Dear Family,

This week your student is learning how to find the distance between points on the same horizontal or vertical line in the coordinate plane.

Point *A* and point *B* are in **different quadrants**. So, **add the absolute values** of the coordinates that are different to find the distance between *A* and *B*.

$$|-3| + |2| = 3 + 2 = 5$$

Point *D* and point *C* are in the **same quadrant**. So, **subtract the absolute values** of the coordinates that are different to find the distance between *D* and *C*.

$$|-4| - |-2| = 4 - 2 = 2$$

Your student will be learning to solve problems like the one below.
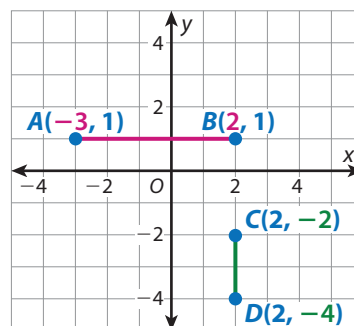
> A rectangle has vertices at $A(-2, -1)$, $B(2, -1)$, $C(2, -3)$ and $D(-2, -3)$. What is the perimeter of the rectangle?

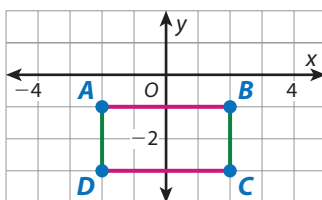➤ **ONE WAY** to find the lengths of the sides is to use absolute value.

$$AB = |-2| + |2| = 4$$
$$BC = |-3| - |-1| = 2$$
$$CD = |-2| + |2| = 4$$
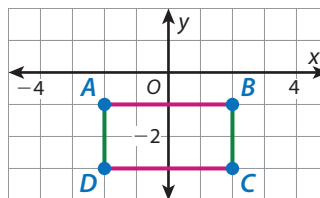$$AD = |-3| - |-1| = 2$$
$$4 + 2 + 4 + 2 = 12$$

➤ **ANOTHER WAY** to is to use properties of polygons.

Opposite sides of rectangles have the same length.

$$\ell = DC = |-2| + |2| = 4$$
$$w = DA = |-3| - |-1| = 2$$
$$2(4) + 2(2) = 12$$

Using either method, the perimeter of the rectangle is 12 units.

▶ Use the next page to start a conversation about coordinate planes.

Solve Problems in the Coordinate Plane

Activity Thinking About Distance in the Coordinate Plane

➤ **Do this activity together to investigate using the coordinate plane to show distances in the real world.**

A land surveyor is someone who measures land to mark property boundaries, especially for construction of new buildings or houses.

Coordinate planes help land surveyors make precise maps that clearly identify where one person's property ends and another person's property begins. It would be a big problem if someone started building a new house right in someone else's backyard!
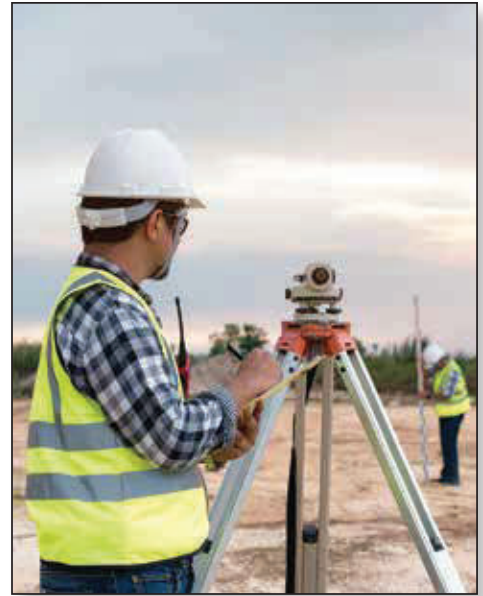
? How else can a coordinate plane be used when planning the construction of a new building or house?

Explore Problems in the Coordinate Plane

Meek's Lake	3.5 mi	↑
Lookout Point	1.5 mi	→
Pilar's Rock	2.0 mi	↑
Sandy Creek	2.0 mi	←
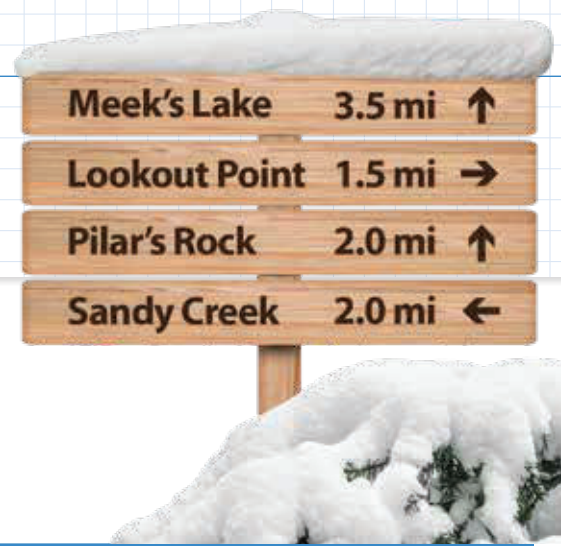
Previously, you learned about the four-quadrant coordinate plane. In this lesson, you will learn about solving problems in the coordinate plane.

➤ **Use what you know to try to solve the problem below.**

A sign at an intersection of two snowshoe trails shows the distance along the trails to four locations. When traveling along the trails, how much farther is it from Sandy Creek to Lookout Point than it is from Pilar's Rock to Meek's Lake?

TRY IT   **Math Toolkit** graph paper

DISCUSS IT

Ask: How did you get started?

**Share:** I got started by thinking about . . .

⊚ **Learning Targets   SMP 1, SMP 2, SMP 3, SMP 4, SMP 5, SMP 6, SMP 7**
• Solve problems by graphing points in all four quadrants of the coordinate plane. Use coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate.
• Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate.

CONNECT IT

1 **Look Back** How much farther is it from Sandy Creek to Lookout Point than it is from Pilar's Rock to Meek's Lake? Explain how you know.

2 **Look Ahead** One way to find the distances between the locations on the snowshoe trails is to model the problem on the axes in a coordinate plane. You can find the distance between two points on an axis by using the distances of the points from the origin.

a. Points *A* and *B* are on the *y*-axis and on opposite sides of the origin. How many units is each of these points from the origin?

b. To find the distance between points *A* and *B*, do you add their distances from the origin or subtract them? Why?

c. Points *C* and *D* are on the *x*-axis and on the same side of the origin. How many units is each of these points from the origin?

d. To find the distance between points *C* and *D*, do you add their distances from the origin or subtract them? Why?

3 **Reflect** How can you determine the distance between any two points on an axis by using their distances from the origin?

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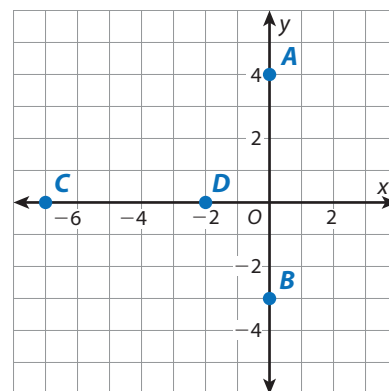
Prepare for Solving Problems in the Coordinate Plane

1 Think about what you know about absolute value. Fill in each box. Use words, numbers, and pictures. Show as many ideas as you can.

What Is It?	What I Know About It

absolute value

Examples	Examples

2 Morgan says that the absolute value of −8 is greater than the absolute value of 7. Do you agree with Morgan? Explain.

3 A map on Rodrigo's phone shows the distances from his apartment building to the nearest restaurants.

Restaurant	Distance
Taco truck	0.3 mi north
Café	0.4 mi east
Korean bistro	0.7 mi south
Sandwich shop	0.8 mi east

a. How much farther is it from the taco truck to the Korean bistro than it is from the café to the sandwich shop? Show your work.
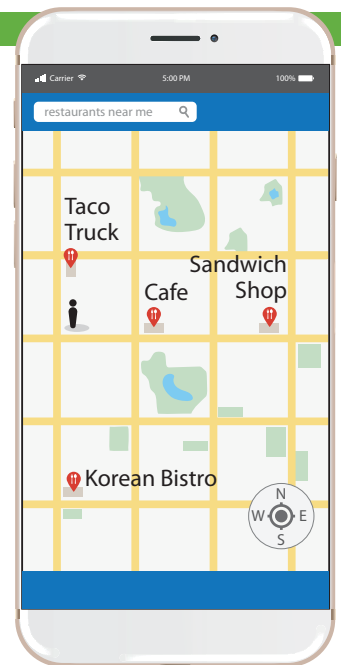
SOLUTION _____

_____

b. Check your answer to problem 3a. Show your work.

Develop Finding Distance Between Points on a Horizontal or Vertical Line

➤ **Read and try to solve the problem below.**

Madison competes in a robotics challenge. For one task, she programs her robot to move to locations on a grid. The robot picks up a ball at point $A(-6, 3)$ and moves it first to point $B(-6, -4)$ and then to point $C(-2, -4)$ along straight paths. Each unit on the grid represents 1 ft. What is the total distance Madison's robot moves with the ball?
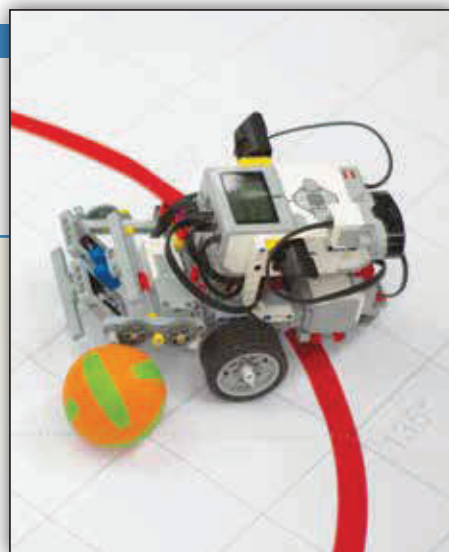
Robotics Challenge

1. Pick up ball at point $A(-6, 3)$.
2. Then, travel to point $B(-6, -4)$ along straight paths.
3. Then, travel to point $C(-2, -4)$ along straight paths.

TRY IT

✎ **Math Toolkit** graph paper

DISCUSS IT

Ask: How does your model show distance?

Share: My model shows distance . . .

➤ **Explore different ways to find distance between points on a horizontal or vertical line.**

Madison competes in a robotics challenge. For one task, she programs her robot to move to locations on a grid. The robot picks up a ball at point $A(-6, 3)$ and moves it first to point $B(-6, -4)$ and then to point $C(-2, -4)$ along straight paths. Each unit on the grid represents 1 ft. What is the total distance Madison's robot moves with the ball?

Model It

You can use a graph to understand how to find the distance between points on a horizontal or vertical line.
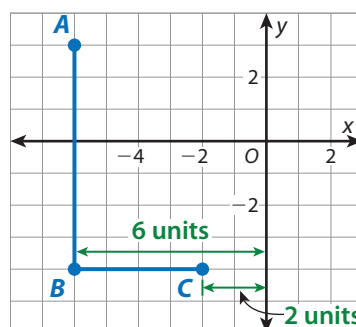
Points $A(-6, 3)$ and $B(-6, -4)$ are on the same vertical line and opposite sides of the x-axis.

Points $B(-6, -4)$ and $C(-2, -4)$ are on the same horizontal line and the same side of the y-axis.
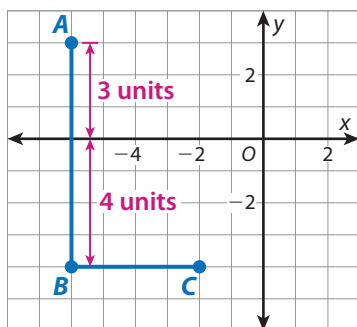
Use the distance of each point from the x-axis to find the distance between them.

Distance from A to $B = $ **3** $+$ **4**

Use the distance of each point from the y-axis to find the distance between them.

Distance from B to $C = $ **6** $-$ **2**

Analyze It

You can use absolute value to find the distance between points with the same first coordinate or the same second coordinate.

Points A and B have the same x-coordinate. Their y-coordinates have opposite signs.

$A(-6, \mathbf{3})$
$B(-6, \mathbf{-4})$ Distance from A to $B = |\mathbf{3}| + |\mathbf{-4}|$

Points C and D have the same y-coordinate. Their x-coordinates have the same sign.

$B(\mathbf{-6}, -4)$
$C(\mathbf{-2}, -4)$ Distance from B to $C = |\mathbf{-6}| - |\mathbf{-2}|$

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CONNECT IT

➤ **Use the problem from the previous page to help you understand how to find the distance between points on a horizontal or vertical line.**

1 Look at **Model It**. Do you use *x*-coordinates or *y*-coordinates to find the distance between points *A* and *B*? Explain.

2 Look at the expression $|-6| + |-2|$ in **Analyze It**. What distances do $|-6|$ and $|-2|$ represent in the coordinate plane in **Model It**?

3 Why do you add to find the distance between points *A* and *B*?

4 Why do you subtract to find the distance between points *B* and *C*?

5 What is the total distance Madison's robot moves with the ball? How do you know?

6 How is finding the distance between two points on a horizontal line affected by whether the points are on the same side of the *y*-axis or on different sides?

7 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

➤ **Use what you learned to solve these problems.**

8 **a.** Reflect point *B* across the *x*-axis and label the point *C*. What is the distance between points *B* and *C*? Show your work.
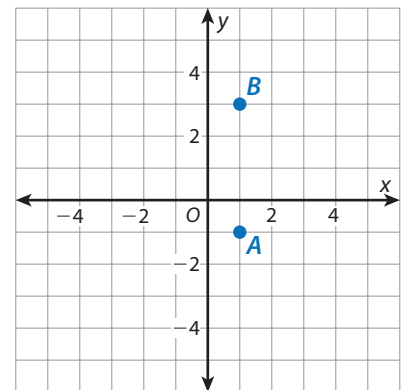
SOLUTION _____

b. Why do you always add the absolute values when finding the distance between a point and its reflection across an axis?

9 What is the distance between point *J*(−8.5, 6) and point *K*(5.5, 6)?

A 3 units

B 4 units

C 12 units

D 14 units

10 A map of an airport is laid out in a coordinate plane. Distances on the map are in miles. An airplane starts at a gate at (0, 0.1). To reach a runway, the plane travels west to (−0.4, 0.1), then south to (−0.4, −0.8), and then west to (−0.8, −0.8). What is the total distance the plane travels? Show your work.

SOLUTION _____

# Practice Finding Distance Between Points on a Horizontal or Vertical Line

➤ **Study the Example showing how to find distance between points on a horizontal or vertical line. Then solve problems 1–5.**

Example

What is the distance between point J(−3, −4) and point K(4, −4) in the coordinate plane?

You can use coordinates and absolute value to find the distance between points on a horizontal or vertical line.

Points J and K are on the same horizontal line. Because the points are in different quadrants, you can add their distances to the y-axis to find the distance between them.
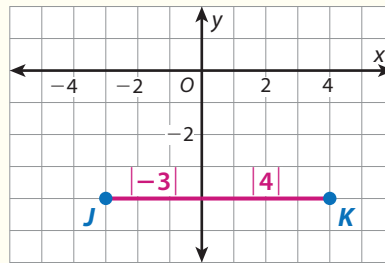
$$|-3| + |4| = 3 + 4$$
$$= 7$$

The distance between points J and K is 7 units.

1   Point L is located at (4, −1). Plot point L. Explain how to use absolute value to find the distance between point L and point K.
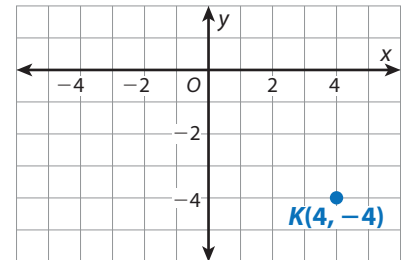
2   A map in the coordinate plane shows the distance between two cities in miles. The x-axis runs east/west, and the y-axis runs north/south. The town of Elgin is located at (−3, 2). The town of McDade is 8 mi east and 4.5 mi south of Elgin. Plot and label the locations of both towns in the coordinate plane.
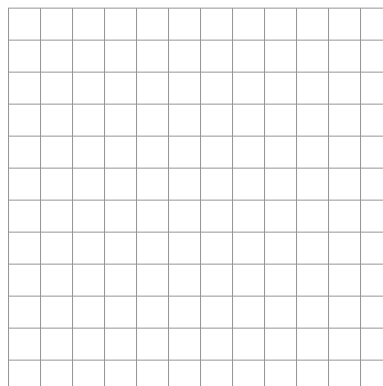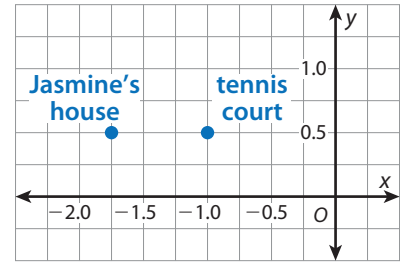
Vocabulary

quadrants
the four regions of the coordinate plane that are formed when the x-axis and y-axis intersect at the origin.

3 Jasmine walks east from her house to a tennis court. She plays for 1.5 hours and then walks home. Her walking speed is 3 miles per hour. Distances on the map are in miles. For how many hours is Jasmine away from home? Show your work.

SOLUTION _____

4 Point F is at (-10, 12), and point G is at (18, 12).

a. What quadrant is point F located in? What quadrant is point G located in? Can you use the x-coordinates or y-coordinates to find the distance between points F and G? Explain.

b. What is the distance between points F and G? Show your work.

SOLUTION _____

5 The coordinate plane shows several locations in a neighborhood. Each unit on the coordinate plane represents 1 block. Which statement about the locations is correct?
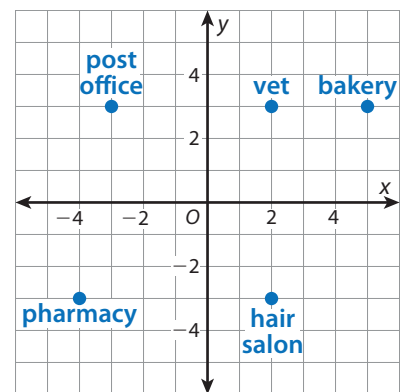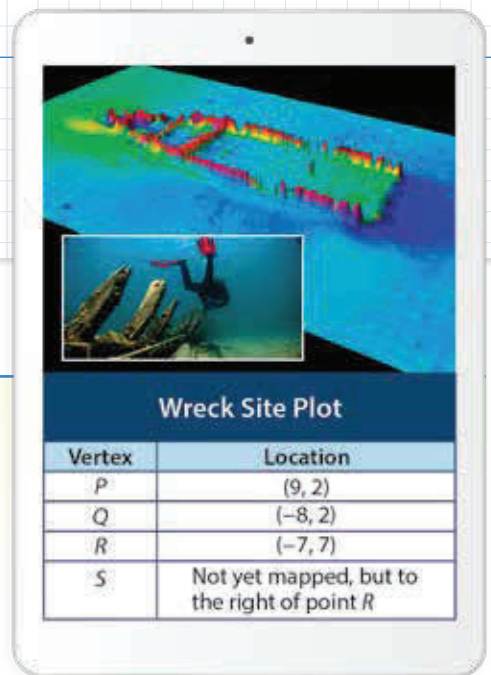
A The bakery is 6 blocks from the post office.

B The pharmacy is 5 blocks from the hair salon.

C The vet and the pharmacy are the same distance from the hair salon.

D The post office and the hair salon are the same distance from the vet.

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Develop Solving Problems About Polygons in the Coordinate Plane

➤ **Read and try to solve the problem below.**

Archaeologists are studying a shipwreck on the ocean floor. The wreck site is roughly shaped like a parallelogram. The archaeologists make a map of the site in the coordinate plane. Each unit on the map represents 1 m. According to the map, what is the area of the wreck site?

Wreck Site Plot

Vertex	Location
P	(9, 2)
Q	(−8, 2)
R	(−7, 7)
S	Not yet mapped, but to the right of point R

TRY IT

✏️ **Math Toolkit** graph paper, rulers

DISCUSS IT

Ask: What did you do first to find the area of parallelogram *PQRS*? Why did you do this step?

Share: First, I . . . because . . .

➤ **Explore different ways to solve a problem about a polygon in the coordinate plane.**

Archaeologists are studying a shipwreck on the ocean floor. The wreck site is roughly shaped like a parallelogram. The archaeologists make a map of the site in the coordinate plane. Each unit on the map represents 1 m. Parallelogram *PQRS* represents the wreck site, with *P* at (9, 2), *Q* at (−8, 2), and *R* at (−7, 7). Vertex *S* is not yet mapped but is to the right of vertex *R*. According to the map, what is the area of the wreck site?
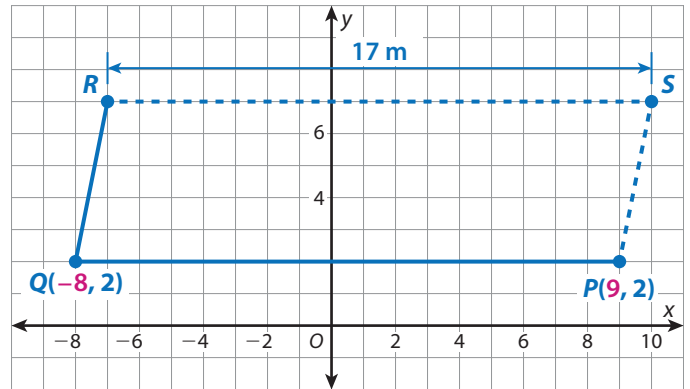
Model It

You can use properties of polygons to draw the parallelogram in the coordinate plane.

Opposite sides of a parallelogram are parallel and have the same length. $\overline{QP}$ is horizontal, so $\overline{RS}$ must also be horizontal and have the same length.

$QP = |-8| + |9|$

$\quad = 8 + 9$

$\quad = 17$

$\overline{QP}$ has a length of 17 m, so $\overline{RS}$ also has a length of 17 m.
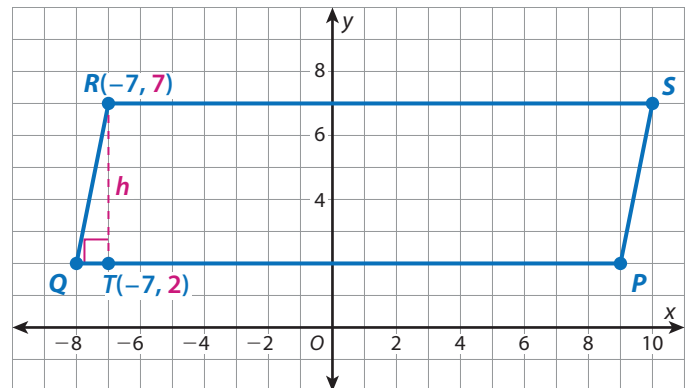

Model It

You can find the height of the parallelogram and use an area formula.

Use $\overline{QP}$ as the base of the parallelogram. Then a vertical segment joining $\overline{QP}$ to $\overline{RS}$ is the height.

$b = QP = 17$

$h = |7| - |2|$

$\quad = 7 - 2$

$\quad = 5$

Use the formula for the area of a parallelogram.

$A = b \cdot h$

CONNECT IT

➤ **Use the problem from the previous page to help you understand how to solve problems about polygons in the coordinate plane.**

1 Look at the first **Model It**. What are the coordinates of point *S*? How does finding the length of $\overline{QP}$ help you locate point *S*?

2 How can you use points *R* and *S* to check that the length of $\overline{RS}$ is 17 m?

3 Look at the second **Model It**. The point where the height intersects the base is labeled *T*. Explain why the coordinates of *T* are $(-7, 2)$.

4 What is the area of the wreck site? Explain how you know.

5 How can you find the area or perimeter of a polygon in the coordinate plane when you know only the coordinates of its vertices?

6 **Reflect** Think about all the models and strategies you have discussed today. Describe how one of them helped you better understand how to solve the **Try It** problem.

Apply It

➤ **Use what you learned to solve these problems.**

7 Central Park in New York City is shaped like a rectangle. On a map of the park in the coordinate plane, three of the vertices are located at $(-1.25, -0.25)$, $(-1.25, 0.25)$, and $(1.25, 0.25)$. Distances on the map are in miles. What is the perimeter of Central Park? Show your work.

SOLUTION _____

8 Explain why the expression $\frac{1}{2} \cdot (|-5| + |5|)(|-4|)$ represents the area of triangle *RST*.
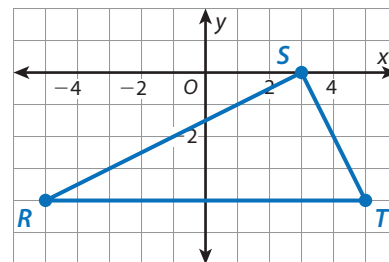
9 Trapezoid *FGHJ* has vertices at *F*(2, −3), *G*(2, 4), *H*(6, 4), and *J*(9, −3). What is the area of the trapezoid? Show your work.

SOLUTION _____

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Practice Solving Problems About Polygons in the Coordinate Plane

➤ **Study the Example showing how to solve problems about polygons in the coordinate plane. Then solve problems 1–5.**
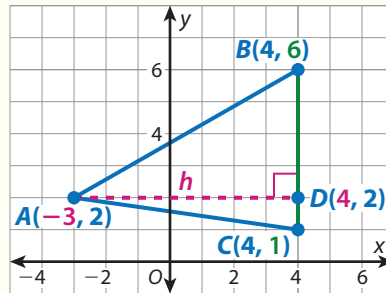
Example

A triangle has vertices at $A(-3, 2)$, $B(4, 6)$, and $C(4, 1)$ in the coordinate plane. What is the area of the triangle?

Use coordinates to find the base and height.

$$b = BC$$
$$= |6| - |1|$$
$$= 6 - 1$$
$$= 5$$

$$h = AD$$
$$= |-3| + |4|$$
$$= 3 + 4$$
$$= 7$$

$$A = \frac{1}{2}bh$$
$$= \frac{1}{2}(5)(7)$$
$$= 17.5$$

The area of the triangle is 17.5 square units.

1   How is the height of the triangle in the Example found once $\overline{BC}$ is selected as the base?

2   A rhombus is a four-sided figure with all sides the same length. Points $F(-2, -2)$, $G(-2, 3)$, and $H(2, 6)$ are three vertices of rhombus $FGHJ$. Vertex J is directly below vertex H.

a. Graph rhombus $FGHJ$. Label J with its coordinates.

**b.** What is the perimeter of the rhombus? Show your work.
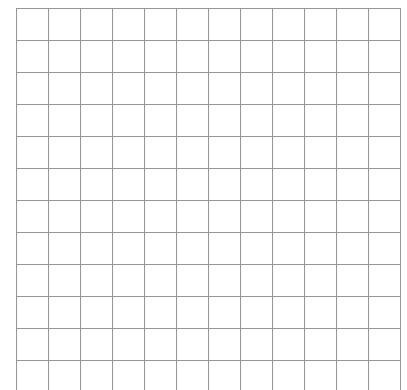
SOLUTION _____

3 A plan for a baseball diamond is drawn in a coordinate plane. The baseball diamond is in the shape of a square with vertices at approximately $(0, 64)$, $(64, 0)$, $(0, -64)$, and $(-64, 0)$. One unit in the coordinate plane represents 1 ft. What is the approximate area of the baseball diamond? Show your work.
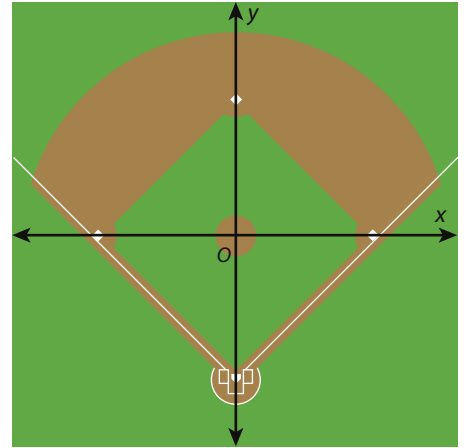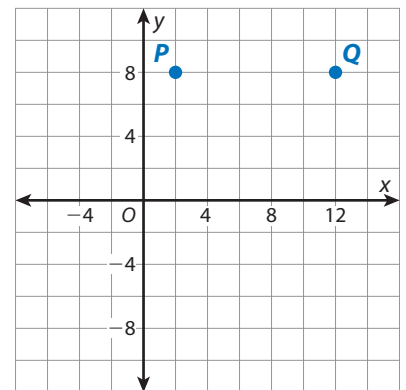
SOLUTION _____

4 What is the area of the trapezoid in the coordinate plane? Show your work.
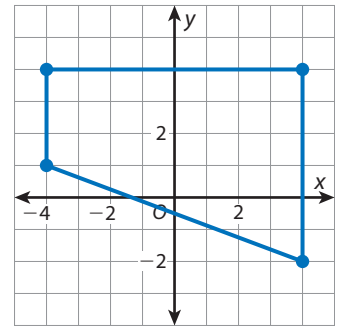
SOLUTION _____

5 Christopher is designing a rectangular fence to go around his school's chicken coop. The length should be 2 ft longer than the width. Christopher marks two vertices of the rectangle at P and Q in the coordinate plane. $\overline{PQ}$ is one of the shorter sides. Each unit in the coordinate plane represents 1 ft.

a. Draw rectangle $PQRS$ in the coordinate plane to model the fence.

b. How many feet of fencing does Christopher need to go around the chicken coop? Show your work.
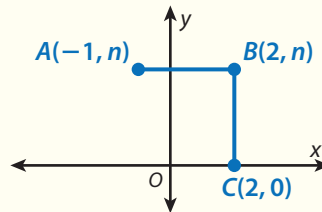
SOLUTION _____

Refine Solving Problems in the Coordinate Plane

➤ **Complete the Example below. Then solve problems 1–9.**

Example

The graph shows the coordinates of points A, B, and C. The distance between points A and B is the same as the distance between points B and C. What is the value of n?

$A(-1, n)$ $B(2, n)$

O $C(2, 0)$

Look at how you could use coordinates to solve the problem.

Points *A* and *B* have the same *y*-coordinate and are in different quadrants. The distance *AB* is $|-1| + |2| = 3$.

Points *B* and *C* have the same *x*-coordinate and *C* is on the *x*-axis. Because *n* is positive, the distance $BC = n$.

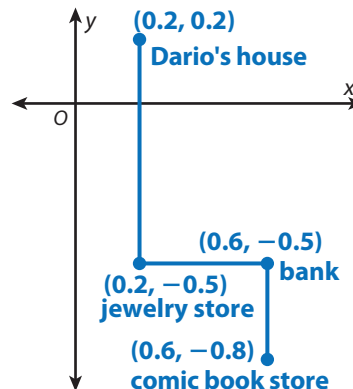The problem states that the distances *AB* and *BC* are equal.

SOLUTION _____

Apply It

1 Dario walks from his house to a comic book store along the route shown. Distances in the coordinate plane are in units of miles. How many miles does Dario walk to reach the comic book store? Show your work.

(0.2, 0.2)
Dario's house

O

(0.6, −0.5)
bank
(0.2, −0.5)
jewelry store

(0.6, −0.8)
comic book store

SOLUTION _____

2 The tile on the floor of a kitchen is being replaced. The new tile costs $1.79 per square foot. The kitchen floor is shaped like a polygon. In a coordinate plane, the vertices of the polygon, in counterclockwise order, are at (0, 0), (0, 4), (−9, 4), (−9, −4), (−5, −4), and (−5, 0). Units in the coordinate plane are in feet. What is the total cost of the new tile for the kitchen? Show your work.

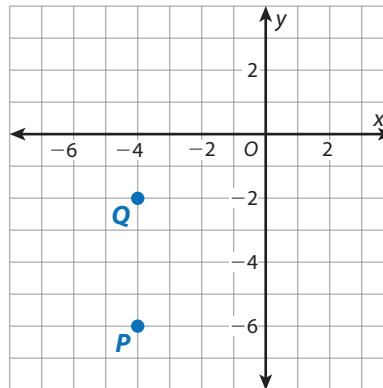**CONSIDER THIS . . .**
Why is it helpful to know that the vertices are listed in counterclockwise order?

PAIR/SHARE
How can you decompose the kitchen floor a different way to find the area?

SOLUTION

3 Which expression represents the distance from point *P* to point *Q*?

A $|-6| - |-2|$

B $|-6| - |-4|$

C $|-2| + |-4|$

D $|-2| + |-6|$

CONSIDER THIS . . .
How are the coordinates of points *P* and *Q* the same? How are they different?

Alita chose D as the correct answer. How might she have gotten that answer?

PAIR/SHARE
What is the distance, in units, from point *P* to point *Q*?

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4 The coordinate plane shows several locations of stations in a city's subway system. Distances are in miles. Tell whether each statement is *True* or *False*.
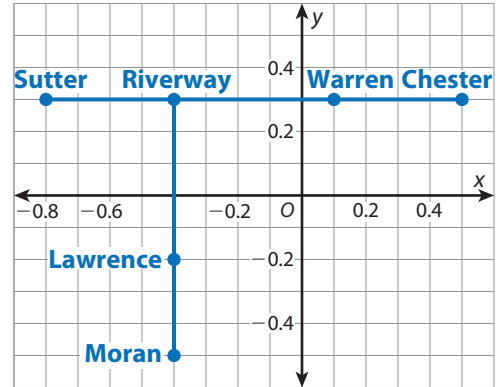
	True	False
a. The distance between Lawrence and Riverway is 0.5 mi.	◯	◯
b. The distance in miles from Moran to Lawrence is $\lvert-0.5\rvert + \lvert-0.2\rvert$.	◯	◯
c. The distance between Sutter and Warren is the same as the distance between Riverway and Chester.	◯	◯

5 One side of a rectangle in the coordinate plane has vertices at $(-5, 1)$ and $(4, 1)$. The perimeter of the rectangle is 26 units. What are all the possible coordinates of the other two vertices of the rectangle? Show your work.

SOLUTION

6 Triangle *JKL* has vertices $J(-2, -3)$, $K(-2, 3)$, and $L(6, -3)$. The perimeter of triangle *JKL* is 24 units. What is the length, in units, of $\overline{KL}$?
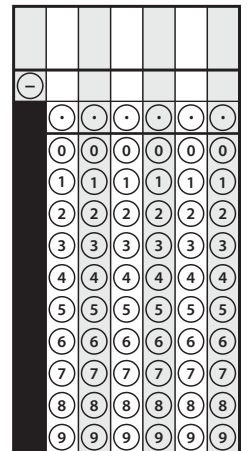
7 A surveyor is determining the area of a triangular piece of land bordered by three streets. In the coordinate plane, the vertices of the triangle are at $(0, 0)$, $(-100, -300)$, and $(200, -200)$. One unit in the coordinate plane represents 1 m. What is the area of the piece of land? Show your work.

SOLUTION _____

8 Points $R(-6, -5)$, $S(-2, -5)$, and $T(-2, n)$ are plotted in the coordinate plane. The distance between points R and S is half the distance between points S and T.

The value of n could be _____ or _____ .

9 **Math Journal** Choose a point in Quadrant III and a point in Quadrant IV on the same horizontal line. Explain how to use absolute value to find the distance between the two points.

✔ **End of Lesson Checklist**

☐ **INTERACTIVE GLOSSARY** Find the entry for *quadrants*. Tell how to find the distance between two points that are in different quadrants and on the same vertical line.

☐ **SELF CHECK** Go back to the Unit 6 Opener and see what you can check off.