# Co-ordinate Geometry

Coordinate Geometry is considered to be one of the interesting concepts of Mathematics. Coordinate Geometry describes the link between geometry and algebra through graphs involving curves and lines. It provides geometric aspects in Algebra and enables to solve geometric problems. It is a part of geometry where the position of points on the plane is described using an ordered pair of numbers.

## What is a Co-ordinate and a Co-ordinate Plane?

You must be familiar with plotting graphs on a plane from the tables of numbers for both linear and nonlinear equations. The number line which is also known as Cartesian plane is divided into four quadrants by two axes perpendicular to each other, labeled as the x-axis (horizontal) and the y-axis(vertical line). The point at which the axes intersect is known as the origin. The location of any point on a plane is expressed by a pair of values (x, y) and these pairs are known as the coordinates.

The figure below shows the Cartesian plane with coordinates (4,2). If the coordinates are identified, the distance between the two points and the interval's midpoint that is connecting the points can be computed.
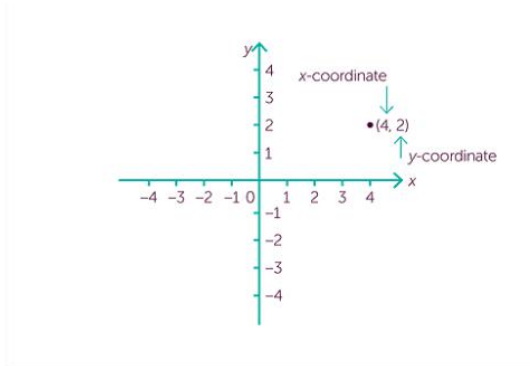
Distance Between two Points

Make a line between the two points A and B, develop a right angle triangle and apply Pythagoras theorem to find the length of the line.
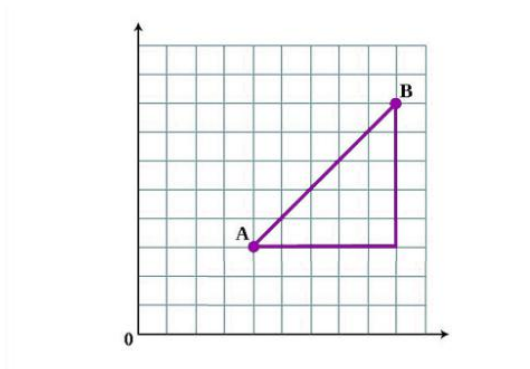
Between A and B:

$AB^2 = (Bx - Ax)^2 + (By - Ay)^2$

Midpoint of a line connecting two points:

The midpoint of a line that connects the two points (x_1, y_1) and (x_2, y_2) is:

$[½(3 + 1), ½(2 + 1)] = (2, 1.5)$

Gradient of a line connecting two points:

Gradient is the slope of the line that measures "steepness". It is usually denoted by the letter m. It is the change in y for a unit change in x along the line.

The gradient of a line that connects points (x_1, y_1) and (x_2, y_2) is $(y_2 - y_1)/(x_2 - x_1)$.

Perpendicular and Parallel lines:

The two lines have the similar gradient if the two lines are parallel.

The product of the gradients of two lines is -1 when the two lines are perpendicular.

Example

1. y = 2x + 1
2. 1/2y = x − 3
3. y = -½ x + 2

The gradients of the lines are 2, 2 and -½. Hence, (a) and (c) are perpendicular, and (a) and (b) are parallel.
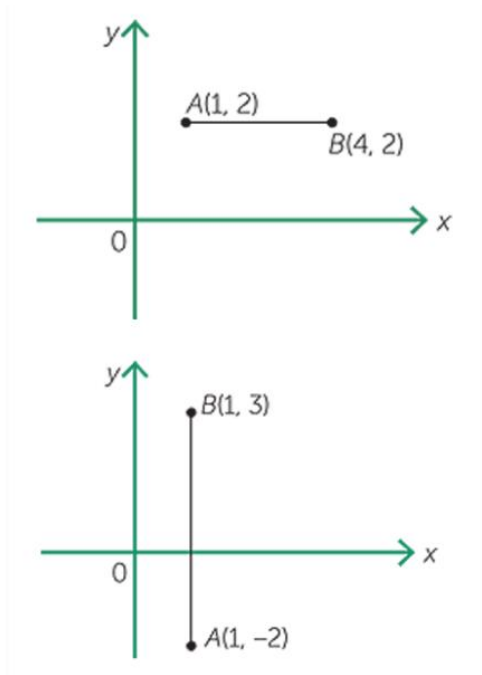
Example Problem

Let's solve an example to calculate the distance between two points.

› A(1, 2) and B(4, 2)   A(1, -2) and B(1, 3)

To calculate the distance between A and B, find the difference of x and y coordinates of the two points.

› The distance AB = 4 − 1, which is 3

› The distance $AB = 3 - (-2) = 5$

The above example considers a different case when the interval of line AB is either vertical or horizontal. Pythagoras theorem is applied to determine the distance between two points when the interval between them is neither horizontal nor vertical.

The distance between the points AB is determined in the following manner.
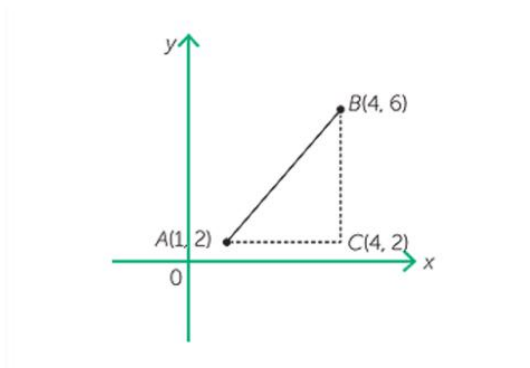
AC = 4 − 1 = 3 and BC = 6 − 2 = 4.

According to Pythagoras' theorem,

$AB^2 = 3^2 + 4^2 = 25$

Therefore, AB = 5