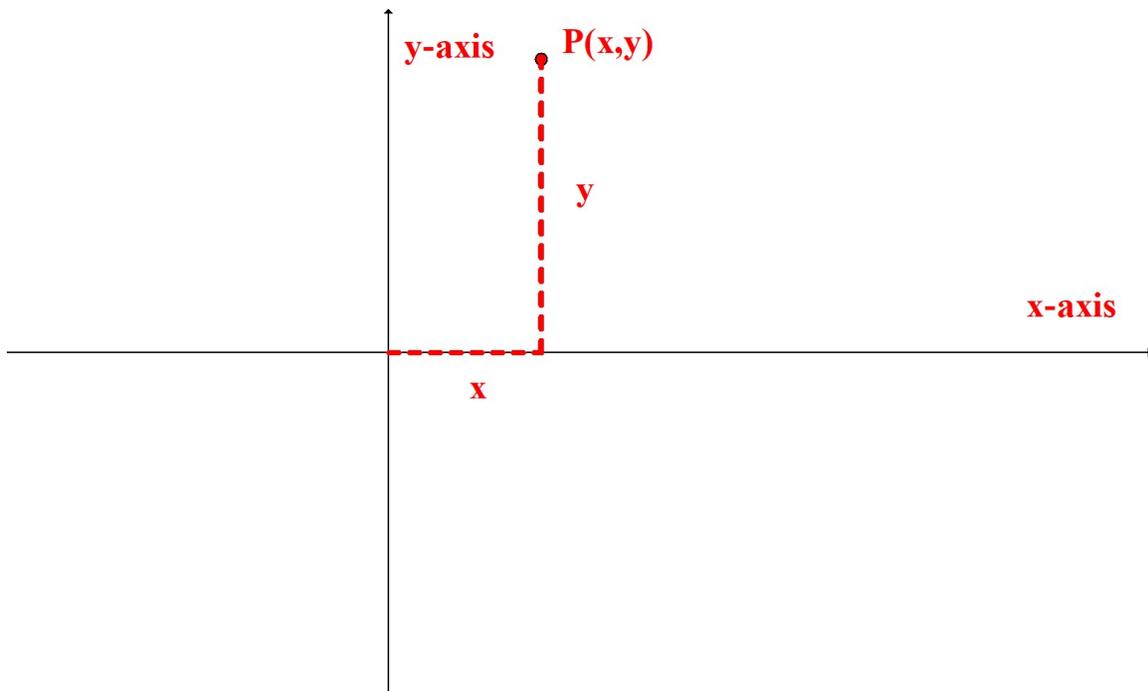


Rectangular Coordinate System with Distance & Midpoint Formulas

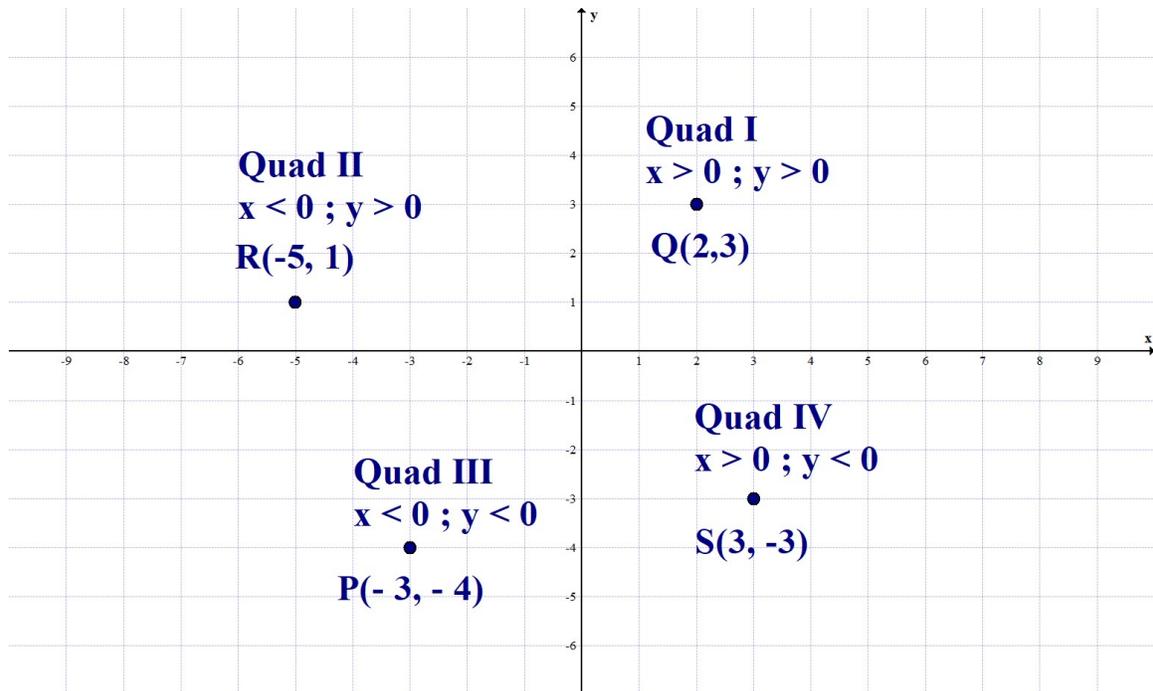
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We have been considering the *horizontal* number line (called the **x-axis**) and have used it to graph the solution sets of various equations and inequalities. It is a (1) dimension graphical representation of the solution set.

If we now make a copy of it and rotate it 90 degrees counterclockwise, we get what we call the **y-axis**. We can now graph in two (2) dimensions. **Ordered pairs (points)** $P(x, y)$ the form (x-coordinate, y-coordinate) are used to graph in what we call the **number plane** or in the **Cartesian Coordinate System**:



The x-axis and the y-axis divide the number plane into four (4) regions called **quadrants**:



Two (2) important formulas used throughout Mathematics and its applications are given below with an example:

Given points $P(x_1, y_1); Q(x_2, y_2)$

1. The **distance between P and Q** is given by

Distance between P & Q: d_{PQ}

$$d_{PQ} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

2. The **mid-point between P and Q** is given by

Midpoint of P & Q: $M(\bar{x}, \bar{y})$

$$\bar{x} = \frac{x_1 + x_2}{2} ; \bar{y} = \frac{y_1 + y_2}{2}$$

Example:

Given points: $P(x_1, y_1) = P(-6, -2)$; $Q(x_2, y_2) = Q(4, 8)$

Distance between P & Q: d_{PQ}

$$\begin{aligned}d_{PQ} &= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\&= \sqrt{([4] - [-6])^2 + ([8] - [-2])^2} \\&= \sqrt{(10)^2 + (10)^2} \\&= \sqrt{200} = 10\sqrt{2} \approx 14.142\end{aligned}$$

Midpoint of P & Q: $M(\bar{x}, \bar{y})$

$$\begin{aligned}\bar{x} &= \frac{x_1 + x_2}{2} ; \bar{y} = \frac{y_1 + y_2}{2} \\ \bar{x} &= \frac{[-6] + [4]}{2} = \frac{-2}{2} = -1 \\ \bar{y} &= \frac{[-2] + [8]}{2} = \frac{6}{2} = 3\end{aligned}$$

$M(-1, 3)$

