Polar And Rectangular Coordinates:

A. Rectangular coordinates are what most people use when graphing coordinates. Given the point (a,b) you move over 'a' spaces on the x-axis, and then up or down 'b' spaces on the y-axis.

B. Polar Coordinates are the same points as rectangular coordinates, only they are expressed in terms of 'r' and 'θ' as the point (r, θ). Here is a picture of the relationship between polar and rectangular coordinates:

\[ r = \sqrt{a^2 + b^2} \]

\[ \theta = \tan^{-1} \left( \frac{b}{a} \right) \]

As you can see, r is the hypotenuse and θ is the angle.

C. Change from Rectangular to Polar:

1. To change from rectangular coordinates you should be familiar with the basic trigonometric properties and also Pythagorean Triples.

2. \( r = \sqrt{a^2 + b^2} \)

3. \( \theta = \tan^{-1} \left( \frac{b}{a} \right) \)

Ex [1] If \((2,2) = (r, \theta)\), then \( \theta = \) _______ (degrees)

a. The answer is \( \tan^{-1}(2/2) \) or \( \tan^{-1}(1) = 45 \) degrees.

Ex [2] If \((6,-8) = (r, \theta)\), then \( r = \) _______

a. You should know the Pythagorean Triple (6,8,10). The answer is 10.

b. If you don't know this, then you can see that

\[ \sqrt{6^2 + (-8)^2} = \sqrt{100} = 10 \]
D. Changing from Polar to Rectangular

1. Like above, you need to know *basic trigonometric properties*.

2. \( x = r \cos \theta \)

3. \( y = r \sin \theta \)

Ex [1] If \( (4, \frac{\pi}{3}) = (x, y) \) then \( y = \) ______.

a. The answer is \( 4 \sin \frac{\pi}{3} \) which is \( 4 \left( \frac{\sqrt{3}}{2} \right) \) which is \( 2\sqrt{3} \).

Ex [2] If \( (6, 60^\circ) = (x, y) \) then \( x = \) ______.

a. The answer is \( 6 \cos 60^\circ = 6 \times \frac{1}{2} = 3 \).