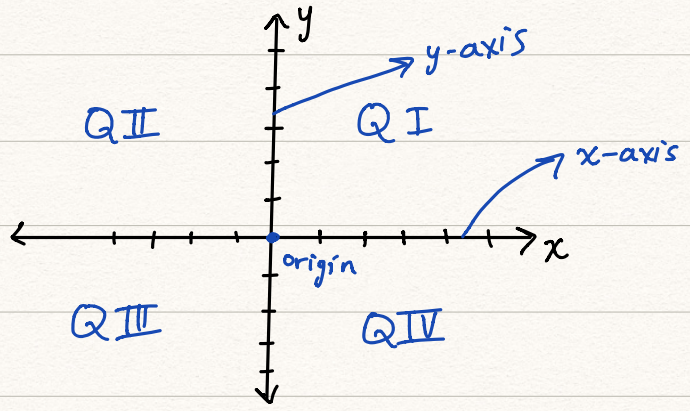
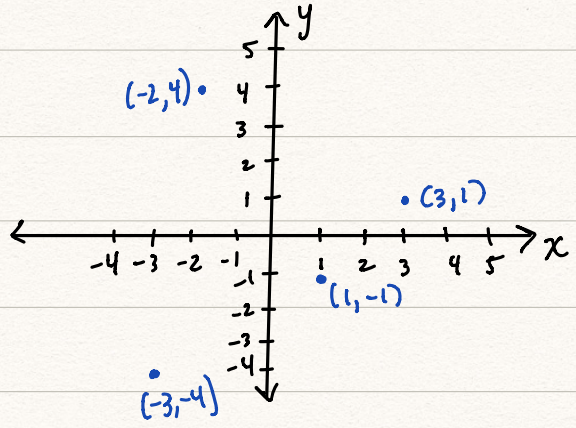
2.1 - The Coordinate Plane

- Two number lines crossing perpendicularly
- Helps to visualize relationships between numbers.



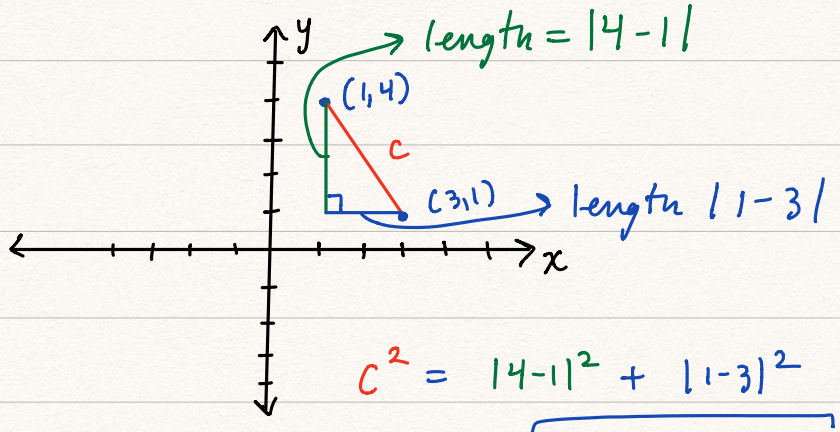
- A point on the coordinate plane is an ordered pair (a,b), where "a" is called the x-value, and b is called the y-value of the point.



Distance Formula

$P=(x_1,y_1)$, $Q=(x_2,y_2)$

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



$$c^2 = |4-1|^2 + |1-3|^2$$

$$c = \sqrt{|4-1|^2+|1-3|^2}$$

$$c = \sqrt{(4-1)^2+(1-3)^2}$$

Ex: $d((1,4),(2,1)) = \sqrt{(1-2)^2+(4-1)^2}$

$= \sqrt{1+9}$

$= \sqrt{10}$

- Three points P, Q, and R are said to be <u>collinear</u> if they lie on the same line, or if

$$d(P,Q) + d(P,R) = d(Q,R).$$

Ex: ① $(-1,4)$, $(3,0)$, $(11,-8)$

$d((-1,4),(3,0)) = \sqrt{(-1-3)^2+(4-0)^2} = \sqrt{16+16}$

$= \sqrt{32}$

$= \sqrt{16 \cdot 2}$

$= 4\sqrt{2}$

$d((-1,4),(11,-8)) = \sqrt{144+144}$

$= \sqrt{2(144)}$

$= 12\sqrt{2}$

$d((3,0),(11,-8)) = \sqrt{(3-11)^2+(0-(-8))^2}$

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

$= \sqrt{64+64}$

$= \sqrt{2(64)}$

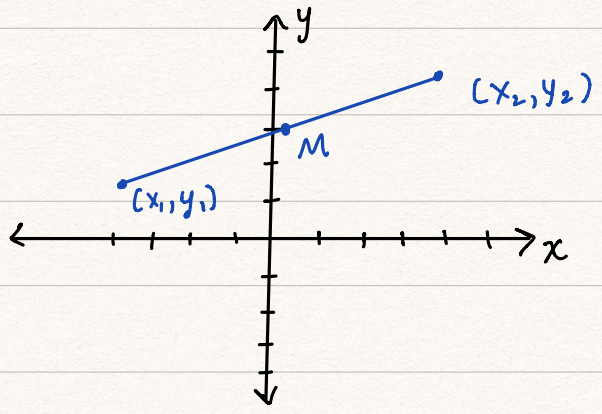
$= 8\sqrt{2}$

Since $4\sqrt{2} + 8\sqrt{2} = 12\sqrt{2}$, the points are collinear.

② $(4,-4), (15,1), (1,2)$ collinear? → No!

Midpoint Formula

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



Ex: $(3,5), (-2,5)$

$$M = \left(\frac{3+(-2)}{2}, \frac{5+5}{2} \right)$$

$$= \left(\frac{1}{2}, 5 \right)$$