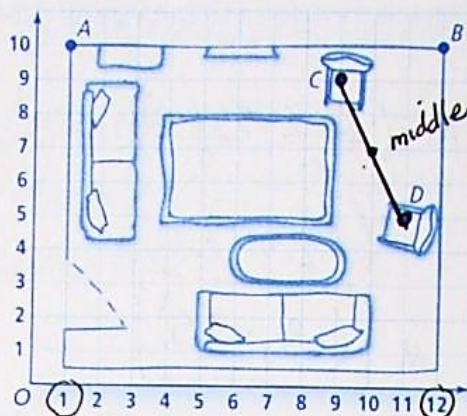


## MODEL &amp; SOLVE

LaTanya is decorating her living room and draws a floor plan to help look at placement.



- A. LaTanya wants to hang a picture at the center of the back wall. How do you find the point at the center between A and B?

(Visual) The grid could be used to find the measure (length) of the wall. Then take half that distance and move that number of spaces from A or B.

(Mathematical) Use the x-values for A & B.  $A(1, 10)$  and  $B(12, 10)$ . Find the difference ( $12 - 1 = 11$ ), take half ( $\frac{11}{2} = 5.5$ ), then add that amount to the x-value of A ( $1 + 5.5 = 6.5$ ). Picture hangs at  $(6.5, 10)$ .

- B. **Communicate Precisely** LaTanya wants to place a lamp halfway between the chairs at points C and D. How can you find the point where the lamp should go? **MP.6**

Sketch the segment connecting C to D, then visually find the middle of it. To find the coordinate that is horizontally halfway between the two points use the total distance (2), take half and move from C one right. Now drop down half the distance that C & D are vertically apart,  $4 \div 2 = 2$ . The coordinates for the lamp are  $(10, 7)$ .

## HABITS OF MIND

**Use Appropriate Tools** What tools did you use to help you answer the questions? Why was it helpful to use the tools you did? **MP.5**

The coordinate grid was helpful because you could use the grid to count units and the axes numbers also helped with lengths and naming points & midpoint.

Look at:

## EXAMPLE 1

Pg 22

## Try It! Find a Midpoint

1. Find the midpoint for each segment with the given endpoints.

a.  $C(-2, 5)$  and  $D(8, -12)$

b.  $E(2.5, -7)$  and  $F(-6.2, -3.8)$

$$M = \left( \frac{-2+8}{2}, \frac{5+(-12)}{2} \right)$$

$$\left( \frac{6}{2}, \frac{-7}{2} \right)$$

$$M \quad \boxed{(3, -3.5)}$$

$$M = \left( \frac{2.5+(-6.2)}{2}, \frac{-7+(-3.8)}{2} \right)$$

$$\left( \frac{-3.7}{2}, \frac{-10.8}{2} \right)$$

$$M \quad \boxed{(-1.85, -5.4)}$$

Look at:

## EXAMPLE 2

Pg 23

## Try It! Partition a Segment

2. Find the coordinates of each point described.

a.  $\frac{7}{10}$  of the way from  $A$  to  $B$ .

$A(3, -4)$   $B(13, 11)$

b.  $\frac{4}{5}$  of the way from  $B$  to  $A$ .

horizontal	vertical
$\frac{7}{10}(13-3)$	$\frac{7}{10} -4-11 $
$\frac{7}{10} 10 $	$\frac{7}{10} 15 $
$\frac{7}{10}(10)$	$\frac{7}{10}(15)$
7	21
	21
	2
	10.5

$$(x) 3+7 \quad 10.5+(-4)(y)$$

$$\boxed{(10, 6.5)}$$

horizontal	vertical
$\frac{4}{5}(2)$	$\frac{4}{5}(3)$
$\frac{4}{5}(10)$	$\frac{4}{5}(15)$

$$(x) 8 \quad (y) 12$$

subtract from  $B(13, 11)$ 

$$13-8 \quad 11-12$$

$$\boxed{(5, -1)}$$

## HABITS OF MIND

**Generalize** Is there a mathematical rule for finding the coordinates of the point  $R$  that is fraction  $q$  of the way from point  $P(x_1, y_1)$  to  $Q(x_2, y_2)$ ? Explain. **MP8**

Fractions are parts, so just take the fraction (or part) of the horizontal and vertical distances, then add those amounts to the coordinates of the starting point (or subtract as in part b)

Look at:  
EXAMPLE 3  
Pg 23

**Try It!** Derive the Distance Formula

3. Tavon claims that  $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$  can also be used to find distance between two points. Is he correct? Explain.

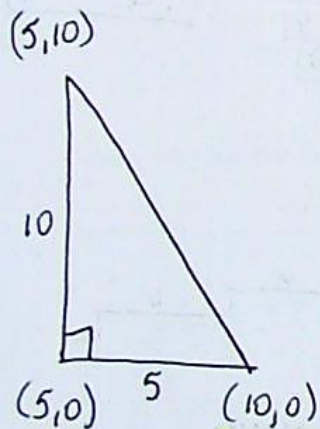
Yes! The order of the subtraction doesn't matter since the differences are both squared.

Look at:  
EXAMPLE 4  
Pg 25

**Try It!** Find the Distance

4. How far does the shortstop need to throw the ball to reach first base? Round to the nearest tenth of a foot.

Shortstop (5, 10) First base (10, 0)



$$d = \sqrt{(10-5)^2 + (0-10)^2}$$

$$= \sqrt{(5)^2 + (-10)^2}$$

$$= \sqrt{25 + 100}$$

$$= \sqrt{125}$$

$$\approx 11.18$$

**Remember!**  
1 unit = 9 ft

$$(11.18)(9) \approx 100.62 \text{ ft}$$

$$\text{or } \approx 100.6 \text{ ft}$$

**HABITS OF MIND**

**Look for Relationships** How do you relate the distance formula between two points to the Pythagorean Theorem? **MP.7**

The distance formula uses the horizontal & vertical distances between points as the legs of a RIGHT TRIANGLE!

## Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How are the midpoint and length of a segment on the coordinate plane determined?

Midpoint - Apply the midpoint formula to the coordinates of the endpoints of a segment.  
 Length - Apply the distance formula to the coordinates of the endpoints of a segment.

2. **Error Analysis** Corey calculated the midpoint of  $\overline{AB}$  with  $A(-3, 5)$  and  $B(1, 7)$ . What is Corey's error? **MP.3**

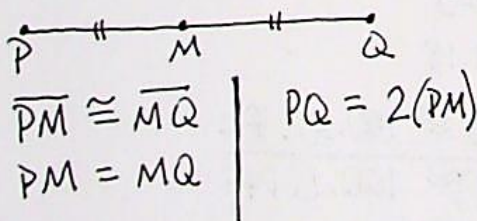
$$M\left(\frac{-3+5}{2}, \frac{1+7}{2}\right)$$

$$M(1, 4)$$

X

Corey took half the sum of the coordinates for each point instead of half the sum of the x-values and half the sum of the y-values for both points.

3. **Vocabulary** If  $M$  is the midpoint of  $\overline{PQ}$ , what is the relationship between  $\overline{PM}$  and  $\overline{MQ}$ ? Between  $\overline{PM}$  and  $\overline{PQ}$ ?



4. **Reason** Is it possible for  $\overline{PQ}$  to have two distinct midpoints,  $M_1(a, b)$  and  $M_2(c, d)$ ? Explain. **MP.2**

No! If  $(a, b)$  and  $(c, d)$  are midpoints, then  $a = \frac{x_1 + x_2}{2} = c$  and  $b = \frac{y_1 + y_2}{2} = d$ , so  $a = c$  and  $b = d$

## Do You KNOW HOW?

$\overline{PQ}$  has endpoints at  $P(-5, 4)$  and  $Q(7, -5)$ .

5. What is the midpoint of  $\overline{PQ}$ ?

$$M = \left( \frac{-5+7}{2}, \frac{4+(-5)}{2} \right)$$

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

$$\boxed{\left( 1, -\frac{1}{2} \right)}$$

6. What are the coordinates of the point  $\frac{2}{3}$  of the way from  $P$  to  $Q$ ?

<u>horizontal</u>	<u>vertical</u>	$P(-5, 4)$
$7 - (-5)$	$-5 - 4$	
$7 + 5$	$-9$	$-5 + 8, 4 + (-6)$
$12$	$\frac{2}{3}(-9)$	$\boxed{(3, -2)}$
$\frac{2}{3}(12)$	$(-3)$	
$(x) 8$	$(y) -6$	

7. What is the length of  $\overline{PQ}$ ?

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

$$\sqrt{(7+5)^2 + (-9)^2}$$

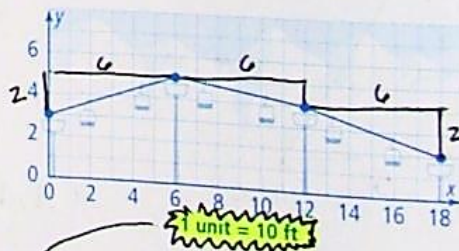
$$\sqrt{12^2 + 81}$$

$$\sqrt{144 + 81}$$

$$\sqrt{225}$$

$$\boxed{PQ = 15 \text{ units}}$$

8. A chair lift at a ski resort travels along the cable as shown.



How long is the cable? Round your answer to the nearest whole foot.

$$d = 2\sqrt{2^2 + 6^2} + \sqrt{12^2 + 6^2}$$

$$= 2\sqrt{4 + 36} + \sqrt{144 + 36}$$

$$= 2\sqrt{40} + \sqrt{180}$$

$$\approx 2(6.3) + 6.1$$

$$\approx 12.6 + 6.1$$

$$\approx 18.7$$

$$\boxed{\approx 187 \text{ ft}}$$