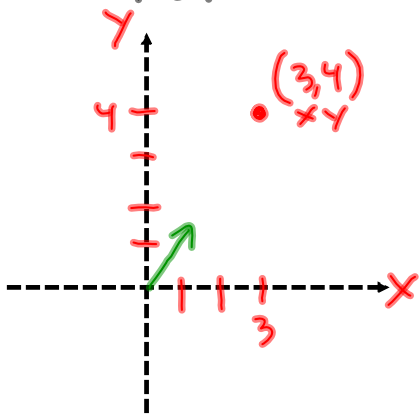


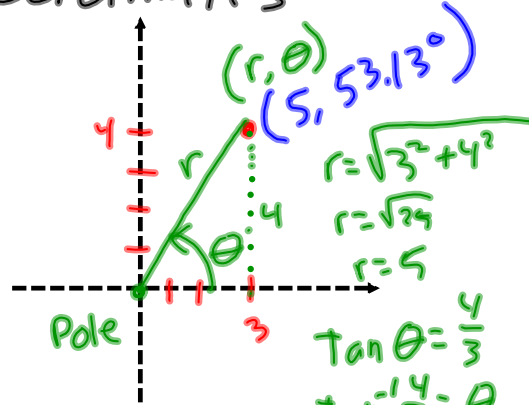
Polar Axis & Coordinates



Rectangular plane

$r \rightarrow$ distance from pole to point

$\theta \rightarrow$ angle from polar axis to terminal side



Polar plane

$$r = \sqrt{3^2 + 4^2}$$

$$r = \sqrt{25}$$

$$r = 5$$

$$\tan \theta = \frac{4}{3}$$

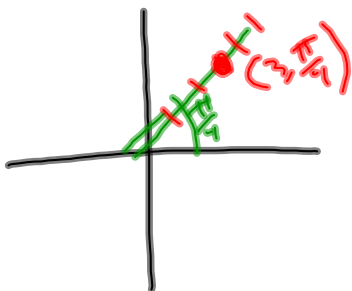
$$\tan^{-1} \frac{4}{3} = \theta$$

$$53.13^\circ = \theta$$

Plot polar coordinates

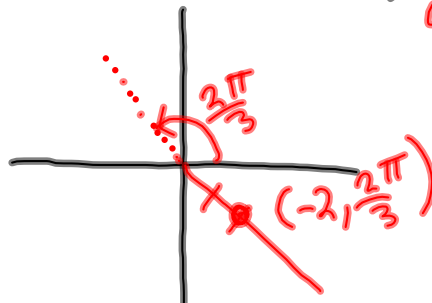
- plot angle first
- count along terminal side 'r' units.

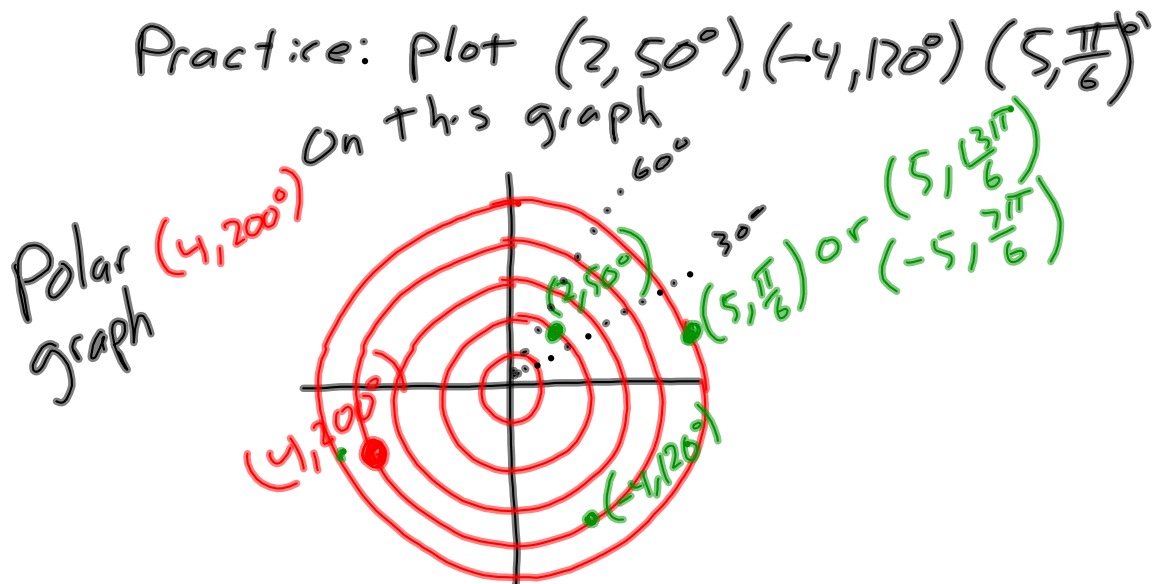
plot $(3, \frac{\pi}{4})$



'r' can be negative
 $(-2, \frac{2\pi}{3})$

• point is on opposite of terminal side.





Multiple Representation of a Polar Coordinates

$$(r, \theta) = (r, \theta + 2\pi)$$

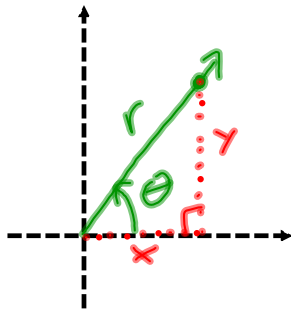
$$(r, \theta) = (-r, \theta + \pi)$$



ex. give three other coordinates for $(2, 60^\circ)$

$(-2, 240^\circ)$, $(2, 420^\circ)$, $(2, 780^\circ)$

Convert from polar to rectangular coordinates



$$\sin \theta = \frac{y}{r} \rightarrow \begin{cases} y = r \sin \theta \\ x = r \cos \theta \end{cases}$$

$$\cos \theta = \frac{x}{r}$$

ex. convert $(2, 60^\circ)$ to rectangular

$$x = 2 \cos 60^\circ = 2 \left(\frac{1}{2}\right) = 1$$

$$y = 2 \sin 60^\circ = 2 \left(\frac{\sqrt{3}}{2}\right) = \sqrt{3}$$

$(1, \sqrt{3})$



examples.

$$x = 4 \cos 120^\circ = 4(-\frac{1}{2}) = -2$$

$$y = 4 \sin 120^\circ = 4 \left(\frac{\sqrt{3}}{2}\right) = 2\sqrt{3}$$

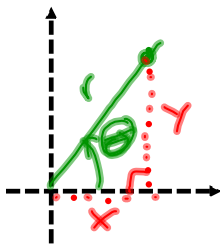
convert $(4, 120^\circ)$
 $(-2, 2\sqrt{3})$

$(-3, \frac{\pi}{2}) \rightarrow (0, -3)$

$$x = -3 \cos \frac{\pi}{2} = -3(0) = 0$$

$$y = -3 \sin \frac{\pi}{2} = -3(1) = -3$$

Convert rectangular to polar coordinates



$$x^2 + y^2 = r^2 \rightarrow \begin{cases} r = \sqrt{x^2 + y^2} \\ \tan^{-1} \frac{y}{x} = \theta \end{cases}$$

Convert $(3, 7)$ to polar coordinates in degrees

$$r = \sqrt{3^2 + 7^2}$$

$$= \sqrt{9 + 49}$$

$$= \sqrt{58}$$

$$= 7.6$$

$$\theta = \tan^{-1} \left(\frac{7}{3}\right)$$

$$\theta = 66.8^\circ$$

$(7.6, 66.8^\circ)$

