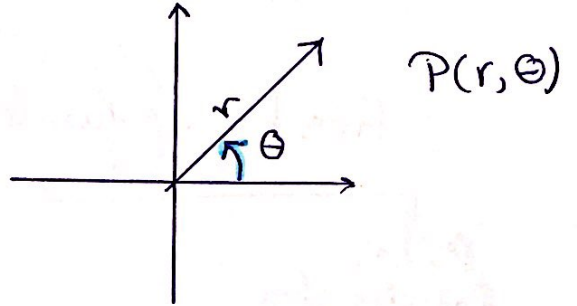


# Polar Coordinates

- $r$ : directed distance from origin
- $\theta$ : directed angle with positive  $x$ -axis



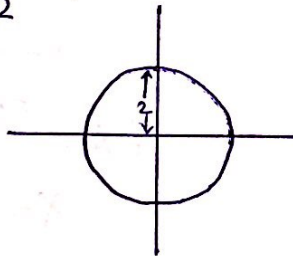
## Polar equations & Graphs

معرفيات ا ل اة وصف القطر  
a القطر

-  $r = a$   
-  $\theta = \theta_0$

Circle of radius  $|a|$  centered at origin.  
line through origin making an angle  $\theta_0$  with the initial ray.

Ex: -  $r = 2$

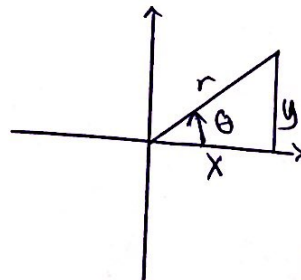


**⚠ Note:**  
if you have :-  
 $P_1 = P_2$   
 $(r_1, \theta_1) = (r_2, \theta_2)$   
That does not necessarily mean that  $r_1 = r_2$  and  $\theta_1 = \theta_2$  ✗

## Relating Polar and Cartesian Coordinates

↳ Equations Relating Polar and Cartesian Coordinates

- $x = r \cos \theta$
- $y = r \sin \theta$
- $r^2 = x^2 + y^2$
- $\tan \theta = \frac{y}{x}$



Alaa Ebaawi

# How to solve Problems

First : finding Coordinates :-

## Polar Coordinates

- If the Question gives you a Cartesian coordinates and wants the Polar coordinates then use:-

$$r = \sqrt{x^2 + y^2}$$

$$x = r \cos \theta \quad / \quad y = r \sin \theta$$

Ex: Point (1,1)

$$x=1, \quad y=1$$

$$r = \sqrt{2}$$

$$\begin{cases} x = \sqrt{2} \cos \theta \Rightarrow \frac{1}{\sqrt{2}} = \cos \theta \\ y = \sqrt{2} \sin \theta \Rightarrow \frac{1}{\sqrt{2}} = \sin \theta \end{cases}$$

$$\theta = \frac{\pi}{4}$$

So :-  $P(\sqrt{2}, \frac{\pi}{4})$

## Cartesian Coordinates

- If the Question gives you a Polar coordinates and wants the Cartesian coordinates then you use:-

$$x = r \cos \theta$$

$$y = r \sin \theta$$

Ex:  $P(-\sqrt{2}, \frac{\pi}{4})$

$$x = r \cos \theta = -\sqrt{2} \left(\frac{1}{\sqrt{2}}\right) = -1$$

$$y = r \sin \theta = (-\sqrt{2}) \left(\frac{1}{\sqrt{2}}\right) = -1$$

So the point is (-1, -1)

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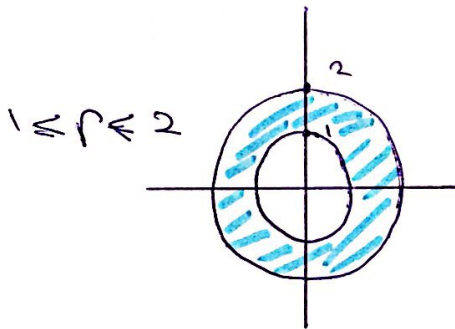
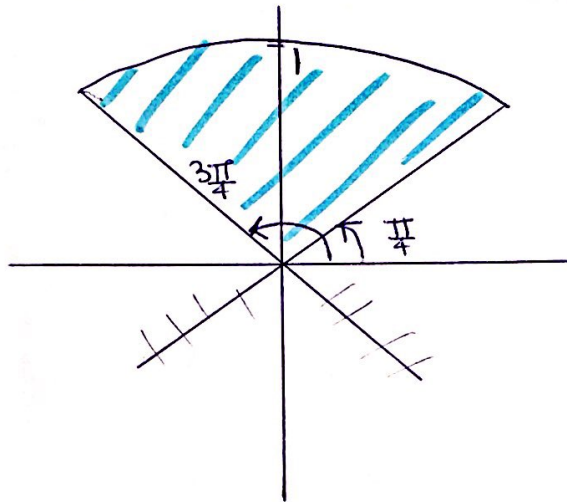
# How to Graph in Polar Coordinates

Graph :-

$$\frac{\pi}{4} \leq \theta \leq \frac{3\pi}{4}$$

$$0 \leq r \leq 1$$

↑ Positive



## EQUATIONS

Pol  $\rightarrow$  Cart

Polar  $\leftrightarrow$  Cart

Cart  $\rightarrow$  Pol

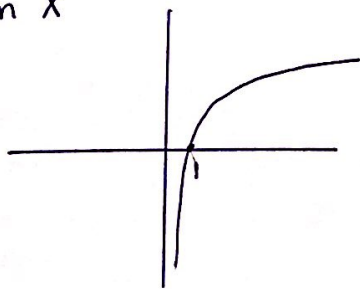
Ex:  $r \sin \theta = \ln r + \ln \cos \theta$

$r \sin \theta = \ln r \cos \theta$

$e^{r \sin \theta} = r \cos \theta$

$e^y = x$

$y = \ln x$



Ex:  $-x^2 + xy + y^2 = 1$

$r^2 \cos^2 \theta + r^2 \cos \theta \sin \theta + r^2 \sin^2 \theta = 1$

$r^2 + r^2 \cos \theta \sin \theta = 1$

$r^2 (1 + \cos \theta \sin \theta) = 1$

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