

## Algebra 3.1 Distance & Midpoint Formula

Distance Formula

$$d(P_1, P_2) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

EX. Find the distance between  $(-2, 5)$  &  $(0, 7)$

$$d = \sqrt{(0 - (-2))^2 + (7 - 5)^2} = \sqrt{4 + 4} = \underline{2\sqrt{2}}$$

EX. Find the distance between  $(-11, 4)$  &  $(3, -3)$

$$d = \sqrt{(3 - (-11))^2 + (-3 - 4)^2} = \sqrt{14^2 + (-7)^2} = \sqrt{196 + 49} = \underline{7\sqrt{5}}$$

Midpoint Formula

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

EX. Find the midpoint between  $(-4, 5)$  &  $(2, -1)$

$$M = \left( \frac{-4 + 2}{2}, \frac{5 + (-1)}{2} \right) = \left( \frac{-2}{2}, \frac{4}{2} \right) = \underline{(-1, 2)}$$

EX. Given  $A(6, -4)$  &  $B(-2, 12)$  Find the point on the segment  $AB$  that is  $\frac{3}{4}$  of the way from  $A$  to  $B$ .

$$x \text{ coordinate } x_1 + \frac{3}{4}(x_2 - x_1) = 6 + \frac{3}{4}(-2 - 6) = 6 + \frac{3}{4}(-8) = 6 - 6 = 0$$

$$y \text{ coordinate } y_1 + \frac{3}{4}(y_2 - y_1) = -4 + \frac{3}{4}(12 - (-4)) = -4 + \frac{3}{4}(16) = -4 + 12 = 8$$

$$\underline{(0, 8)}$$

EX. Find a formula that expresses the fact that  $P(x, y)$  is 3 units away from the origin.

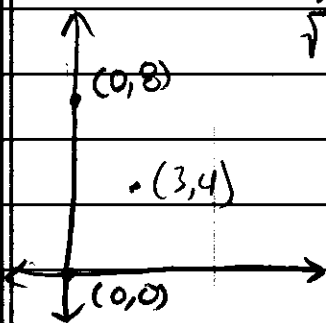
$$\sqrt{(x - 0)^2 + (y - 0)^2} = 3$$

$$\sqrt{x^2 + y^2} = 3$$

$$\underline{x^2 + y^2 = 9}$$

# Algebra 3.1

EX. Find all points on the y-axis that are 5 units away from (3,4)  
(0, y)



$$\sqrt{(0-3)^2 + (y-4)^2} = 5$$

$$\sqrt{(-3)^2 + (y-4)^2} = 5$$

$$9 + (y-4)^2 = 25$$

$$(y-4)^2 = 16$$

$$y-4 = \pm 4$$

$$y = 0, 8$$

$$(0,0), (0,8)$$

EX Find all points on the x-axis that are 7 units away from (1,-3)  
(x, 0)

$$7 = \sqrt{(x-1)^2 + (0-(-3))^2}$$

$$49 = (x-1)^2 + 9$$

$$40 = (x-1)^2$$

$$\pm\sqrt{40} = x-1$$

$$x = 1 \pm 2\sqrt{10}$$

$$(1+2\sqrt{10}, 0), (1-2\sqrt{10}, 0)$$

EX Given  $P_1(-5, 1)$  find  $P_2$  such that  $(3, -2)$  is the midpoint

of  $P_1$  &  $P_2$

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

$$M_x = \frac{x_1 + x_2}{2}$$

$$3 = \frac{-5 + x_2}{2}$$

$$6 = -5 + x_2$$

$$x_2 = 11$$

$$M_y = \frac{y_1 + y_2}{2}$$

$$-2 = \frac{1 + y_2}{2}$$

$$-4 = 1 + y_2$$

$$y_2 = -5$$

$$(11, -5)$$