

The Distance Formula

The distance formula is used to ...

- find the distance between two points
 - find the length of a segment
- find the distance between a point and a line

The Distance Formula:

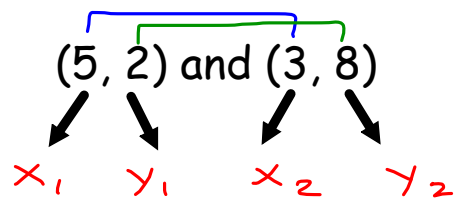
The distance d between any two points (x_1, y_1) and (x_2, y_2) is

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

This is how it's done ...

EXAMPLE 1: Find the distance between $(5, 2)$ and $(3, 8)$.

Step 1: Label your points



Step 2: Substitute into formula

$$d = \sqrt{(3 - 5)^2 + (8 - 2)^2}$$

Step 3: Perform correct operations!

$$d = \sqrt{(-2)^2 + (6)^2}$$

$$d = \sqrt{4 + 36} = \sqrt{40} = 2\sqrt{10}$$

exact \longrightarrow

$$d \approx 6.3$$

approximate \longrightarrow

The Mid-point Formula

The midpoint formula is used to ...

- find the midpoint between two points
- find the midpoint of a segment

The Midpoint Formula:

The midpoint M of the line segment with endpoints

$A(x_1, y_1)$ and $B(x_2, y_2)$ is

$$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

This is how it's done ...

EXAMPLE 1: Find the midpoint of the line segment with endpoints $(14, 3)$ and $(6, 9)$.

Step 1: Label your points

$$\begin{array}{ccc} (14, 3) & \text{and} & (6, 9) \\ \swarrow \quad \searrow & & \swarrow \quad \searrow \\ x_1 \quad y_1 & & x_2 \quad y_2 \end{array}$$

Step 2: Substitute into formula $M = \left(\frac{14 + 6}{2}, \frac{3 + 9}{2} \right)$

Step 3: Perform operations! $M = \left(\frac{20}{2}, \frac{12}{2} \right) = (10, 6)$

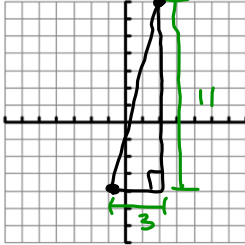
Compare / Contrast: Two Methods for Finding Distance

Focus Question: How does the Pythagorean Theorem relate to the distance formula?

They are directly related!



Use the Pythagorean Theorem to find the distance between (2, 7) and (-1, -4)



$$c^2 = a^2 + b^2$$

$$c^2 = 11^2 + 3^2$$

$$c^2 = 121 + 9$$

$$c^2 = 130$$

$$c = \sqrt{130}$$



Use the distance formula to find the distance between (2, 7) and (-1, -4)

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

$$d = \sqrt{(-1 - 2)^2 + (-4 - 7)^2}$$

$$d = \sqrt{(-3)^2 + (-11)^2}$$

$$d = \sqrt{9 + 121}$$

$$d = \sqrt{130}$$



They are basically the same process!