Model 46

Mechanical Engineering

The Hewlett-Packard Company Calculator Products Division

INTRODUCTION

The HP-46 is a desk-top printing calculator power packed for scientists and engineers. With its 9 data storage registers and up to 10-digit accuracy (depending upon the calculation), it is a truly versatile machine. This booklet contains examples you can do on the HP-46 to show yourself how this calculator will solve your problems.

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GRID PATTERN

Point-to-point x & y coordinates

$$x = x_0 + x_{inc.}$$
$$y = y_0 + y_{inc.}$$

Sample: $x_0 = .92$ $x_{inc.} = .55$
$y_0 = .88$ $y_{inc.} = .47$
no. of pts. in x = 4 no. of pts. in y = 3

Step	Key Strokes	Printer Tape	Description
1	[ ] [CL x / CLR] [FIX] 4	CLEAR	Clear storage, stack
2	.92 [ENTER ↑] [PRINT]	0.9200 ↑ 0.9200 ◇	x_0
3	.55 [STO] 1	0.5500 → 1	$x_{inc.}$
4	[+] [PRINT]	+ 1.4700 ◇	x coordinate
5	[RCL] 1	← 1 0.5500	
6	Repeat steps 4 & 5 for each remaining x coordinate (in this case 2 more repeats)	+ 2.0200 ◇ ← 1 0.5500 + 2.5700 ◇	
7	0.88 [ENTER ↑] [PRINT]	0.8800 ↑ 0.8800 ◇	y_0
8	.47 [STO] 2	0.4700 → 2	$y_{inc.}$
9	[+] [PRINT]	+ 1.3500 ◇	y coordinate
10	[RCL] 2	← 2 0.4700 + 1.8200 ◇	
11	Repeat steps 9 & 10 for each remaining y coordinate (in this case 1 more repeat)		
12	Match appropriate x & y values to get x, y coordinate		

BOLT HOLE CIRCLE

$$x = x_c + (\text{radius} \times \cos \alpha_{acc})$$
$$y = y_c + (\text{radius} \times \sin \alpha_{acc})$$

Sample:

$x_c = 1.5$ radius = .89
$y_c = 2$ angle between x axis & first hole = 25°
No. of holes = 5

Step	Key Strokes	Printer Tape	Description
1	[ ] [CL x / CLR] [FIX] 4	CLEAR	Clear storage, stack
2	[ ] [ENTER ↑ / DEG]	D	Sets degrees
3	25 [STO] 1 [STO] 6 360 [ENTER ↑] 5 [÷] [STO] 5	25.0000 → 1 → 6 360.0000 ↑ 5.0000 ÷ → 5	Angle (α)
4	.89 [STO] 2	0.8900 → 2	Radius
5	1.5 [STO] 3	1.5000 → 3	x_c
6	2 [STO] 4	2.0000 → 4	y_c
7	[RCL] 1	← 1 25.0000	
8	[COS] [RCL] [×] 2	C ←×2	radius x cos α_{acc}
9	[RCL] [+] 3 [PRINT]	←+3 2.3066 ◇	x coordinate
10	[RCL] 5	← 5 72.0000	$\alpha_{acc.} + \alpha_{inc.}$
	[RCL] [+] 1	←+1	
	[STO] 1	→ 1	
11	Repeat steps 8-10 for each remaining x coordinate	C ←×2 ←+3 1.3915 ◇ ← 5 72.0000 ←+1 → 1 C ←×2 ←+3 0.6264 ◇ ← 5 72.0000 ←+1 → 1 C ←×2 ←+3 1.0685 ◇ ← 5 72.0000 ←+1 → 1 C ←×2 ←+3 2.1070 ◇	

Step	Key Strokes	Printer Tape	Description
		← 6	
12	RCL 6	25.0000	
		S	
13	SIN RCL × 2	←×2	radius x sin α_{acc}
		←+4	
14	RCL + 4 PRINT	2.3761 ◇	y coordinate
15	RCL 5	← 5	$\alpha_{acc} + \alpha_{inc.}$
		72.0000	
		←+6	Puts $\alpha_{inc.} + \alpha_{acc}$
	RCL + 6 STO 6	→ 6	into α_{acc}
		S	
		←×2	
16	Repeat steps 13-15 for each remaining y coordinate	←+4	
		2.8834 ◇	
		← 5	
		72.0000	
		←+6	
		→ 6	
		S	
		←×2	
		←+4	
		2.1698 ◇	
17	Match appropriate x & y values to get x, y coordinate	← 5	
		72.0000	
		←+6	
		→ 6	
		S	
		←×2	
		←+4	
		1.2216 ◇	
		← 5	
		72.0000	
		←+6	
		→ 6	
		S	
		←×2	
		←+4	
		1.3491 ◇	

POLAR TO RECTANGULAR

Rectangular coordinates of a point defined in polar coordinates

Sample:

Angle = 30°
Radius = 1.3750"

Polar Coordinates

Step	Key Strokes	Printer Tape	Description
1	[ ] CL x (CLR) FIX 4	CLEAR	Clear storage, stack
2	[ ] ENTER↑ (DEG)	D	Sets degrees
3	30 ENTER↑ 1.3750	30.0000 ↑	Angle & radius
	[ ] TO POL (REC)	1.3750	Rectangular coordinates
		TO RECT	
		0.6875 ◇	
		1.1908 ◇	

POINTS ON LINE AT ANGLE

Point-to-point x & y coordinates

$$x = x_0 + x_{acc} \cos \alpha$$
$$y = y_0 + x_{acc} \sin \alpha$$

Sample:

$x_0 = .4$
$y_0 = .26$
no. of holes = 4

$$x_{acc} = \frac{\text{no. of holes} - 1}{\Sigma x_n + x_{inc.}} \quad n = 0$$

$\alpha = 35°$
$x_{inc.} = .47$

Step	Key Strokes	Printer Tape	Description
1	CL x (CLR) FIX 4	CLEAR	Clear storage, stack. Sets degrees
	ENTER ↑	D	
2	35 ENTER ↑	35.0000 ↑	Angle (α)
3	COS STO 2	C → 2	Cosine α
4	R↓ SIN	↓ S	Sine α
	STO 3	→ 3	
5	.26 STO 6	0.2600 → 6	y_0
6	.47 STO 1	0.4700 → 1	$x_{inc.}$
	STO 4	→ 4	
7	.4 STO 5 ENTER ↑ PRINT	0.4000 → 5 ↑ 0.4000 ◇	x_0
8	RCL 4	→ 4 0.4700	x_{acc}
9	RCL × 2	←×2	$x_{acc} \cos \alpha$
10	RCL + 5 PRINT	←+5 0.7850 ◇	x coordinate
11	RCL 1	← 1 0.4700	$x_{inc.}$
	RCL + 4	←+4	$x_{acc} + x_{inc.}$
	STO 4	→ 4	
12	Repeat steps 9-11 for each remaining x coordinate	←×2 ←+5 1.1700 ◇ ← 1 0.4700 ←+4 → 4 ←×2 ←+5 1.5550 ◇	

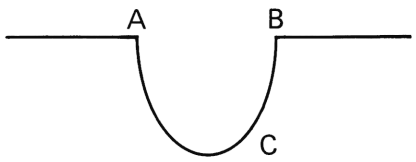
Step	Key Strokes	Printer Tape	Description
		← 6	
13	RCL 6 ENTER↑ PRINT	0.2600	y_0
		↑	
		0.2600 ◇	
		← 1	
14	RCL 1	0.4700	$x_{inc.}$
	STO 4	→ 4	
15	RCL × 3	←×3	$x_{acc} \sin \alpha$
		←+6	
16	RCL + 6 PRINT	0.5296 ◇	y coordinate
		← 1	
17	RCL 1	0.4700	$x_{inc.}$
	RCL + 4	←+4	$x_{acc} + x_{inc.}$
	STO 4	→ 4	
		←×3	
		←+6	
18	Repeat steps 15-17 for each remaining y coordinate	0.7992 ◇	
		← 1	
		0.4700	
		←+4	
		→ 4	
19	Match appropriate x & y values to get x, y coordinates	←×3	
		←+6	
		1.0687 ◇	

QUADRATIC EQUATION

Find the x coordinate of points A and B if the curve labeled C is a parabola with an equation of

$y = x^2 - 4x$ where $y = -3$

$o = x^2 - 4x + 3$



Step	Key Strokes	Printer Tape	Description
1	[ ] CL x (CLR) FIX 4	CLEAR	Clear storage
2	1 ENTER↑ 2 ×	1.0000 ↑ 2.0000 ×	2a
	STO 3	→ 3	
3	2 × 3 ×	2.0000 × 3.0000 ×	4ac
	4 CHS STO 1	- 4.0000 → 1	
4	x^2 $x\rightleftarrows y$	x^2 ⇄ -	$\sqrt{b^2 - 4ac}$
	− [ ] x^2	√	
	STO 2	→ 2	
5	RCL 1 CHS	← 1	x coordinate of point A
	RCL − 2	- 4.0000 ⇄S	
	RCL ÷ 3	←−2 ←÷3	
	PRINT	1.0000 ◇	
6	RCL 1 CHS	← 1	x coordinate of point B
	RCL + 2	- 4.0000 ⇄S ←+2	
	RCL ÷ 3	←÷3	
	PRINT	3.0000 ◇	

LAW OF COSINES

$a^2 = b^2 + c^2 - 2bc \cos A$

Sample:
b = 11
c = 9
A = 54° 30′

Find the other side, a, of the triangle.

Step	Key Strokes	Printer Tape	Description
1	[ ] [CL x / CLR] [FIX] 4	CLEAR	Clear storage
2	54.30 [ ] [RCL / DM→]	54.3000 DMS→	DMS to degrees
3	[cos]	C	cos A
4	9 [STO] 1 [×]	9.0000 → 1 ×	2bc cos A
	11 [STO] 2 [×]	11.0000 → 2 ×	
	2 [×]	2.0000 ×	
5	[RCL] 1 [x^2]	← 1	c^2 - 2bc cos A
	[$x \rightleftarrows y$] [−]	9.0000 x^2 ⇄ −	
6	[RCL] 2 [x^2] [+]	← 2	a.
	[ ] [x^2 / $\sqrt{x}$] [PRINT]	11.0000 x^2 + √ 9.3285 ◇	