MODE, PAIRS ARE OUTPUT USING THE RIS KEY; IN -AUTO- MODE PAIRS ARE FLASHED CONTINUOUSLY, IN SEQUENCE.

ELLIPSES (CIRCLES, POLYGONS)	$X = A \cos \theta \quad Y = B \sin \theta$
CYCLOIDS (HYPOCYCLOIDS +) (EPICYCLOIDS -)	$X = NA \cos \theta \pm A \cos N\theta$ $Y = NA \sin \theta - A \sin N\theta$
SPIRALS	$R^N = A^N \cdot \theta / 360$
LISSAJOUS' FIGURES	$X = \cos M\theta \quad Y = \sin N\theta$

Operating Limits and Warnings THERE ARE N+1 AND N-1 CUSPS FOR THE HYPO AND EPICYCLOIDS, RESPECTIVELY, IF THESE NUMBERS ARE INTEGERS. IF ONE IS A FRACTION P/Q (P AND Q PRIME TO EACH OTHER), THERE ARE P CUSPS FOR Q REVOLUTIONS OF THE LINE OF CENTRES OF THE GENERATING CIRCLES. NOTE: MORE THAN ONE REVOLUTION IS REQUIRED TO GENERATE MANY OF THE FIGURES; FOR THESE FIGURES Δθ MUST BE MADE CORRESPONDINGLY SMALL.

This program has been verified only with respect to the numerical example given in Program Description II. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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51702 Program Description II

Sketch(es)		1. 00	0. 00	3. 00	0. 00	0. 00	0. 00	0. 00	1. 00	0. 00	0. 00	1. 71	1. 71	0. 00	0. 00
		1. 41	0. 41	1. 41	0. 41	0. 09	0. 09	0. 71	1. 00	0. 29	0. 29	0. 13	45. 00		
0. 00	1. 00	1. 00	2. 00	-1. 00	2. 00	0. 00	0. 25	0. 00	0. 00					0. 25	90. 00
-0. 75	0. 31	-1. 41	2. 41	-1. 41	2. 41	-0. 27	0. 27	-0. 71	-1. 00					0. 37	13. 5
-0. 59	-0. 81	-3. 00	0. 00	-1. 00	0. 00	-0. 50	0. 00	-1. 00	0. 00					0. 50	18. 0
0. 59	-0. 81	-1. 41	-2. 41	-1. 41	-2. 41	-0. 44	-0. 44	-0. 71	1. 00					0. 62	-1. 35
0. 95	0. 31	1. 00	-2. 00	-1. 00	-2. 00	0. 00	-0. 75	0. 00	0. 00					0. 75	-90
		1. 41	-0. 41	1. 41	-0. 41	0. 00	-0. 62	0. 71	-1. 00					0. 87	-45

Sample Problem(s)

1/ TABULATE, USING RECTANGULAR COORDINATE AND AUTOMATIC OUTPUT MODES, THE FOLLOWING UNIT SIZE FIGURES CENTRED AT THE ORIGIN.

(i) AN UPRIGHT PENTAGON

(ii) A CARDIoid

(iii) A DELToid

(iv) A COMMON SPIRAL

(v) A SIMPLE LISSAJOUS' FIGURE.

2/ TABULATE, USING RECTANGULAR COORDINATE AND MANUAL OUTPUT MODES, A STRAIGHT LINE OF TWO UNITS LENGTH, INCLINED AT 45° AND CENTRED AT THE POINT (1,1). — CHECKS G, Φ , X, Y. —

3/ TABULATE, USING POLAR COORDINATE AND MANUAL OUTPUT MODES, A COMMON SPIRAL, CENTRED AT THE ORIGIN.

Solution(s) h, RTN, R/S $\rightarrow$ 0.00; 1, ENTER, 1, fA $\rightarrow$ 5.00; 90, B $\rightarrow$ 90.00; D $\rightarrow$ 0.00; E $\rightarrow$ 1.00; 72 fE $\rightarrow$ RESULTS (10)

h, RTN, R/S $\rightarrow$ 0.00; h, SF2, 1, ENTER, 2, fB $\rightarrow$ 6.00; D $\rightarrow$ 0.00; E $\rightarrow$ 1.00; 45 fE $\rightarrow$ RESULTS (16)

h, RTN, R/S $\rightarrow$ 0.00; h, CF2, 1, ENTER, 2, fB $\rightarrow$ 6.00; D $\rightarrow$ 0.00; E $\rightarrow$ 1.00; 45 fE $\rightarrow$ RESULTS (16)

h, RTN, R/S $\rightarrow$ 0.00; 1, ENTER, 1, fC $\rightarrow$ 7.00; D $\rightarrow$ 0.00; E $\rightarrow$ 1.00; 45 fE $\rightarrow$ RESULTS (16)

h, RTN, R/S $\rightarrow$ 0.00; 1, ENTER, 2, fD $\rightarrow$ 8.00; D $\rightarrow$ 0.00; E $\rightarrow$ 1.00; 45 fE $\rightarrow$ RESULTS (16)

h, RTN, R/S $\rightarrow$ 0.00; .5 ENTER 0 fA $\rightarrow$ 5.00; 2A $\rightarrow$ 2.00; 45, B $\rightarrow$ 45.00; 1, ENTER, 1, C $\rightarrow$ 1.00; D $\rightarrow$ 0.00; E $\rightarrow$ 0.00; 180 fE $\rightarrow$; R/S $\rightarrow$; R/S $\rightarrow$; R/S $\rightarrow$; (4)

h, RTN, R/S $\rightarrow$ 0.00; 1, ENTER, 1, fC $\rightarrow$ 7.00; D $\rightarrow$ 1.00; E $\rightarrow$ 0.00; 45 fE $\rightarrow$; R/S $\rightarrow$; ETC (16)

Reference(s)

A BOOK OF CURVES . E.H. LOCKWOOD
CAMBRIDGE UNIVERSITY PRESS. 1961



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Program Listing I

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STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	1	01	RESET G, ϕ , X, Y		7	07	
	STOA	33 11	To NORMAL VALUES		STI	35 33	
	ϕ	00			RTN	35 22	
	STOB	33 12		060	* LBLd	32 25 14	
	STOC	33 13			STO7	33 07	
	STOD	33 14			X $\rightarrow$ Y	35 52	
	RTN	35 22			STOb	33 06	
*	LBLA	31 25 11			8	08	
	STOA	33 11	STORE G		STI	35 33	
010	RTN	35 22			RTN	35 22	
*	LBLB	31 25 12		*	LBL e	32 25 15	
	STOB	33 12	STORE ϕ		STOE	33 15	
	RTN	35 22			ϕ	00	
*	LBLC	31 25 13		070	STO9	33 09	
	STOD	33 14		*	LBLZ	31 25 02	
	X $\rightarrow$ Y	35 52	STORE X.Y		GSB(C)	31 22 24	
	STOC	33 13			$\rightarrow$ P	32 72	
	RTN	35 22			RCLA	34 11	
*	LBLD	31 25 14			X	71	
020	F? ϕ	35 71 00			X $\rightarrow$ Y	35 52	
	GTO ϕ	22 00	RECTANGULAR		RCLB	34 12	
	SF ϕ	35 51 00	POLAR		+	61	
	1	01			X $\rightarrow$ Y	35 52	
	RTN	35 22		080	R $\leftarrow$	31 72	
*	LBL ϕ	31 25 00	TOGGLE		RCLC	34 13	
	CF ϕ	35 61 00			+	61	
	ϕ	00			X $\rightarrow$ Y	35 52	
	RTN	35 22			RCLD	34 14	
*	LBL E	31 25 15			+	61	
	F? 1	35 71 01			X $\rightarrow$ Y	35 52	
	GTO 1	22 01			F? ϕ	35 71 00	
	SFI	35 51 01	MANUAL		$\rightarrow$ P	32 72	
	1	01	AUTO		F? 1	35 71 01	
	RTN	35 22		090	GTO3	22 03	
*	LBLI	31 25 01	TOGGLE		RIS	84	
	CFI	35 61 01			X $\rightarrow$ Y	35 52	
	ϕ	00			RIS	84	
	RTN	35 22			GTO4	22 04	
*	LBL a	32 25 11		*	LBL3	31 25 03	
040	STOI	33 01			-X-	31 84	
	X $\rightarrow$ Y	35 52			X $\rightarrow$ Y	35 52	
	STO ϕ	33 00	PREPARE		-X-	31 84	
	5	05	ELLIPSES	*	LBL4	31 25 04	
	STI	35 33		100	RCL E	34 15	
	RTN	35 22			STO+9	33 61 09	
*	LBL e-	32 25 12			GTO2	22 02	
	STO3	33 03		*	LBL5	31 25 05	
	X $\rightarrow$ Y	35 52	PREPARE		RCL9	34 09	
	STO2	33 02	CYCLOIDS		SIN	31 62	
050	6	06			RCL1	34 01	
	STI	35 33			X	71	
	RTN	35 22			RCL9	34 09	
*	LBL c	32 25 13			COS	31 63	
	STO5	33 05	PREPARE	110	RCL ϕ	34 00	
	X $\rightarrow$ Y	35 52	SPIRALS		X	71	
	STO4	33 04			RTN	35 22	

REGISTERS

0 ELLIPSE A	1 ELLIPSE B	2 CYCLOID A	3 CYCLOID N	4 SPIRAL A	5 SPIRAL R	6 LISSAJOUS M	7 LISSAJOUS N	8 -	9 $\Sigma \Delta \theta$
S0 -	S1 -	S2 -	S3 -	S4 -	S5 -	S6 -	S7 -	S8 -	S9 -
A G	B ϕ	C X	D Y	E $\Delta \theta$	ROUTINE POINTER.				



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Program Listing II

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STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
* 120	LBL6	31 25 46	<u>CYCLOIDS</u>		X	71	IF P2 EPICYCLOIDS
	RCL9	34 49		170	COS	31 63	
	SIN	31 62			RTN	35 22	
	RCL2	34 42		*	LBL9	31 25 49	
	X	71			SF2	35 51 42	
	RCL3	34 43			CHS	42	
	X	71			RTN	35 22	
	RCL9	34 49					
	RCL3	34 43					
	X	71					
	SIN	31 62					
	RCL2	34 42					
	X	71		180			
	—	51					
	RCL9	34 49					
	COS	31 63					
	RCL2	34 42					
130	X	71					
	RCL3	34 43					
	X	71					
	RCL9	34 49					
	RCL3	34 43					
	X	71		190			
	COS	31 63	<u>SPIRALS</u>				
	RCL2	34 42					
	X	71					
	F2.2	35 71 42					
140	GSB 9	31 22 49					
	F2.2	35 71 42					
	SF2	35 51 42					
	+	61					
	RTN	35 22		200			
*	LBL7	31 25 47					
	RCL9	34 49					
	ENTER	41					
	ENTER	41					
	3	43					
150	6	46					
	÷	81					
	RCL4	34 44					
	RCL5	34 45		210			
	Y*	35 63					
	X	71					
	RCL5	34 45					
	1/X	35 62					
	Y*	35 63					
160	R←	31 72	<u>LISSAJOUS</u>				
	RTN	35 22					
*	LBL8	31 25 48					
	RCL9	34 49					
	RCL7	34 47		220			
	X	71					
	SIN	31 62					
	RCL9	34 49					
	RCL6	34 46					

LABELS					FLAGS	SET STATUS		
A G	B Ø	C X.Y	D R/P	E M/A	0 POLAR	FLAGS	TRIG	DISP
a ELLIPSES	b CYCLOIDS	c SPIRALS	d LISSAJOUS	e START	1 AUTO	ON OFF	DEG ☒	FIX ☒
0 TOGGLE	1 TOGGLE	2 CYCLE Δθ	3 FLASH X	4 INC Δθ	2 EPICYCLOID	0 ☐ ☒	GRAD ☐	SCI ☐
5 ELLIPSES	6 CYCLOIDS	7 SPIRALS	8 LISSAJOUS	9 EPICYCLOID	3 —	1 ☐ ☒	RAD ☐	ENG ☐
						2 ☐ ☒		n 2
						3 ☐ ☒		