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NEW JERSEY CENTER  
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# **6th Grade**

## **Graphing**

**2017-01-09**

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# **Cartesian Plane**

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# Cartesian Plane History

The development of the Coordinate or Cartesian plane is often credited to the French philosopher and mathematician, Rene Descartes.

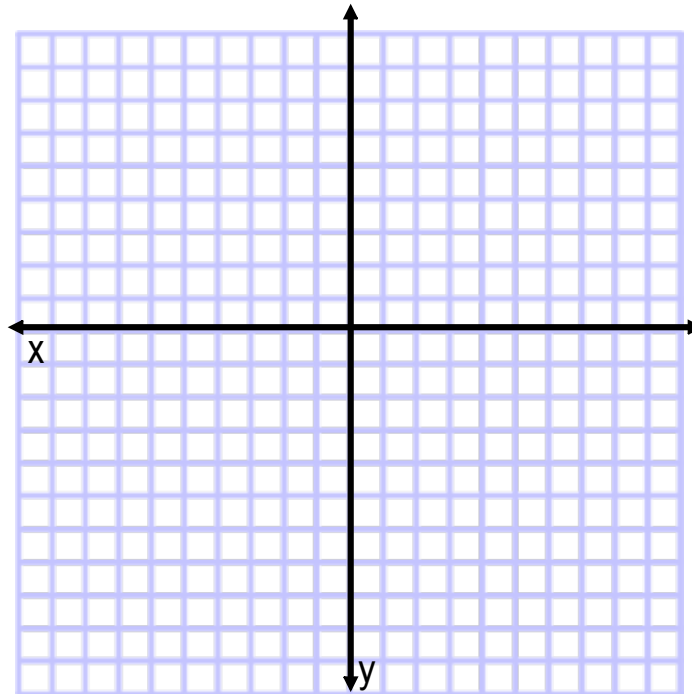
It is said that Descartes first came up with the idea for the **plane** as he lay in bed watching several flies crawl across his tiled ceiling; as he observed their movement he realized that he could use the intersecting lines formed by the tiles to describe a fly's location.



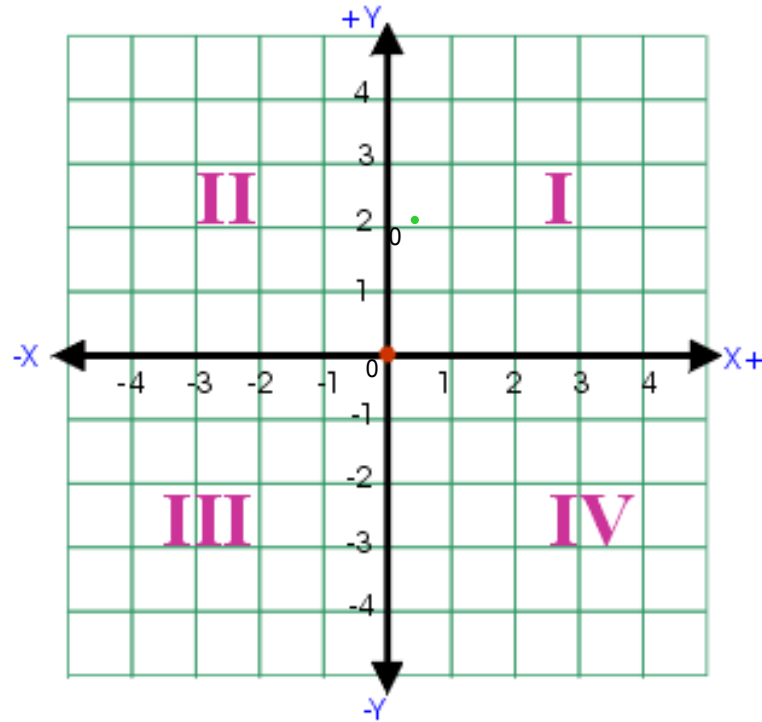
Rene Descartes  
1596 - 1650

# Cartesian Plane History

Although historical evidence suggests that a contemporary of Descartes, Pierre de Fermat, did more to develop the coordinate system, Rene Descartes' work certainly revolutionized mathematics by describing the properties of the plane and using it as the first systematic link between Euclidean geometry and algebra.



# Coordinate Plane

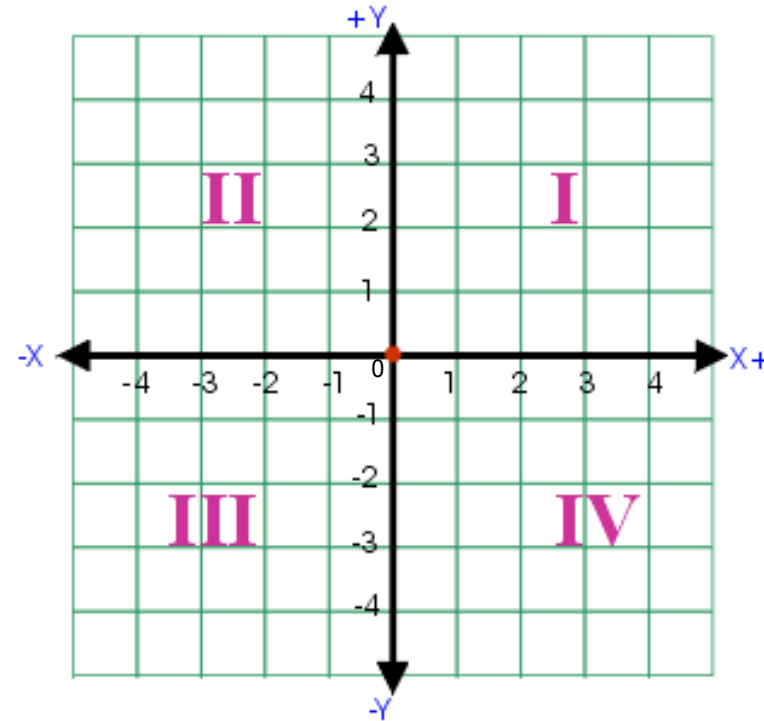
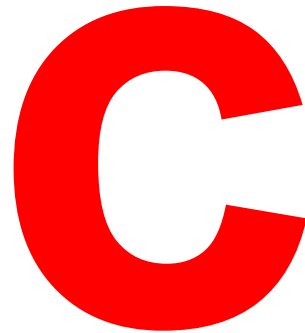


The coordinate plane is divided into four sections called **quadrants**.

Each quadrant is numbered using the Roman numerals I through IV, in a **counter-clockwise** direction.

# Coordinate Plane

Slide the "C"  
onto the  
coordinate plane

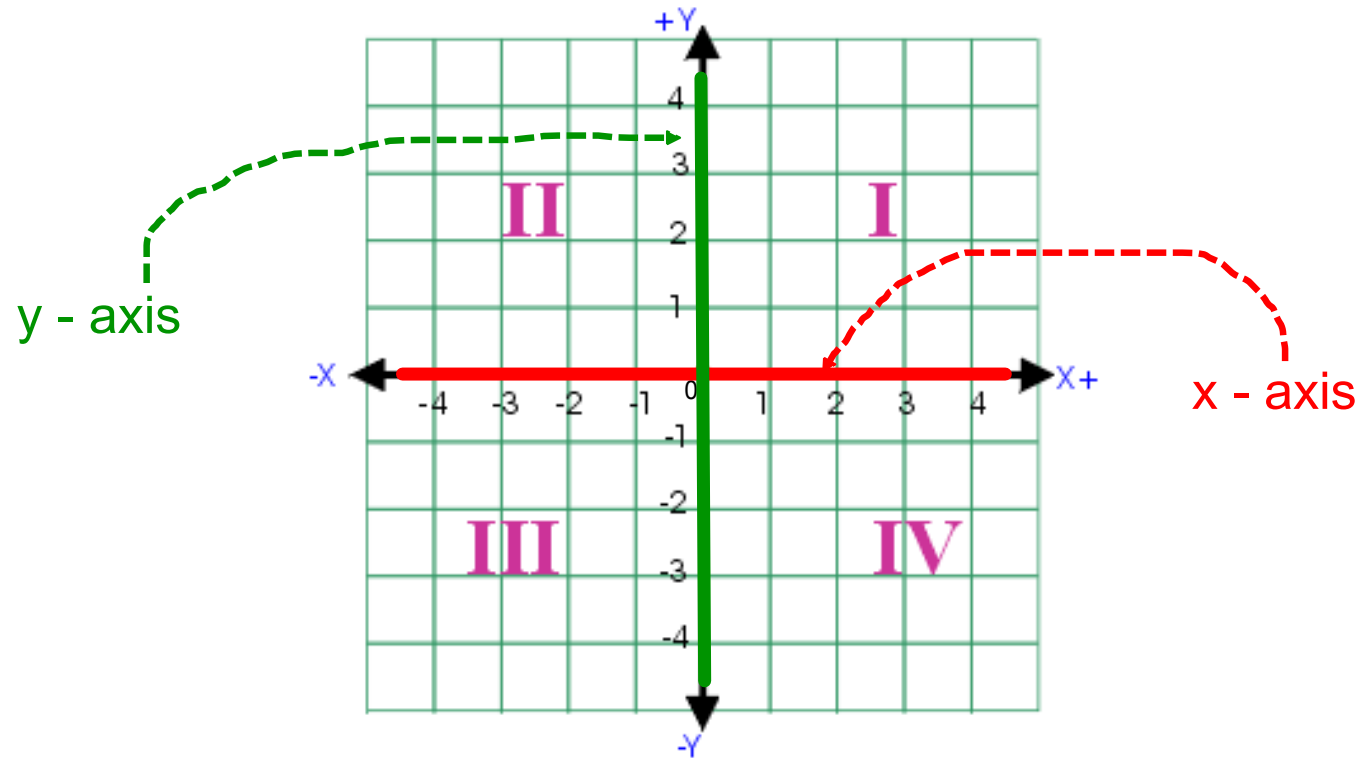


The Coordinate plane is also called the **Cartesian plane**.

One way to remember how the quadrants are numbered is to write a big "C" on top of the plane. The "C" will begin in quadrant I and end in quadrant IV.



# Coordinate Plane Axes

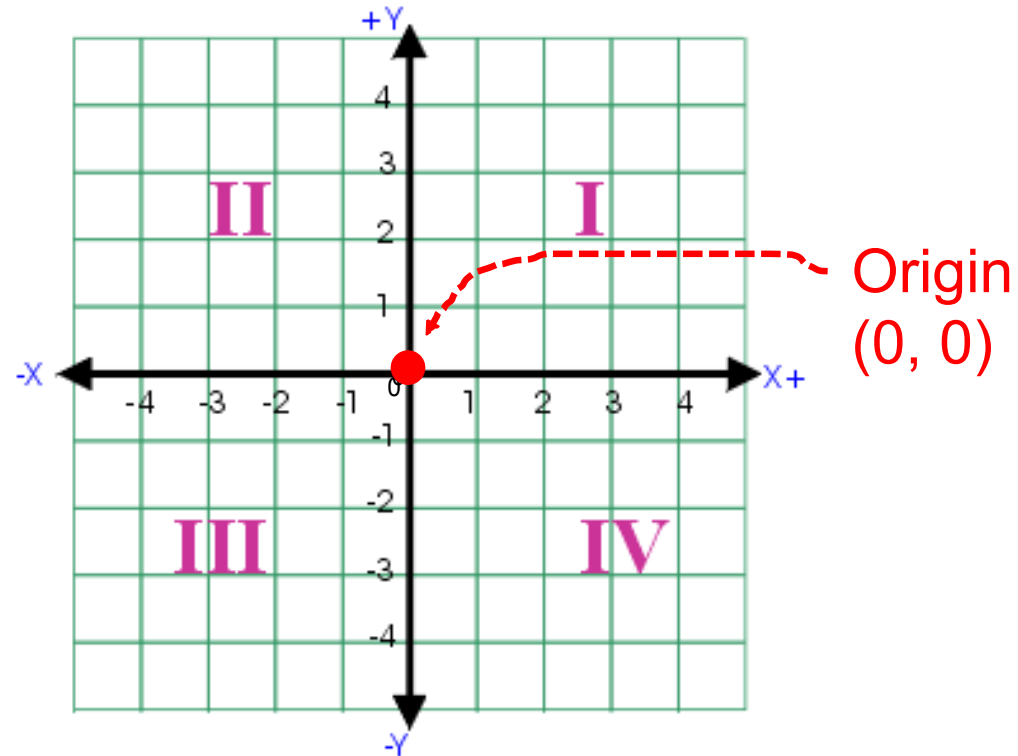


The quadrants are formed by two intersecting number lines called axes.

The **horizontal line** is the **x-axis**.

The **vertical line** is the **y-axis**.

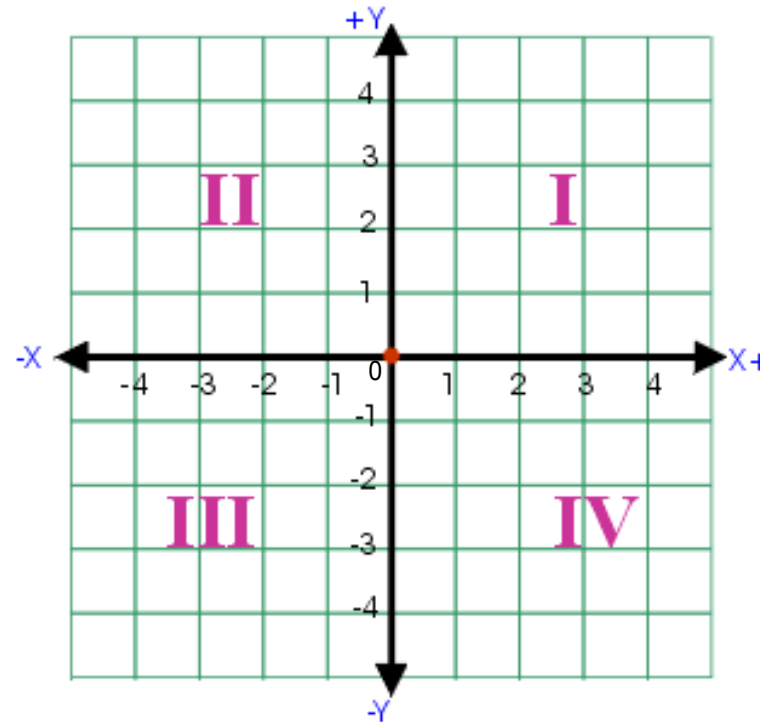
# Coordinate Plane



The point at which the  $x$  and  $y$  axes intersect is called the **origin**.

The **coordinates** of the origin are  $(0, 0)$ .

# Ordered Pairs

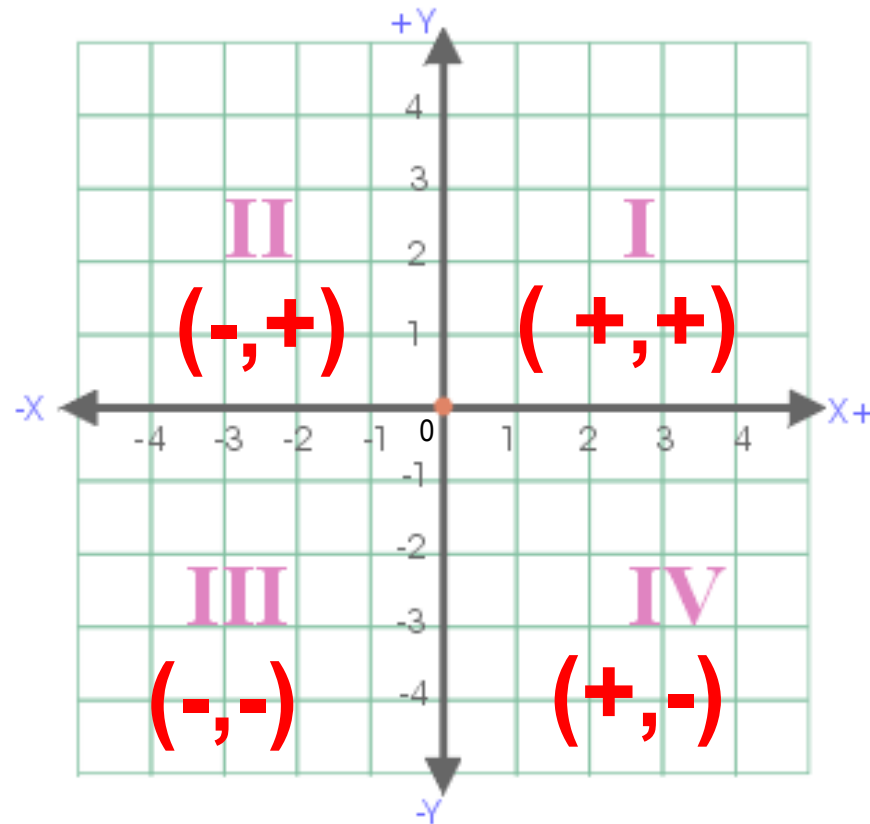


Points can be plotted on the plane using one coordinate from each of the axes. These sets are called **ordered pairs**. The x coordinate always appears first in these pairs. The y coordinate appears second.

**(x, y)**

# Coordinate Plane

Each of the quadrants can be identified by the properties of the numbers that fall within their plane. Remember the ordered pairs are always of the form  $(x, y)$



1 What points are in quadrant II ?

A

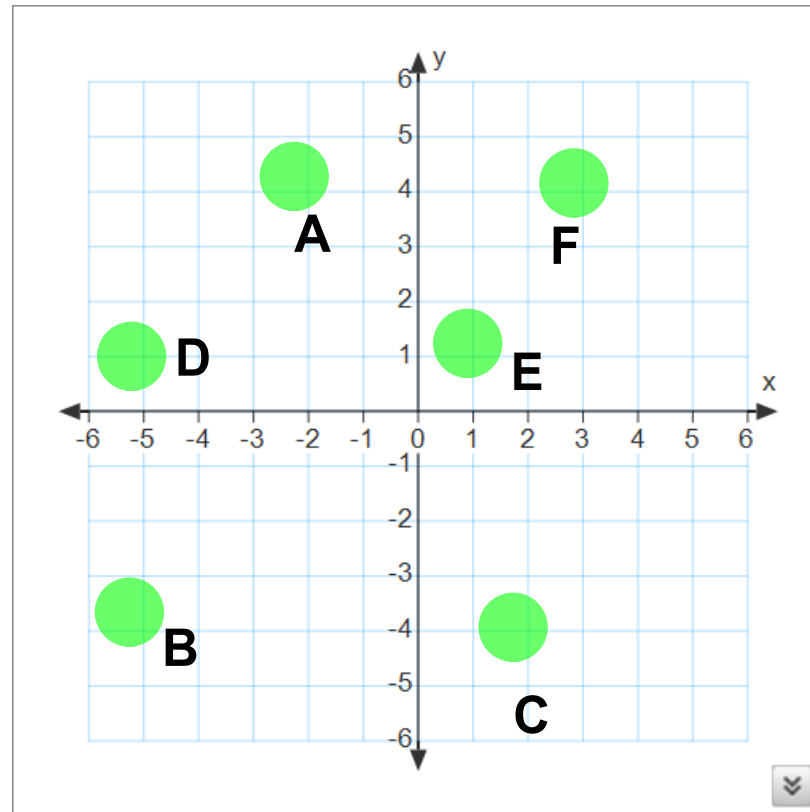
B

C

D

E

F



Answer

2 What points are in quadrant I ?

A

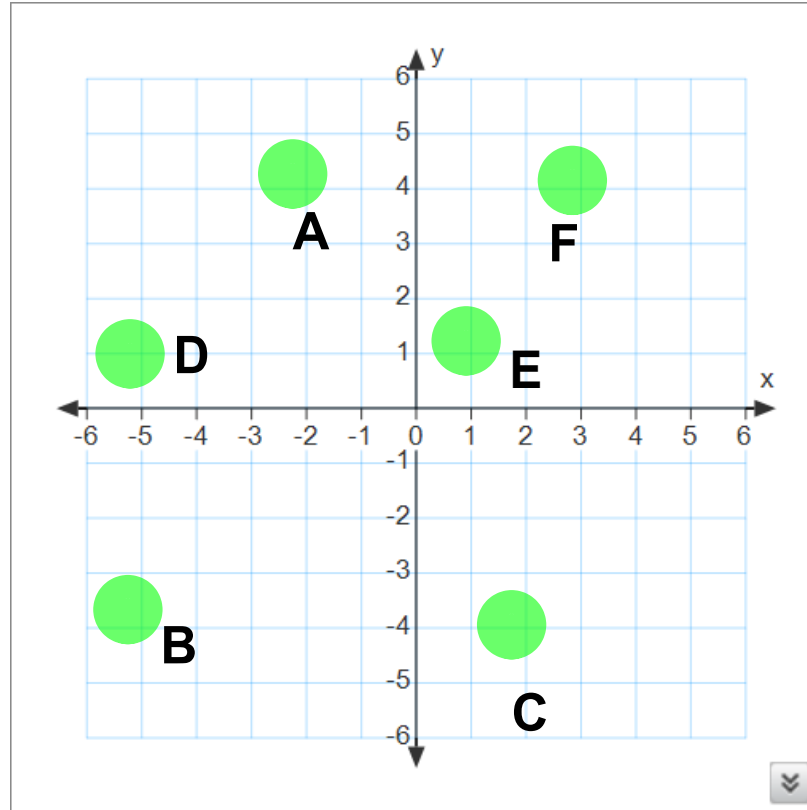
B

C

D

E

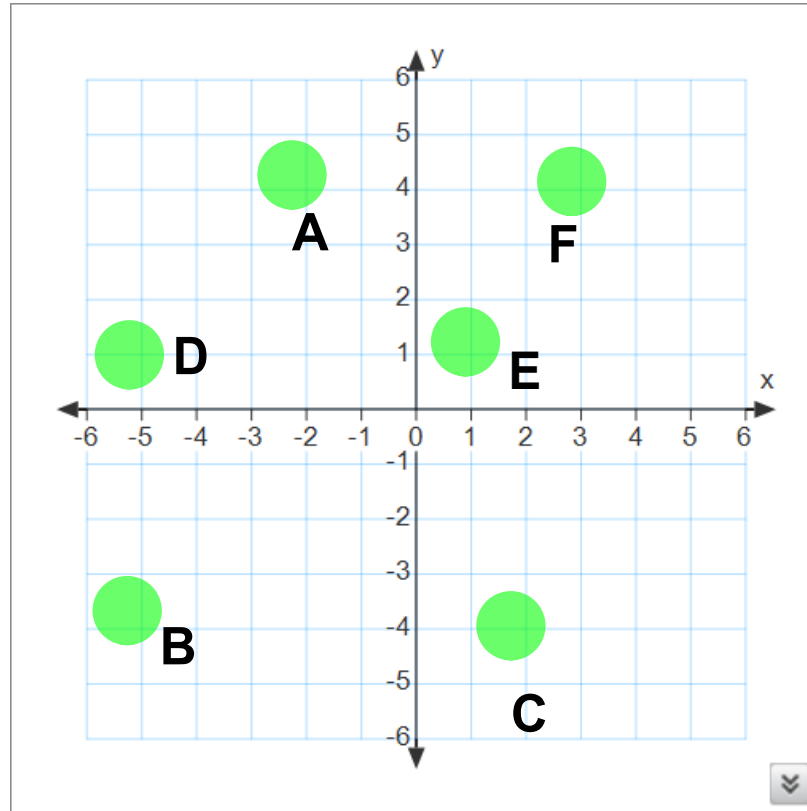
F



Answer

3 What points are in quadrant IV ?

- A
- B
- C
- D
- E
- F



Answer

4 What points are in quadrant III ?

A

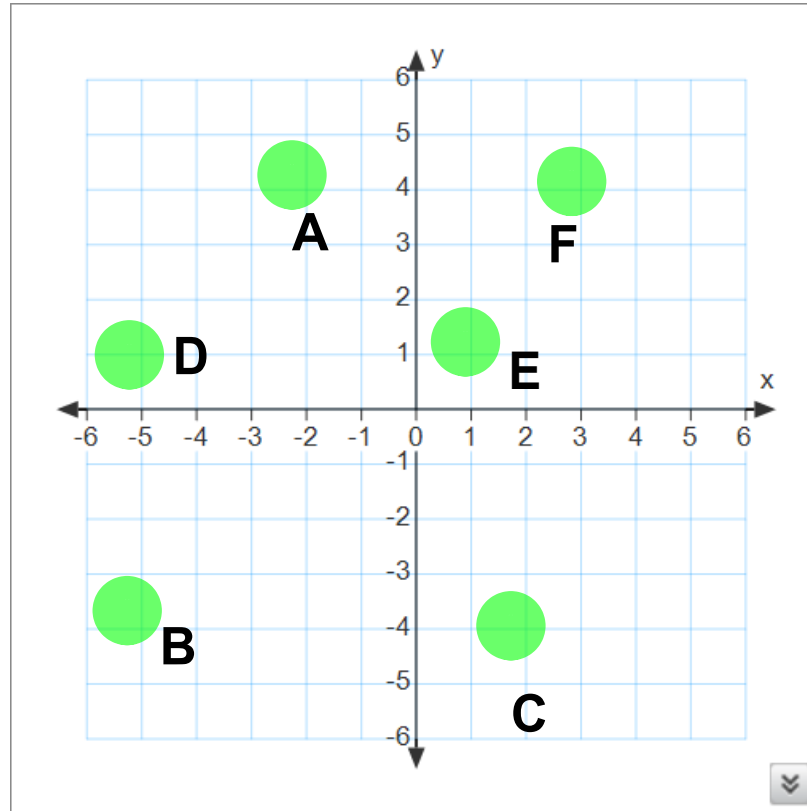
B

C

D

E

F



Answer



5 What point is closest to the origin?

A

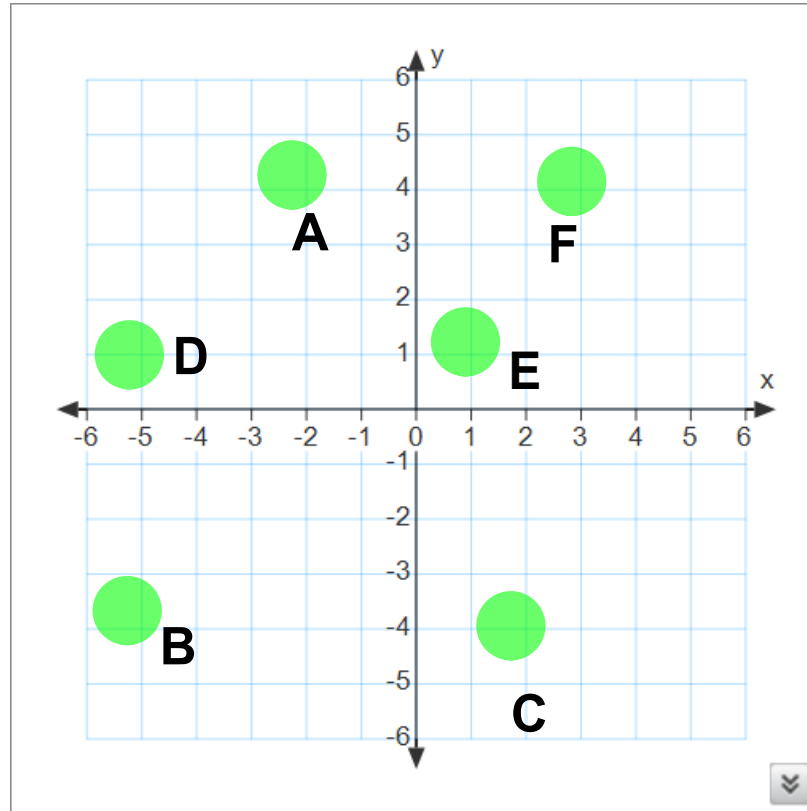
B

C

D

E

F



Answer

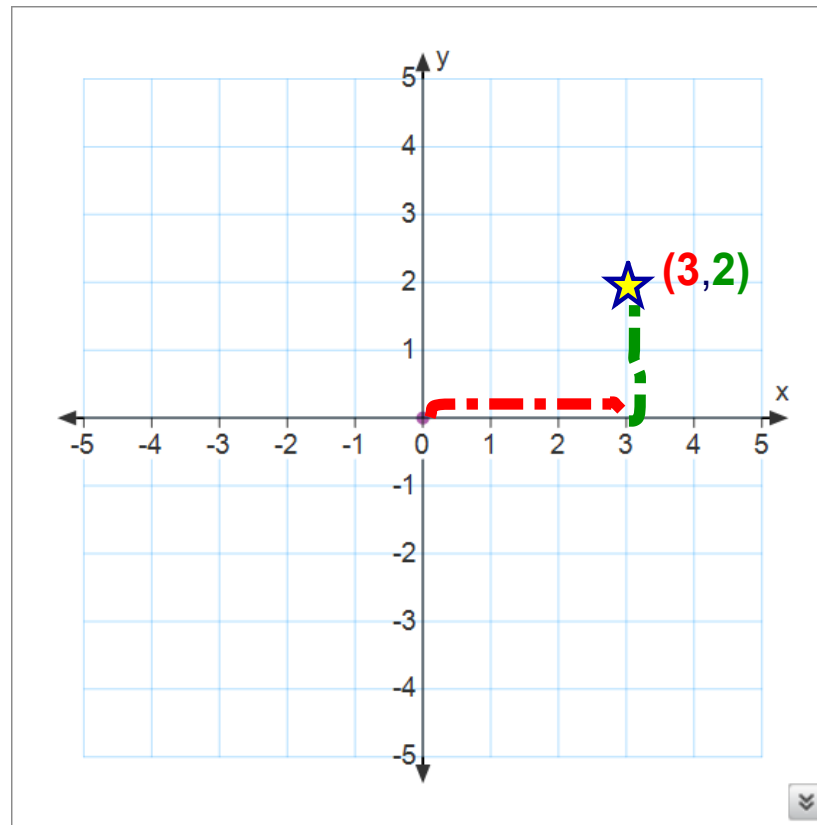
# Graphing Ordered Pairs

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# Ordered Pairs

To graph an ordered pair, such as  $(3, 2)$ :

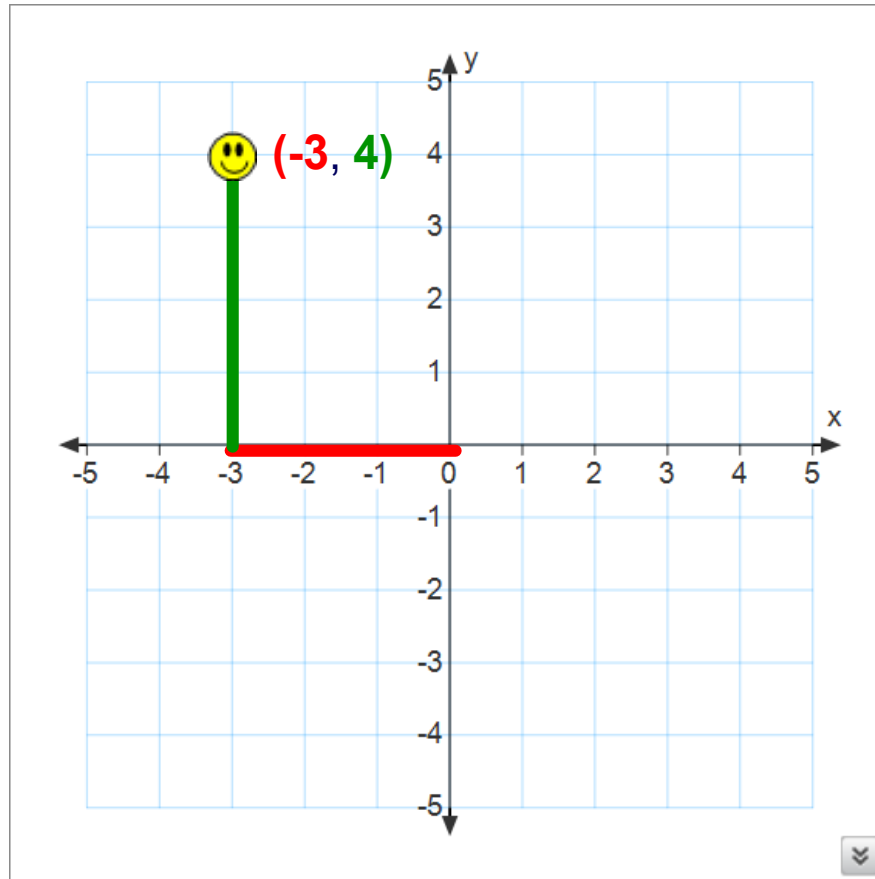
- start at the origin  $(0, 0)$
- move **left or right on the x-axis** depending on the **first number**
- then move **up or down** from there depending on the **second number**
- plot the point



# Ordered Pairs

To graph  $(-3, 4)$ :

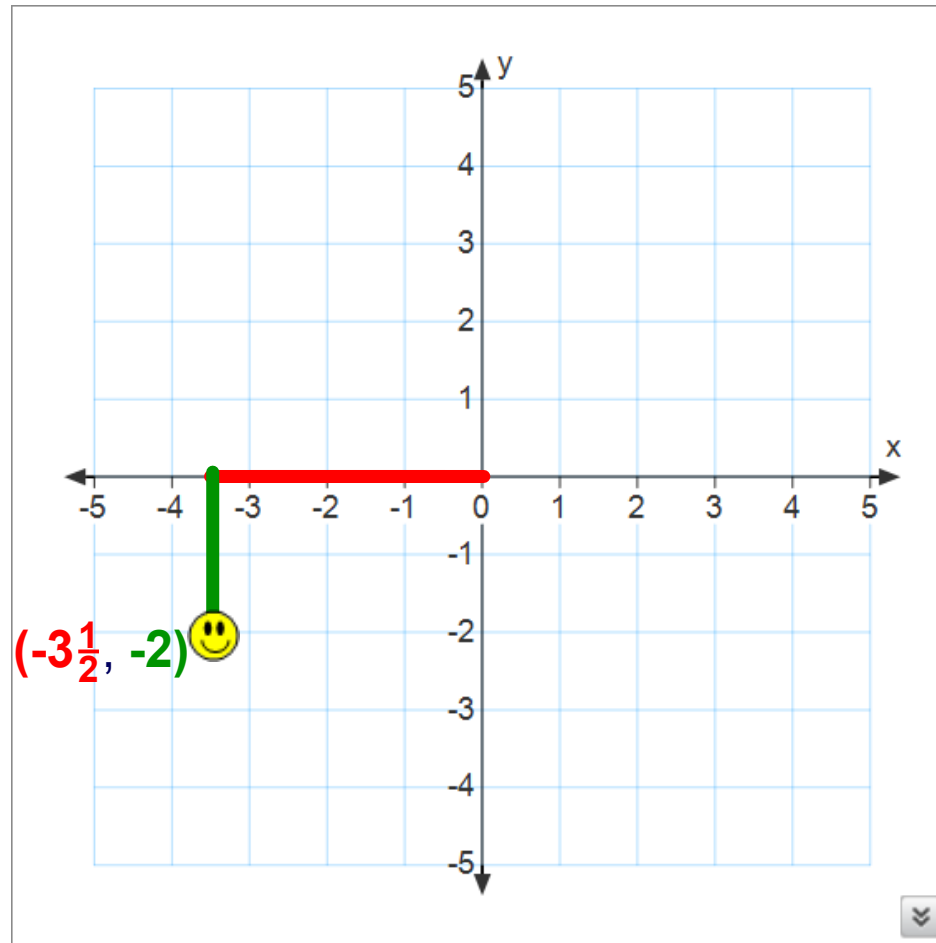
Start at the origin and then move 3 left, up 4



# Ordered Pairs

To graph  $(-3\frac{1}{2}, -2)$ :

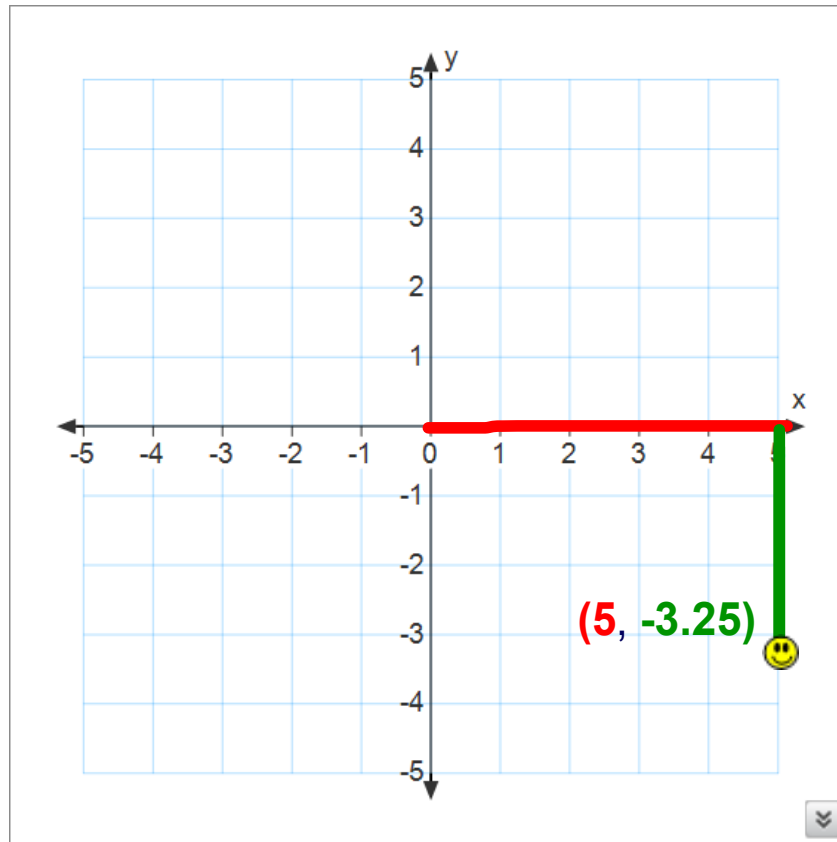
Start at the origin and then move 3 and a half left, down 2



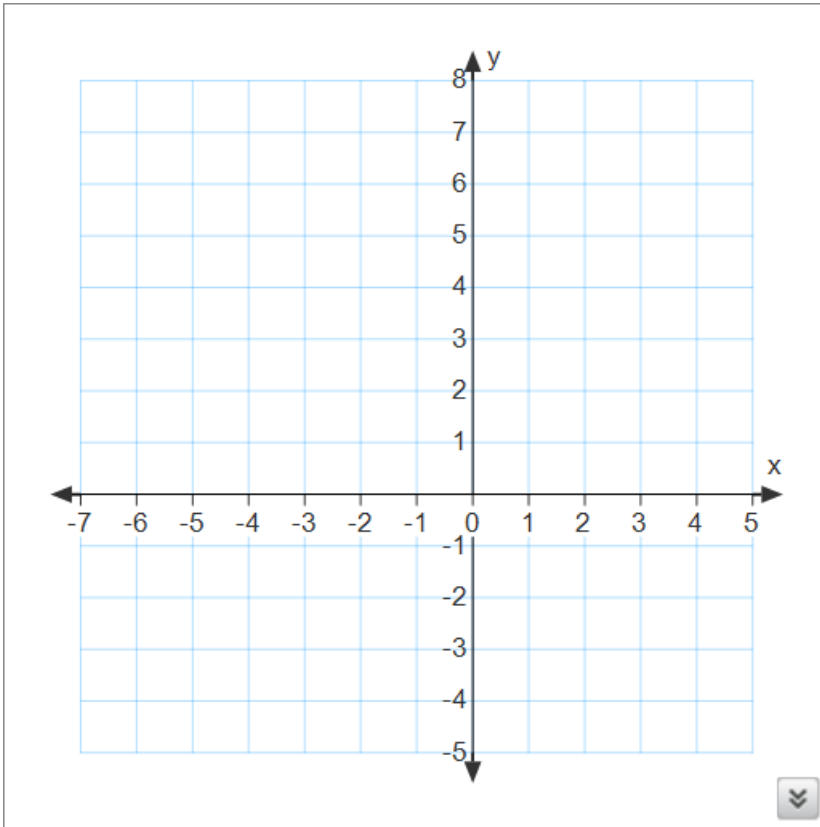
# Ordered Pairs

To graph  $(5, -3.25)$ :

Start at the origin and then move **5 right**, **down 3.25**

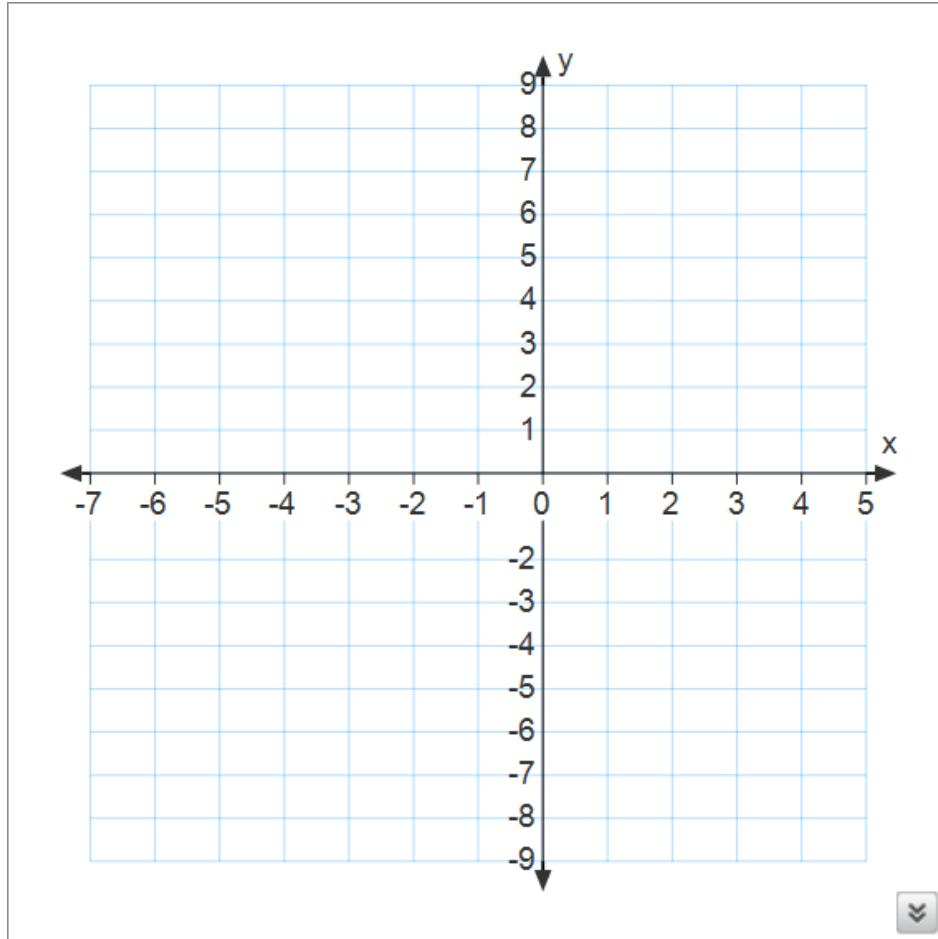


# Ordered Pairs Practice



- ★ Place the star on  $(2.5, 8)$  in quadrant I
- ▲ Place the triangle on  $(-4, 4)$  in quadrant II
- Place the square on  $(-7, -3\frac{1}{2})$  in quadrant III
- Place the circle on  $(1, -4)$  in quadrant IV

# Ordered Pairs Practice



● Place the circle on  $(-7, -5)$

★ Place the star on  $(4\frac{1}{3}, 9)$

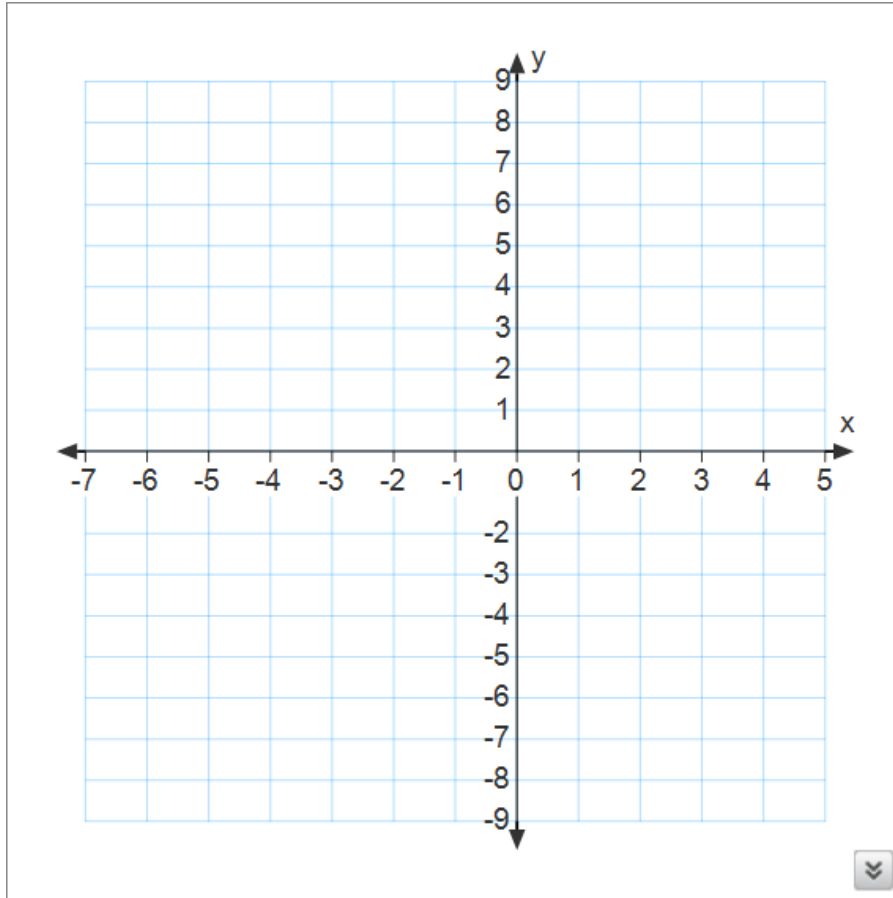
▲ Place the triangle on  $(-6.25, 2)$

■ Place the square on  $(3, -9)$

In which quadrant is the circle?



# Ordered Pairs Practice



● Place the circle on  $(-4, -3)$

★ Place the star on  $(4, 3)$

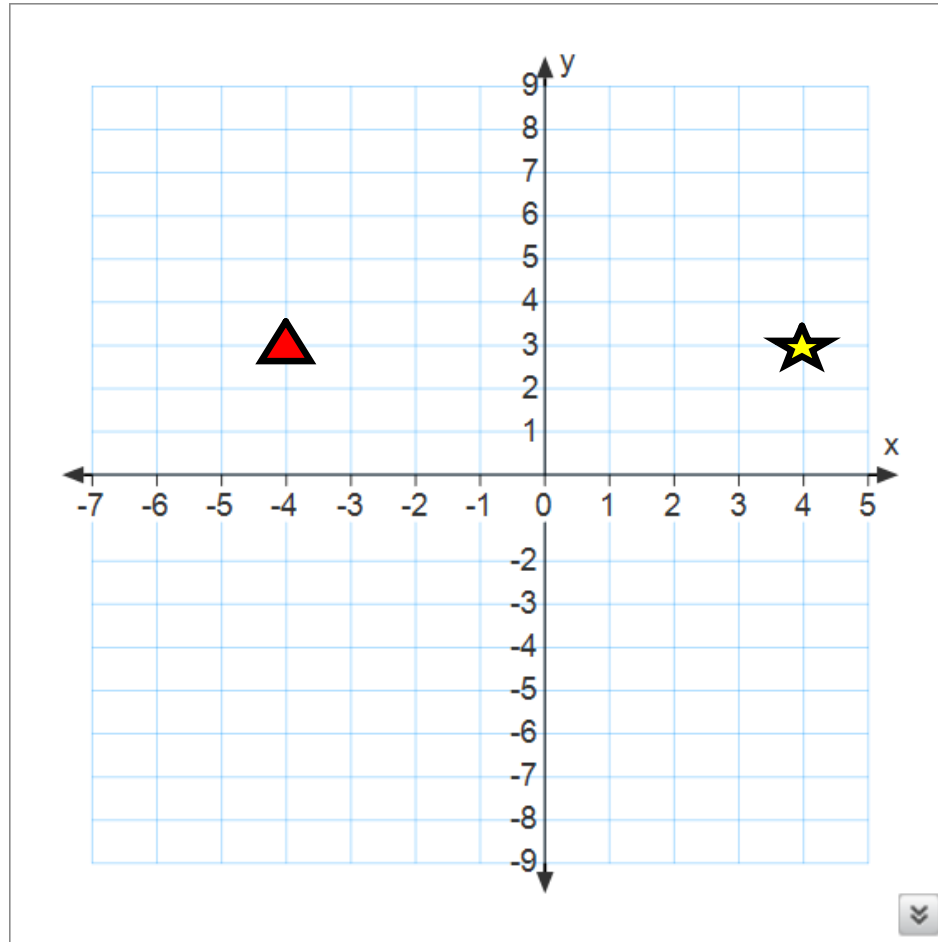
▲ Place the triangle on  $(-4, 3)$

■ Place the square on  $(4, -3)$

Answer  
& Math Practice

What do you notice about the location of the points in relation to each other? What patterns do you see in the coordinates of the points?

# Ordered Pairs Practice

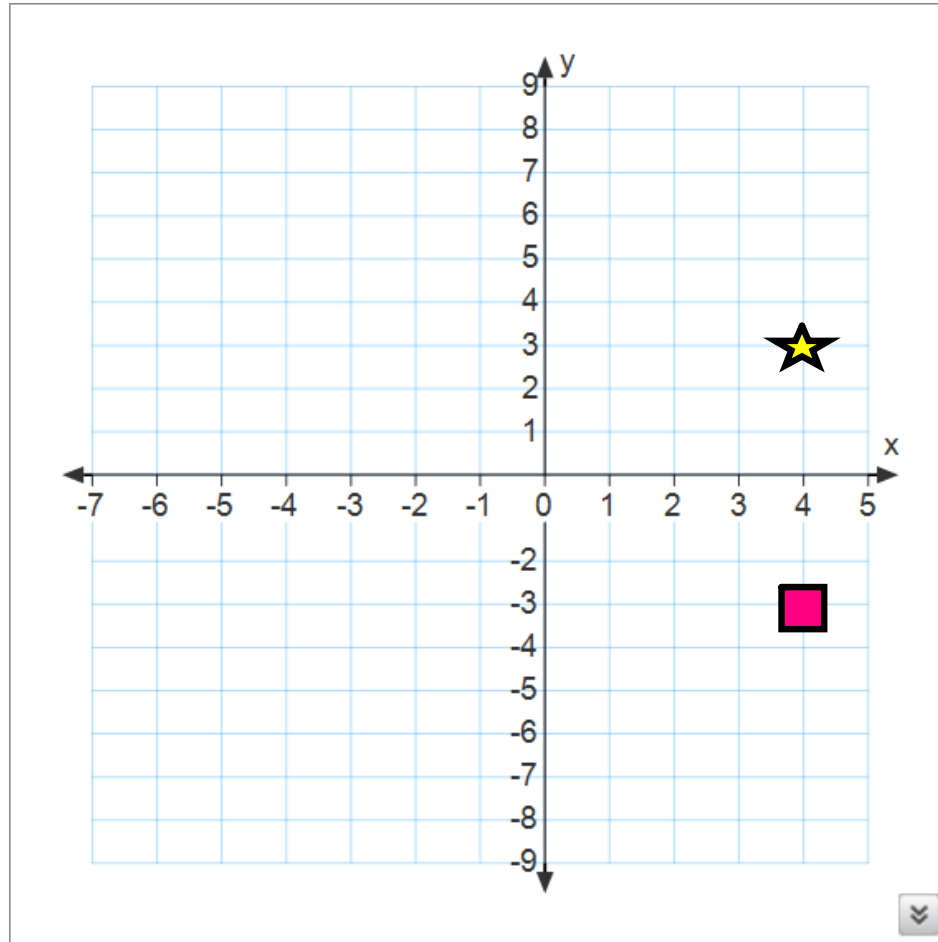


The points  $(4, 3)$  and  $(-4, 3)$  show a reflection across the y-axis.

What generalization can you make about the coordinates of a point when it is reflected across the y-axis?

**Answer &  
Math Practice**

# Ordered Pairs Practice

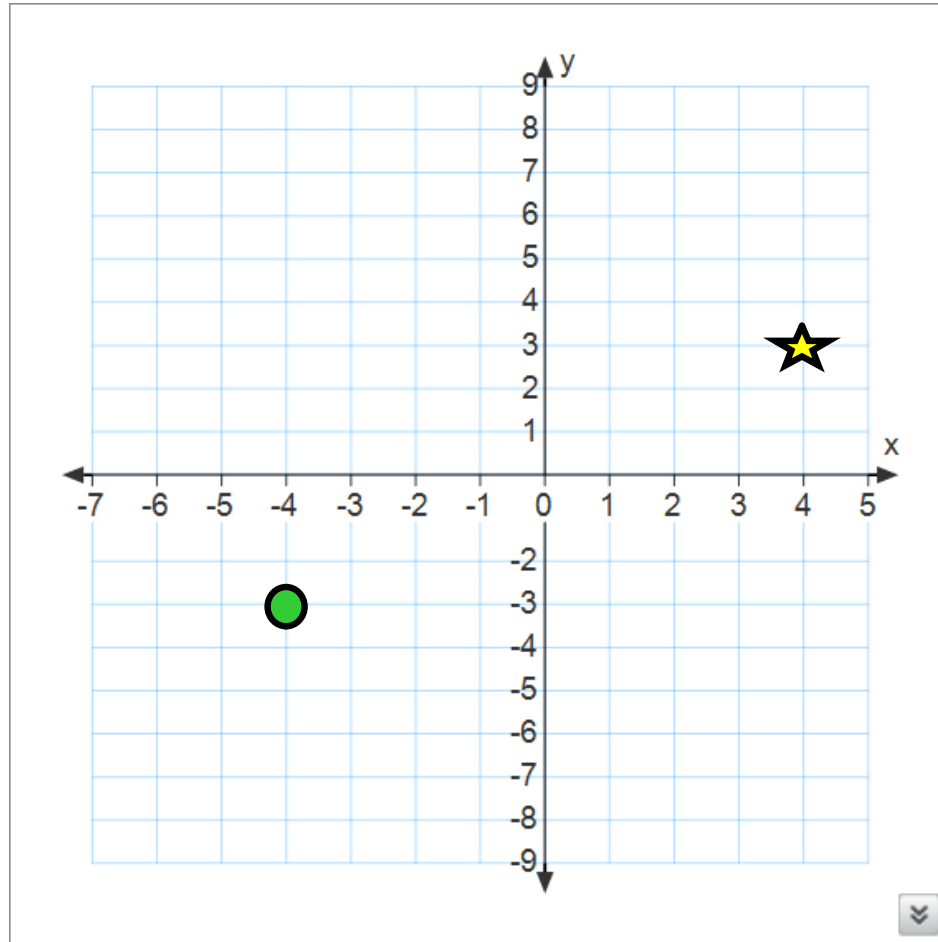


The points  $(4, 3)$  and  $(4, -3)$  show a reflection across the x-axis.

What generalization can you make about the coordinates of a point when it is reflected across the x-axis?

Answer

# Ordered Pairs Practice



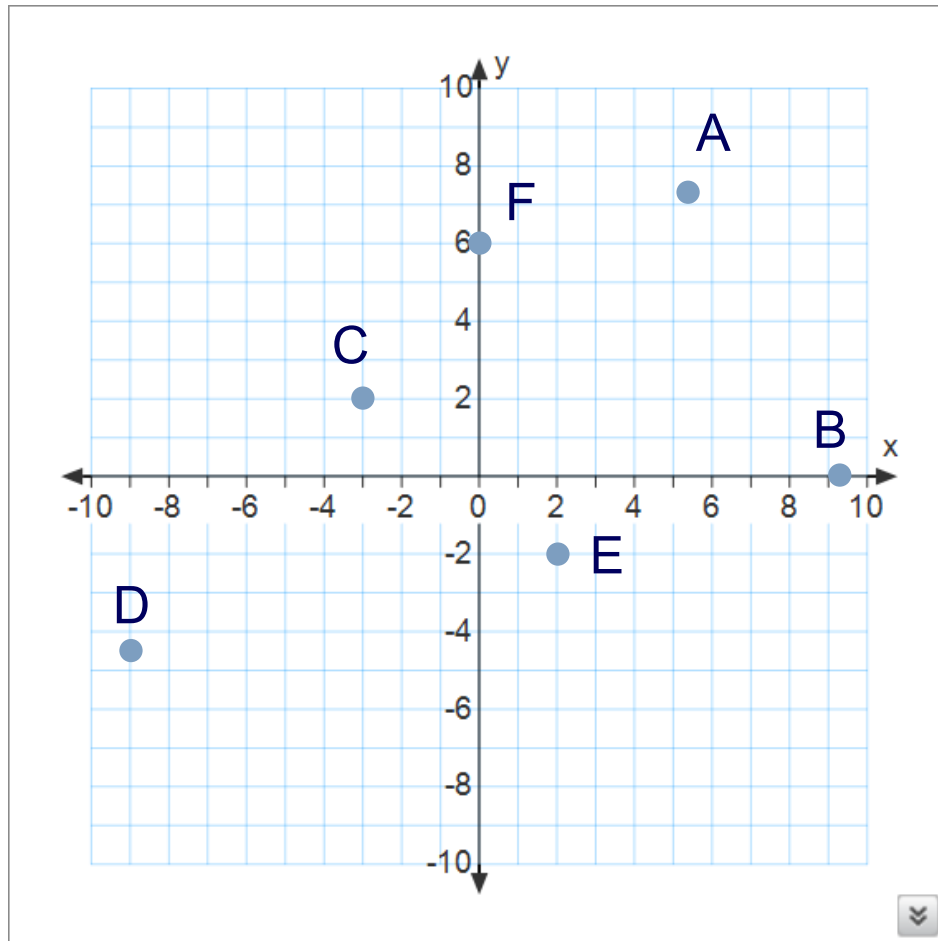
The points  $(4, 3)$  and  $(-4, -3)$  show a reflection across both the x-axis and y-axis.

What generalization can you make about the coordinates of a point when it is reflected across the x-axis and y-axis?

**Answer**

# Ordered Pairs Practice

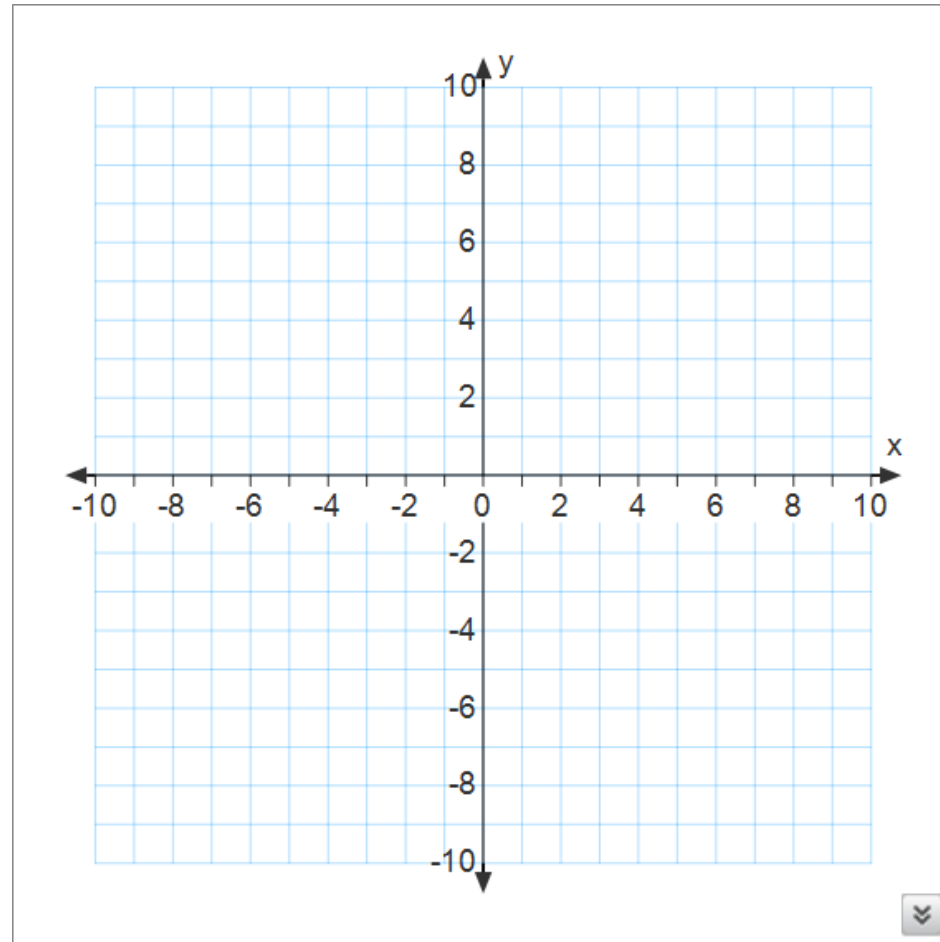
Move the letter to match it to the correct coordinate point. Then move the circle to check your answer.



- (-9, -4.5) ●
- (2, -2) ●
- (9 1/4, 0) ●
- (0, 6) ●
- (5.25, 7 1/3) ●
- (-3, 2) ●

6 The point  $(-5, 4)$  is located in quadrant \_\_\_\_\_.

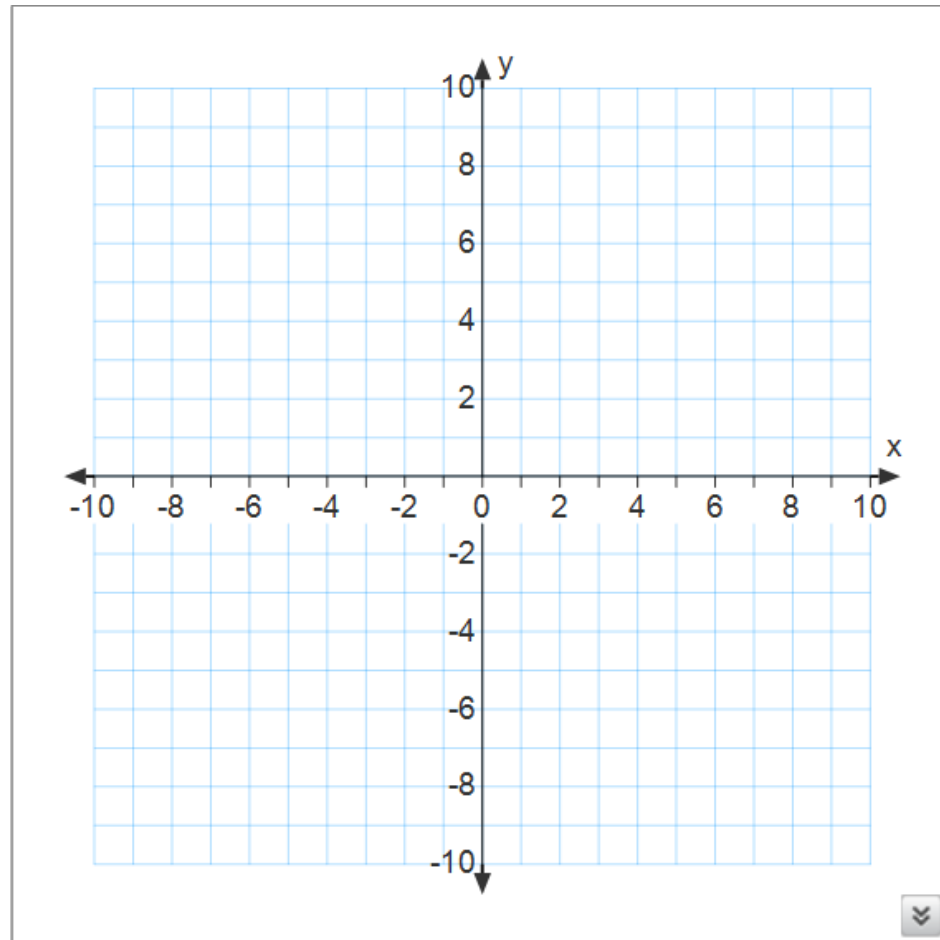
- A I
- B II
- C III
- D IV



**Answer**

7 The point  $(7, -2)$  is located in quadrant \_\_\_\_\_.

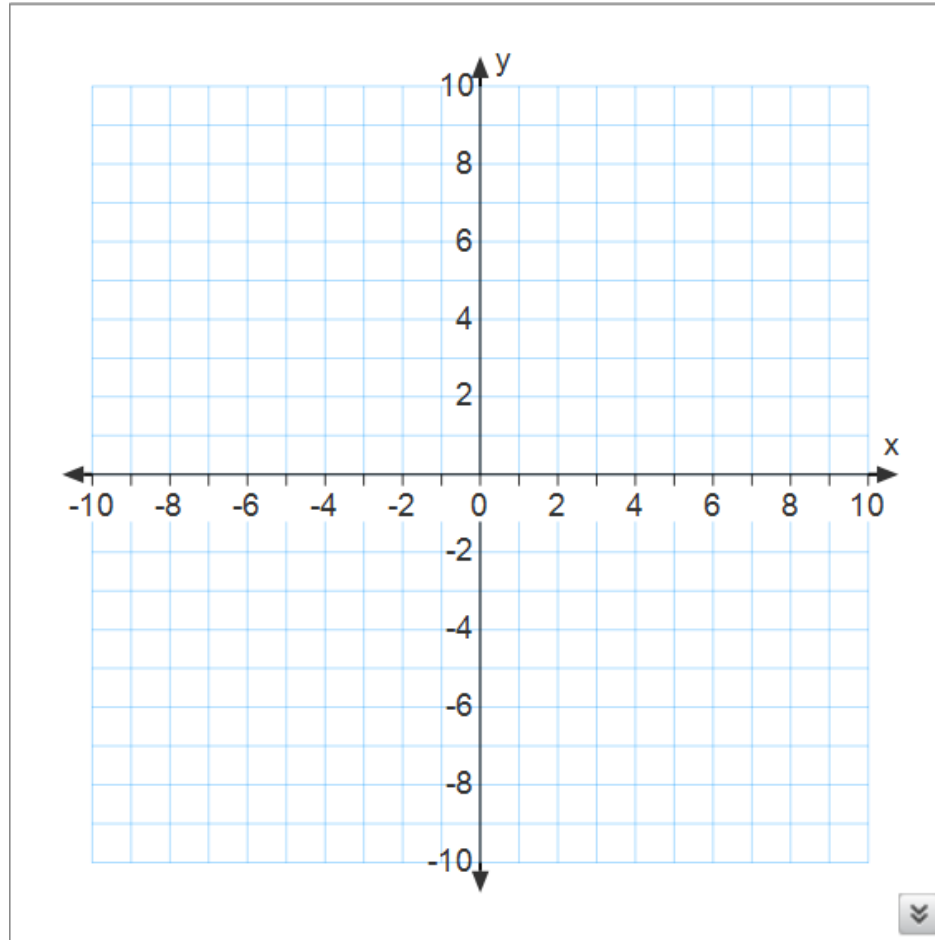
- A I
- B II
- C III
- D IV



**Answer**

8 The point  $(4, 5.75)$  is located in quadrant \_\_\_\_\_.

- A I
- B II
- C III
- D IV

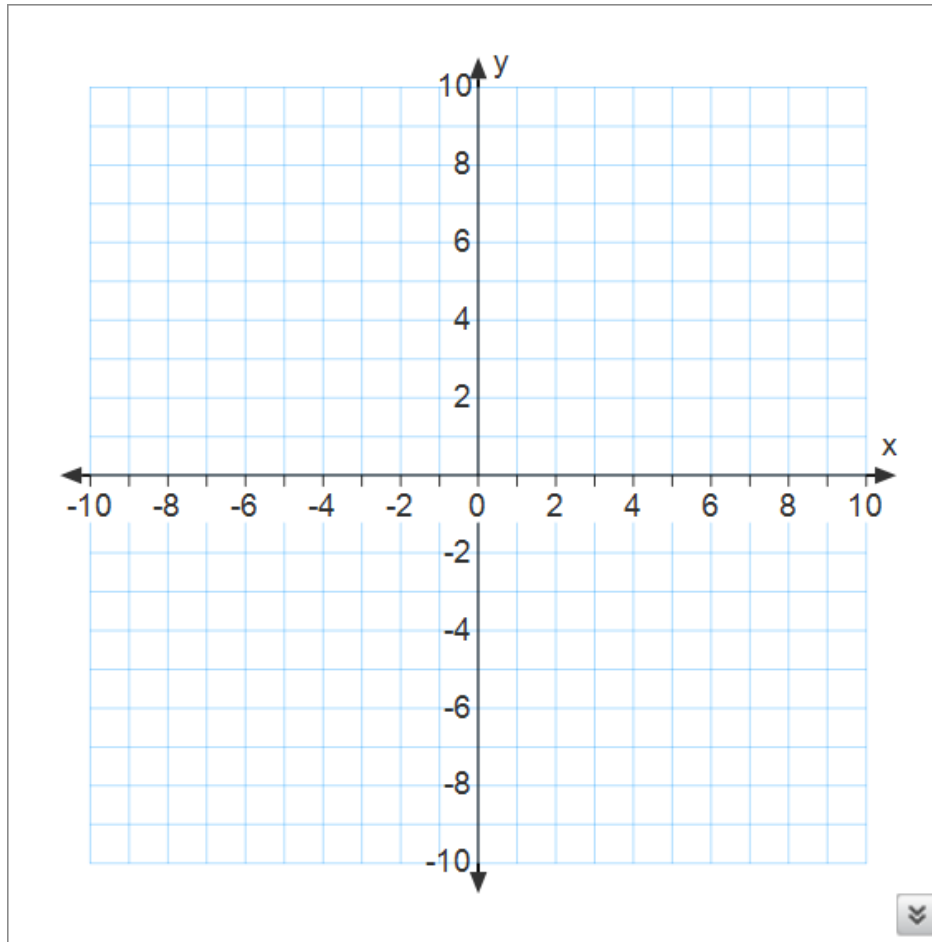


**Answer**



9 The quadrant where the x & y coordinates are both negative is quadrant \_\_\_\_.

- A I
- B II
- C III
- D IV



**Answer**

10 When plotting points in the Cartesian Plane, you always start at \_\_\_\_\_.

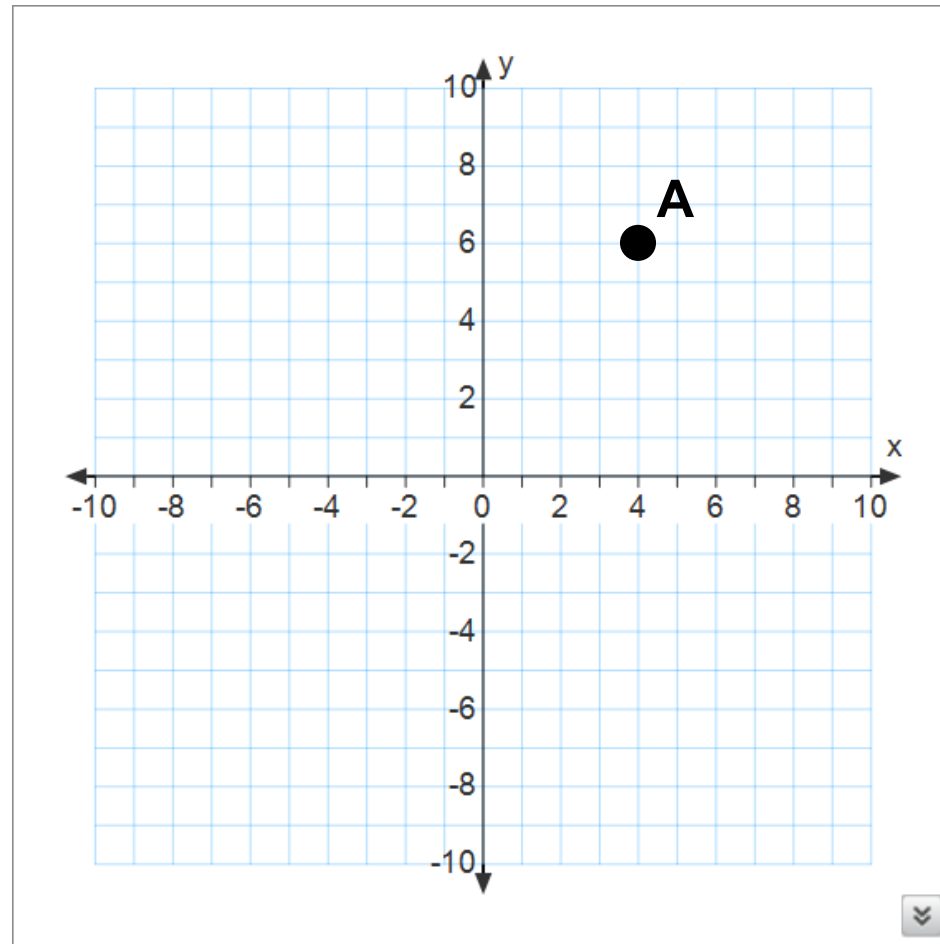
- A the x-axis
- B the origin
- C the y-axis
- D the Coordinate Plane
- E (0,0)

Answer

11 Point A is plotted on the coordinate plane.

Point A is reflected across the y-axis. What are the coordinates of the reflection of point A?

- A (4, 6)
- B (-4, 6)
- C (4, -6)
- D (-4, -6)

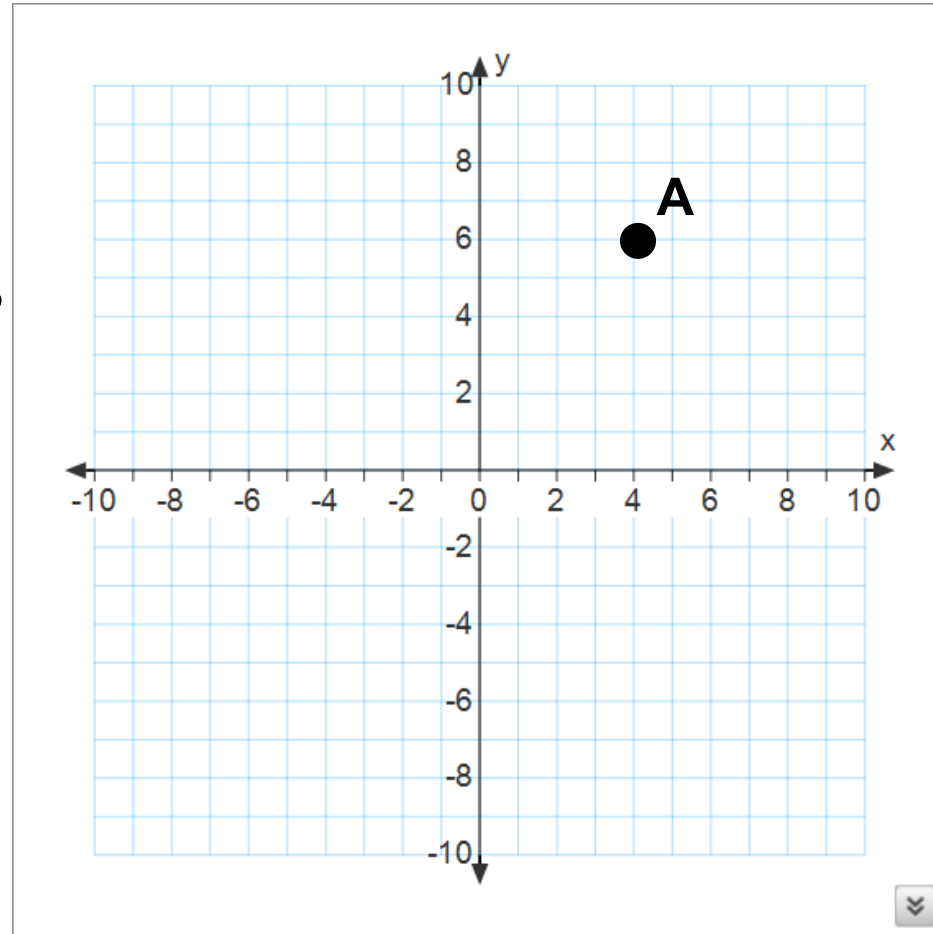


**Answer**

12 Point A is plotted on the coordinate plane.

Point A is reflected across the x-axis. What are the coordinates of the reflection of point A?

- A (4, 6)
- B (-4, 6)
- C (4, -6)
- D (-4, -6)

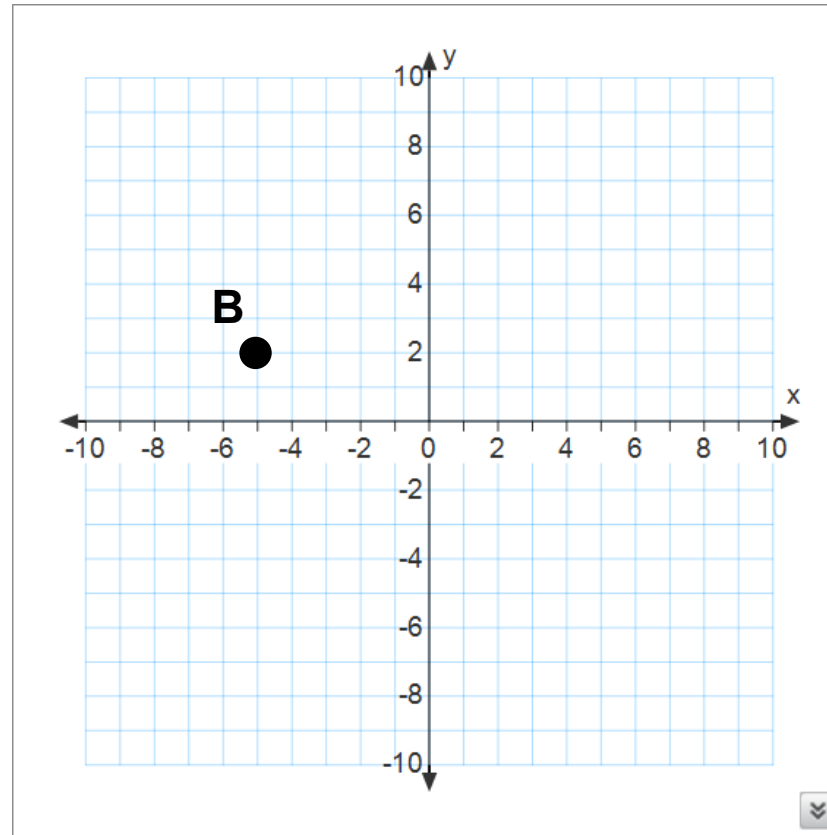


**Answer**

13 Point B is plotted on the coordinate plane.

Point B is reflected across the x-axis. What are the coordinates of the reflection of point B?

- A (5, 2)
- B (-5, 2)
- C (5, -2)
- D (-5, -2)

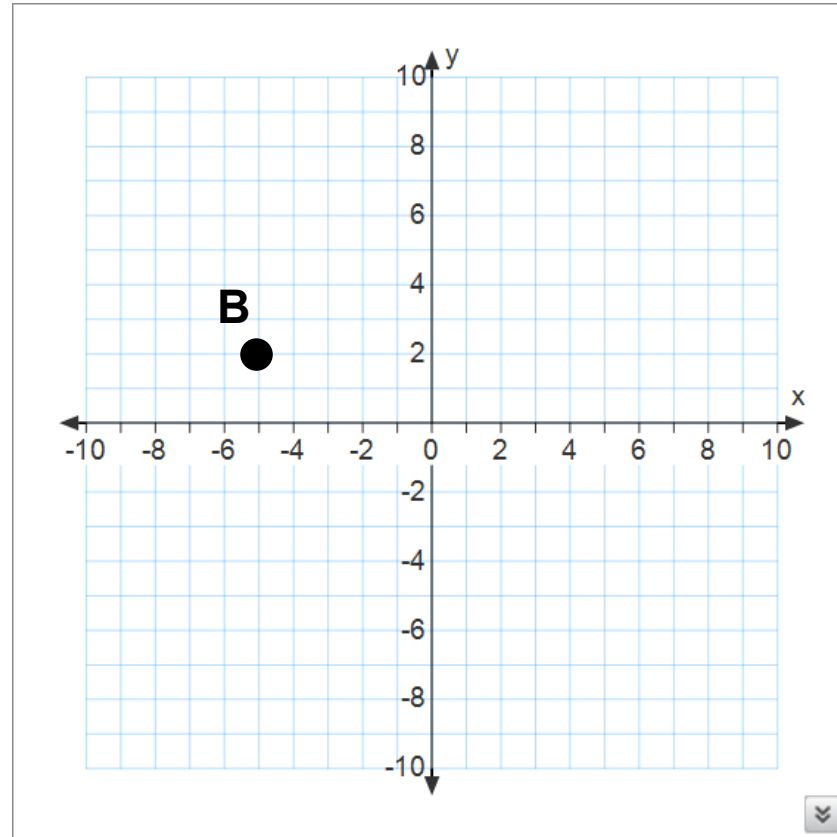


**Answer**

14 Point B is plotted on the coordinate plane.

Point B is reflected  
across the y-axis.  
What are the  
coordinates of the  
reflection of point B?

- A (5, 2)
- B (-5, 2)
- C (5, -2)
- D (-5, -2)

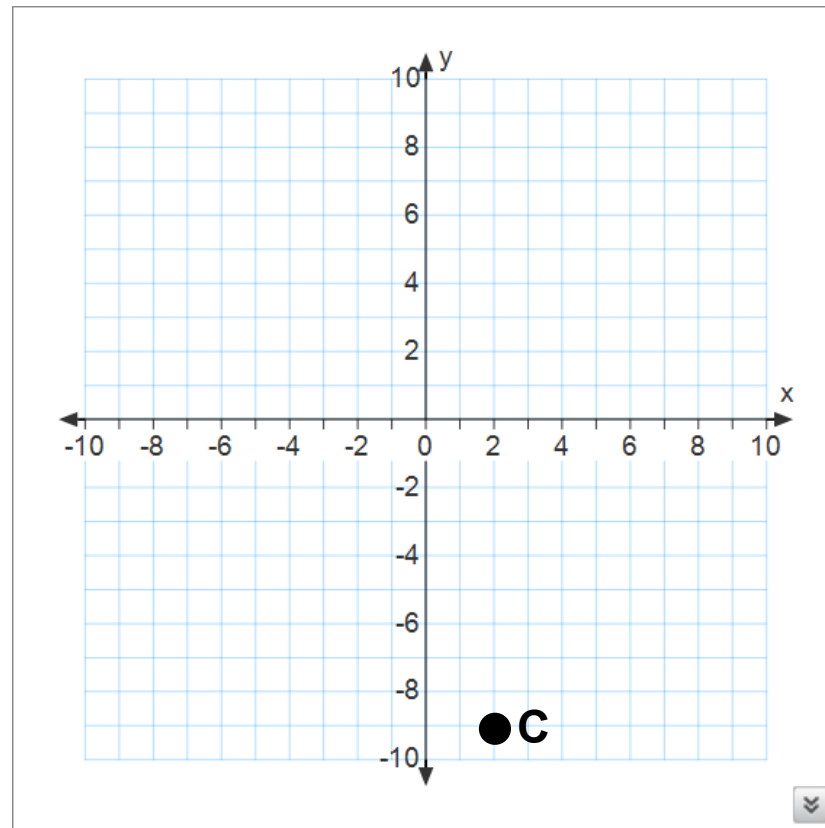


Answer

15 Point C is plotted on the coordinate plane.

Point C is reflected across the x-axis and y-axis. After both reflections, what are the coordinates of point C?

- A (2, 9)
- B (-2, 9)
- C (2, -9)
- D (-2, -9)

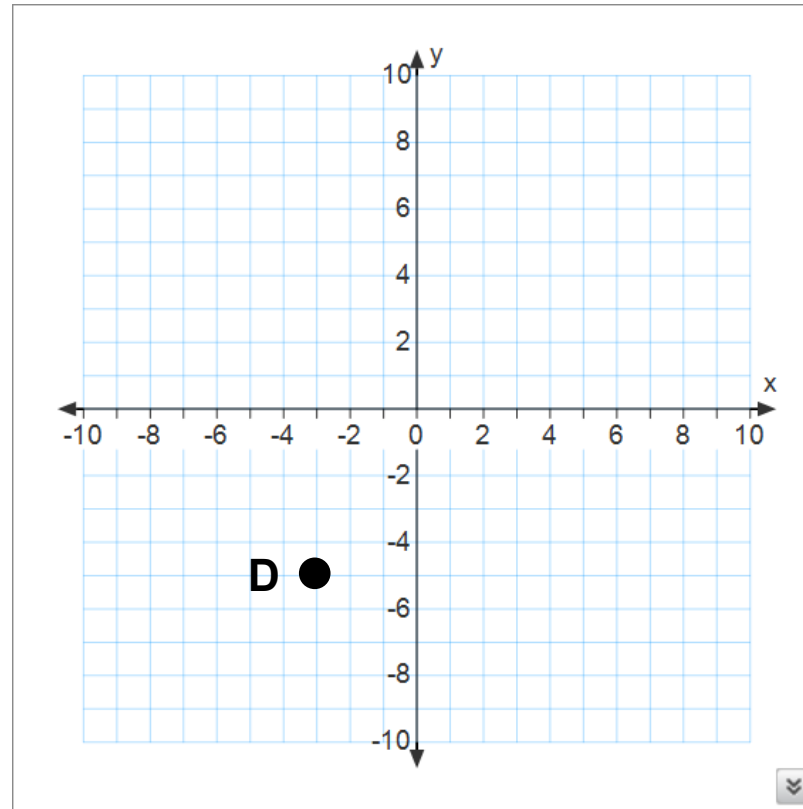


**Answer**

16 Point D is plotted on the coordinate plane.

Point D is reflected across the x-axis and y-axis. After both reflections, what are the coordinates of point D?

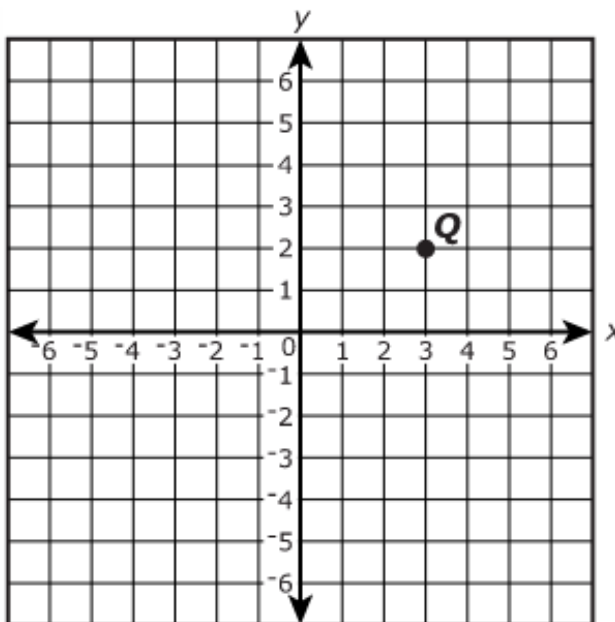
- A (3, 5)
- B (-3, 5)
- C (3, -5)
- D (-3, -5)



Answer



17 Point Q is plotted on the coordinate plane.



Answer

Point Q is reflected across the x-axis.

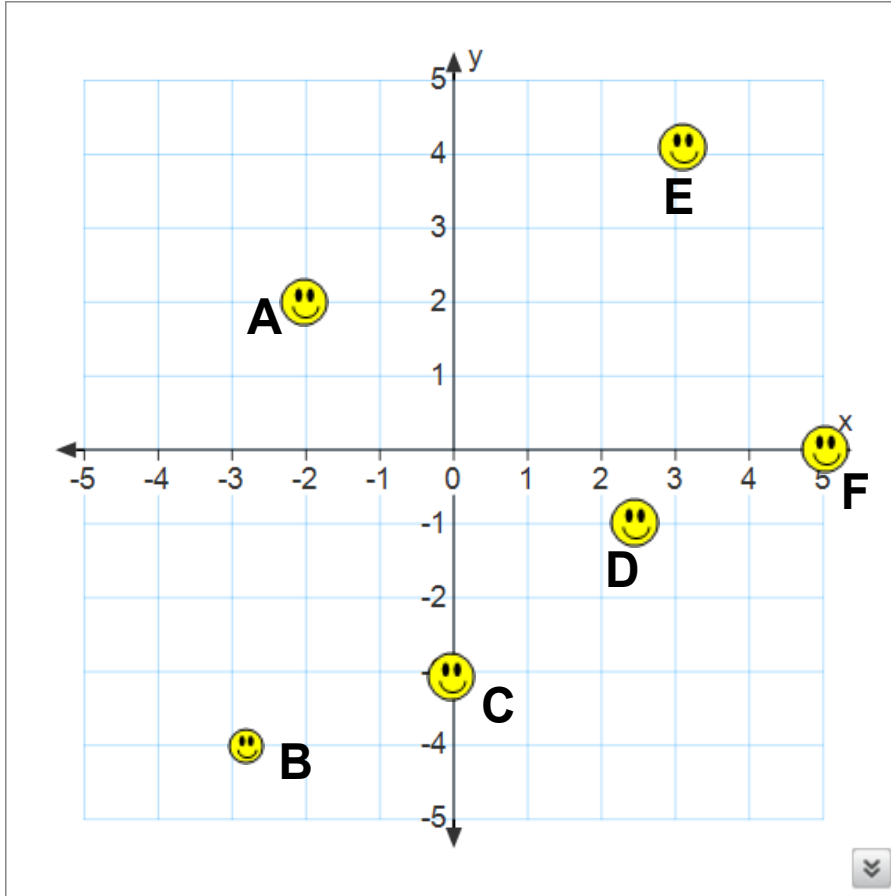
What are the coordinates of the reflection of point Q?

(\_\_\_\_,\_\_\_\_)

From PARCC EOY sample test non-calculator #11



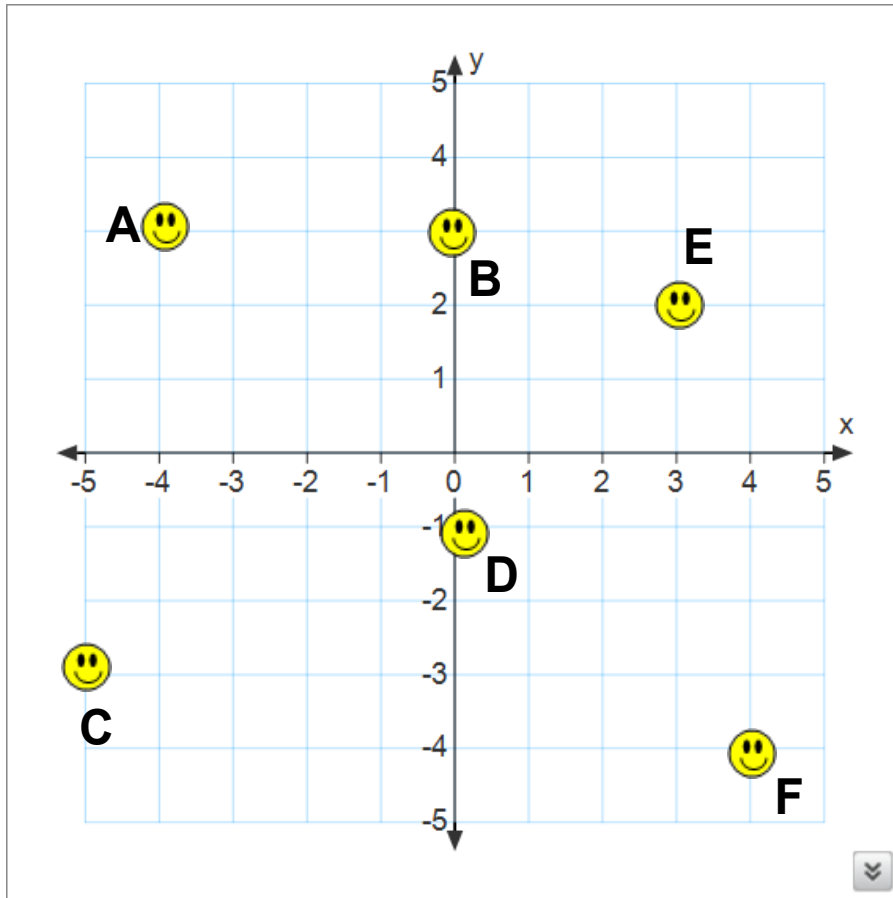
# Ordered Pairs Practice



List the coordinates of each point

- A
- B
- C
- D
- E
- F

# Ordered Pairs Practice



List the coordinates of each point

A

B

C

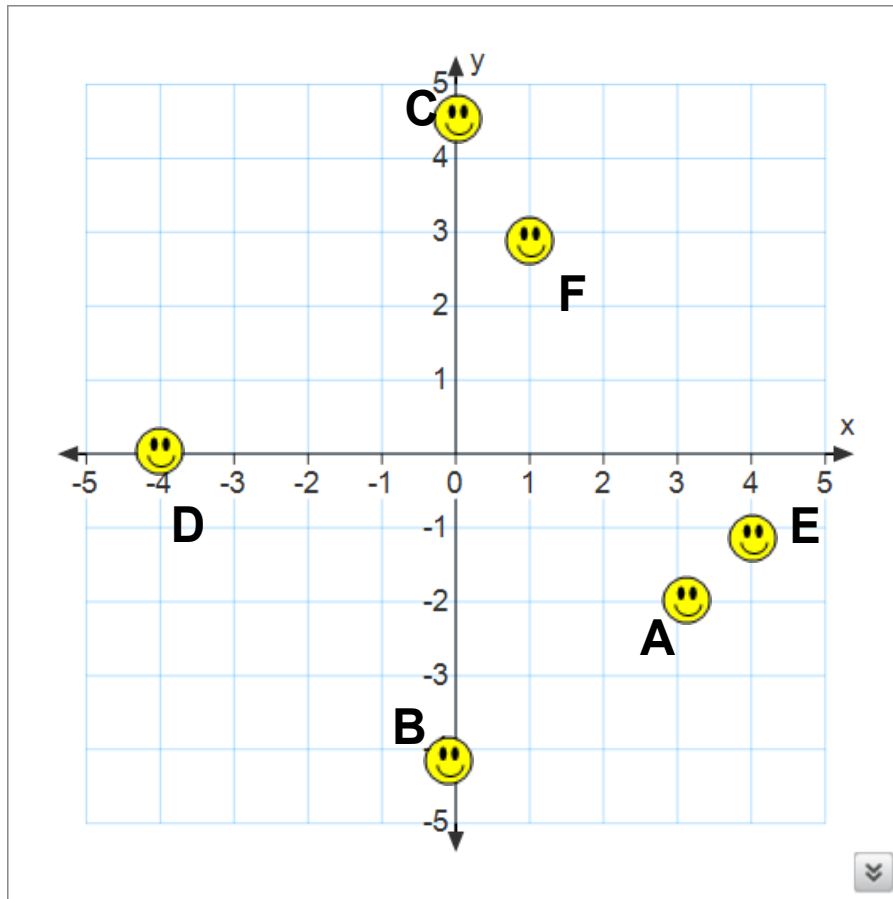
D

E

F

Answer

# Ordered Pairs Practice



List the coordinates of each point

A

B

C

D

E

F

Answer

18 If the x-coordinate is positive, the point to be plotted will be in quadrant \_\_\_\_\_.

A I

B I & II

C I & IV

D II

**Answer**

19 If the y-coordinate is positive, the point to be plotted will be in quadrant \_\_\_\_\_.

A I

B I & II

C I & IV

D II

**Answer**

20 If the x - coordinate is negative and the y-coordinate is positive, the point to be plotted will be in quadrant \_\_\_\_\_.

A I

B I & II

C I & IV

D II

**Answer**

21 If the  $x$  - coordinate is positive and the  $y$ -coordinate is negative, the point to be plotted will be in quadrant \_\_\_\_\_.

A I

B II

C III

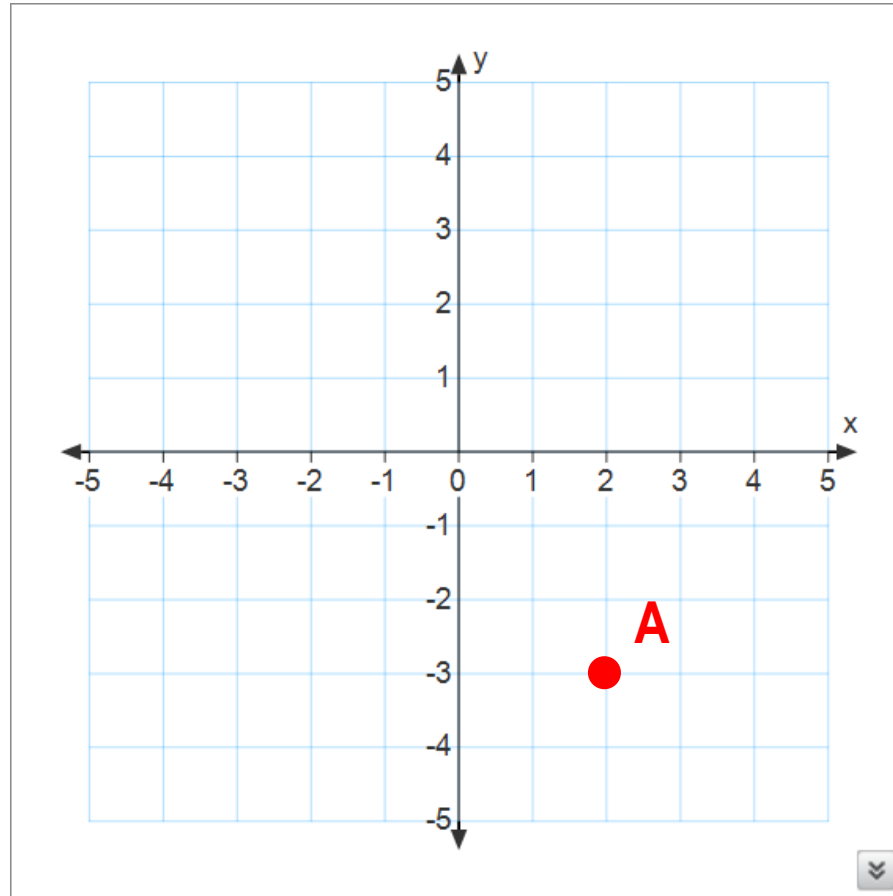
D IV

**Answer**



22 Point A is located at  $(-3, 2)$

True  
False

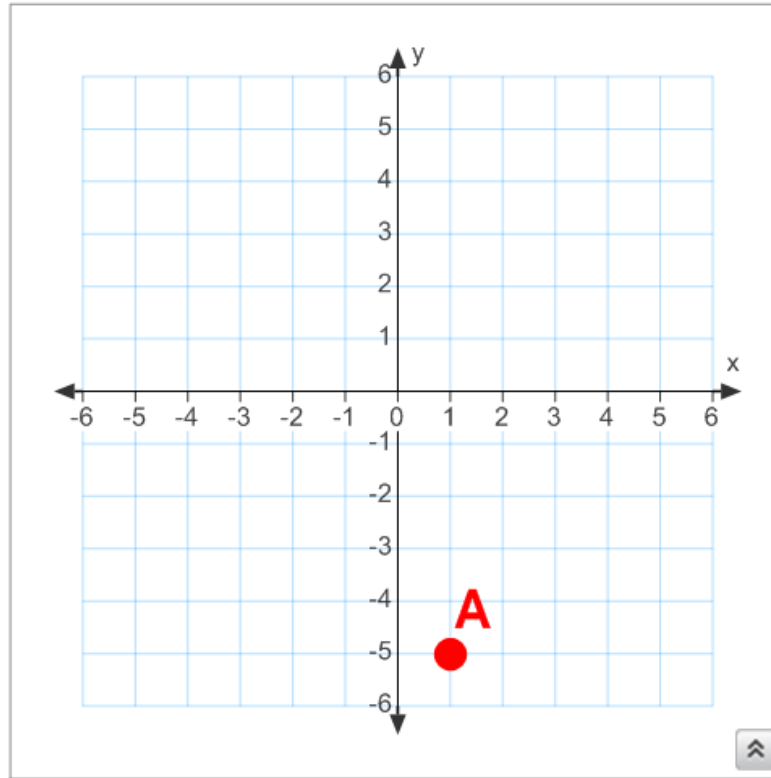


Answer

23 Point A is located at  $(-5, 1)$

True

False

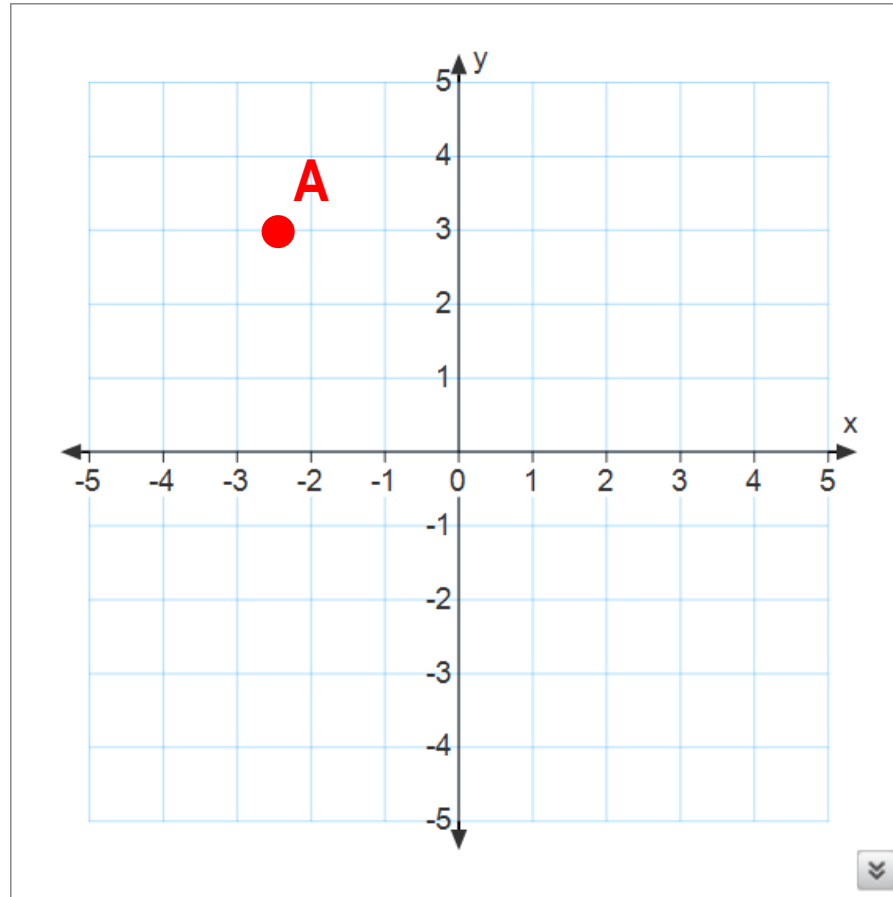


**Answer**

24 Point A is located at  $(-2.5, 3)$

True

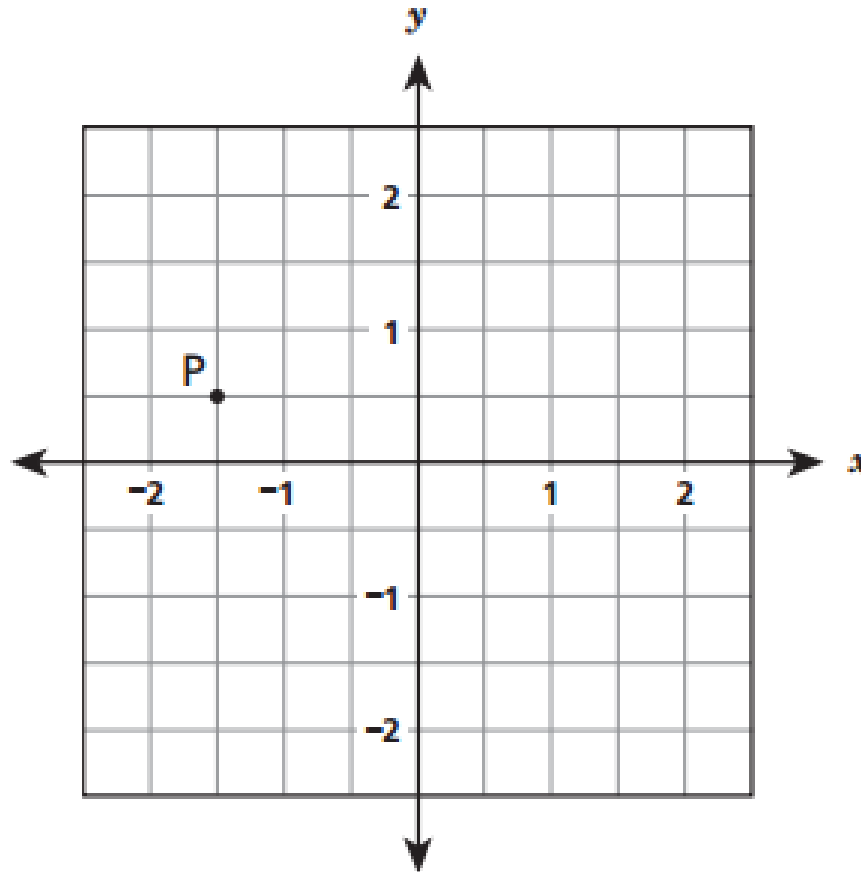
False



Answer

25 What is the x-coordinate of Point P on the coordinate grid?

- A  $-1\frac{1}{2}$
- B  $-\frac{1}{2}$
- C  $\frac{1}{2}$
- D  $1\frac{1}{2}$



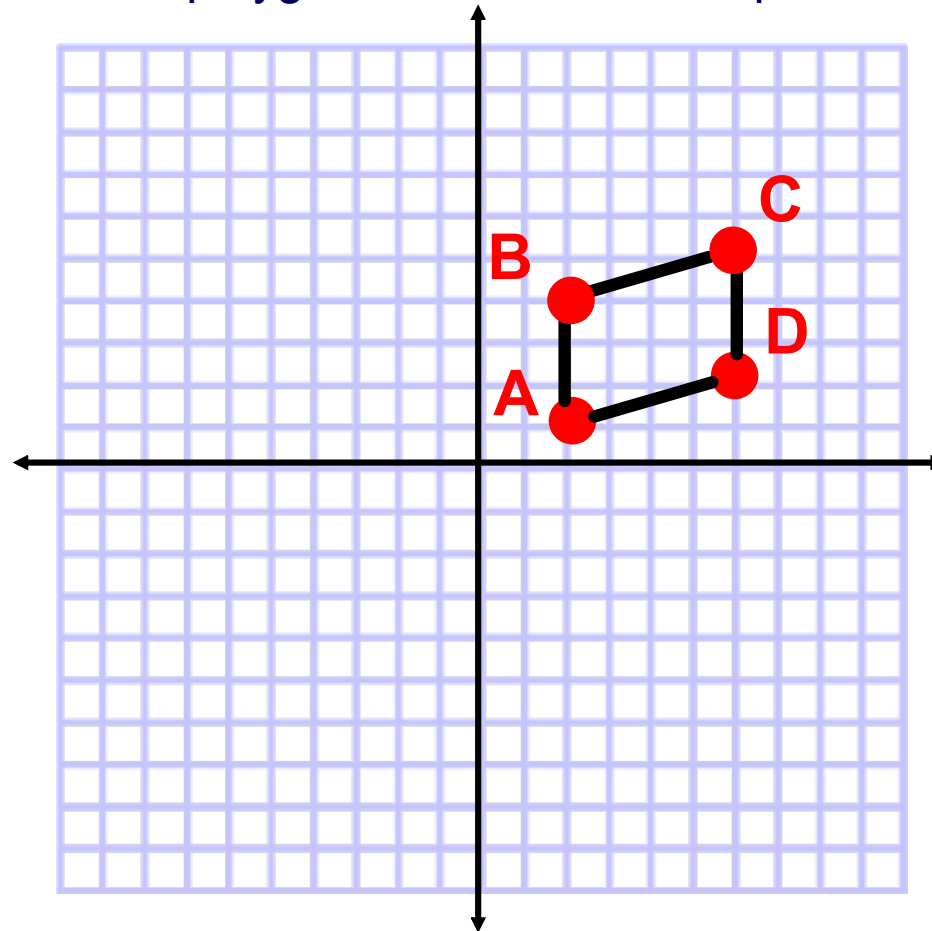
**Answer**

# **Polygons in the Coordinate Plane**

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# Polygons

We can use coordinates as **vertices**, and connect the dots to draw polygons on a coordinate plane.



# Polygons

Point A and point B  
have been plotted.

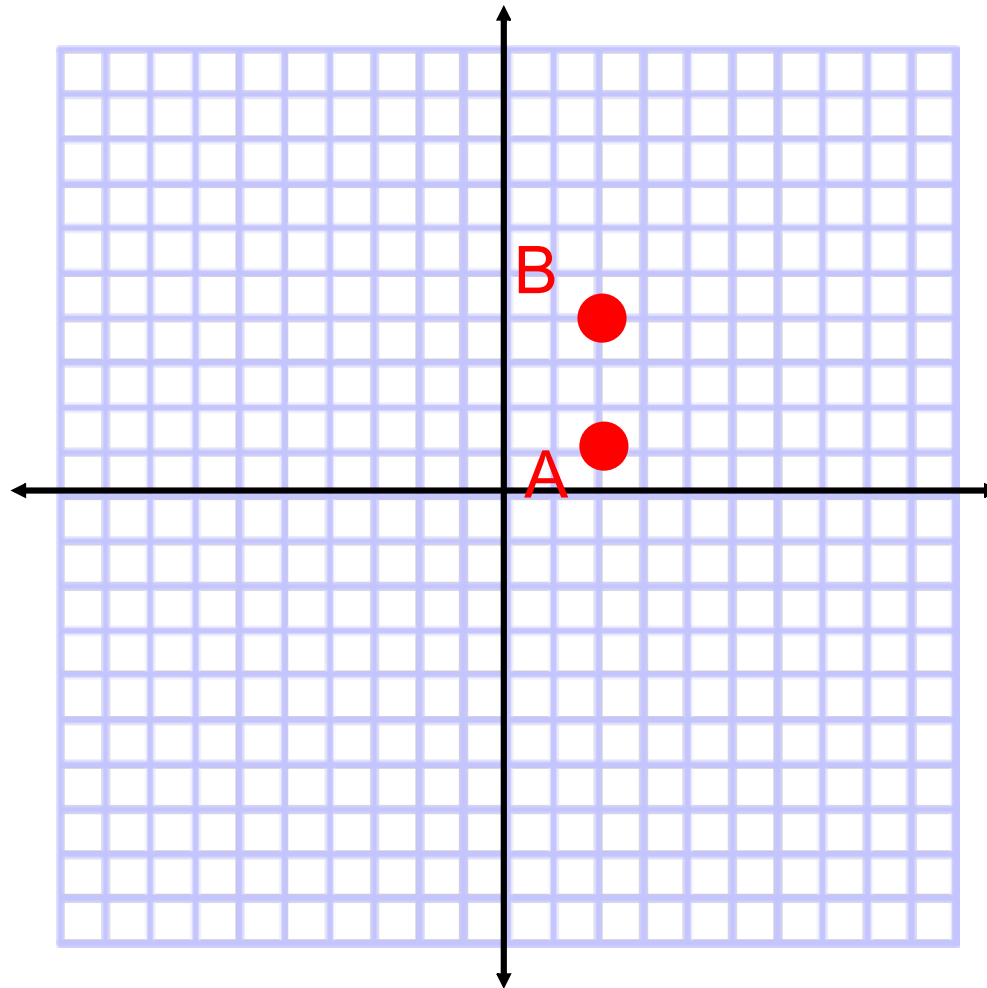
A (2, 1)

B (2, 4)

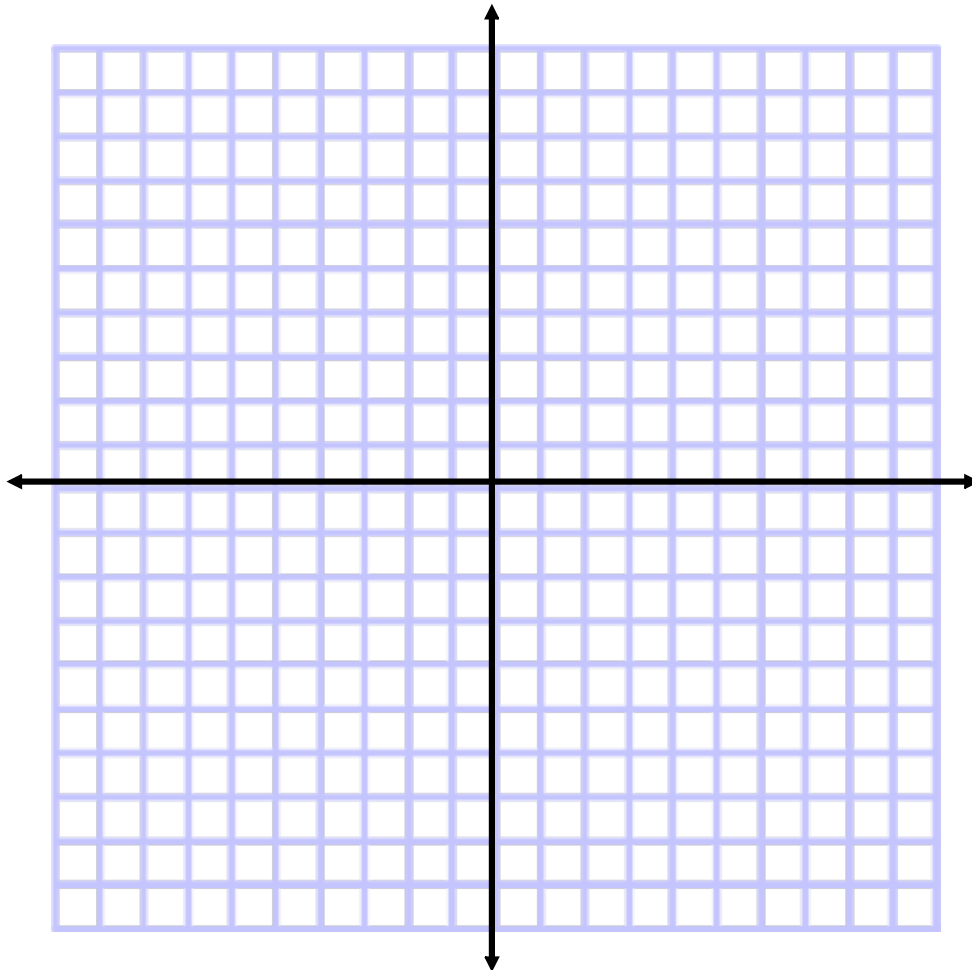
List 4 possible  
coordinates for point C  
that would form a right  
triangle.

Plot point C  
to check.

C 



# Polygons



Plot and label the following points:

H (4, 3)

I (0, 3)

J (4, 0)

What 4th point would form rectangle HIJK?



(Drag to plot)

Answer



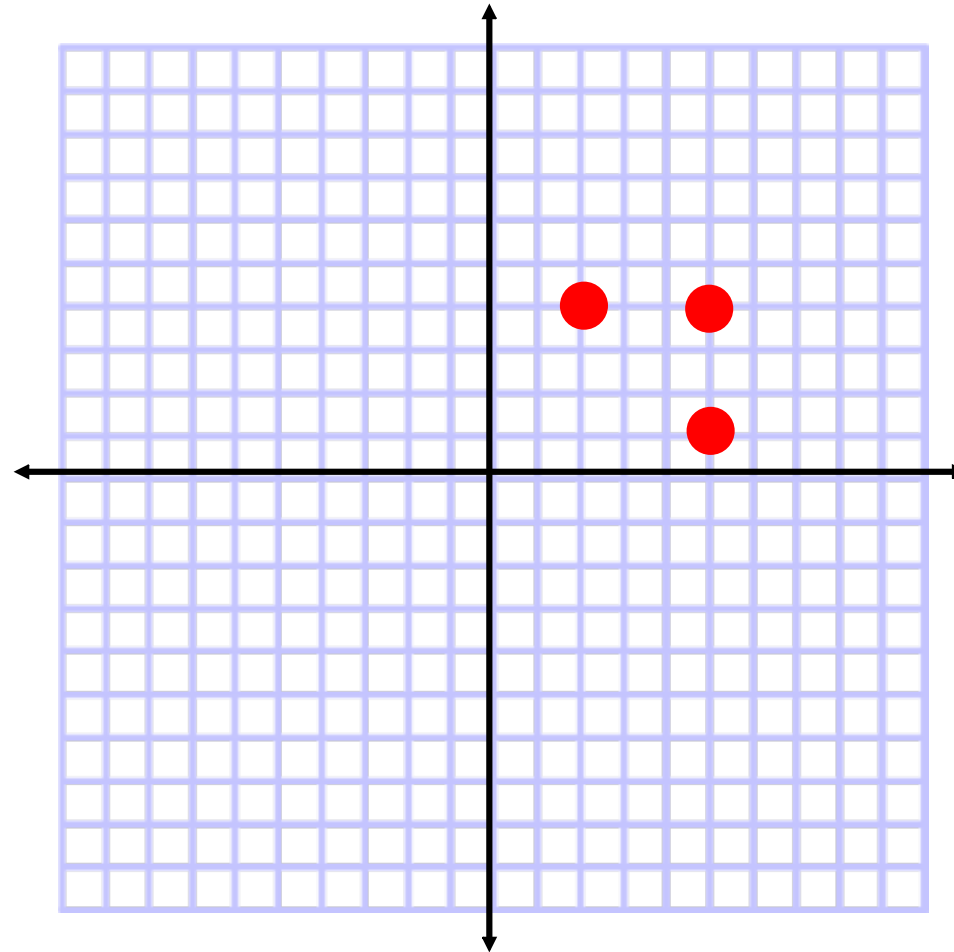
26 Which point will create a square?

A (3, 2)

B (5, 1)

C (2, 1)

D (1, 2)



Answer

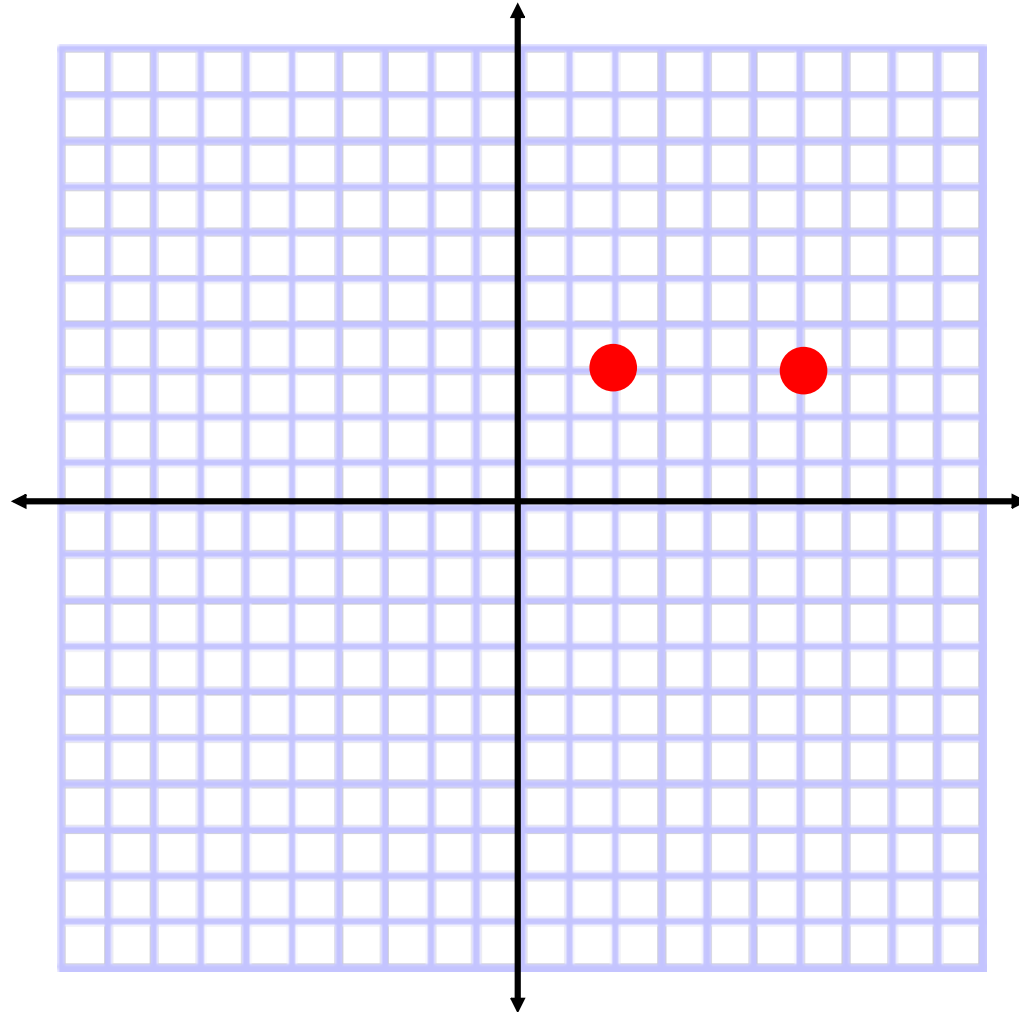
27 Which point will create a right triangle?

A (1, 4)

B (4, 1)

C (3, 4)

D (2, 1)



Answer

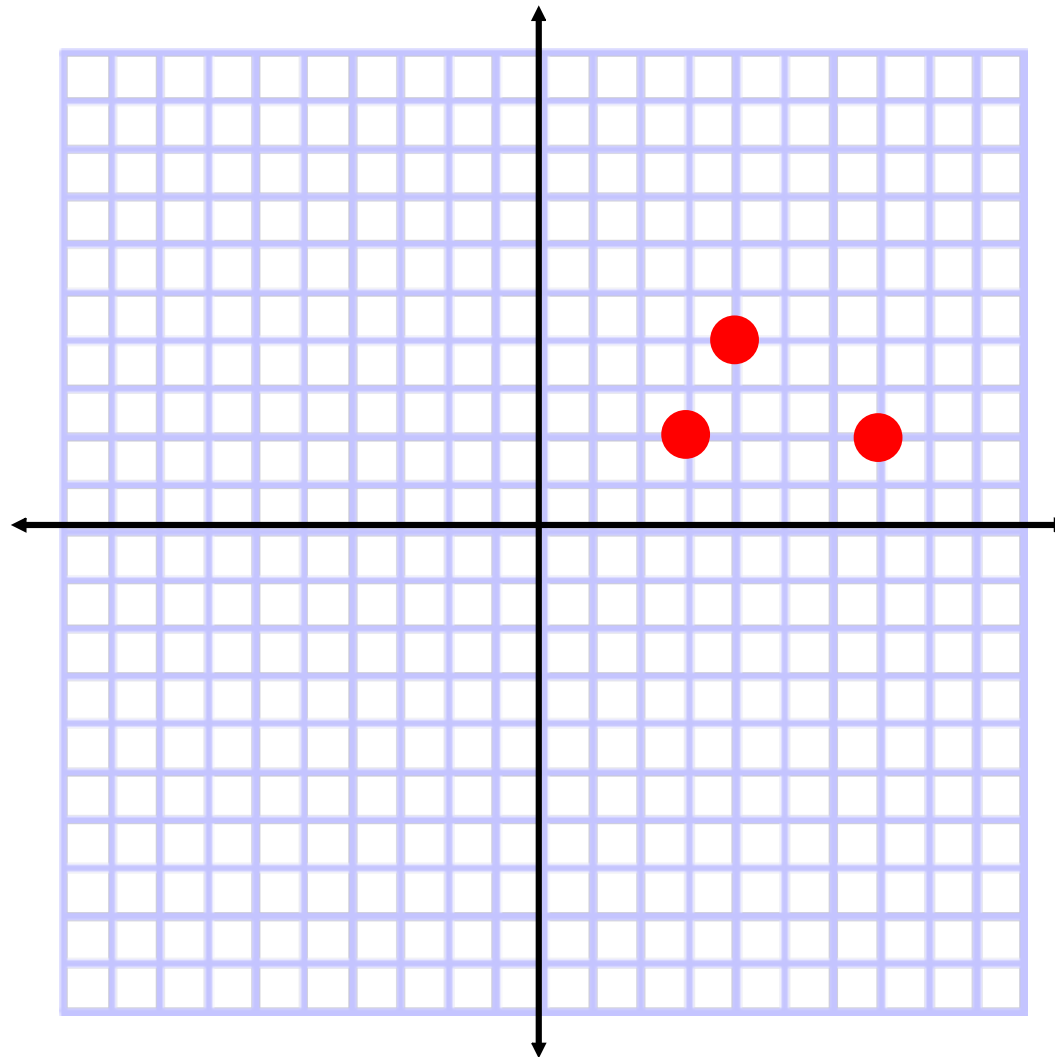
28 Which point will create a parallelogram?

A (4, 8)

B (8, 4)

C (9, 5)

D (7, 4)



Answer

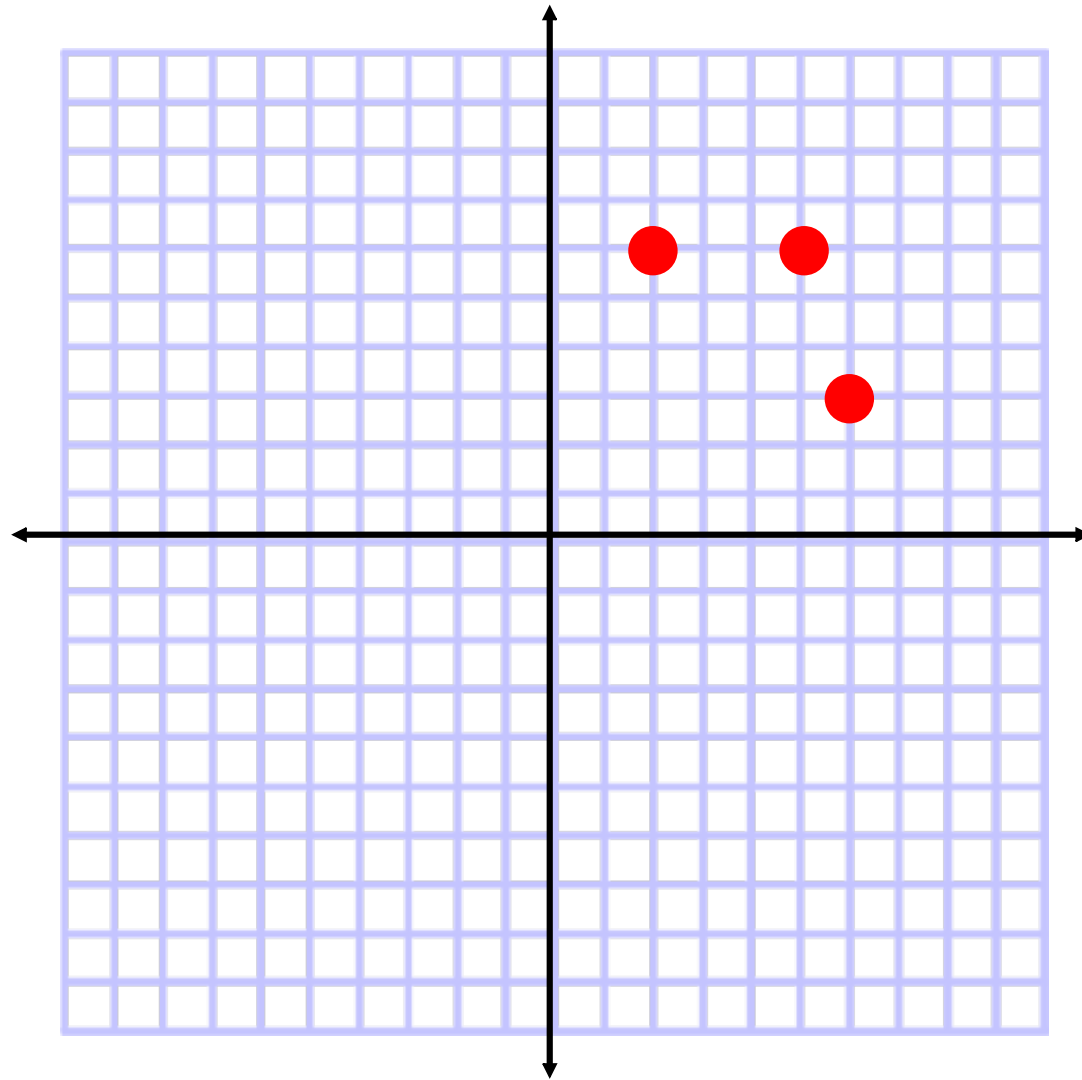
29 Which point will create a trapezoid?

A (1, 3)

B (1, 1)

C (3, 3)

D (3, 1)



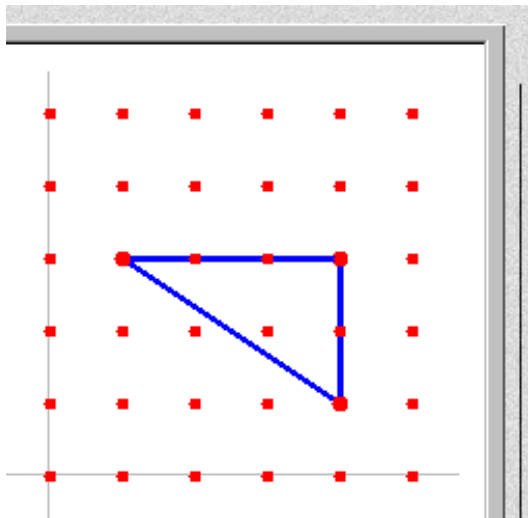
Answer

- 30 Three vertices of rectangle PQRS are  $P(3, 2)$ ,  $Q(3, -3)$ , and  $R(0, -3)$ . What are the coordinates of vertex S?
- A  $(2, 0)$
  - B  $(-2, 0)$
  - C  $(0, 2)$
  - D  $(-3, 0)$

**Answer**

# Coordinate Grid Geoboards Activity

- Work in partners.
- One partner creates a polygon on the geoboard and writes down the vertices.
- Other partner plots the points, and connects them with line segments.
- Compare the polygons, then switch roles.



This example, the vertices are:

(1, 3)

(4, 1)

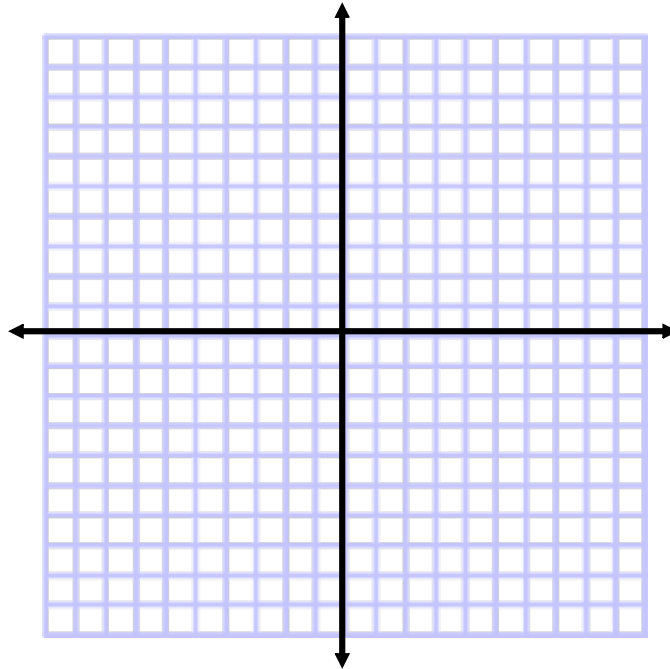
(4, 3)

[Click above to practice using the National Library of Virtual Manipulatives web site.](#)

# Length of Each Side

Plot the following points and connect them in the order given. Use the coordinates to find the length of each side.

A (4, 2) B (-2, 2) C (-2, -2) D (4, -2)

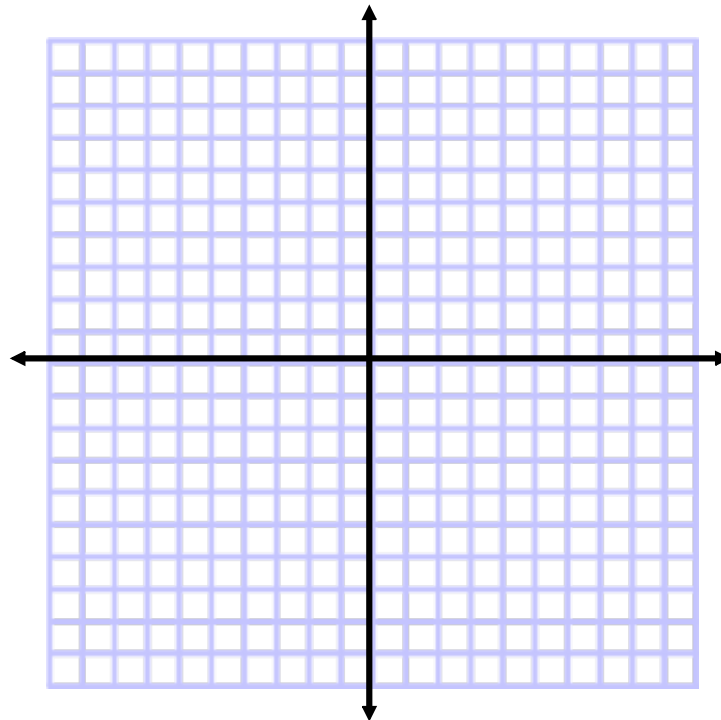


Answer

# Length of Each Side

Plot the following points and connect them in the order given.  
Use the coordinates to find the length of side  $\overline{CD}$ .

A (6, 8) B (-3, 8) C (-3, -1) D (6, -1)

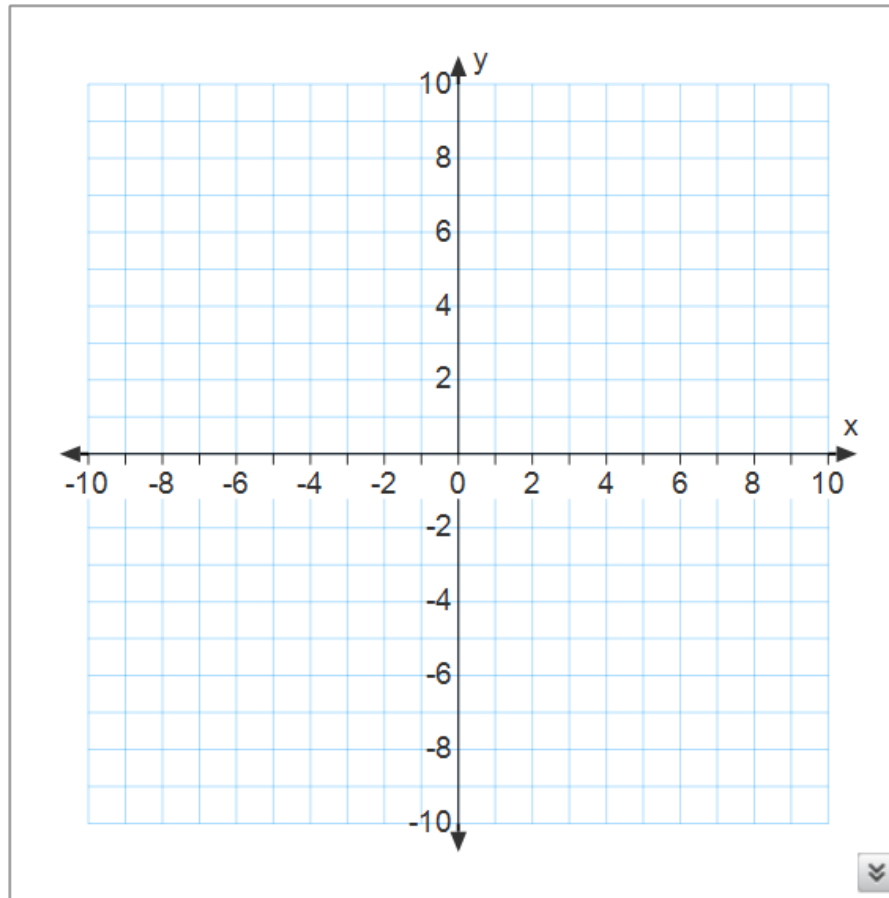


Answer



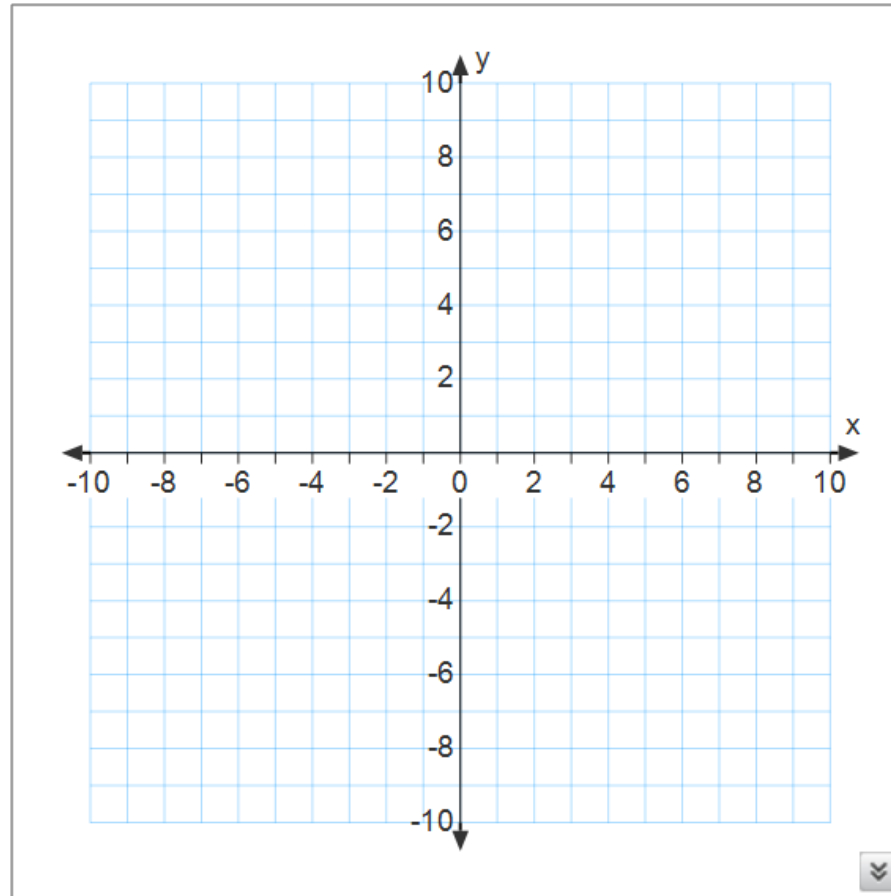
31 Plot the following points and connect them in the order given. What is the length of  $\overline{AD}$ ?

A (-1, -2) B (-5, -2) C(-2, -4) D(-1, -4)



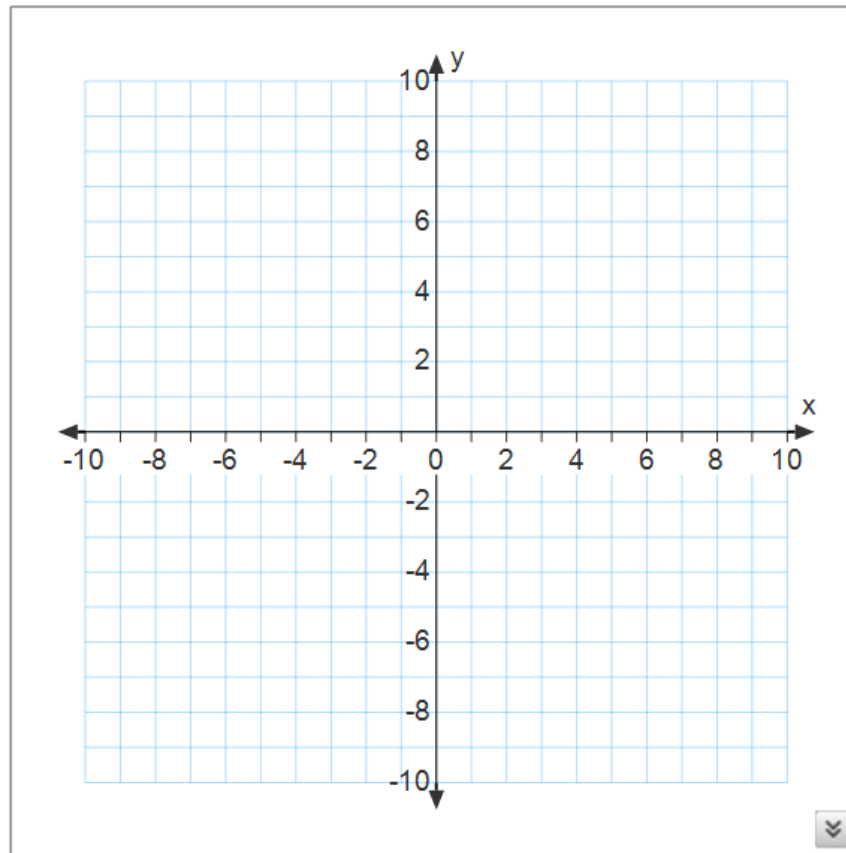
**Answer**

32 Plot and connect the following points:  $M(1,2)$ ,  $A(-1,2)$ ,  $T(1,4)$ ,  $H(-1,4)$ . What is the length of  $\overline{CD}$  ?



**Answer**

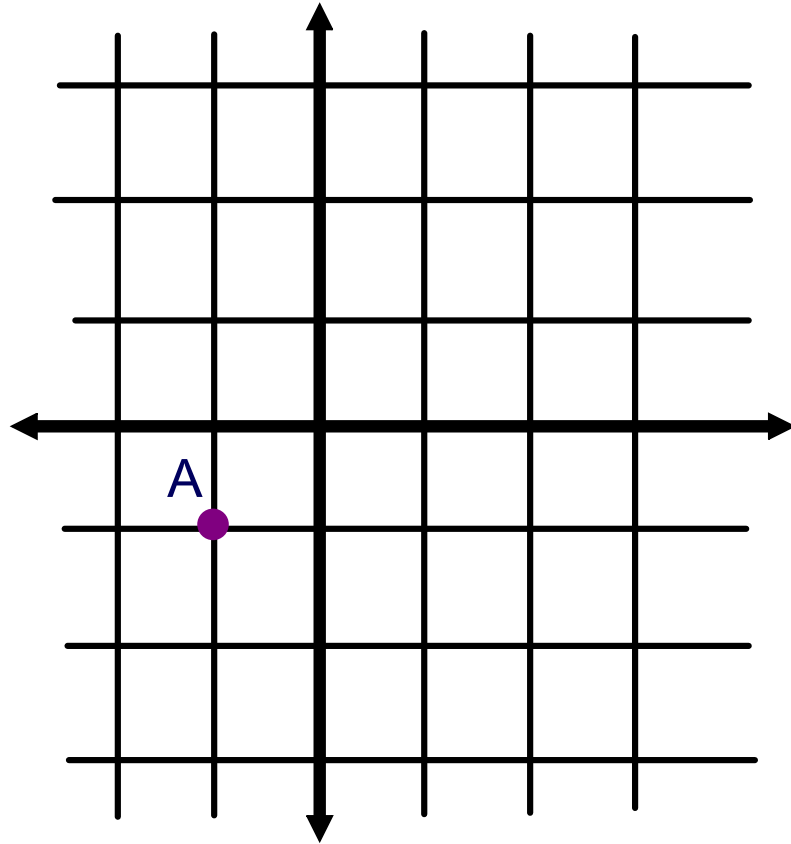
- 33 Plot and connect the following points:  $A(-2, 2)$ ,  $B(6, 2)$ ,  $C(0, 4)$ . What is the measure of  $\overline{AC}$ ?



**Answer**

# Plotting Points

Help Sarah make a map of her town by plotting the buildings correctly. Her house (point A) is 2 units West and one unit South of the school (point B). Town Hall (point C) is 3 units South of the school. The library (point D) forms parallelogram ABCD.



B



C



D



# Plotting Points

What can be said about the distance between the school and Sarah's house, and the distance between the library and Town Hall?

Justify your answer.

**Answer**

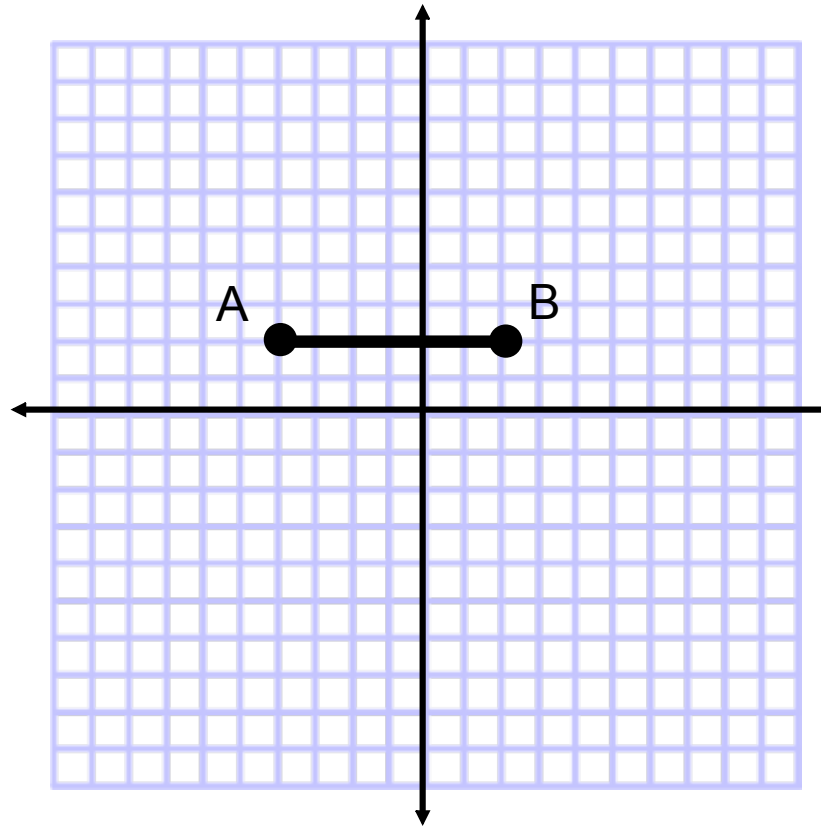
- 34  $\overline{AB}$  is one side of right triangle ABC. In the triangle, angle A is the right angle, and the length of side  $\overline{AC}$  is 5 units. Choose all the possible coordinates for vertex C.

A (-4, 7)

B (2, 7)

C (-4, -3)

D (2, -3)



Answer

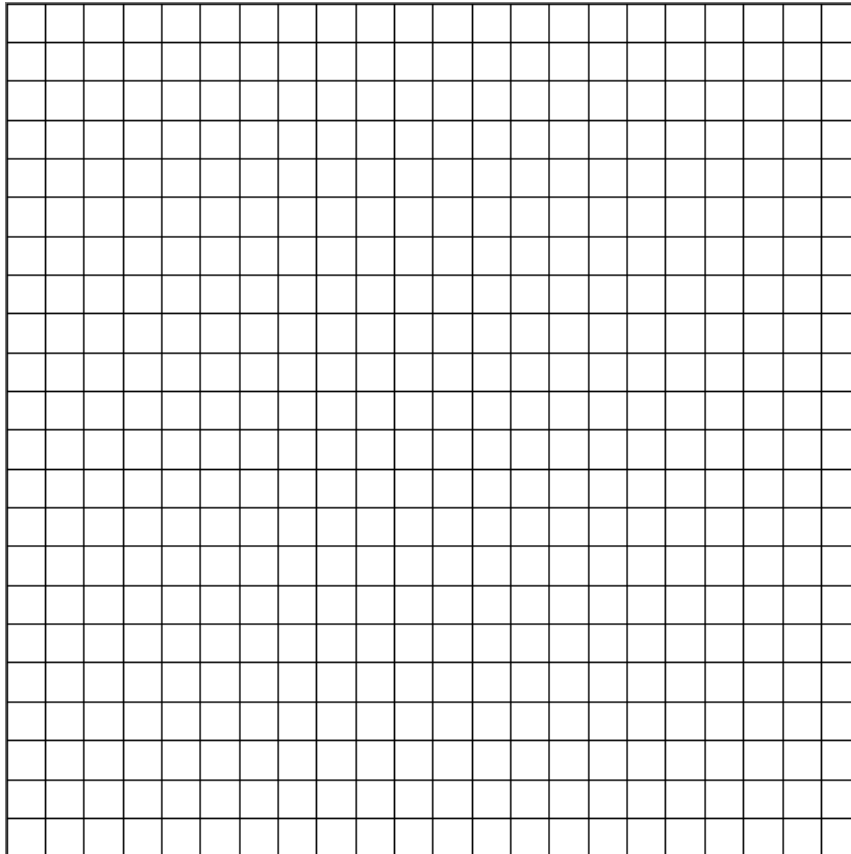
# **Cartesian Plane Applications**

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# Navigation Application

Four friends are touring on motorcycles. They come to an intersection of two roads; the road they are on continues straight, and the other is perpendicular to it. The sign at the intersection shows the distances to several towns. Draw the roads and plot the towns on the map.

The sign at the intersection shows the distances to several towns. Draw the roads and plot the towns on the map. Then, use the map to answer the following questions.



**Teacher Notes**

Derived from engage<sup>ny</sup>





# Navigation Solution

Click to Reveal

# Think, Pair, Share

What is the distance between Albertsville and Dewey Falls?

Click to Reveal

.....

.....

Click to reveal answer

**Teacher Notes**

# Think, Pair, Share

What is the distance between Blossville and Cheyenne?

Click to Reveal

Click to reveal answer

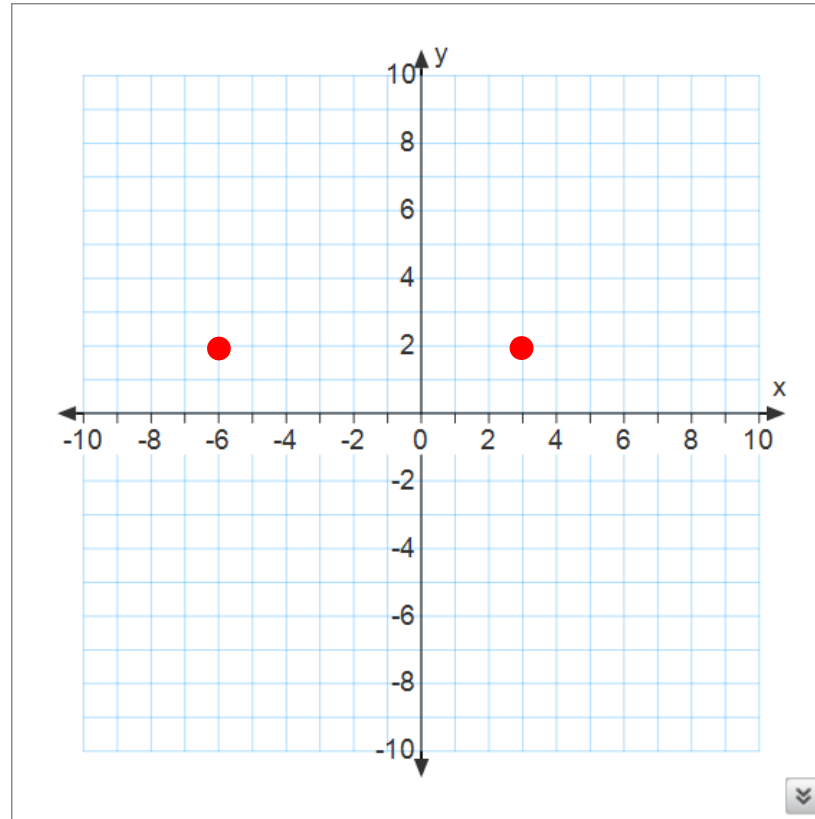
Teacher Notes

# Think, Pair, Share

On the coordinate plane, what represents the intersection of the two roads?

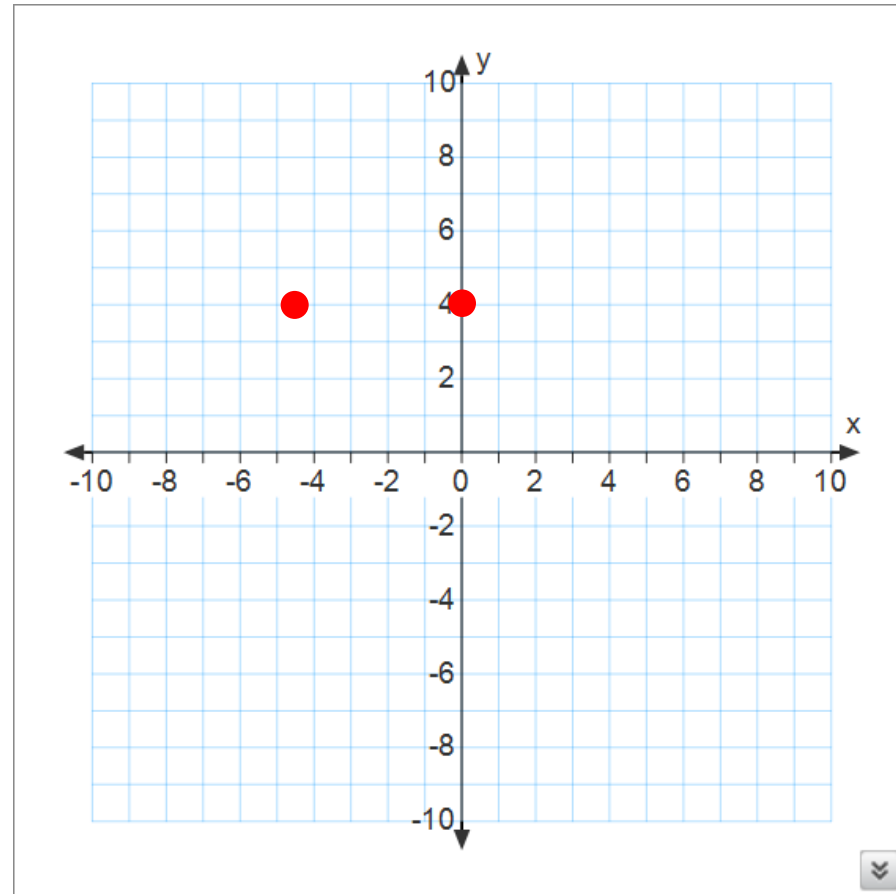
Click to reveal answer

35 The points  $(-6, 2)$  and  $(3, 2)$  are plotted below. What is the distance between these two points?



Teacher Notes

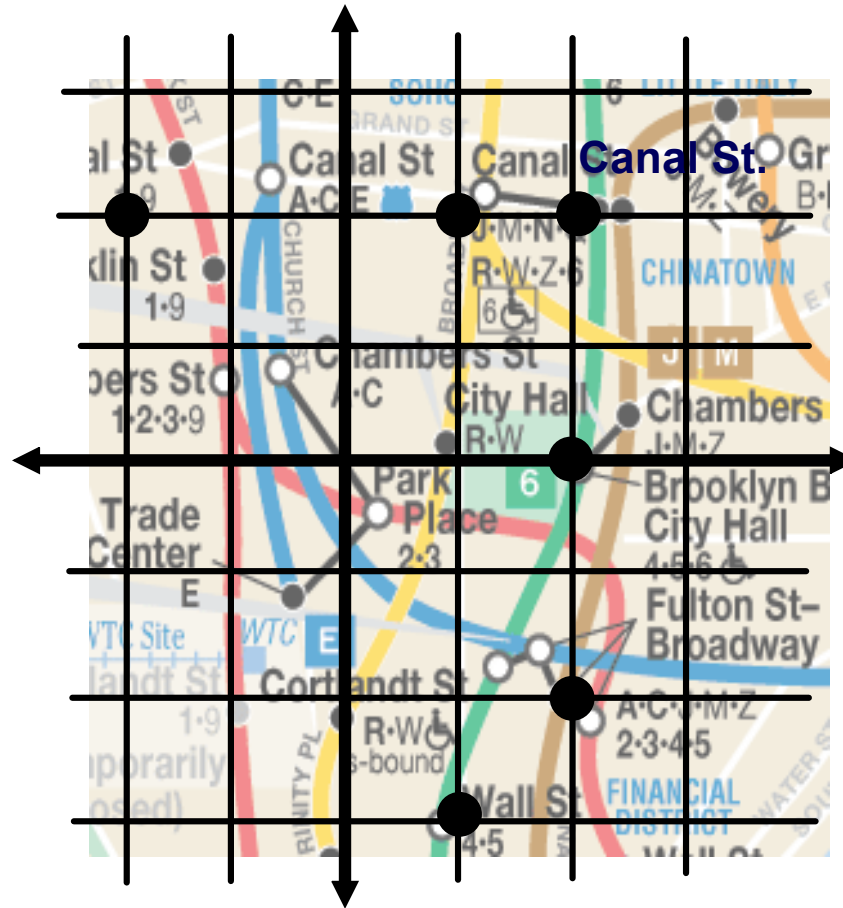
- 36 The points  $(-4.5, 4)$  and  $(0, 4)$  are plotted below. What is the distance between these two points?



**Answer**

37 The Canal St station is related to another station on the map. Its x-coordinate is the same as point mystery station's, but its y-coordinate is the opposite of the mystery station's. What are the coordinates of the mystery station?

- A (0, 2)
- B (-2, 2)
- C (1, -3)
- D (2, -2)

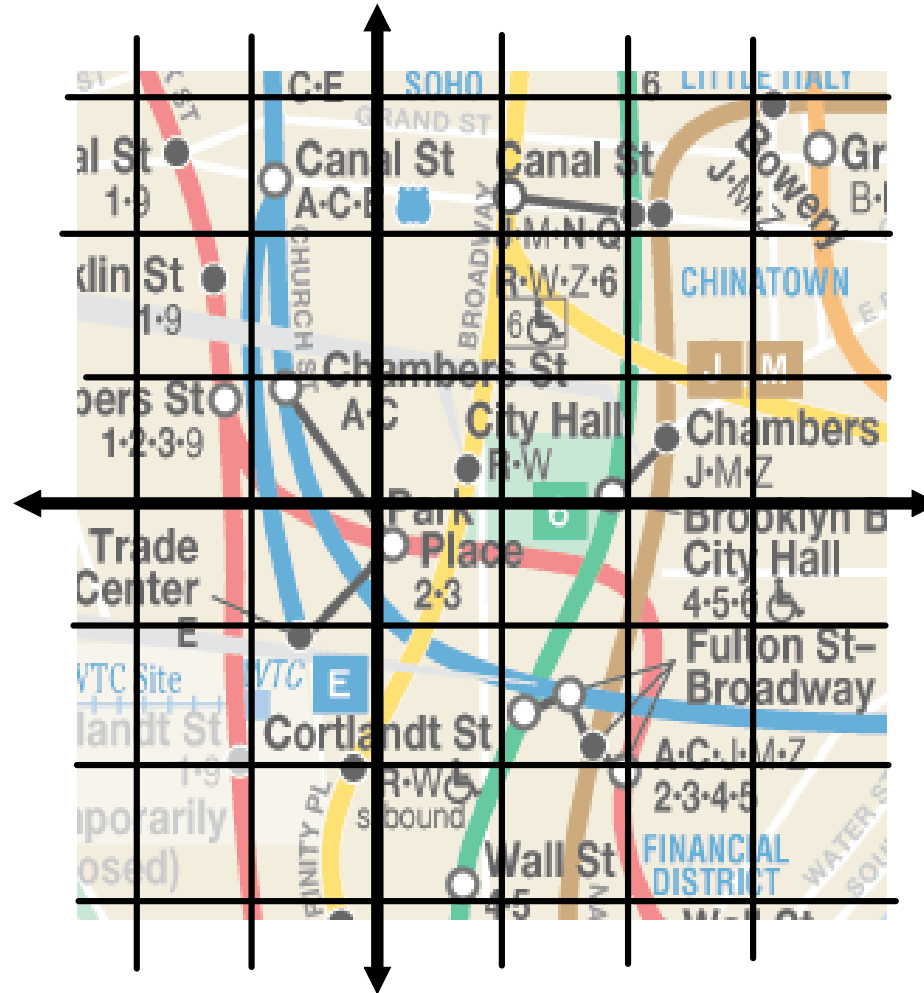


Answer

# Navigation Application

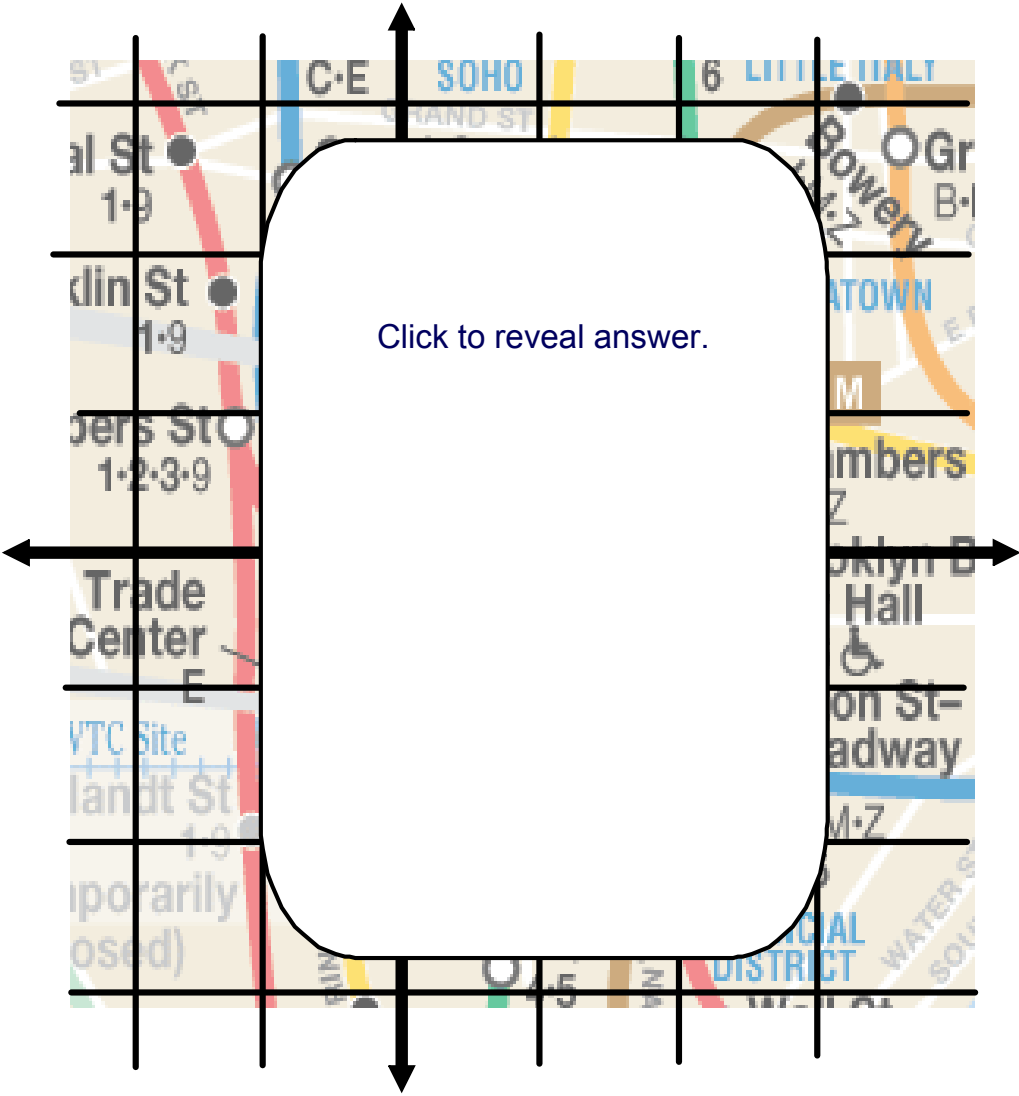
Find and plot the point at the following subway stops.

- Canal St  
(2, 2)
- Fulton St.-Broadway  
(2, -2)
- World Trade Center  
(-1/2, -1)





# Navigation Solution

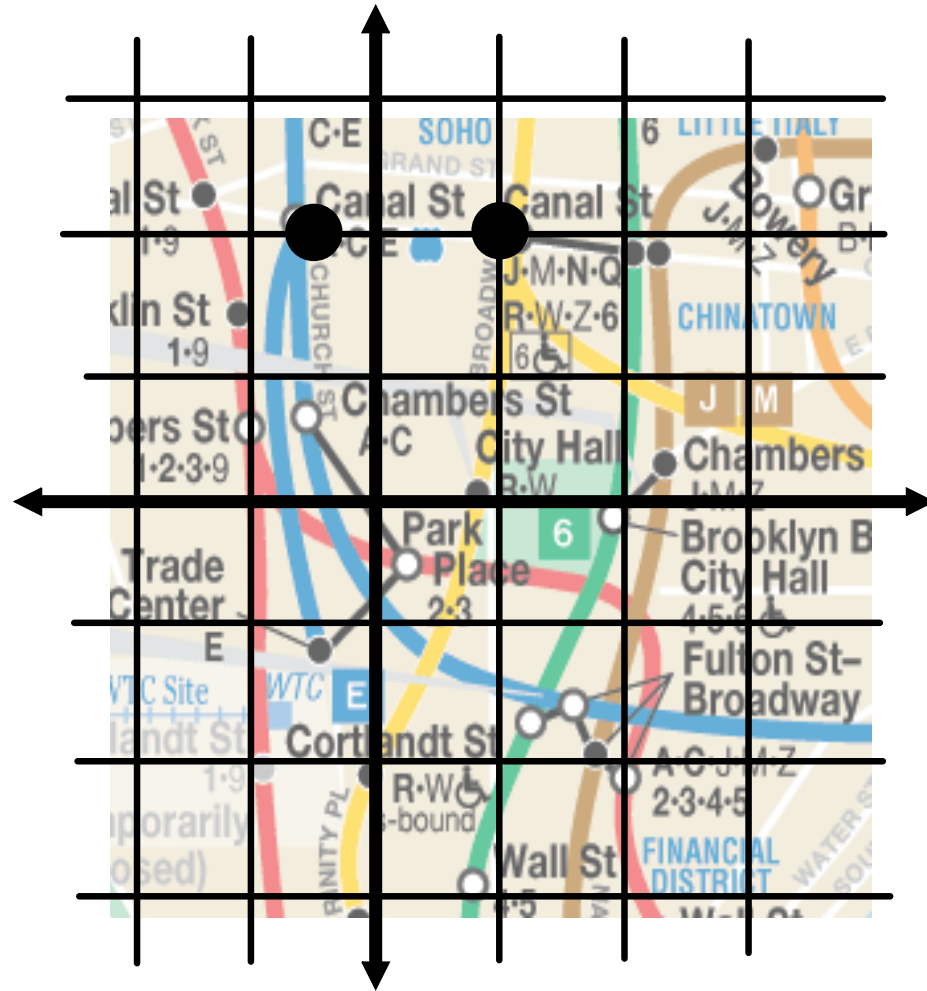


# Navigation Application

If each unit equals .5 miles, calculate the distance between the Canal St. and the Fulton St. Broadway stop.



- 38 Each unit of the coordinate plane represents  $\frac{1}{4}$  mile.  
About how far is the intersection of Canal St and Church Street from the intersection of Canal St and Broadway?



Answer

# Distance

Study the table below. What pattern do you see between the set of points and the distance between them?

Is there a way to find the distance between the two points without graphing them first on a coordinate plane?

Points	Distance
$(-6, 2)$ $(3, 2)$	9
$(-5, 4)$ $(1, 4)$	6
$(-2, 6)$ $(-2, -4)$	10
$(-5, 7)$ $(-5, 3)$	4
$(3, -3)$ $(8, -3)$	5

# Distance

If two points have either the same x- or y-coordinate, the distance between them can be as follows:

If the different coordinates are either both positive or both negative, subtract their absolute values.

If the different coordinates are opposite signs, add their absolute values.

Let's look at the table again to see how this works:

Points	Distance
$(-6, 2)$ $(3, 2)$	$ -6  +  3  = 6 + 3 = 9$
$(-5, 4)$ $(1, 4)$	$ -5  +  1  = 5 + 1 = 6$
$(-2, 6)$ $(-2, -4)$	$ 6  +  -4  = 6 + 4 = 10$
$(-5, 7)$ $(-5, 3)$	$ 7 - 3  =  4  = 4$
$(3, -3)$ $(8, -3)$	$ 3 - 8  =  -5  = 5$

39 Find the distance between  $(-8, 4)$  and  $(-8, 9)$ .

**Answer**

40 Find the distance between  $(6, 9)$  and  $(-2, 9)$ .

**Answer**

41 Find the distance between  $(5, -7)$  and  $(5, -2)$ .

**Answer**



42 Given the points  $A(-3, -3)$ ,  $B(2, -3)$ ,  $C(-3, 0)$ ,  $D(2, 0)$ , what is the distance of  $\overline{CD}$ ?

**Answer**

43 Given the points X (-3, -2), Y (0, 2), Z (3, -2), what is the distance of  $\overline{XZ}$  ?

**Answer**

44 Without plotting the points given, find the perimeter of the shape given its coordinates.

S (5, -5) T (1, -5) U (1, 3) V (5, 3)

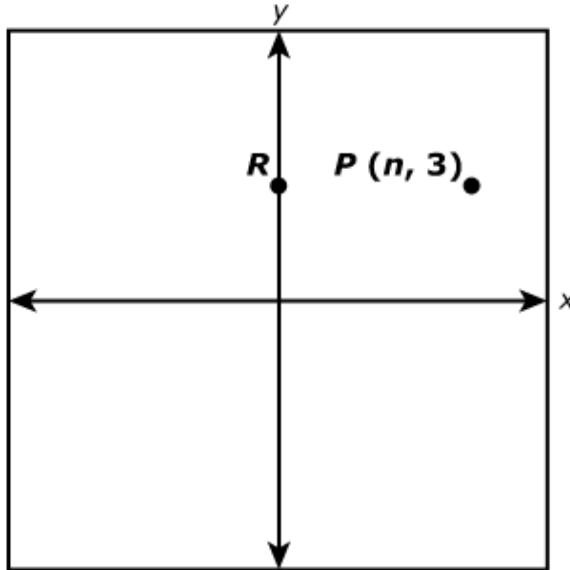
**Answer**

45 Without plotting the points given, find the area of the shape given its coordinates.

L (-1, 1) M (-1, -5) N (4, -5) O (4, 1)

**Answer**

- 46 The graph shows the location of point P and point R. Point R is on the y-axis and has the same coordinate as point P.



Answer

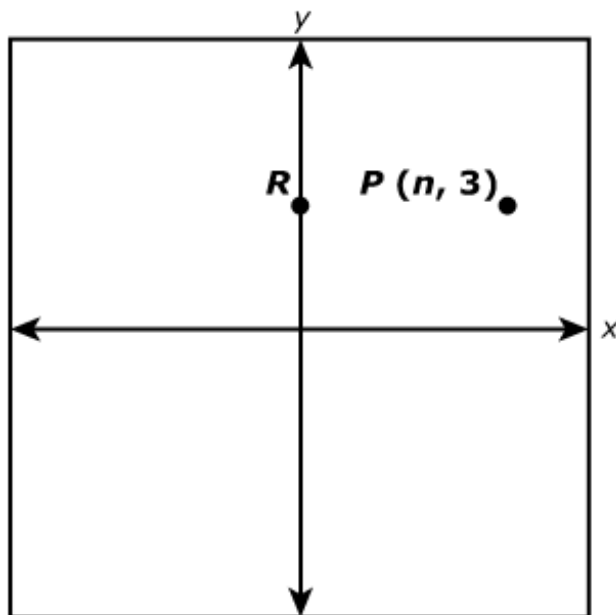
Point Q is graphed at  $(n, -2)$ . The distance from point P to point Q is equal to the distance from point P to point R.

Part A What is the distance from point P to point Q?  
Explain.

From PARCC PBA sample test calculator #6



- 47 The graph shows the location of point P and point R. Point R is on the y-axis and has the same coordinate as point P.



Answer

Point Q is graphed at  $(n, -2)$ . The distance from point P to point Q is equal to the distance from point P to point R.

Part B What is the value of  $n$ ? Explain.

From PARCC PBA sample test calculator #6



- 48 City planners are creating a neighborhood map on a coordinate grid.

**Neighborhood  
Planning**

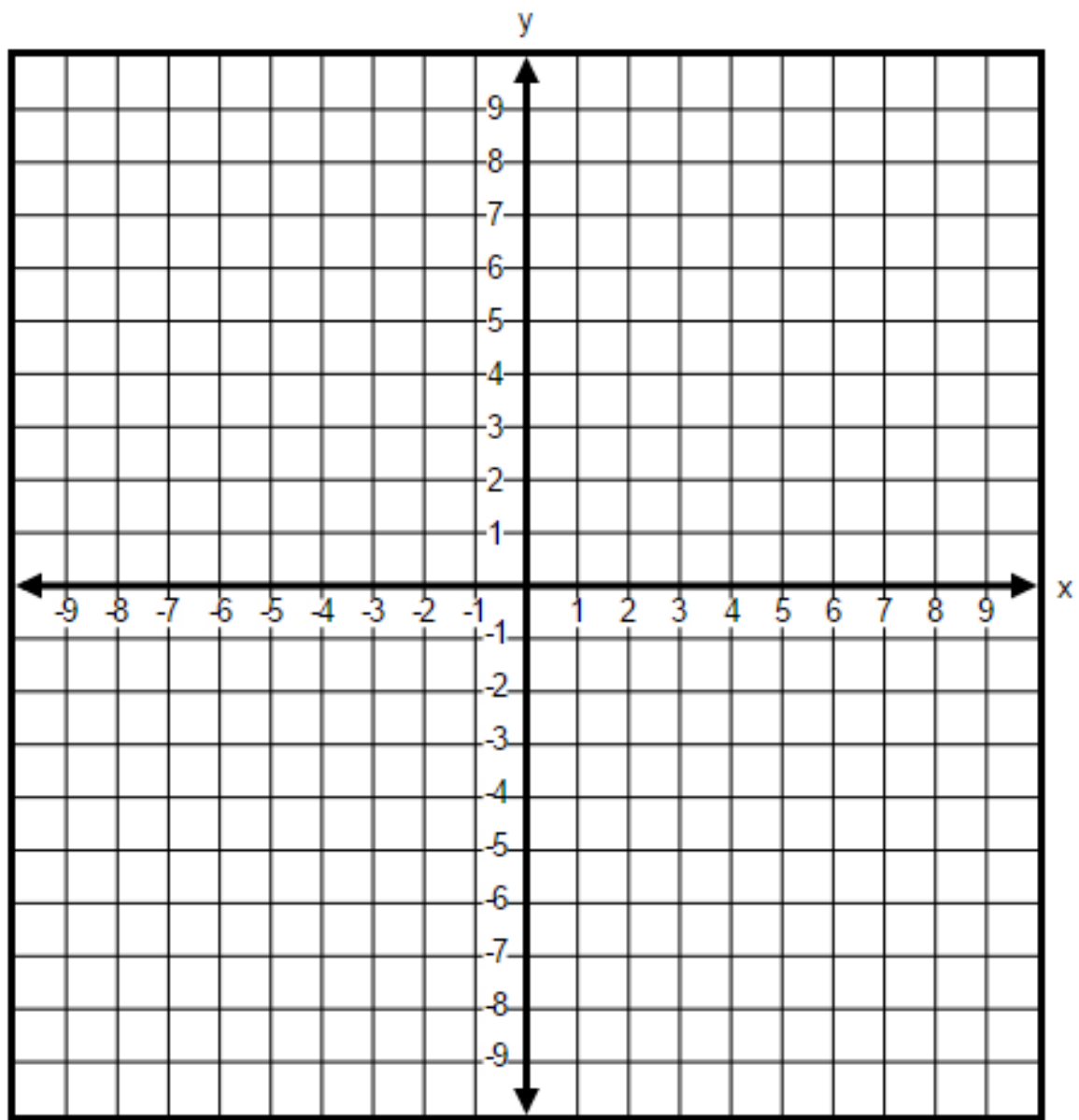
Building	Location
library	$(-4, -6)$
school	$(5, -6)$

Answer

The table shows the locations of the neighborhood library and school on a coordinate grid. In this coordinate grid, the distance between each gridline represents 1 mile. What is the distance, in miles, between the library and the school?

(You can use the coordinate grid on the next page to help you find the answer by plotting two points.)

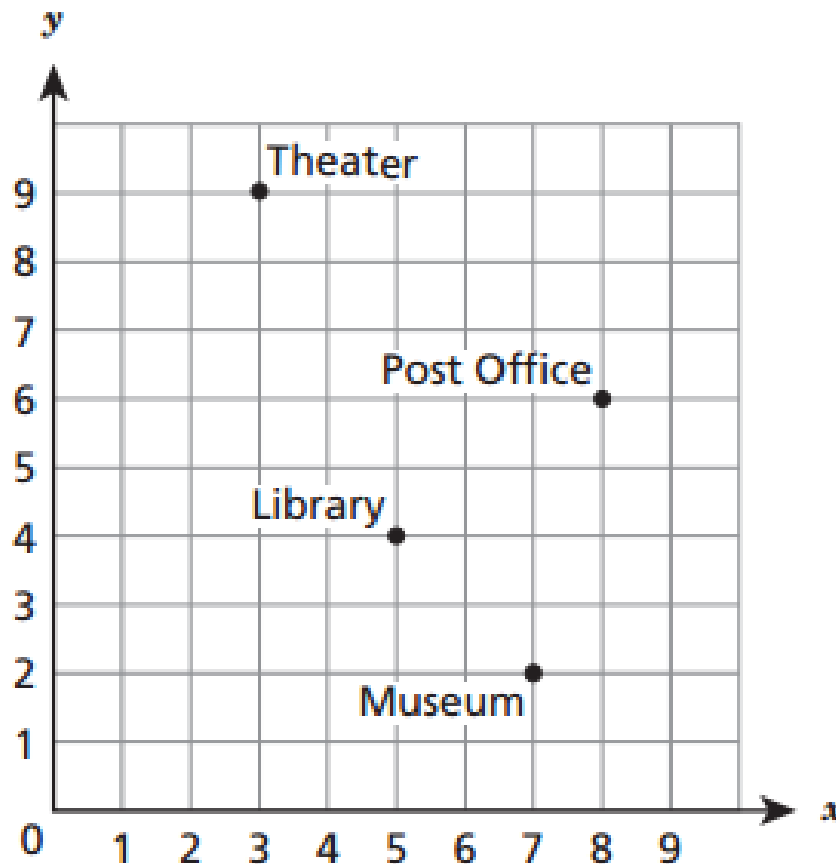






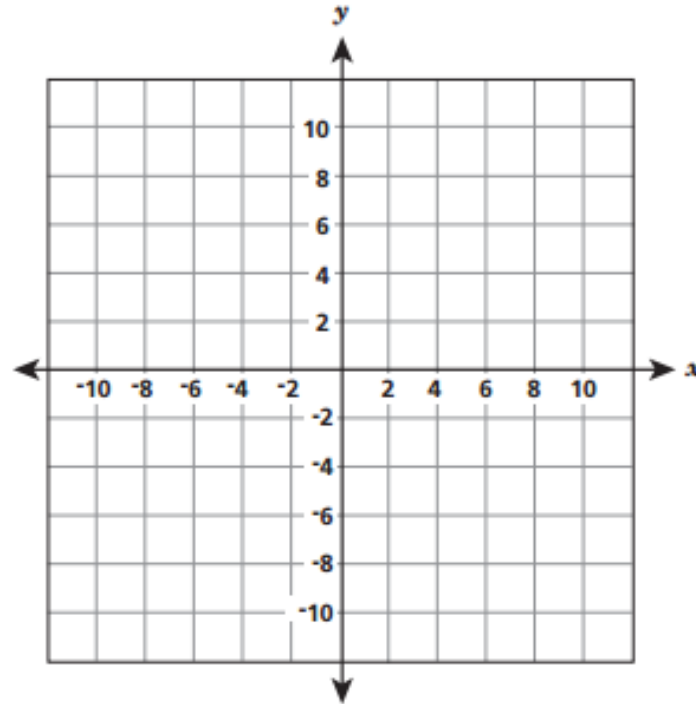
49 The points plotted on the coordinate grid below show different locations in a city. The grid lines represent the city's streets. The city plans to build a parking lot at the location represented by the coordinates  $(8,4)$ . Which building is the shortest driving distance from the parking lot?

- A Theater
- B Library
- C Museum
- D Post Office



Answer

- 50 The endpoints of a line segment can be represented on a coordinate grid by the points  $A(-4,1)$  and  $C(-4,-3)$ . Graph and label each of the endpoints of the line segment on the coordinate grid below.



Answer

What is the distance, in units, between point A and point C?

Answer \_\_\_\_\_ units

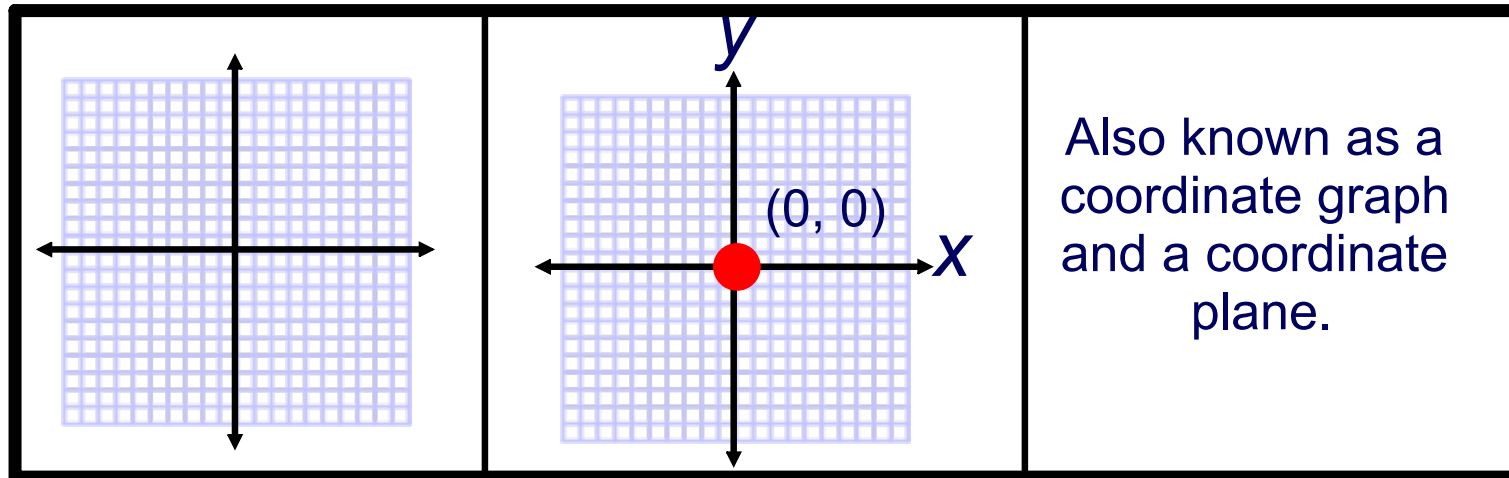
# Glossary & Standards

Teacher Notes

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# Cartesian Plane

The two dimensional plane or flat surface that is created when the x-axis intersects with the y-axis.

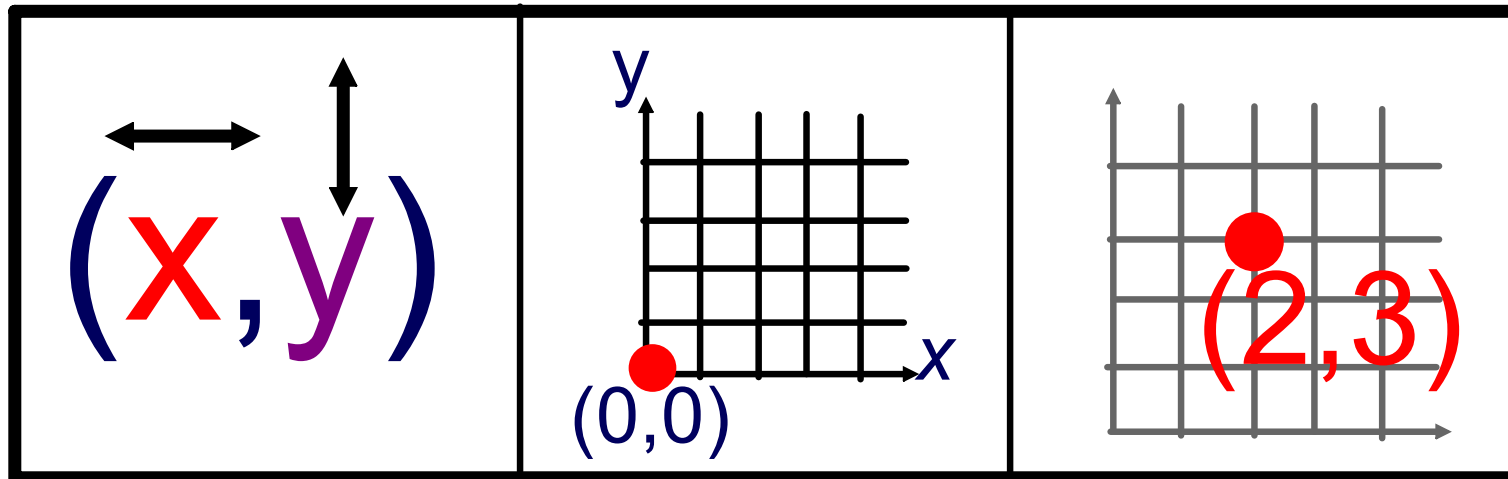


Also known as a coordinate graph and a coordinate plane.

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# Coordinates

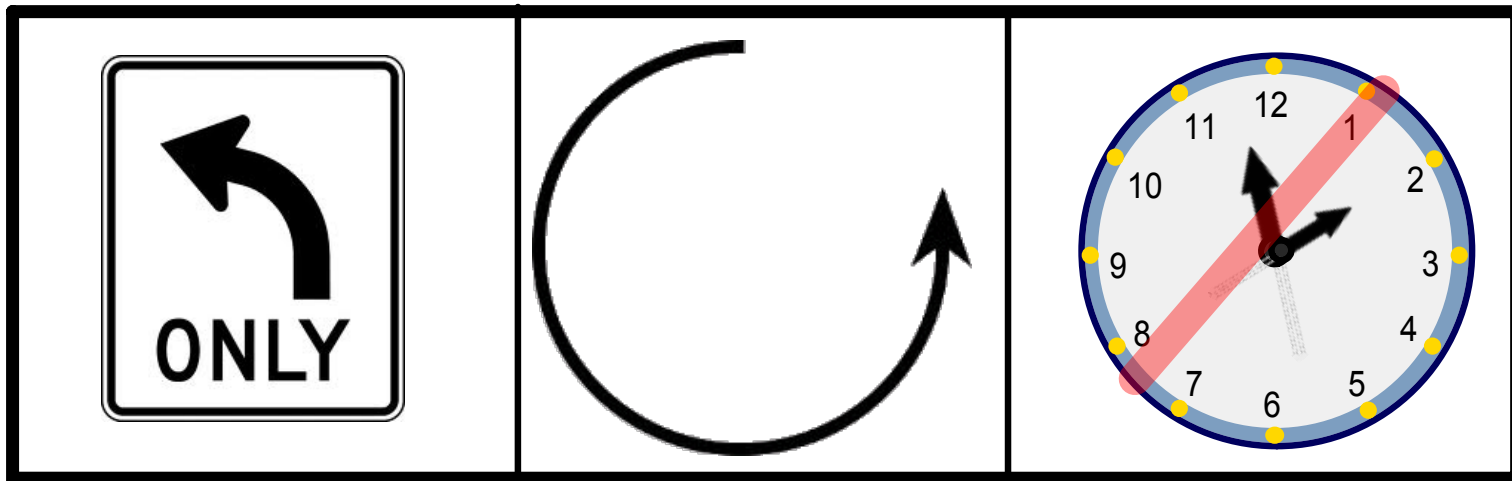
A pair of values that show an exact position on a coordinate plane.



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# Counter-clockwise

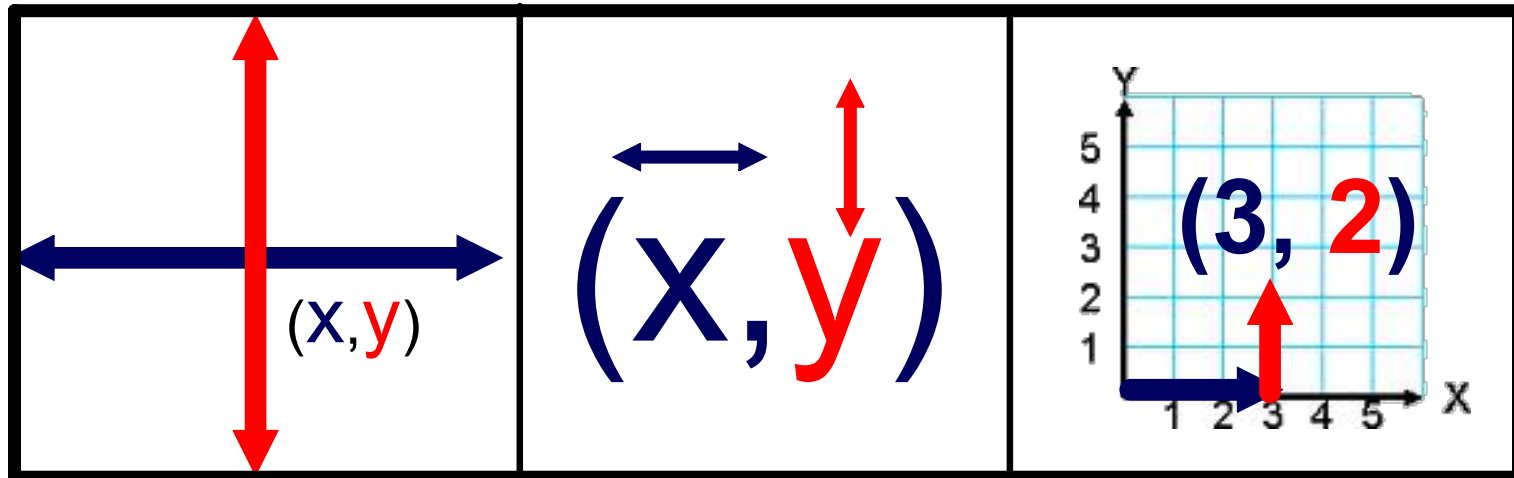
Turning in the opposite direction of the hands on a clock.



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# Ordered Pair

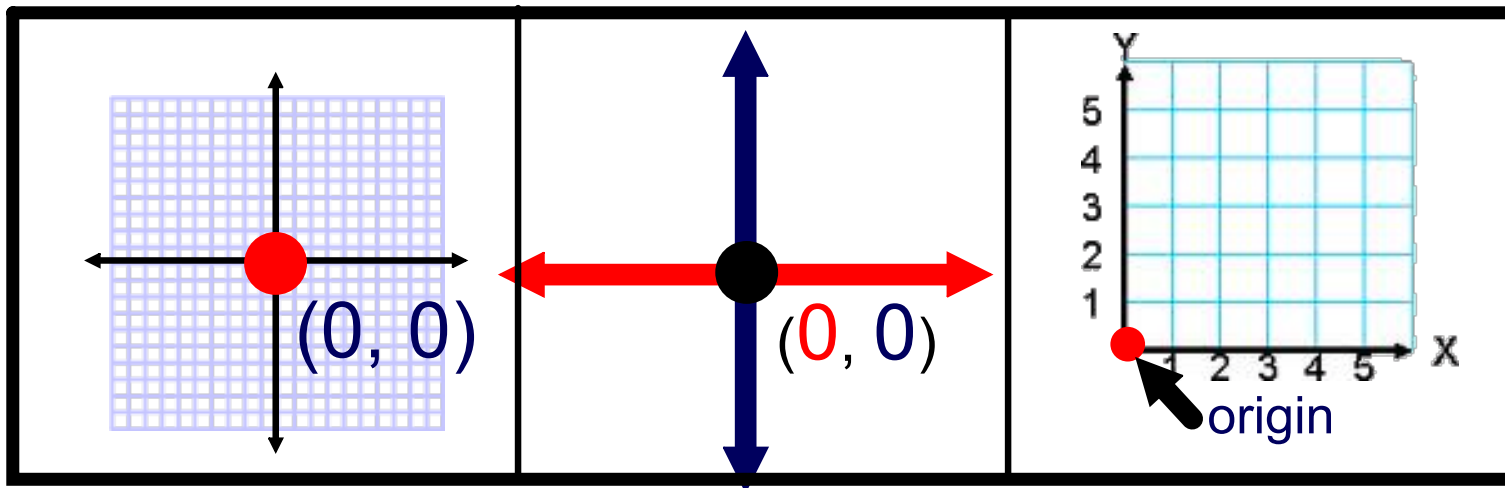
Coordinates on a coordinate graph can also be called an ordered pair.



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# Origin

The point where zero on the x-axis intersects zero on the y-axis. The coordinates of the origin are  $(0, 0)$ .

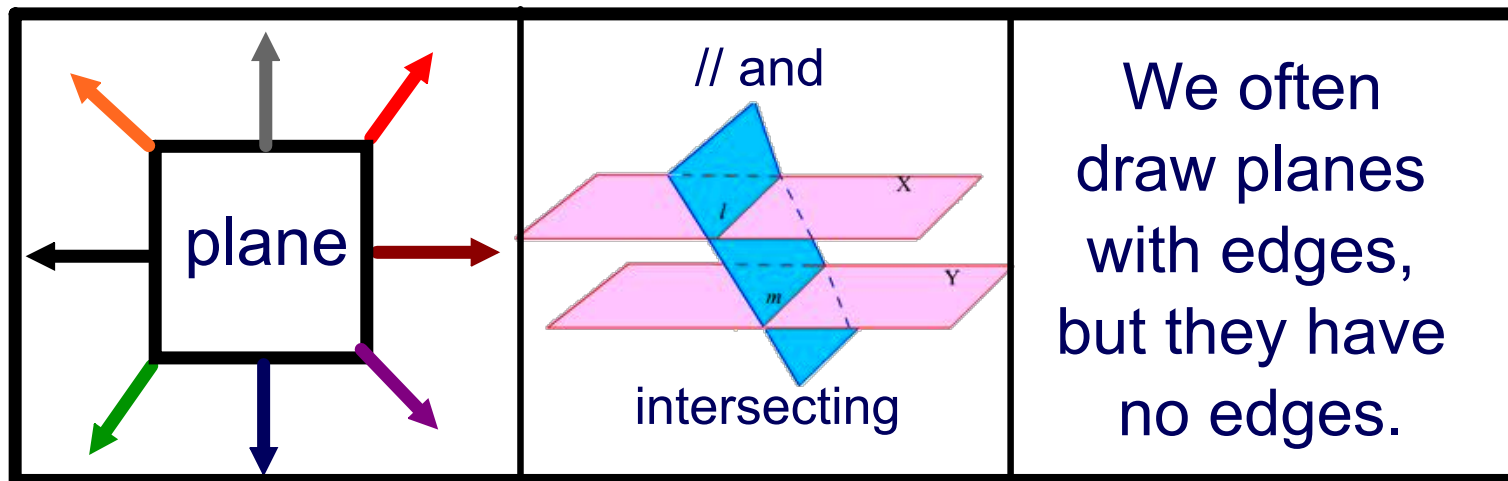


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# Plane

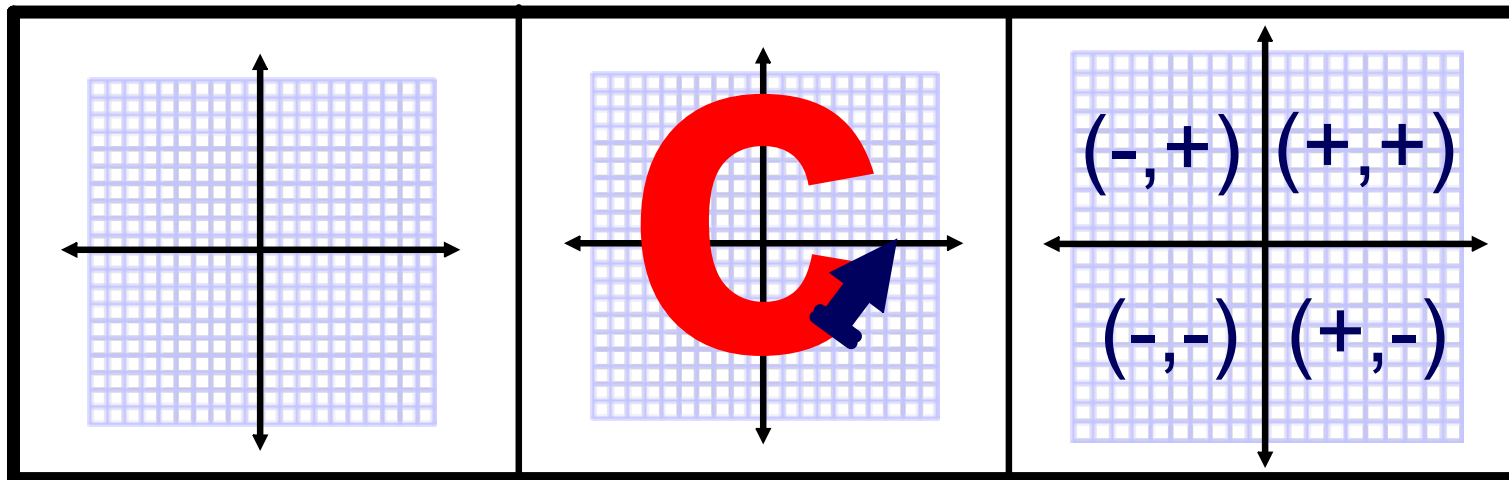
A flat, two-dimensional surface,  
that extends in every direction.



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# Quadrant

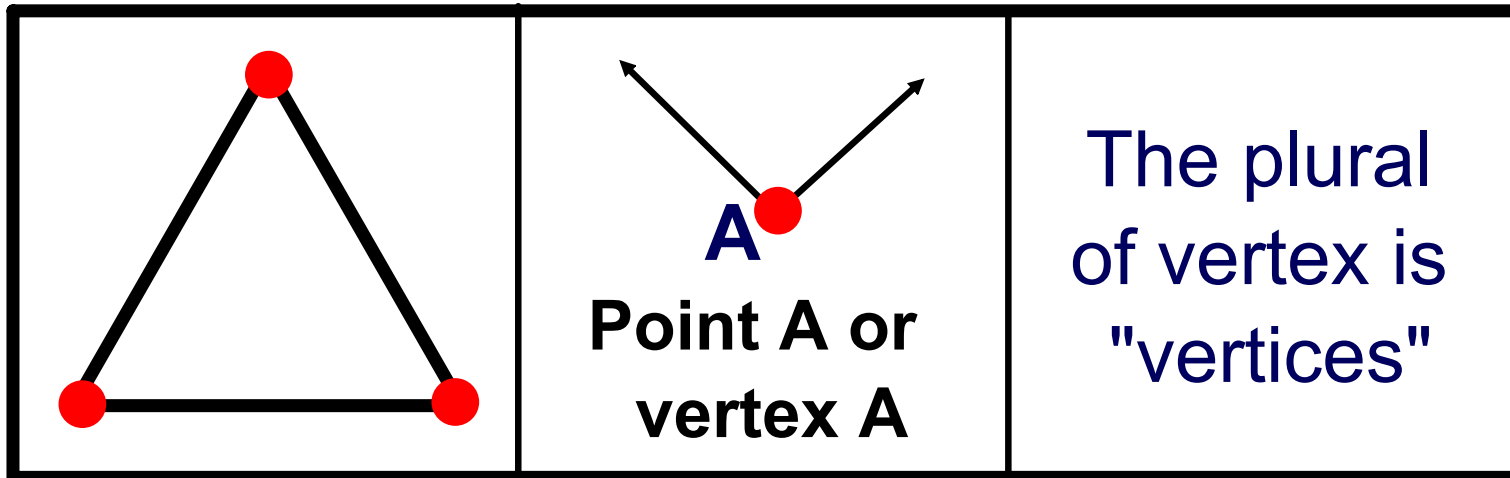
Any of the four regions created when the x-axis intersects the y-axis. They are usually numbered with Roman numerals.



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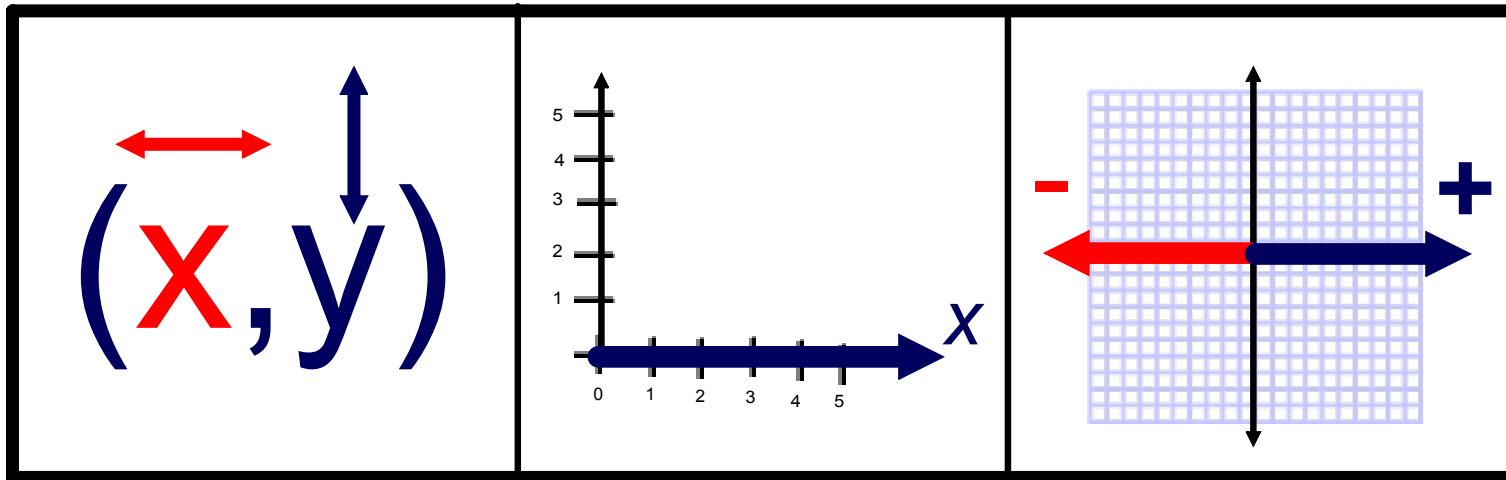
# Vertex

A point where two or more straight lines meet.



# X-axis

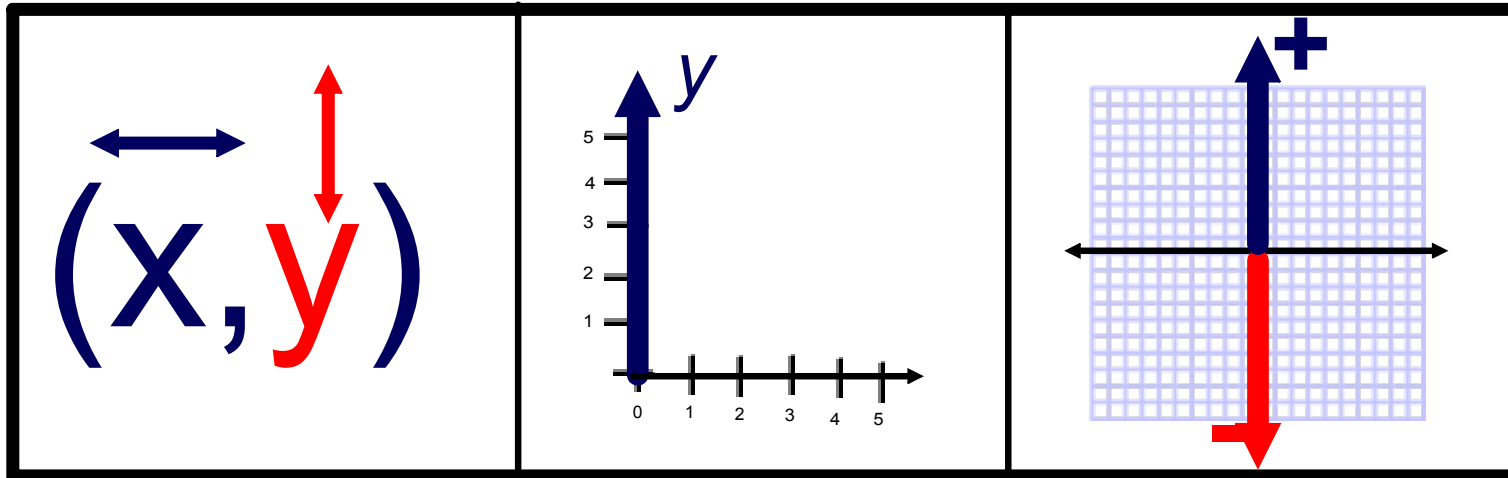
Horizontal number line that extends indefinitely in both directions from zero. (Right- positive Left negative)



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# Y-axis

Vertical number line that extends indefinitely in both directions from zero.  
(Up- positive Down- negative)



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# Standards for Mathematical Practices

Throughout this unit, the Standards for Mathematical Practice are used.

MP1: Making sense of problems & persevere in solving them.

MP2: Reason abstractly & quantitatively.

MP3: Construct viable arguments and critique the reasoning of others.

MP4: Model with mathematics.

MP5: Use appropriate tools strategically.

MP6: Attend to precision.

MP7: Look for & make use of structure.

MP8: Look for & express regularity in repeated reasoning.

Additional questions are included on the slides using the "Math Practice" Pull-tabs (e.g. a blank one is shown to the right on this slide) with a reference to the standards used.

If questions already exist on a slide, then the specific MPs that the questions address are listed in the Pull-tab.