

[6.15] Convert equations between rectangular and polar coordinates

It can be useful to convert equations between polar and rectangular coordinates, and the 89/92+ have functions that make this particularly easy. These two programs, by Alex Astashyn, perform the conversion. $p2c()$ converts from polar to rectangular, and $c2p()$ converts from rectangular to polar.

```
c2p(eq)
func
©Convert 'eq' in rectangular coordinates x,y to polar coordinates r,θ
solve(eq,r)|x=P►Rx(r,θ) and y=P►Ry(r,θ)
EndFunc

p2c(eq)
Func
©Convert 'eq' in polar coordinates r,θ to
rectangular coordinates x,y.
solve(eq,y)|θ=R►Pθ(x,y) and r=R►Pr(x,y)
EndFunc
```

These programs use built-in conversion functions to perform these general coordinate transformations on the equation:

$$\begin{aligned}x &= r \cdot \cos(\theta) \\ y &= r \cdot \sin(\theta) \\ r &= \pm \sqrt{x^2 + y^2} \\ \theta &= \tan^{-1}\left(\frac{y}{x}\right)\end{aligned}$$

The transformation equations might not return the results you expect, because the last two equations do not uniquely define r and θ .

For example, to find the polar coordinate equation for the straight line $y = ax + b$, use

$$c2p(y=a*x+b)$$

which returns

$$r = \frac{-b}{a \cdot \cos(\theta) - \sin(\theta)}$$

To convert the polar equation for a circle with radius = 4 to rectangular coordinates, use

$$p2c(r=4)$$

which returns

$$x^2 - 16 \leq 0 \text{ and } y = -\sqrt{16 - x^2} \text{ or } x^2 - 16 \leq 0 \text{ and } y = \sqrt{16 - x^2}$$

This shows a general issue when converting from one coordinate system to the other, which is that extraneous solutions may be introduced. The only general solution is to check each answer.

(Credit to Alex Astashyn)