Cartesian/Polar Coordinates

Junior high school

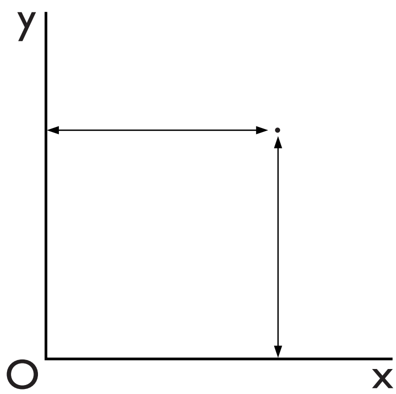
Objective

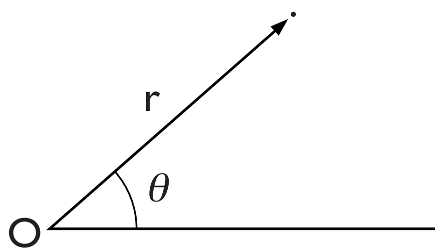
To understand that the position of a point can be uniquely identified on a plane surface using two different plotting methods: Cartesian geometry (Origin, x-axis, y-axis) and Polar geometry (Origin, angle of rotation, length of radius). To explore the relationship between these two methods and to convert coordinate values from one system to the other.

Explanation of the activity

Cartesian coordinates (or rectangular coordinates) use an origin, O, a horizontal line (x axis) and a vertical line (y axis) to give a frame of reference. Any point can then be found by its (x, y) coordinate.

Polar coordinates use an origin, O, and a horizontal line serving as the reference line from which to measure angles of rotation, θ, in an anti-clockwise manner. Any point can then be found by its (r, θ) coordinate.





Using the calculator

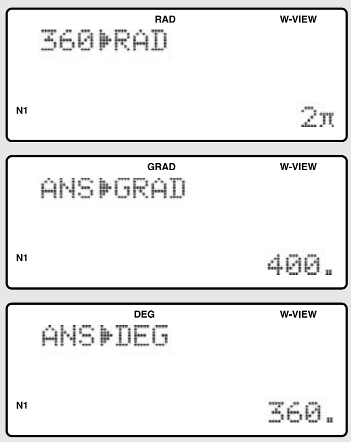
Polar coordinates rely on the use of an angle. It is important that we know how to set the calculator to the angular unit that we will use.

Pressing 2ndF DRG gives the choice of Radians/Gradients/Degrees

2π radians in a circle
400 gradients in a circle
360 degrees in a circle

These all are ways of dividing a circle into a number of parts. The most commonly used is 360°, which we will use.

The 2ndF key will be used to input coordinates (both Cartesian and Polar) and to switch between them.



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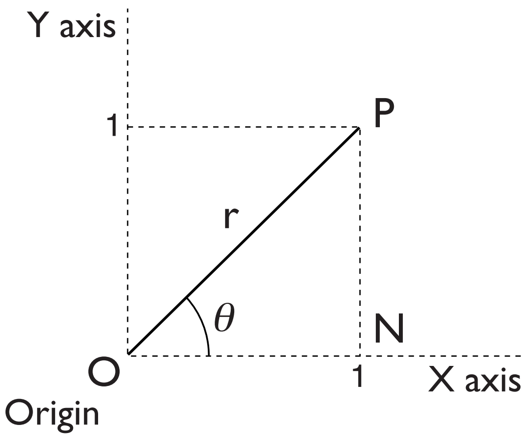
The connection between Cartesian coordinates and Polar coordinates is established by basic trigonometry. Considering the diagram below:



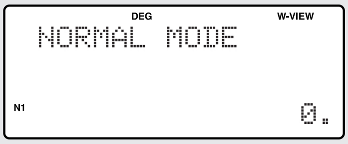
The point P has Cartesian coordinates (1, 1) and Polar coordinates (r, θ).

By Pythagorus
$r^2 = PN^2 + ON^2 = 1^2 + 1^2 = 2$ so that
$r = \sqrt{2} = 1.414\ldots$

By trigonometry

$\tan\theta = PN / ON = 1 / 1 = 1$ so that
$\theta = 45°$

Set the calculator to work in degrees.

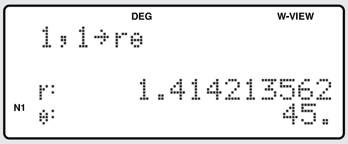


Input the Cartesian coordinates of P (1, 1), x first.

Press [1] [(x,y)] [1]

Change to Polar coordinates.
To find r and θ

Press [2ndF] [8] ($\rightarrow r\theta$)

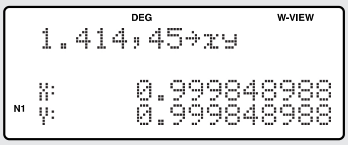


Similarly
Input Polar coordinates of P, r first.

Press [1] [•] [4] [1] [4] [(x,y)] [4] [5]

Change to Cartesian coordinates.

To find x and y press [2ndF] [9] ($\rightarrow xy$)



The current value of r or x is held in calculator memory **X**, the value of θ or y held in memory **Y**.