Number Lines and the Coordinate Grid[1]

Fast Track GRASP Math Packet

Part 2

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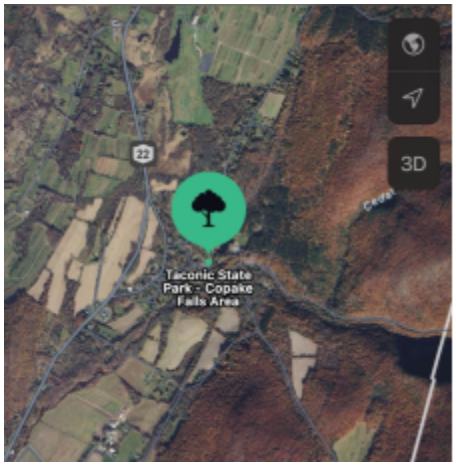
[1] Some of this packet was previously published with the title, Rigid Transformations: Shapes on a Plane, Part 2.

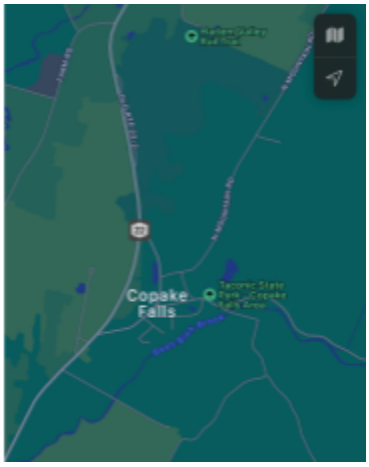
Table of Contents

Introduction to Coordinate Systems

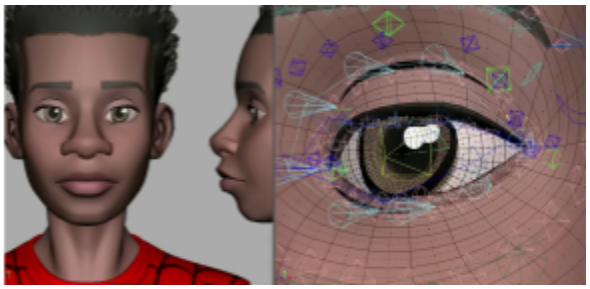
Coordinate systems use one or more numbers to describe the exact location of something. Every coordinate system has one point, known as the origin. Every other point in that coordinate system is defined by its distance from that point.

The Global Position Systems (GPS) that you might use in your car or cellphone use ***coordinates*** to locate any point on Earth.

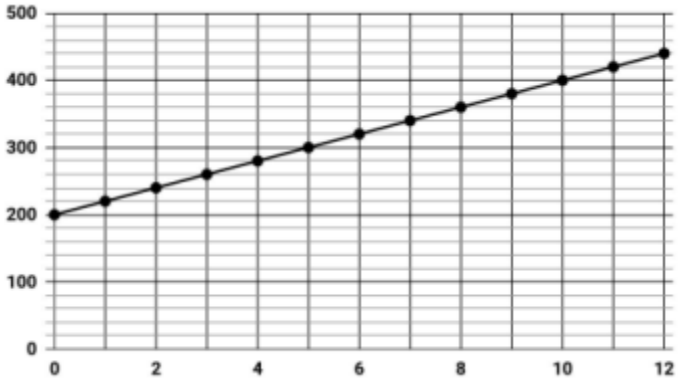




The computer programs that are used in computer generated imagery (CGI) and computer animation in movies, TV shows, and video games all use coordinate graphing systems.



Coordinate systems are also something you will see on the high school equivalency exam, so it is good to have a strong foundation.

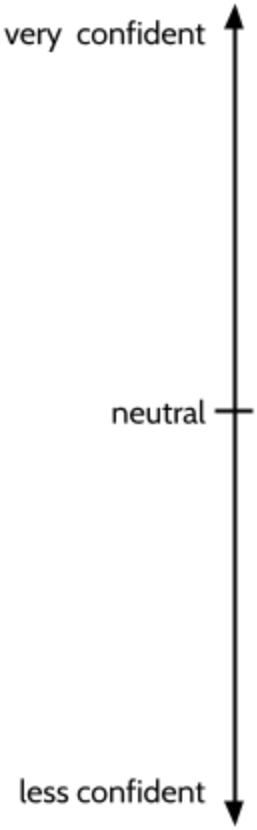


Coordinate Plane

Number lines are the simplest coordinate system. Number lines require just one number to describe an exact location. As we read in Number Lines and the Coordinate Grid, Part 1, the number 0 serves as the origin point. All other points on number lines are defined by their distance from 0. In this packet, you will be studying a coordinate system that uses two numbers to describe an exact location in two dimensions.

1) How confident do you feel about **social studies** on the high school equivalency exam?

Draw a point on the number line below to show how you feel.

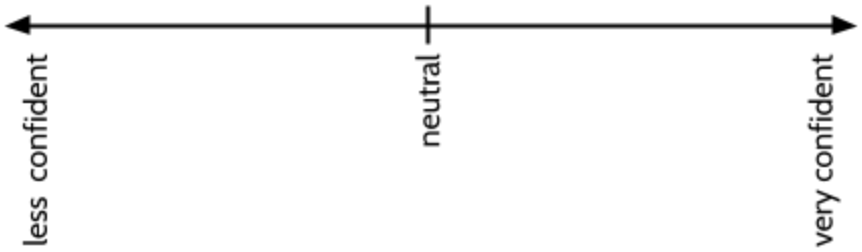


Even though there are no numbers, this works the same as a number line. This number line turns your confidence level about social studies into a point.

On this line, "neutral" is the origin - it is like 0. If you placed your point above neutral, it means you are feeling more confident. If you placed your point below neutral, it means you are feeling less confident. The further away from neutral you put your point, the stronger your feeling.

2) How confident do you feel about **math** on the high school equivalency exam?

   Draw a point on the number line below to show your answer.

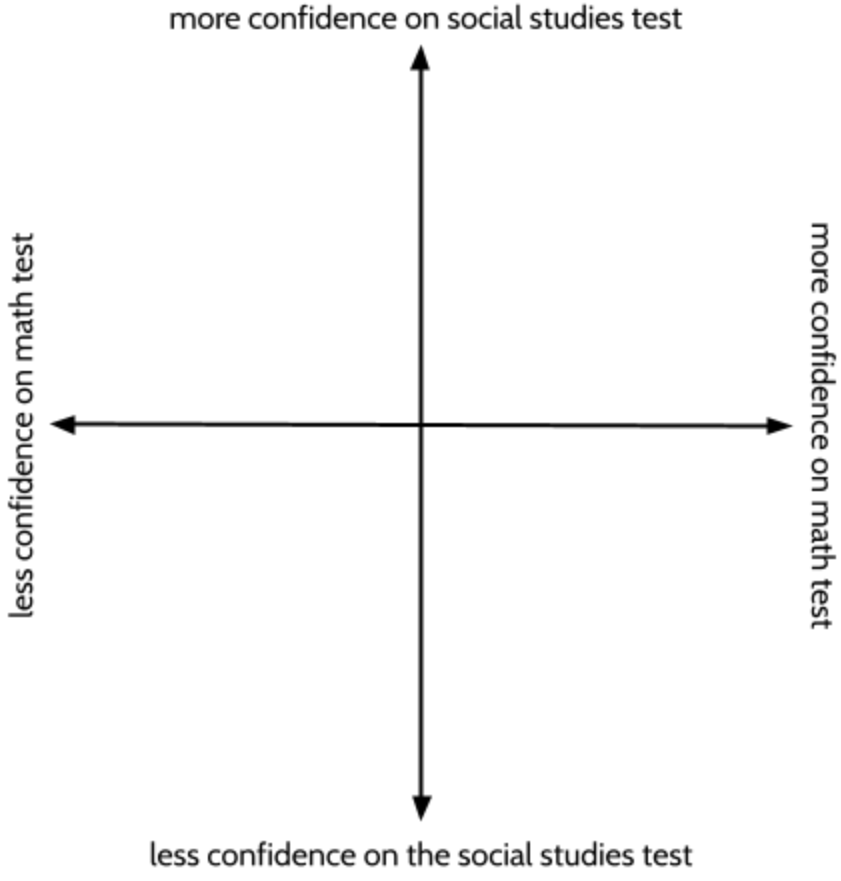


This number line turns your confidence level about math into a point on the line.

Again, "neutral" is the origin—it is like 0. If you placed your point to the right of neutral, it means you are feeling more confident. If you placed your point to the left of neutral, it means you are feeling less confident. The further away from neutral you put your point, the stronger your feeling.

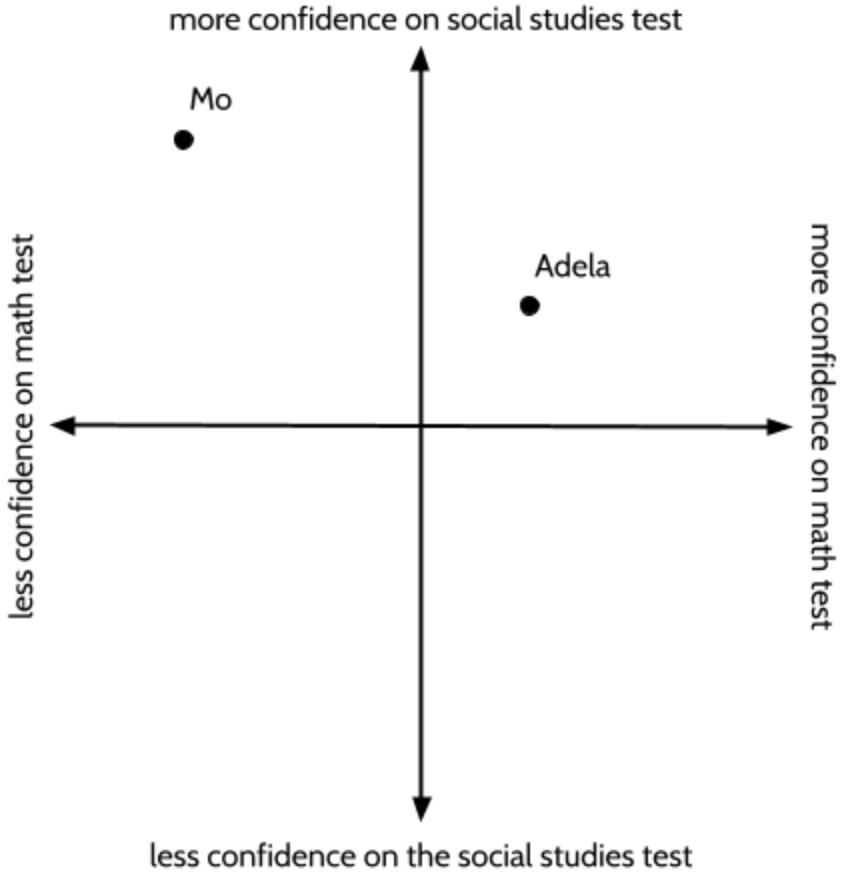
We can combine the two number lines to show how you feel about both the social studies test and the math test at the same time. This graph is called a coordinate plane.

We draw two lines: one horizontal (across) and one vertical (up and down). In this graph, the horizontal line shows confidence levels for math. The vertical line shows confidence levels for social studies. The place where the two lines cross is the *origin* in this coordinate system. It is where confidence levels are neutral on both lines.



Let's see how it works.

Mo and Adela are studying for the high school equivalency exam and placed points on the coordinate plane to express their confidence levels in both math *and* social studies.

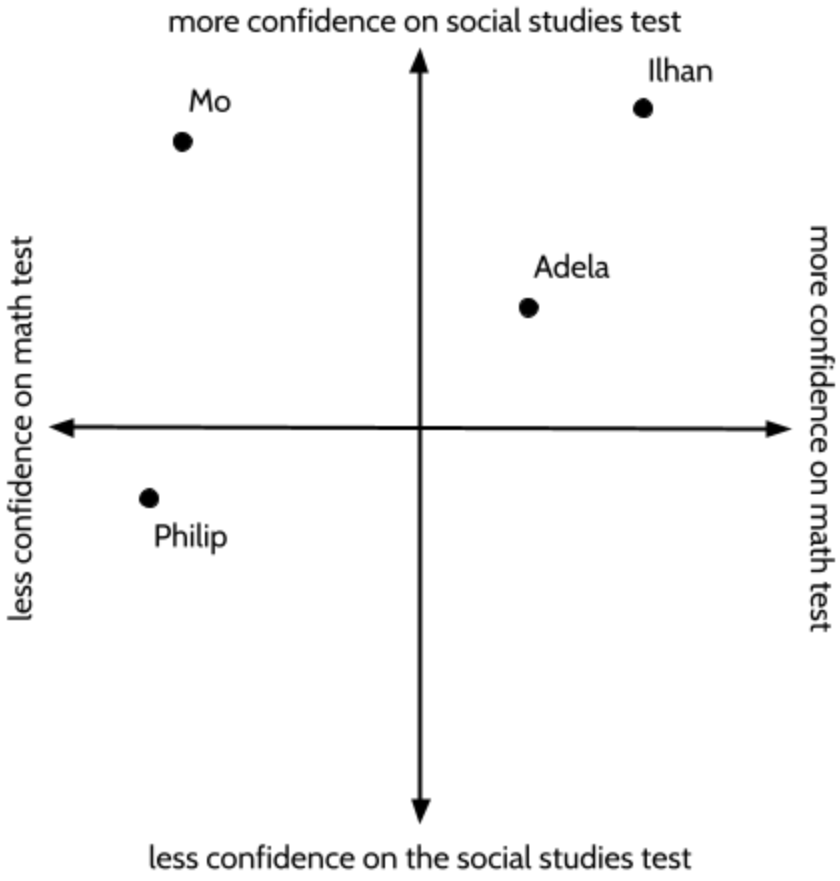


3) Which of these students is more confident in math? How do you know?

4) Which of these students is more confident in social studies? How do you know?

5) Who has the biggest difference between the confidence they feel in math and the confidence they feel in social studies? How do you know?

Two more students added their points to the coordinate plane.

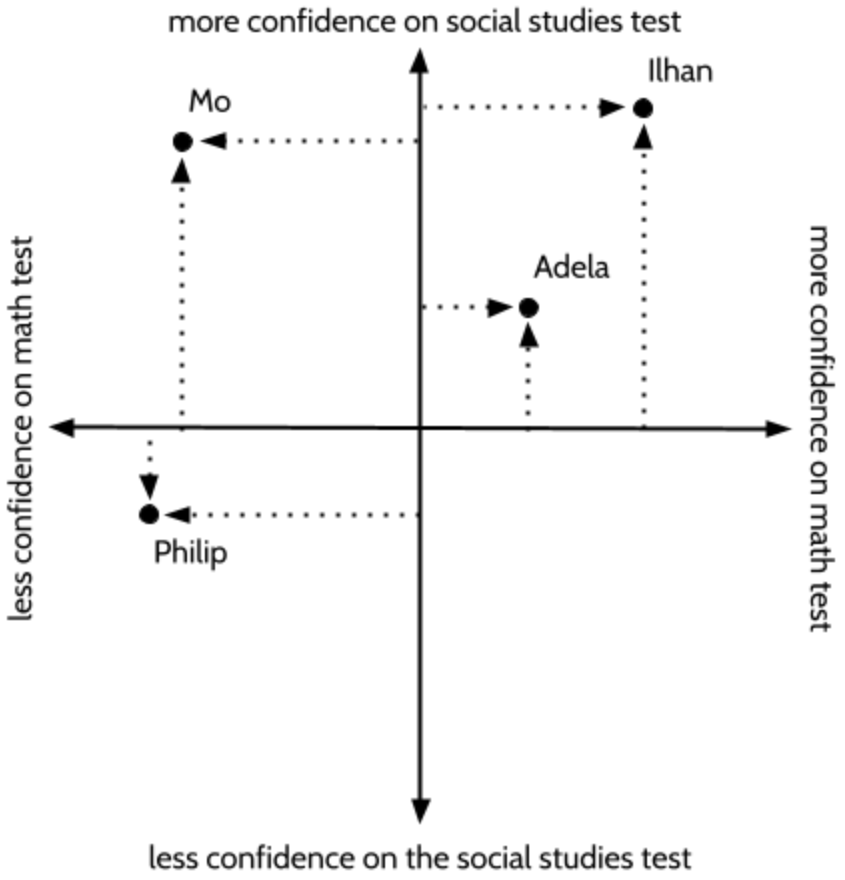


6) Who is the most confident in both math *and* social studies?

7) How are Mo and Philip similar? How are they different?

8) Based on his confidence level, what advice would you give Philip?

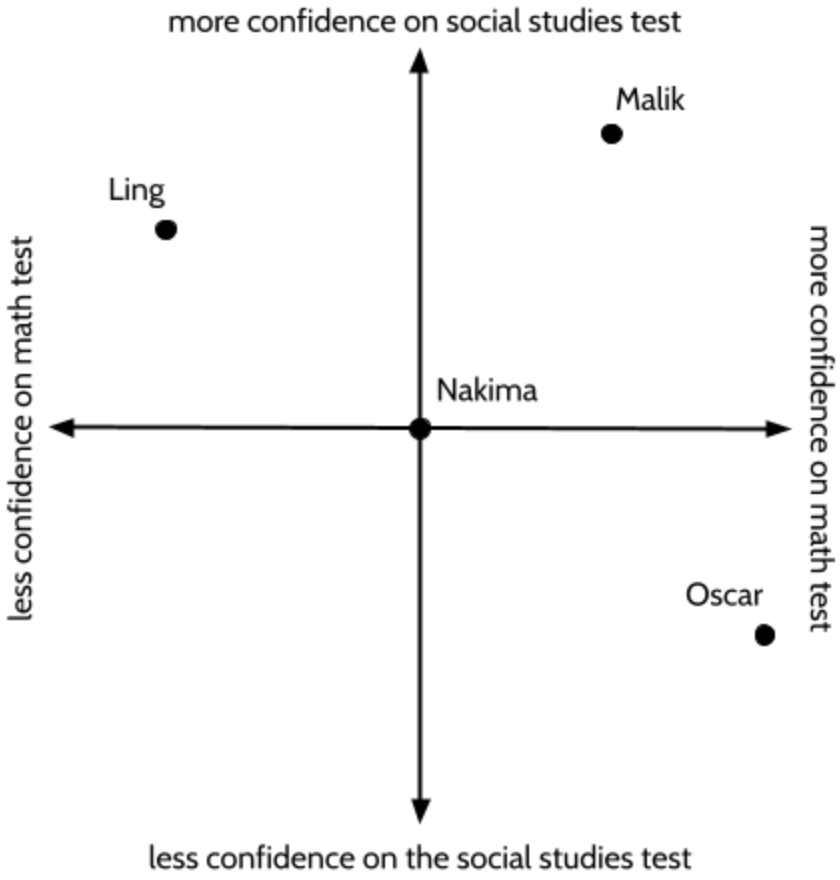
Each point on a coordinate plane has two pieces of information. To read each point, it can help to imagine a line from each point to the horizontal and vertical number lines.



9) Place each student in order of their confidence for each subject:

	Social Studies	Math
Most Confident		
Least Confident		

Ling, Malik, Nakima, and Oscar also answered the two questions above and then put their answers on the graph below,



10) Can you describe how each student is feeling about the social studies test **and** the math test?

Ling:	Malik:
Nakima:	Oscar:

The Chessboard

In the previous activity, we made a coordinate plane by drawing a horizontal line and a vertical line that cross each other. In this section, we will use coordinates to make precise statements about location on a grid.

Chess has a long history and developed over thousands of years. The game has roots in India in the 6th century through a game called chaturanga. It spread to Persia and came to be known as shatranj. The game came to Europe around the 9th century. By the 15th century, the game was played the way it is today.

Chess players developed a way to record each move so they could study strategies.

Gioachino Greco was an Italian chess player in the 17th century. He is responsible for some of the earliest recorded chess games, including one he played in the year 1619.

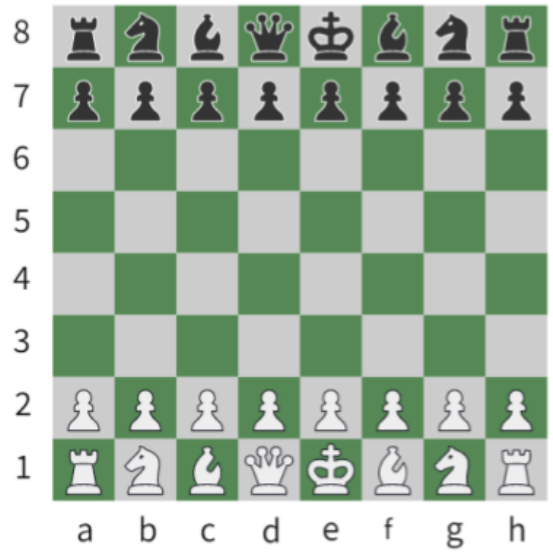
In those days they wrote out a full sentence for each move. The opening move on the board to the right might have been recorded as: *"The white king commands one of his pawns into the fourth house before his own queen."*

In an average game of chess, each player will make about 40 moves. Writing a full sentence for each of those moves would take up a lot of time (and paper!). Over the years, the notation for chess has changed in order to make it easier and more efficient to keep track of moves. It is possible to recreate chess games that took place hundreds of years ago.

Today, we can write the move on the chessboard above as: ♙ **d4.**

In the following pages, we will see how this notation works.

We use letters and numbers together to identify each square on the chessboard.

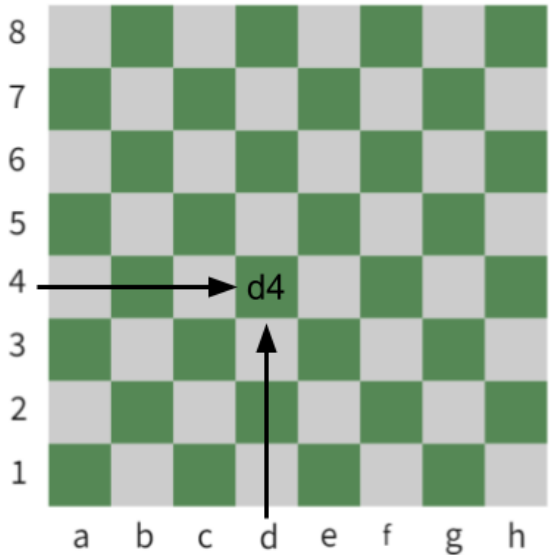


The letters name the columns (up and down) and the numbers name the rows (across). ♙ d4 means the piece moves into the square in the **d** column and the **4** row.

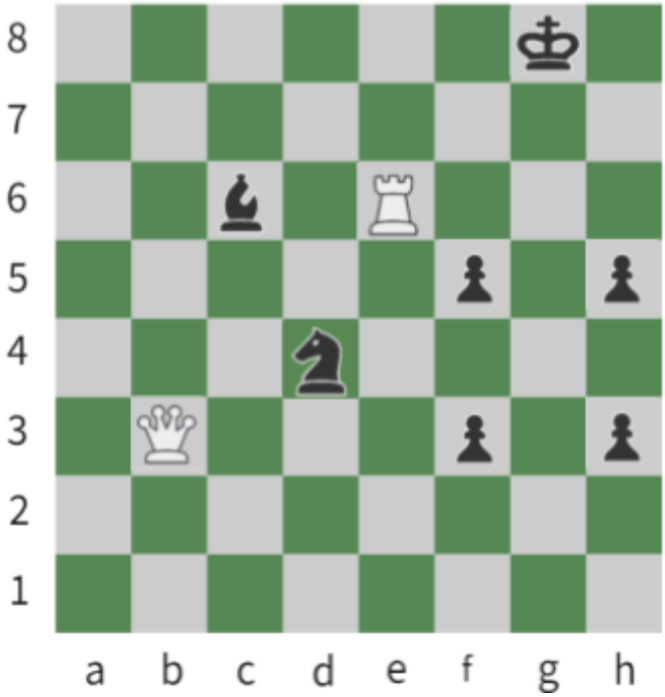
To name each square, we say the letter first and then the number. We start in the bottom left corner. First, we go across and then we go up.

This way of naming the exact location on the board is an example of how we use *coordinates* in a coordinate graphing system. Coordinates are a pair of numbers or letters showing the exact position of a point on a line, a map, a graph, or in this case, a chessboard.

In the example on the left, we can say the pawn moves into the square at the coordinates, **d4.**



Let's practice. There are nine chess pieces on the board below. Write the coordinates for the location of each chess piece. For example, the  is on g8.



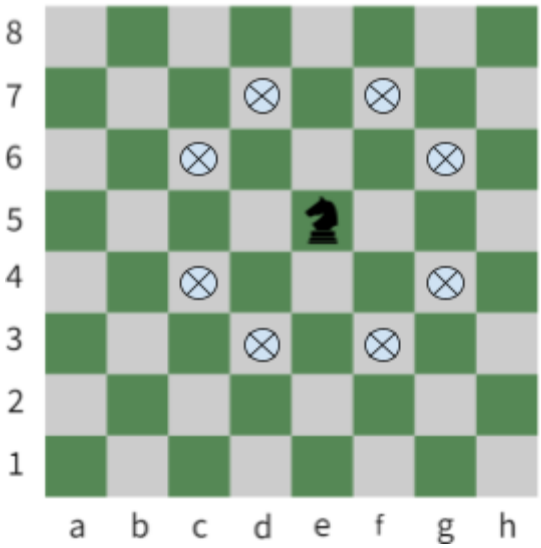
11) 	15) 
12) 	16) 
13) 	17) 
14) 	18) 

In chess, the knight piece  moves like an L.

To figure out where your knight can move:

- move two spaces horizontally and one space vertically, or
- move one space horizontally and two spaces vertically.

The knight on the board to the right is on **e5**. From that position, the knight can move to eight possible squares, shown by the  .



19) On the 8 lines below, write the coordinates for each square where the Knight can move.

_____ _____ _____ _____ _____ _____ _____ _____

Introduction to Coordinate Systems - Answer Key

Coordinate Plane

1) There is no correct place to place the point on the line, but wherever you placed it, we believe in your ability to learn. Choosing to study to pass the high school equivalency exam is not an easy thing to do, but it shows you also believe in your ability to improve.

2) See above.

3) Adela is more confident in math than Mo. We can see because her point is more to the right side of the math confidence line.

4) Mo is more confident in social studies. We can see that because their point is higher than Adela's point on the social studies confidence line.

5) Mo has the biggest difference. Their point shows that they are very confident in social studies, and less confident in math. Adela's point is above the math confidence line and to the right of the social studies confidence line. That means she feels confident in both.

6) Ilhan is the most confident in social studies and math. Her point is the furthest to the right and it is the highest point on the coordinate plane.

7) Mo and Philip are similar because they both do not feel confident in math. They are different because Mo feels confident in social studies, but Philip does not.

8) I would tell Philip that there is no such thing as a math person. Everyone can learn math in a way that makes sense to them. Be patient with yourself and ask as many questions as you can. What would you tell him?

9)

	Social Studies	Math
Most Confident	Ilhan	Ilhan
	Mo	Adela
	Adela	Mo
Least Confident	Philip	Philip

10) There are many different ways to describe each student. Here are some ideas:
    - Ling feels the least confident in math, but has the second highest sense of confidence in social studies.
    - Malik is the most confident in social studies of the four students. He is the second most confident about the math test.
    - Nakima feels neutral about both tests. She is not feeling confident or unconfident about either test.
    - Oscar is feeling confident in math. He is the most confident of the four students. He is also the least confident in social studies.

The Chessboard

11) ♕b3

12) ♖e6

13) ♗c6

14) ♘d4

Note: Your answers for question 15-18 can be in any order.

15) ♟f5

16) ♟f3

17) ♟h5

18) ♟h3

19) The coordinates of the eight positions of the knight are:

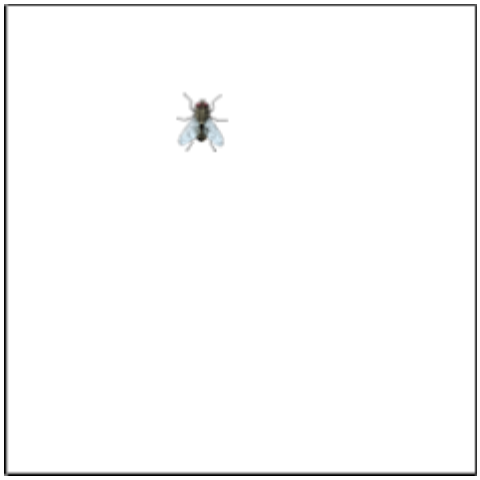
f7 g6 g4 f3 d3 c4 c6 d7

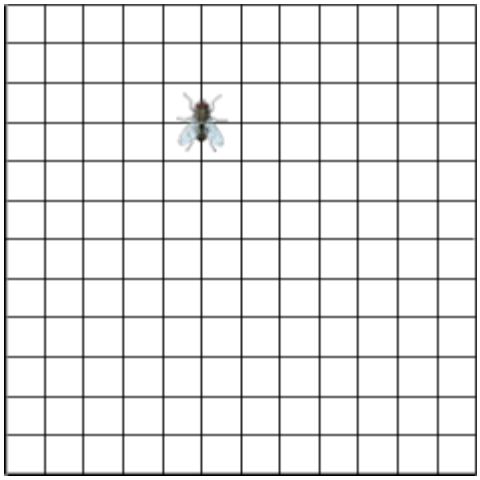
(Your answers do not have to be listed in this order.)

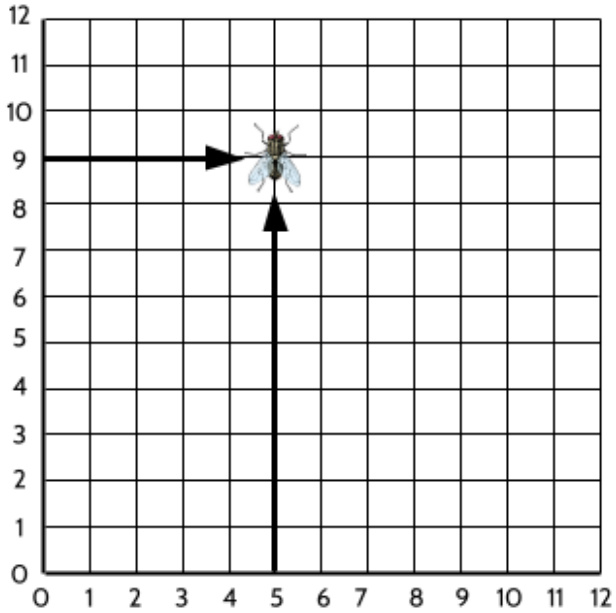
The Coordinate Grid

The coordinate grid was developed by Rene Descartes, about 400 years ago, in the year 1637. Descartes was a French mathematician and philosopher. "I think, therefore I am," is one of his famous ideas.

There is a story (which may or may not be true) that he invented the coordinate grid after watching a fly on the ceiling above his bed. Descartes wondered if the fly ever landed in the same place. To answer his question, he had to figure out how to record where the fly landed. The story goes that he took a piece of coal from the fire and drew lines on his ceiling.



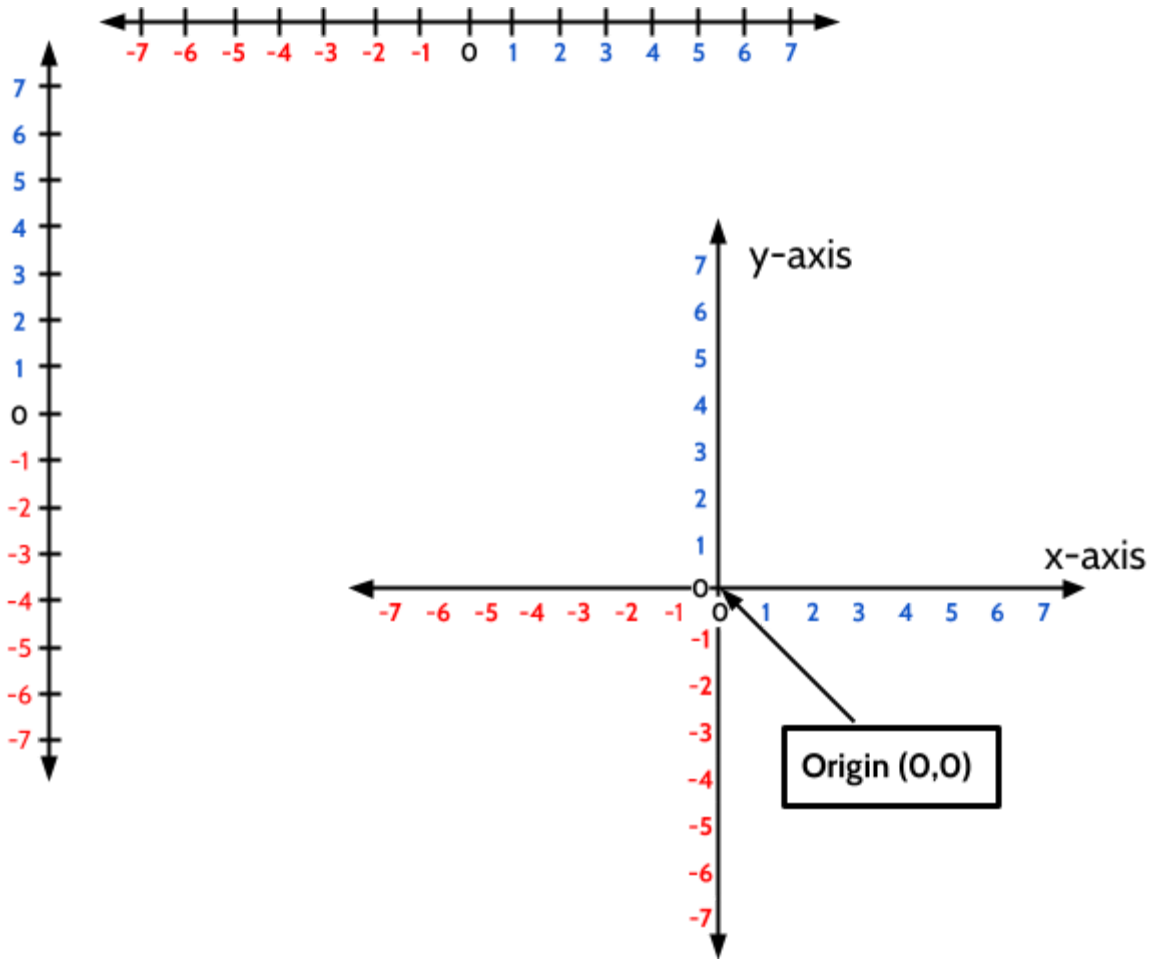




He realized that he could describe the position of the fly with two numbers: one to show the distance from one wall and another number to show the distance from a perpendicular wall.

Whether the story is true or not, we now use the coordinate grid to map the position of objects all over the world, including houses, cars, satellites, etc. Some people call the coordinate grid, the *Cartesian plane*, in honor of Descartes.

A coordinate grid is like two number lines put together.



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

Just like on a number line, as you move to the right on the *x*-axis, the numbers get larger. As you move to the left on the *x*-axis, the numbers get smaller.

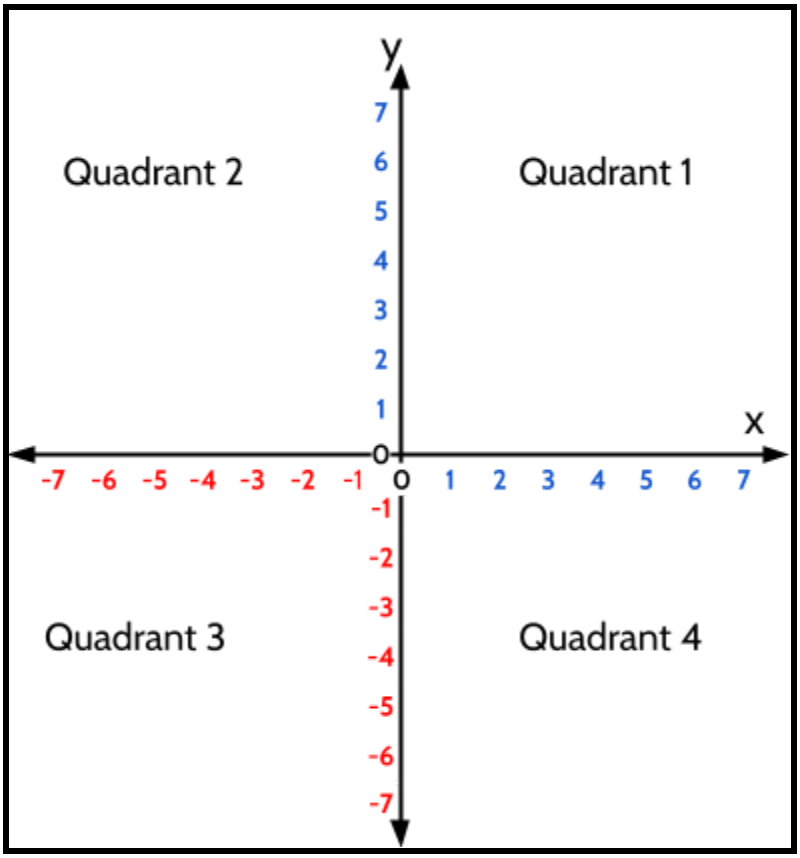
The vertical number line is called the ***y*-axis.**

Again, just like on a number line, as you move up on the *y*-axis, the numbers get larger. As you move down on the y-axis, the numbers get smaller.

On the coordinate grid, the point where the *x*-axis and the *y*-axis cross is called the ***origin***. The origin is the place at 0 on the y-axis and 0 on the *x*-axis. We write the combination of those two coordinates as (0, 0). Since the origin is 0 on both number lines, the origin is the point that divides each axis into positive and negative numbers.

You may have noticed that the *x*-axis and the *y*-axis divide up the coordinate grid into 4 parts. We call each part a ***quadrant***. The quadrants of the coordinate grid are numbered 1, 2, 3, and 4, starting on the top right and going in order, counterclockwise.
The quadrants are sometimes labeled using Roman Numerals:

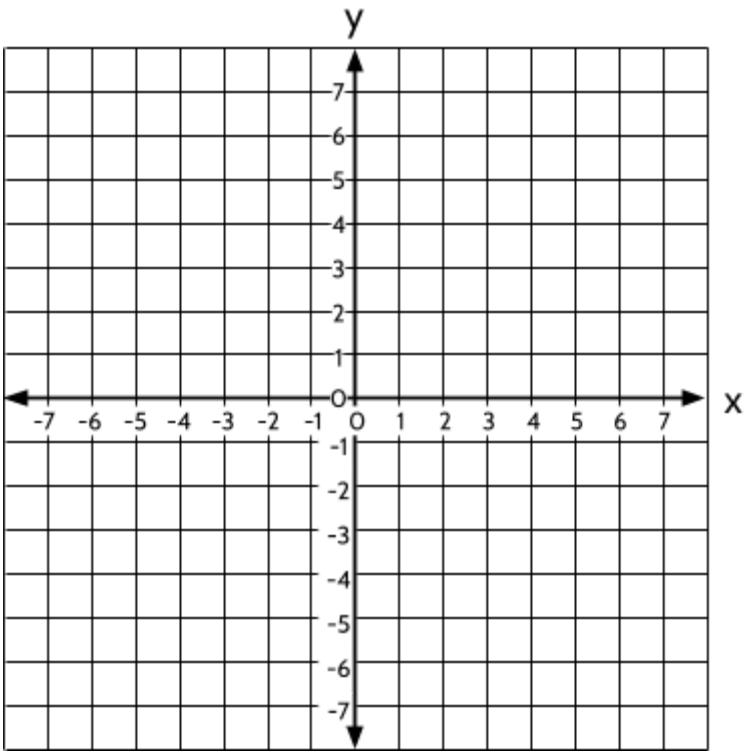
1 = I
2= II
3 = III
4 = IV



The final step in constructing a coordinate grid is to draw lines like Descartes did on his ceiling.

Now that we see how the coordinate grid is made, we can learn how to plot points.

To ***plot*** a point means to draw a point at a precise location on the coordinate grid.

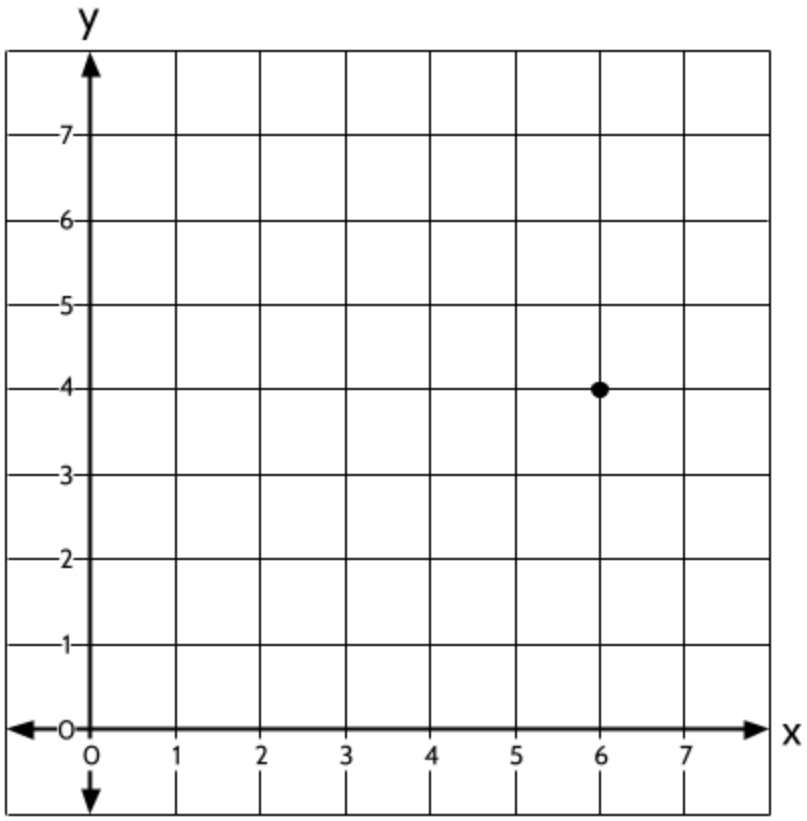


Plotting Points on the Coordinate Grid

For now, we will focus on Quadrant 1 of the coordinate grid.

We use coordinates to describe an exact location on a coordinate grid. Coordinates work like giving someone directions. To describe a point on a coordinate grid, we use two numbers, called an ***ordered pair***.

The coordinates for the point on the graph below are **(6, 4).** Take a moment and see if you can figure out why that point on the graph is called (6, 4).



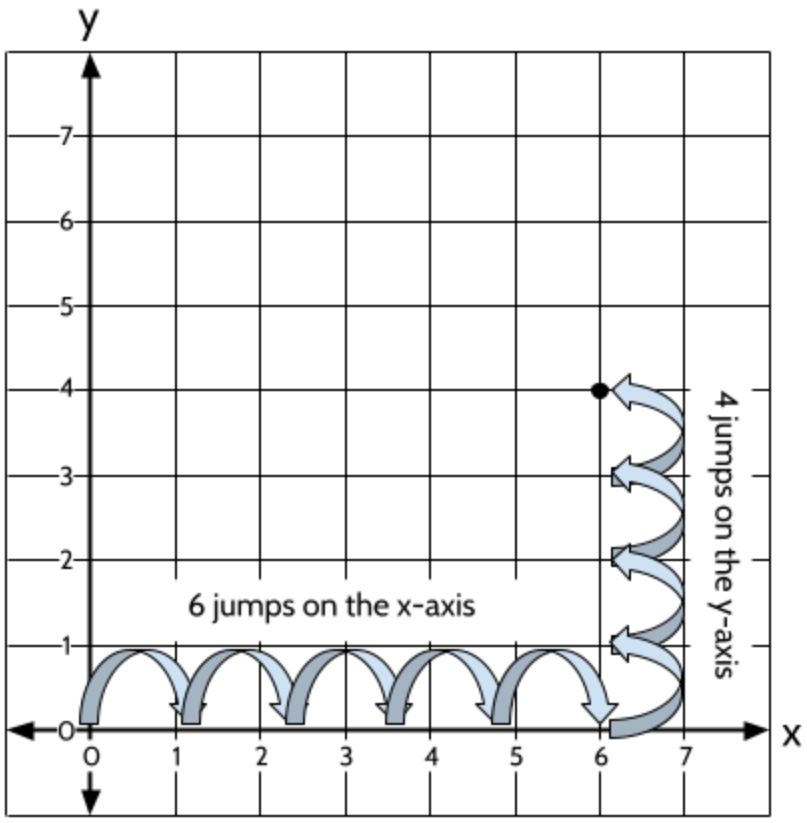
Ordered pairs are directions. The first number tells you the horizontal distance from the origin. The second number tells you the vertical distance from the origin.

To find an exact point on the coordinate grid:

1. Start at the origin
2. follow the horizontal directions
3. follow the vertical directions.

Our point is (6, 4). The 6 tells us to make 6 jumps along the *x*-axis, starting from the origin. The 4 tells us to make 4 jumps on the *y*-axis, starting from the origin.

(6, 4) is the point where the vertical line at 6 intersects with the horizontal line at 4.



The coordinates on the coordinate grid are often called *ordered pairs* to help us remember that the order is always the same. All ordered pairs will be written as (*x*, *y*)

The first number always tells us how far to move along the *x*-axis and the second number tells us how far to move along the y-axis. Let's practice writing coordinates out as ordered pairs.

1) Write the ordered pairs for each point on this coordinate grid.

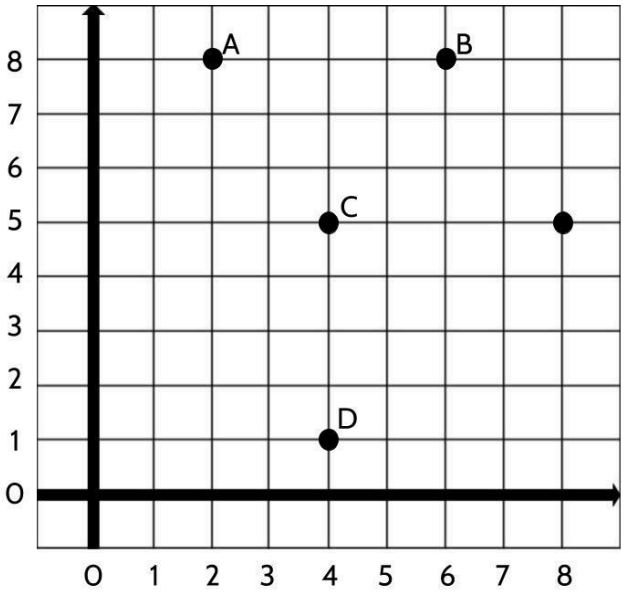
   Point (8, 5) is included as an example.

   Point A:

   Point B:

   Point C:

   Point D:



2) Let's practice using ordered pairs to draw points.

   Use these coordinates to draw the following ordered pairs on the coordinate grid. Make sure to label each point with the letter given.

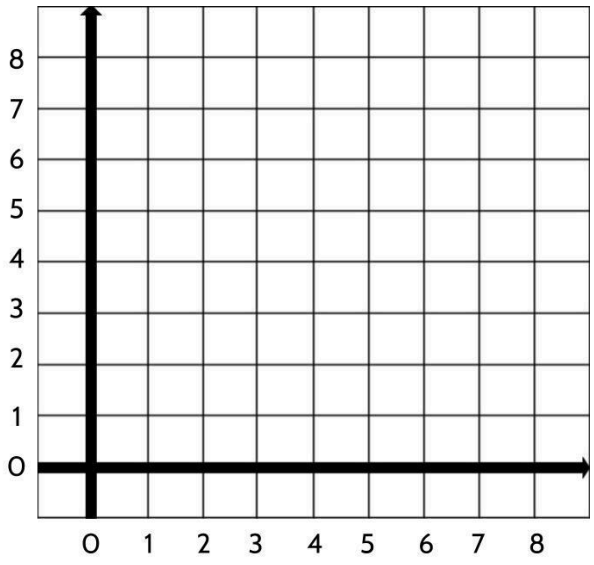
   H (2, 1)

   O (2, 6)

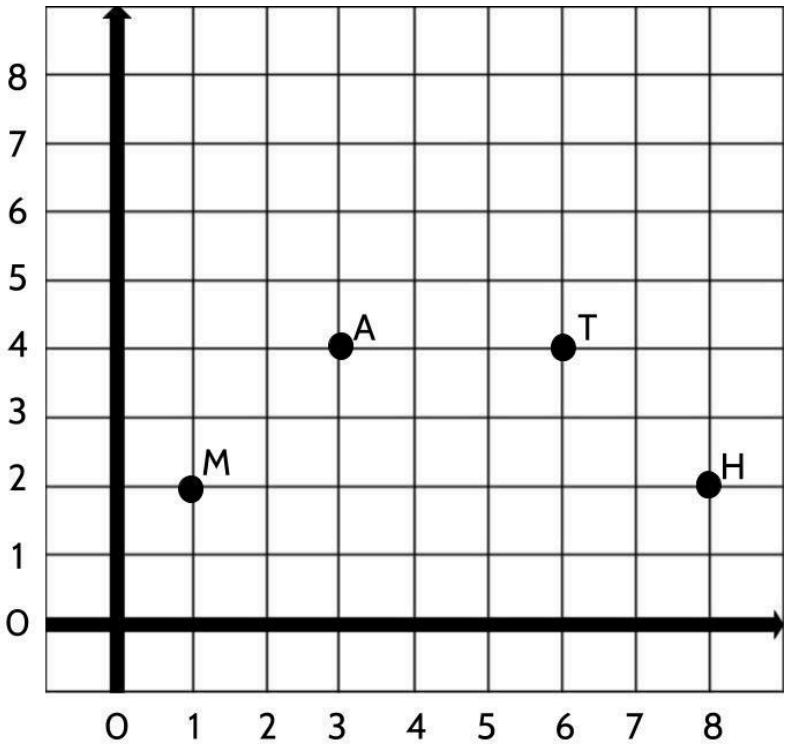
   S (6, 6)

   E (6, 1)

   U (4, 8)



3) Look at the points on this coordinate grid.



Which of the following statements are true? Underline the <u>two</u> true statements.

A. Point T is 6 units to the right and 4 units up from the origin.

B. The distance between Point M and Point H is 8 units.

C. Point A and Point T have the same *x* coordinate.

D. The ordered pair for Point M is (2, 1).

E. To move from Point M to Point T, move 5 units to the right and two units up.

So far, we have been working with positive numbers on the coordinate grid.

You may be wondering, what happens to the numbers as you move to the left along the *x*-axis from the origin? What happens to the numbers as you move down along the *y*-axis from the origin?

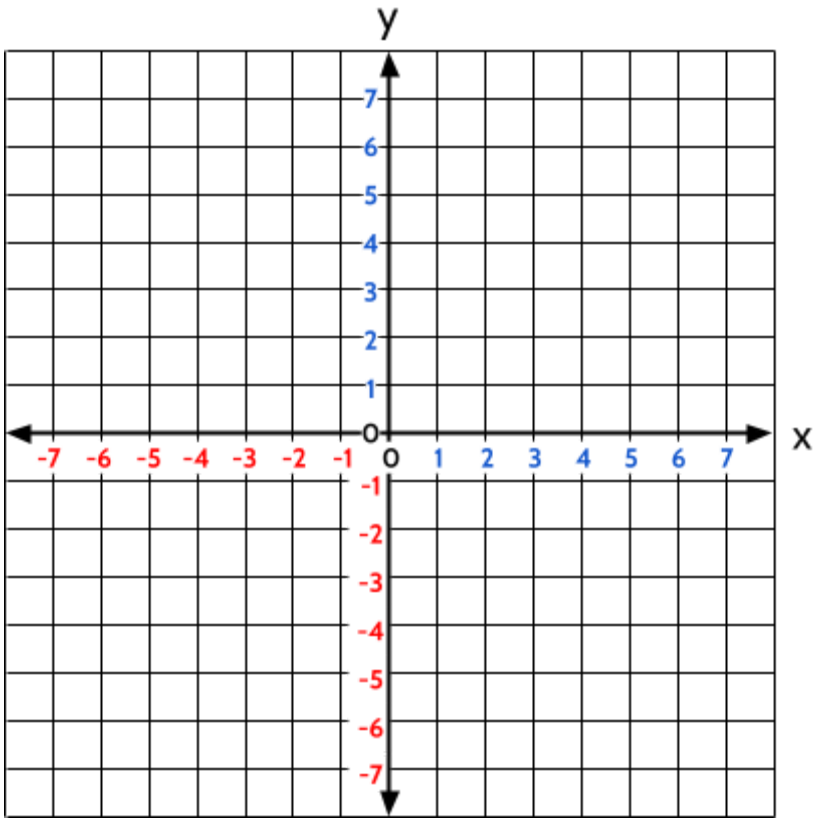
The *x*-axis and the *y*-axis are number lines. The same way number lines can continue below zero, so do the *x*-axis and *y*-axis, with negative numbers.

A negative *x*-value in an ordered pair tells us we need to jump to the left from the origin.

A negative *y*-value in an ordered pair tells us we need to jump down from the origin.

4) Plot the following points on the coordinate grid below:

(3, 5) **(-2, 4)** **(-1, -3)** **(5, -2)**



5) In the following statements, fill in the blanks and circle the correct words:

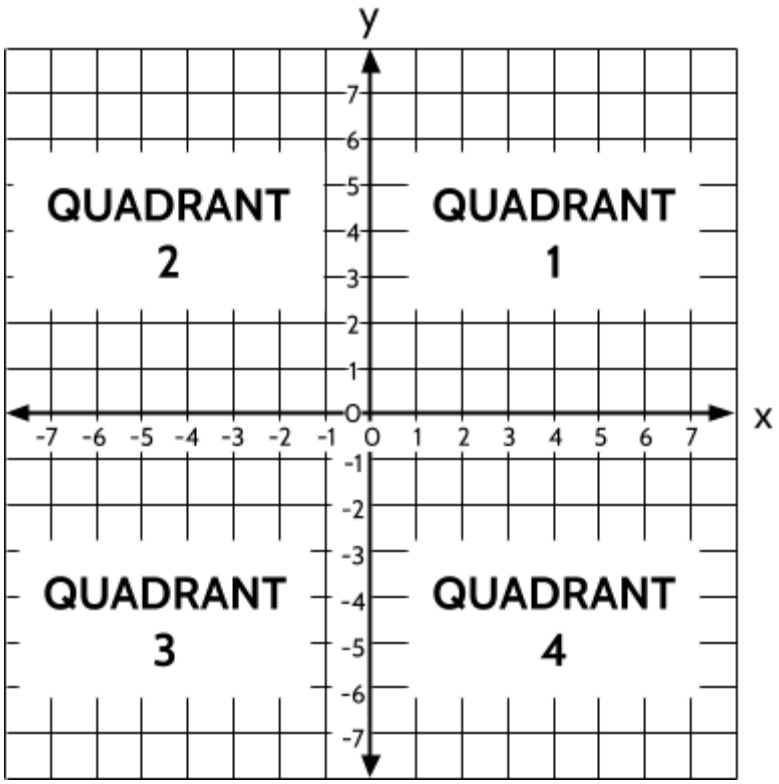
Example: Point (5, 4) is in Quadrant 1 because I start in the origin and move 5 units to the (right) / left and then I move 4 units (up) / down.

a) Point (7, -3) would be in Quadrant _____ because I start in the origin and move _____ units to the right / left and then I move _____ units up / down.

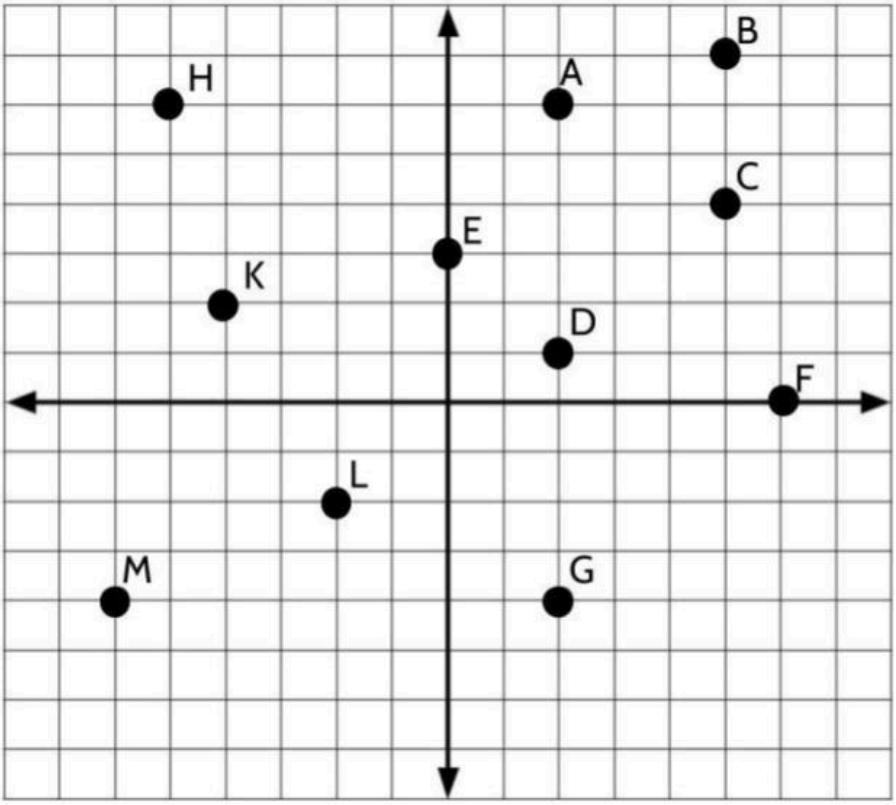
b) Point (-3, -6) would be in Quadrant _____ because I start in the origin and move _____ units to the right / left and then I move _____ units up / down.

c) Point (16, 25) would be in Quadrant _____ because I start in the origin and move _____ units to the right / left and then I move _____ units up / down.

d) Point (-10, 3) would be in Quadrant _____ because I start in the origin and move _____ units to the right / left and then I move _____ units up / down.



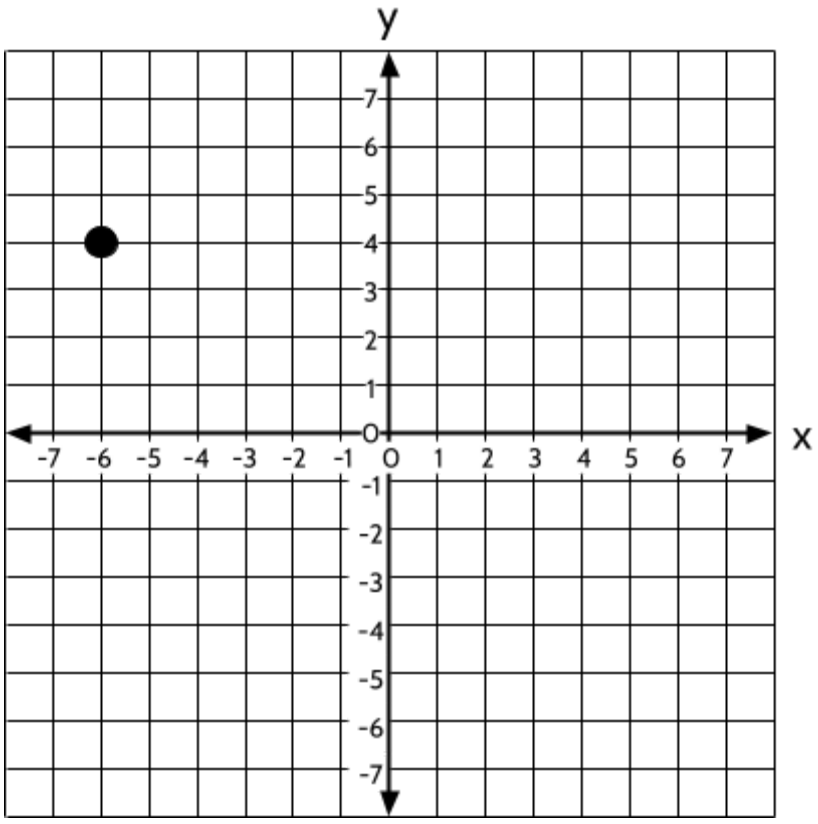
6) Write the name of each point next to the ordered pairs provided below:



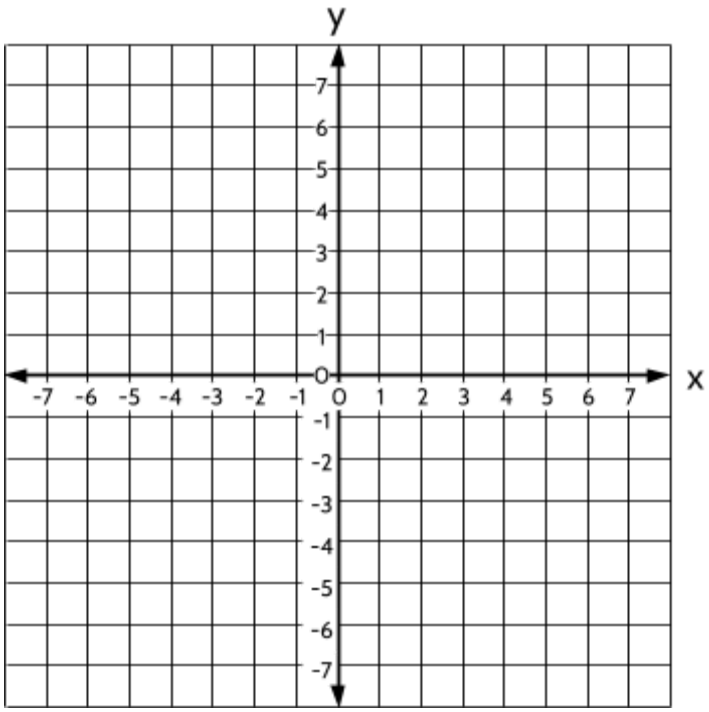
Point D is at (2, 1)	(6, 0)
(-6, -4)	(0, 3)
(-2, -2)	(5, 4)
(-5, 6)	(2, 6)
(-4, 2)	(5, 7)
(2, -4)	

7) Plot at least three ordered pairs on the graph where the sum of the *x*-value and *y*-value is -2.

   Example: The point (-6, 4) has an *x*-value of -6 and a *y*-value of 4, which equal -2 when added together.



8) Create four (4) ordered pairs using the integers -4, -3, -2, -1, 1, 2, 3, or 4 at most one time, so that each point is in a different quadrant.



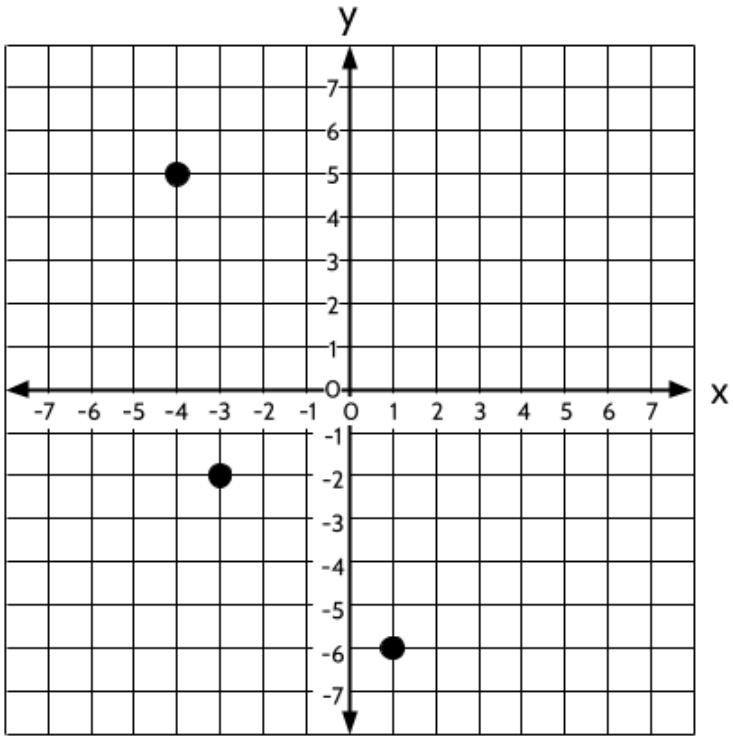
9) What are the coordinates of the three locations on the graph?

A. (-4, 5), (-2, 3), (-6, 1)

B. (-4, 5), (-3, -2), (1, -6)

C. (4, 5), (3, 2), (1, 6)

D. (5, -4), (-2, -3), (-6, 1)



10) Find the ordered pair of the point exactly in the middle of the two given points:

a) The point exactly halfway between (-1, -1) and (-1, -9) is _____

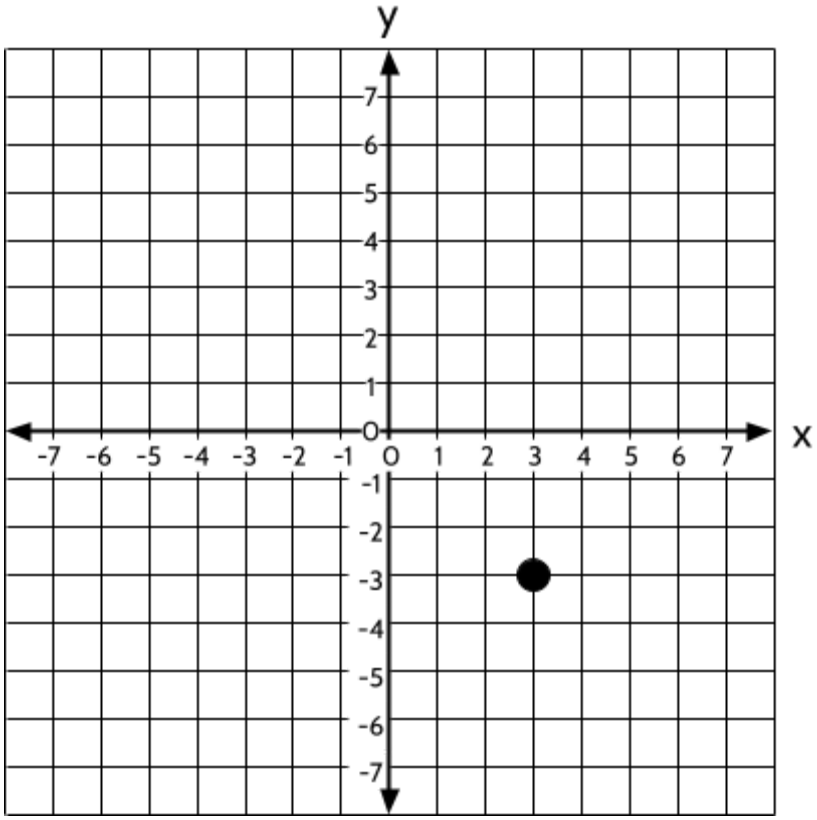
b) The point exactly halfway between (-3, -2) and (5, -2) is _____

c) The point exactly halfway between (4, 4) and (10, 4) is _____

d) The point exactly halfway between (3, 7) and (3, -3) is _____

e) The point exactly halfway between (8, 1) and (12, 1) is _____

11) Which of the following ordered pairs have an *x*-value and *y*-value with the same sum as the *x*-value and *y*-value of the point on the graph?



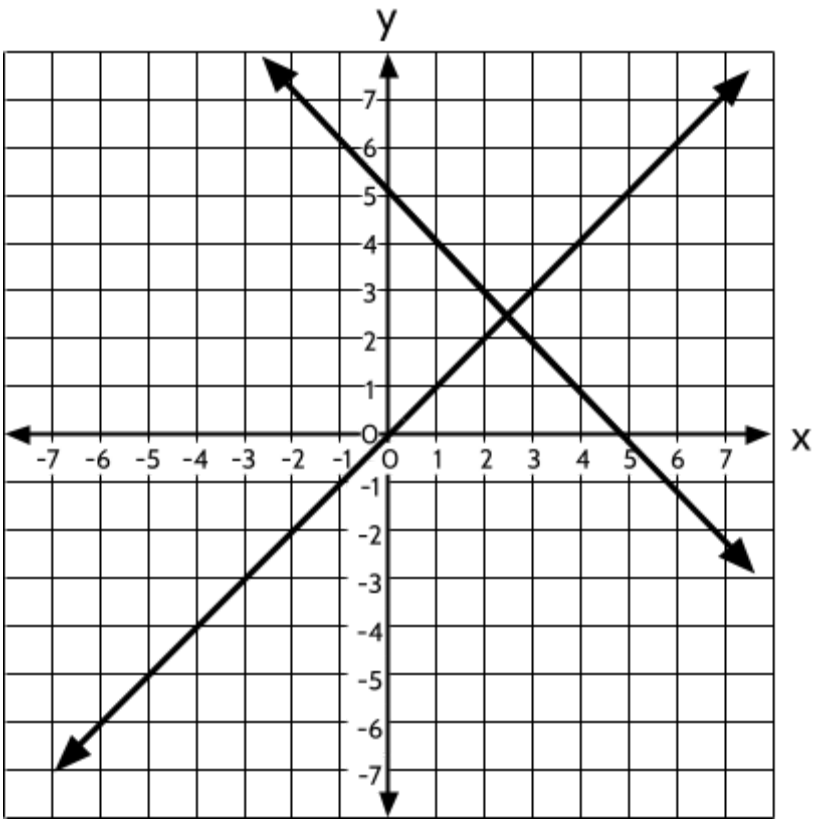
A. (-4, -4)

B. (-6, 6)

C. (3, 3)

D. (-3, -2)

12) What are the coordinates for the point where the two lines intersect?



A. (0, 0)

B. (0, 5)

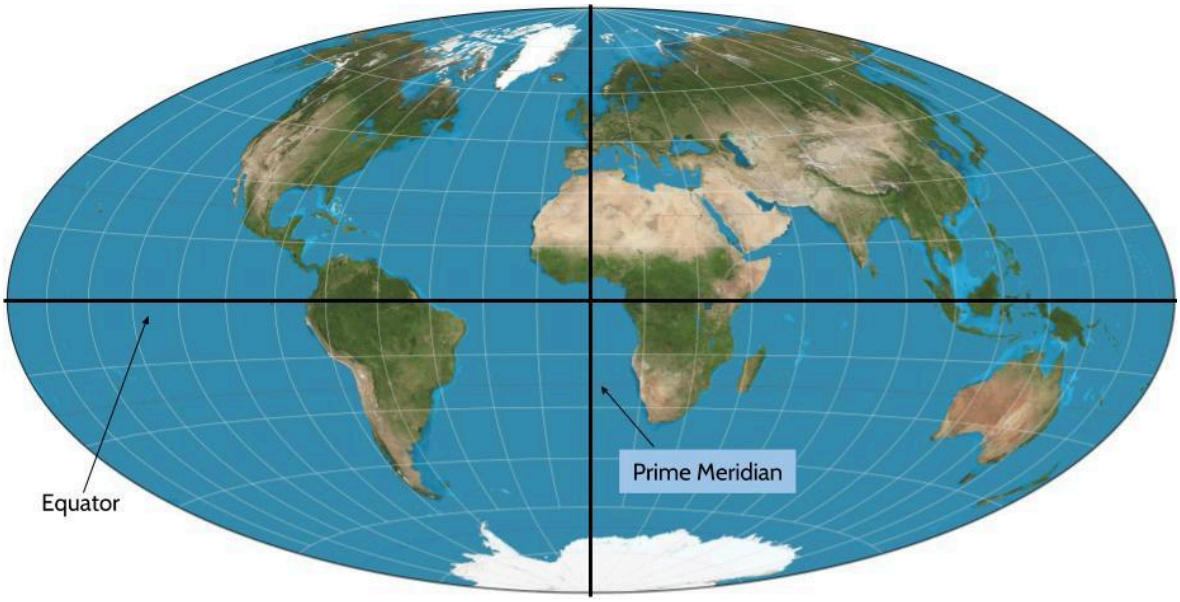
C. (2.5, 2.5)

D. (5, 0)

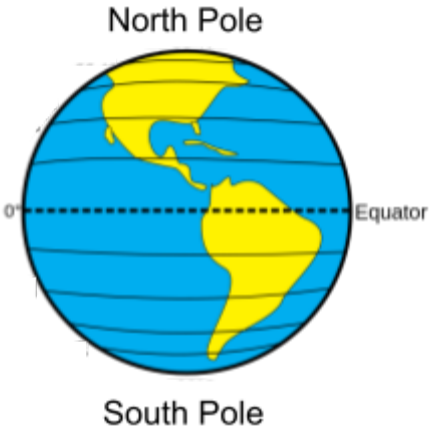
Longitude Lines and Latitude Lines

We use a coordinate system to describe specific locations on Earth. Just like we can describe a location of a point on a coordinate grid, we can describe any point on Earth using latitude and longitude lines.

To visualize how this coordinate system works, we divide the surface of the Earth into four quadrants with two imaginary lines, the ***equator*** and the ***Prime Meridian***.



Even though the Earth is not flat, we can think of the equator as the *x*-axis and the Prime Meridian as the y-axis. Next, we add latitude and longitude lines.



Latitude lines are horizontal lines going East and West around the Earth, which measure the distance from the Equator in degrees (°). The ***equator*** is a special latitude line halfway between the North Pole and the South Pole.

The equator is 0°. The other latitude lines are used to describe how far north or south locations are from the equator.

Latitude lines north of the equator are positive and get larger as you get farther away from the equator.

Latitudes lines south of the equator are negative, and get more negative the farther you get from the equator.

Longitude lines are vertical lines, going North and South, which measure the distance from the Prime Meridian in degrees. The Prime Meridian is a special latitude line at 0° longitude. The other longitude lines are used to describe how far east and how far west locations are from the Prime Meridian.

Technically, we could use any vertical line to represent 0° West/East, but there is an international agreement to use the Prime Meridian, which goes through the city of Greenwich, England, home of the Royal Observatory.

Now we will use what we have learned about coordinate grids to make sense of how the latitude/longitude coordinate system works.

The map below is focused on North America. The black marker on the map shows the location of the Statue of Liberty in New York City.

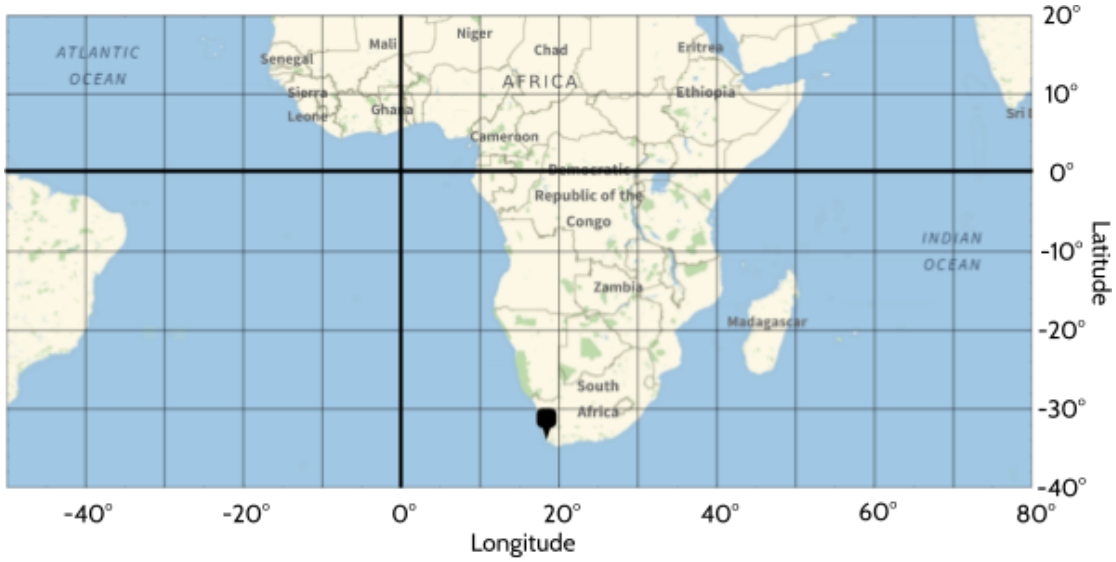
13) Using the coordinate grid above, what are the approximate coordinates of the Statue of Liberty?

Latitude: _____ Longitude: _____

14) The black marker on the map below shows the location of the city of Bangkok, Thailand. What are the approximate coordinates of Bangkok?

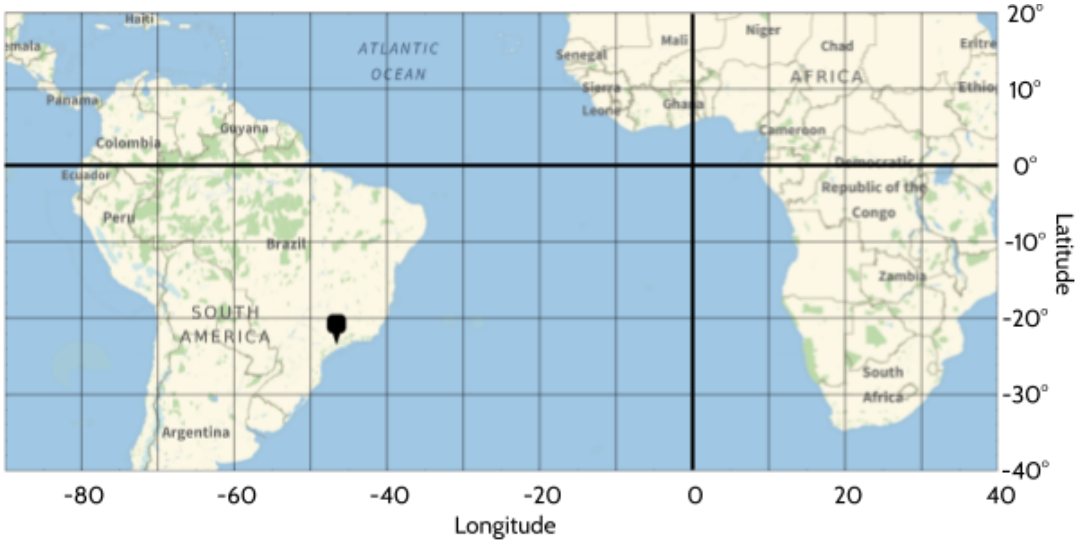
Latitude: _____ Longitude: _____

15) The black marker on the map below shows the location of the city of Cape Town in South Africa. What are the approximate coordinates of Cape Town?



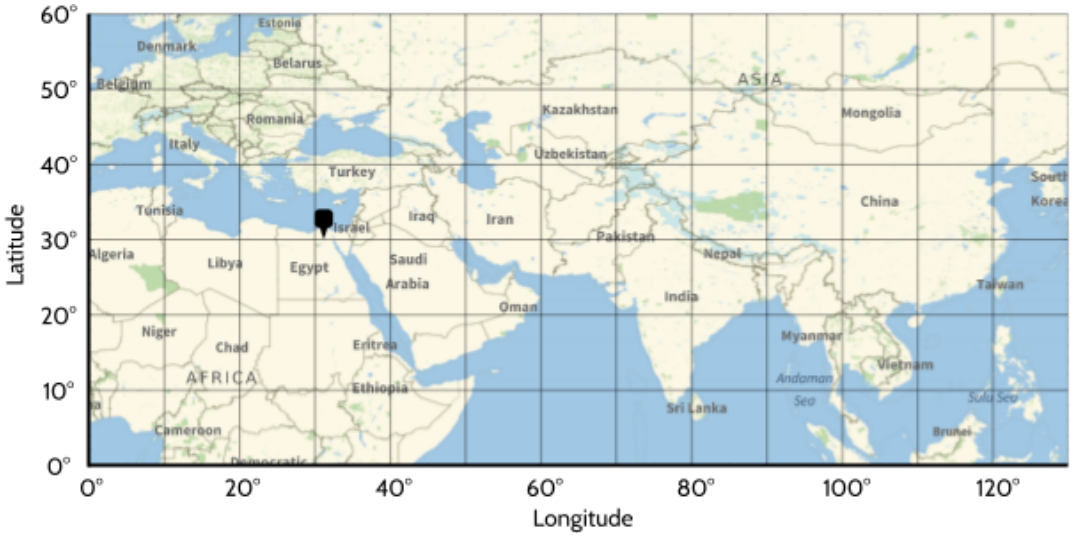
Latitude: _____ Longitude: _____

16) The black marker on the map below shows the location of the city of Sao Paolo in Brazil. What are the approximate coordinates of Sao Paolo?



Latitude: _____ Longitude: _____

17) The black marker on the map below shows the location of the Great Pyramid of Giza in Egypt. What are the approximate coordinates?

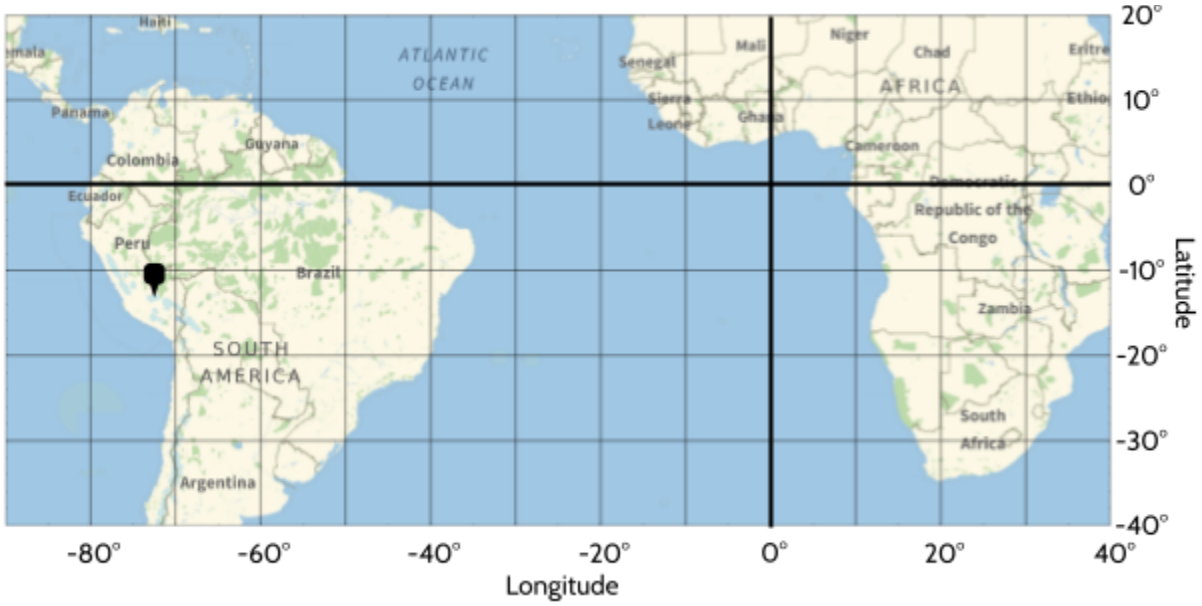


Latitude: _____ Longitude: _____

18) The black marker on the map below shows the location of the Zhejiang Chenxiang Ruyi Bridge in China. What are the approximate coordinates?

Latitude: _____ Longitude: _____

19) The black marker on the map below shows the location of Machu Picchu in Peru. What are the approximate coordinates?



Latitude: _____ Longitude: _____

20) The black marker on the map below shows the location of the Djinguereber Mosque in Mali. What are the approximate coordinates?

Latitude: _____ Longitude: _____

21) The black marker on the map below shows the location of the Eiffel Tower in France. What are the approximate coordinates?

Latitude: _____ Longitude: _____

Plotting Points on the Coordinate Grid- Answer Key

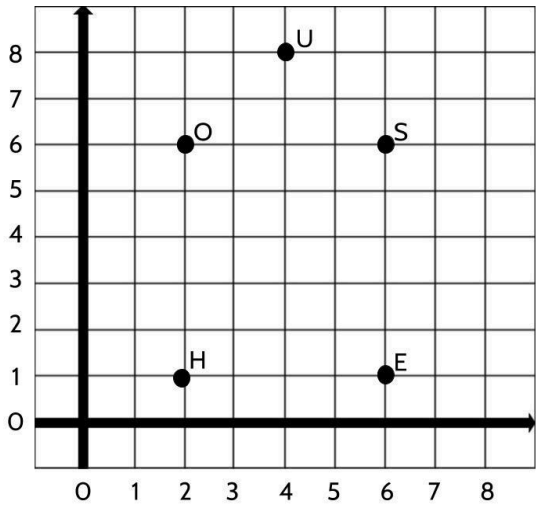
1) Point A: (2, 8)

Point B: (6, 8)

Point C: (4, 5)

Point D: (4, 1)

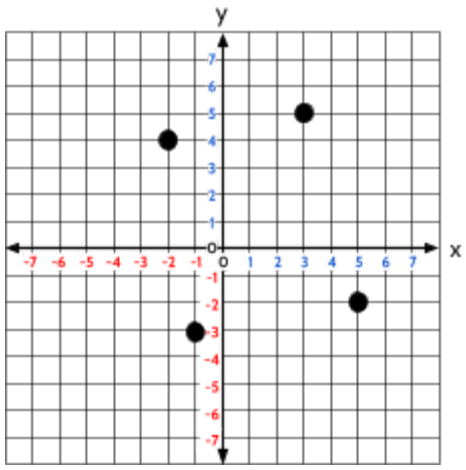
2)



3) Choices A and E are true.

B is false because Point M and Point H are 7 units apart (not eight).
C is false because Point A and Point T have the same *y* coordinate, but they have different *x* coordinates.
D is false because the ordered pair for Point M is (1, 2).

4)



5) Point (7, -3) is in Quadrant 4 because I start in the origin and move 7 units to the right and 3 units down.

Point (-3, -6) is in Quadrant 3 because I start in the origin and move 3 units to the left and 6 units down.

Point (16, 25) is in Quadrant 1 because I start in the origin and move 16 units to the right and 25 units up.

Point (-10, 3) is in Quadrant 2 because I start in the origin and move 10 units to the left and 2 units up.

6) Point *M*: (-6, -4)

Point L: (-2, -2)

Point H: (-5, 6)

Point K: (-4, 2)

Point G: (2, -4)

Point F: (6, 0)

Point E: (0, 3)

Point C: (5, 4)

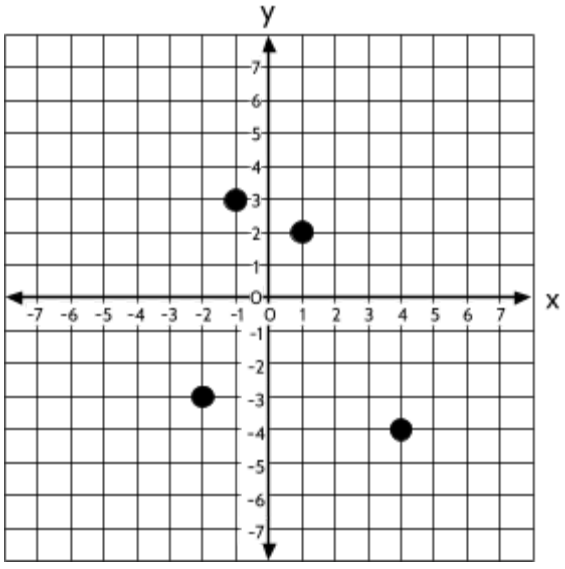
Point A: (2, 6)

Point B: (5, 7)

Take a look at Point E and Point F. We can read the coordinate for Point E as moving 0 units to the right and 3 units up. Point F can be read as moving 6 units to the right and 0 units up. The value of *x* will be zero if the point is on the *y*-axis. Similarly, the *y* value in the ordered pair will be zero when the point is on the *x*-axis.

7) There are many correct answers to this question. A few examples are (-5, 3), (-4, 2), (-3, 1), (-2, 0), (-1, -1), (0, -2). Add any of these ordered pairs that you didn't have on your graph. What do you notice about the points?

8) There is more than one correct answer.
One potential answer is:
Quadrant 1 (1, 2)
Quadrant 2 (-1, 3)
Quadrant 3 (-2, -3)
Quadrant 4 (4, -4)
If you tried a point using 0 as either the x or y value, good for you for thinking outside the box! (or outside the quadrant, in this case). But points on the *x*-axis and *y*-axis are not considered to be in any quadrant.



9) B

10)

a) The point exactly in the middle of (-1, -1) and (-1, -9) is **(-1, -5)**

b) The point exactly in the middle of (-3, -2) and (5, -2) is **(1, -2)**

c) The point exactly in the middle of (4, 4) and (10, 4) is **(7, 4)**

d) The point exactly in the middle of (3, 7) and (3, -3) is **(3, 2)**

e) The point exactly in the middle of (8, 1) and (12, 1) is **(10, 1)**

11) B. (-6, 6) is the only ordered pair with an *x* and y value that add up to 0

12) C. (2.5, 2.5)

13) The Statue of Liberty is approximately located at about 41° to the north of the equator and about -74° to the west of the Prime Meridian.

The precise coordinates for the Statue of Liberty are Latitude: 40.690° N and Longitude -74.045° W.

One difference in the latitude/longitude system is that the ordered pairs place the latitude first and the longitude second. This is probably because humans have been imagining and using latitude lines longer than we have been using longitude.

Visit the website https://www.latlong.net to find the exact coordinates (latitude, longitude) of anywhere on Earth.

14) Bangkok, Thailand is approximately located at about 14° to the north of the equator and about 101° to the east of the Prime Meridian. The precise coordinates for Bangkok are Latitude: 13.756° N and Longitude 100.502° E.

15) Cape Town, South Africa is approximately located at about 34° to the south of the equator and about -18° to the west of the Prime Meridian. The precise coordinates for Cape Town are Latitude: -33.925° S and Longitude 18.424° E.

16) Sao Paolo, Brazil is approximately located at about -24° to the south of the equator and about -47° to the west of the Prime Meridian. The precise coordinates for Sao Paolo are Latitude: -23.551° S and Longitude -46.633° W.

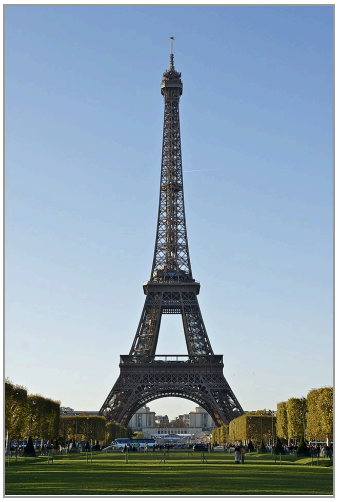
17) The Great Pyramid of Giza is approximately located at about 30° to the north of the equator and about 31° to the east of the Prime Meridian. The precise coordinates for the Great Pyramid are Latitude: 29.9791° N and Longitude 31.134° E.

18) The Ruyi Bridge is approximately located at about 25° to the north of the equator and about 122° to the east of the Prime Meridian. The precise coordinates for the Ruyi Bridge are: 24.681° N and Longitude 121.820° E.

19) Machu Picchu is approximately located at about -13° south of the equator and about -76° to the west of the Prime Meridian. The precise coordinates for Machu Picchu are: -13.163° S and Longitude -72.545° W.

20) The Djinguereber Mosque is approximately located at about 16° north of the equator and about -3° to the west of the Prime Meridian. The precise coordinates for Djinguereber Mosque are: 16.771° N and Longitude -3.010° W. (Image: KaTeznik, CC BY-SA 2.0, via Wikimedia Commons)

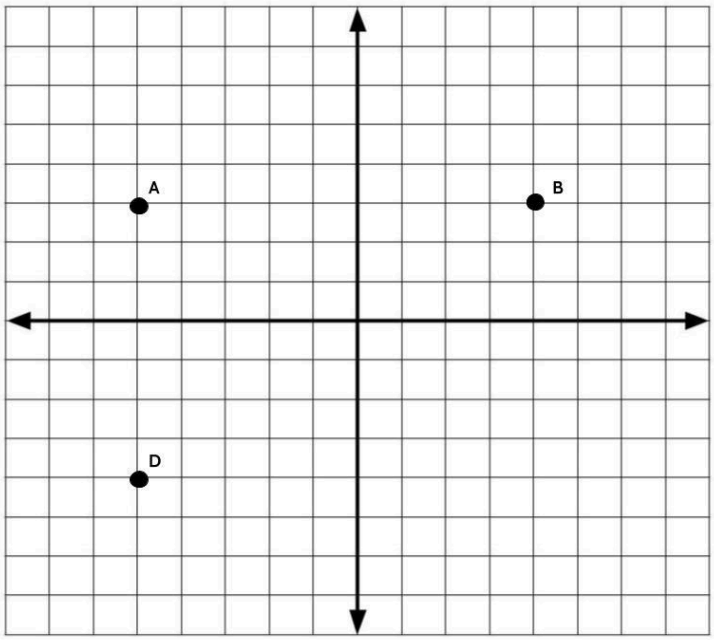
21) The Eiffel Tower is approximately located at about 49° north of the equator and about 2° to the east of the Prime Meridian. The precise coordinates for the Eiffel Tower are: 48.858° N and Longitude 2.294° E.



Shapes on the Coordinate Grid

Now that we have had some practice with naming and plotting points on a coordinate grid, let's use what we have learned to make shapes.

A rectangle is a four-sided shape with four right, or 90° angles. In a rectangle, opposite sides are both equal and parallel.

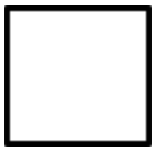


Draw Point C to complete rectangle ABCD.

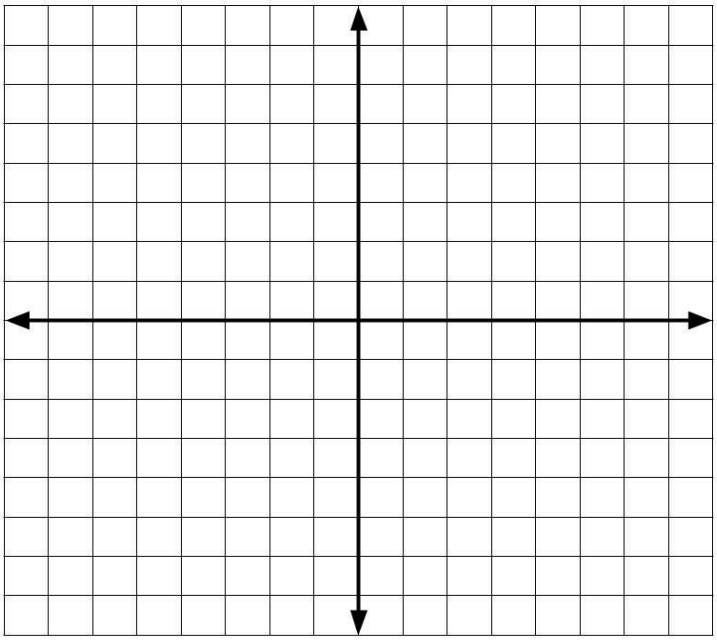
1) What are the coordinates of the ordered pair for Point C?

   Point C: (,)

2) A square is a special type of rectangle. A square is a rectangle where all four sides are equal in length.



On the coordinate grid, draw four points to create your own square. Label the four points E, F, G, and H. Write the coordinates for each point below.



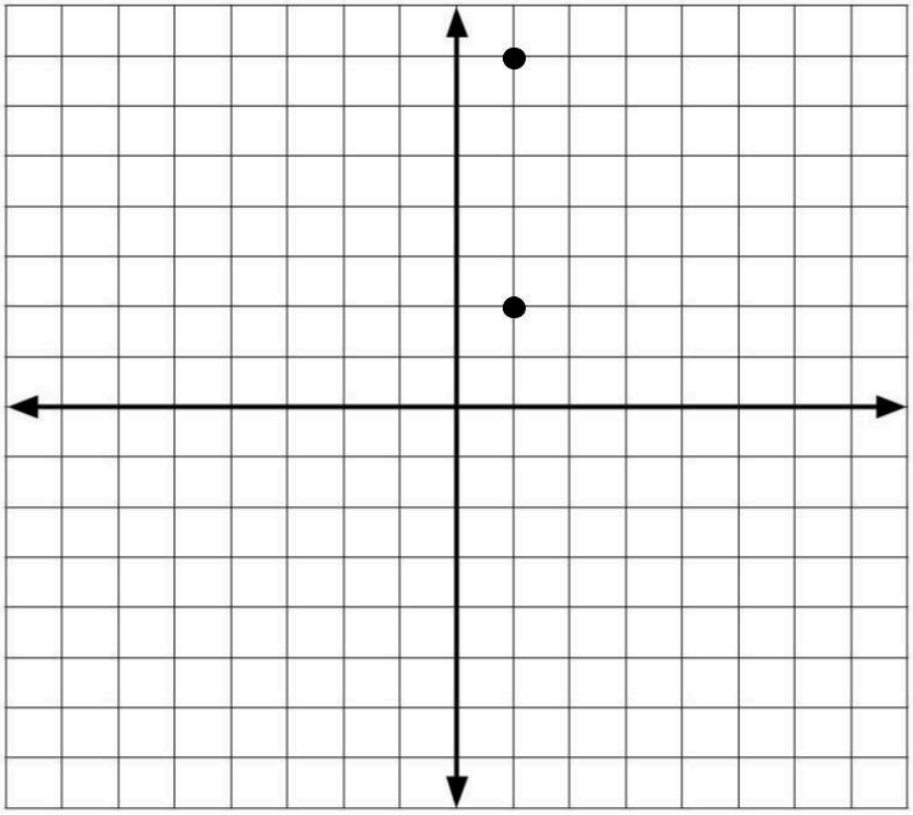
Point E: (,)

Point F: (,)

Point G: (,)

Point H: (,)

3)



Which <u>two</u> sets of ordered pairs can be used to make a <u>square</u> with the two points on the coordinate grid?

A. (7, -7) and (7, -2)

B. (6, 7) and (6, 2)

C. (-2, -2) and (-2, -7)

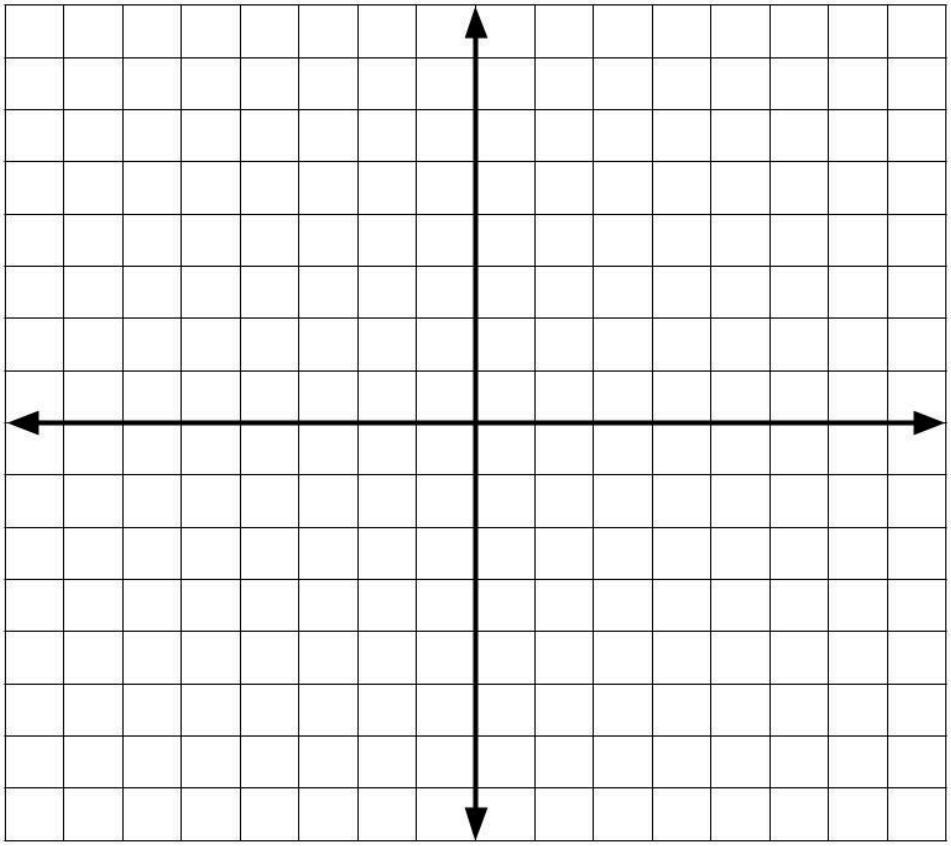
D. (-4, 2) and (-4, 7)

4) Find the perimeter of the rectangle that is formed by these four points:

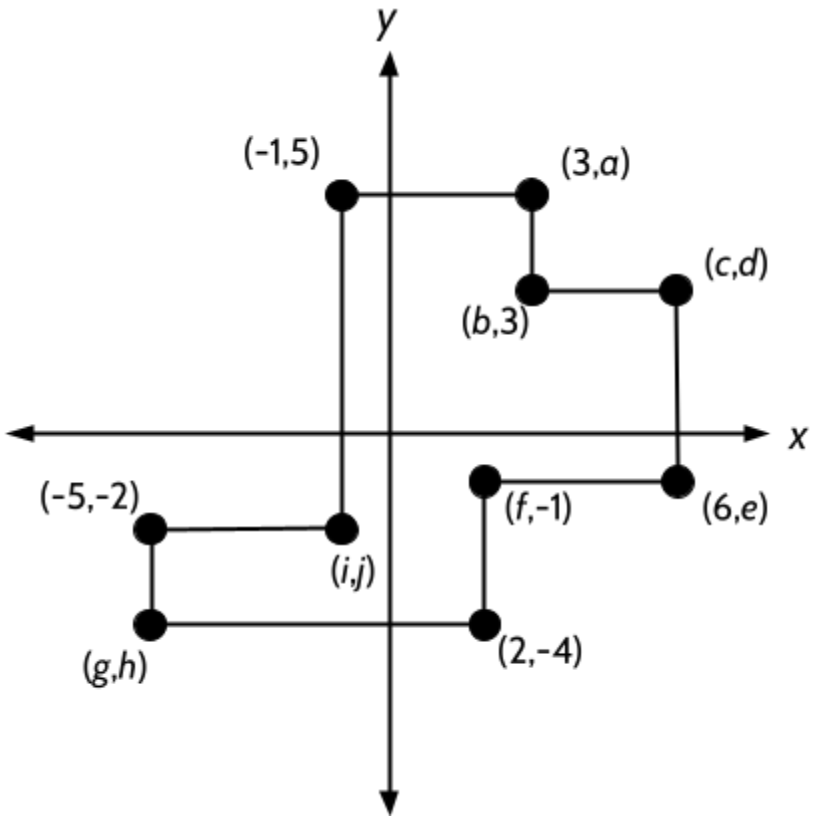
(3, 2) (5, 2) (5, -5) (3, -5)

HINT: The perimeter of any shape can be found by adding up the lengths of each of its sides.

The perimeter of the rectangle is _____.



5) In the figure below, all the angles are right angles and each line segment is parallel to one of the axes. Find the values of the missing coordinates.



a =

b =

c =

d =

e =

f =

g =

h =

i =

j =

6) What is the perimeter of the figure?

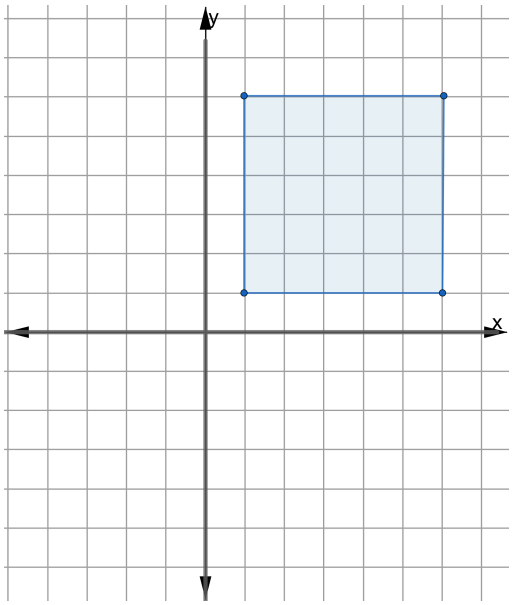
Shapes on the Coordinate Grid- Answer Key

1) Point C is (4, -4).
2) There are many different ways to plot four points to form a square on the coordinate plane. There are two things to pay attention to:

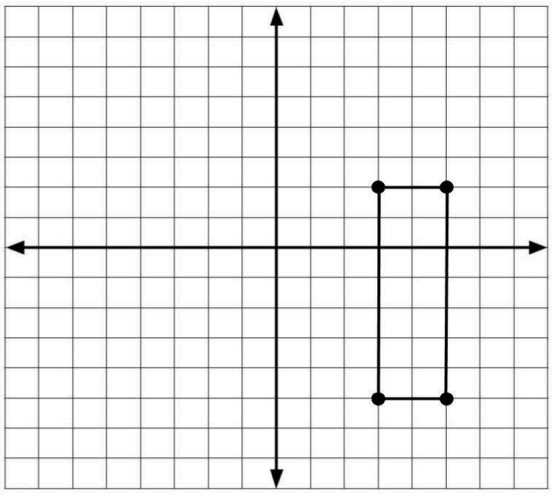
    1 - The points should be in order, clockwise or counterclockwise, CDEF.

    2 - The distance of each side of the square should be the same.

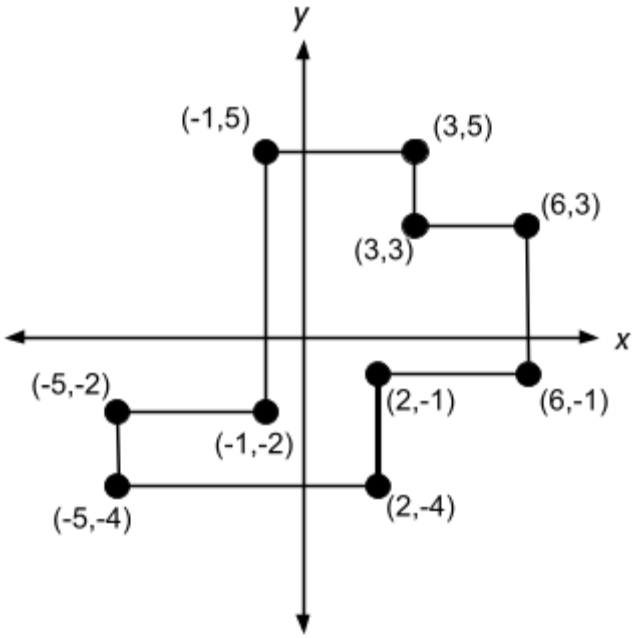
3) The two given points are 5 units away from each other. Both choices B and D would form the remaining sides of a square.



4) The perimeter of the rectangle would be 18 units.



5) a = 5, b = 3, c = 6, d = 3, e = -1, f = 2, g = -5, h = -4, i = -1, j = -2



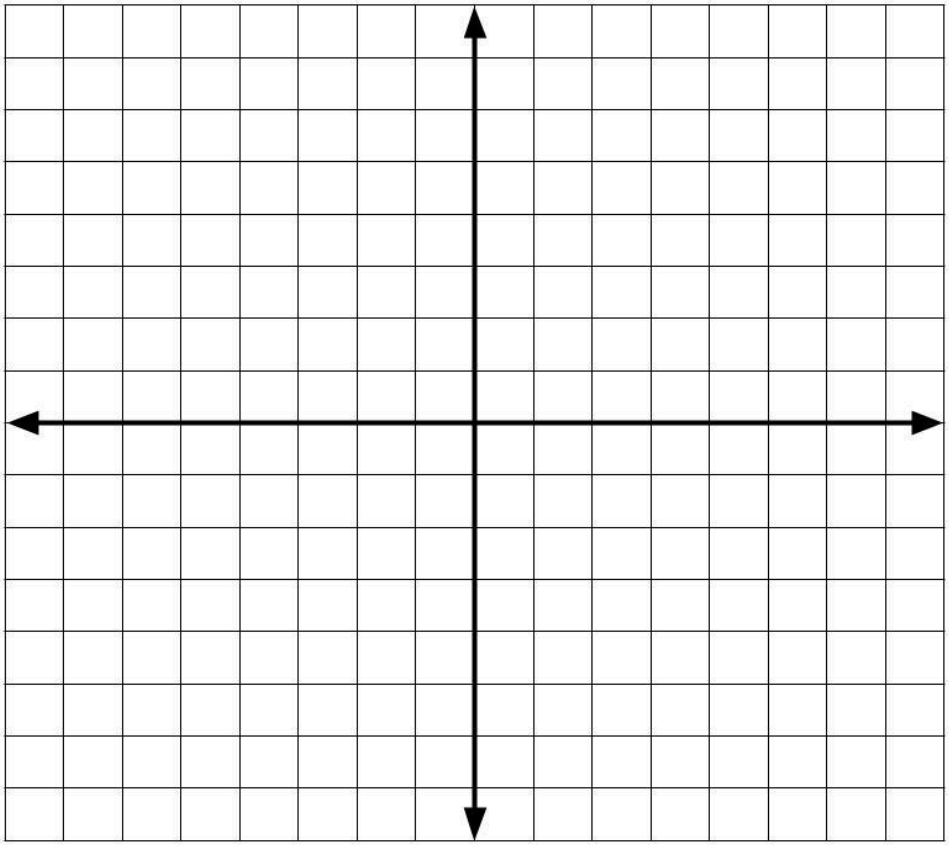
6) The perimeter of the figure is 40 units.

Lines on the Coordinate Grid

We have spent some time thinking about the two lines that define the coordinate grid: the *x*-axis and the *y*-axis. Now, you will plot points and create other lines.

1) Plot the following points on this coordinate grid:

(-7, -7), (-5, -5), (-3, -3), (-1, -1), (0, 0), (2, 2), (4, 4), (6, 6), (8, 8)



What do you notice about these points?

One thing you might have noticed is that the *x* and the *y* coordinates for each ordered pair are the same. You may also have noticed that the points form a line. If we continued plotting points, the line would continue.

In this example, the x values are the same as the y values in each point.

Lines on the coordinate grid are named by an equation that can be used to construct the line. We call this line:

$$y = x$$

This equation can be read as "*y* equals *x*" and describes a line made up of points where every ordered pair has the same *x* and *y* coordinates.

x	y	**Ordered Pair** (x, y)
-7	-7	(-7, -7)
-5	-5	(-5, -5)
-3	-3	(-3, -3)
0	0	(0, 0)
2	2	(2, 2)
4	4	(4, 4)
6	6	(6, 6)

2) From the list of points below, circle points that the line *y* = *x* would pass through if it continued.

(-76, -76)

(16, -16)

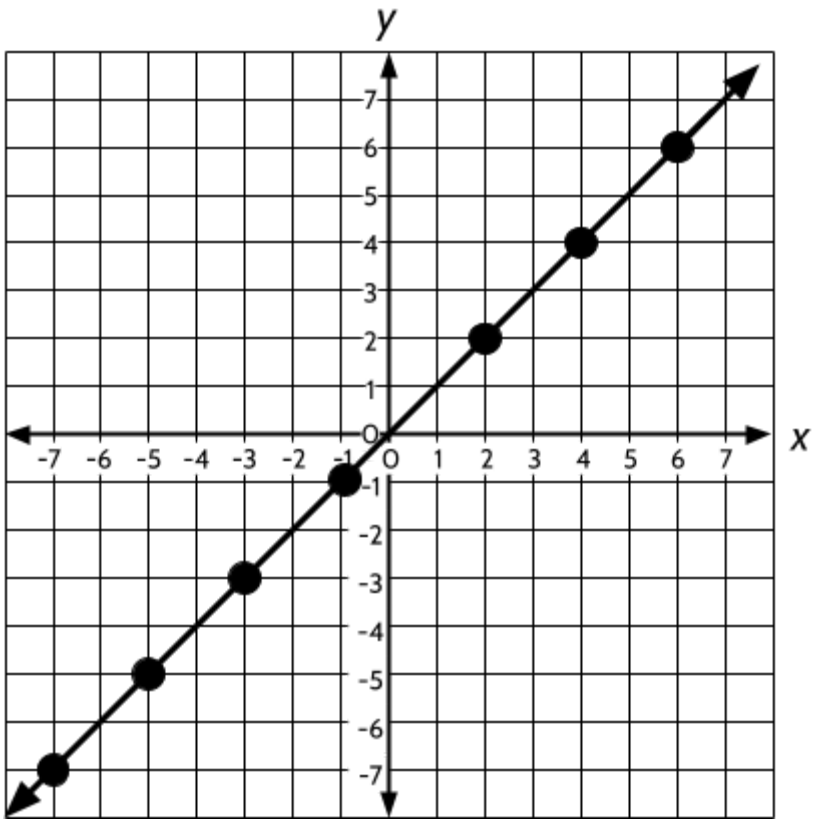
(3, 3)

(24, 24)

(-9, -9)

(5, -5)

How do you know?

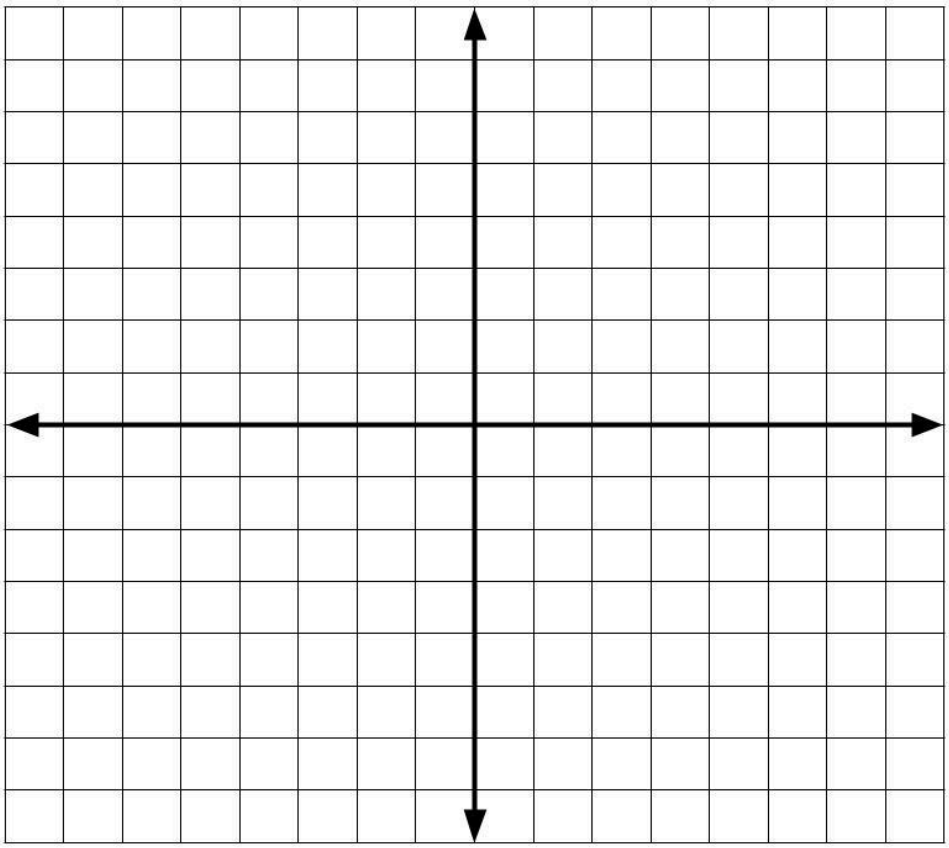


Let's look at another line.

3) Before adding these ordered pairs to the graph, make a prediction about what you think it will look like.

   (3, 6), (-2, 6), (6, 6), (-5, 6), (7, 6), (-4, 6), (1, 6), (-7, 6)

4) Now, plot the points on the graph.



   What do you notice?

One thing you may have noticed is that the *y* coordinate in each ordered pair is always 6.

The equation for this line is:

$$y = 6$$

$y = 6$ refers to the line where every ordered pair has a 6 for the *y* coordinate.

You may have noticed these points form a horizontal line. The line is parallel to the *x*-axis. It is parallel because the two lines (the *x*-axis and $y = 6$) are the same distance apart at any point along the line. They will always be 6 units apart.

x	y	**Ordered Pair** (x, y)
-7	6	(-7, 6)
-4	6	(-5, 6)
-2	6	(-3, 6)
0	6	(0, 6)
1	6	(2, 6)
3	6	(4, 6)
6	6	(6, 6)

5) Circle any points that would be on the line $y = 6$.

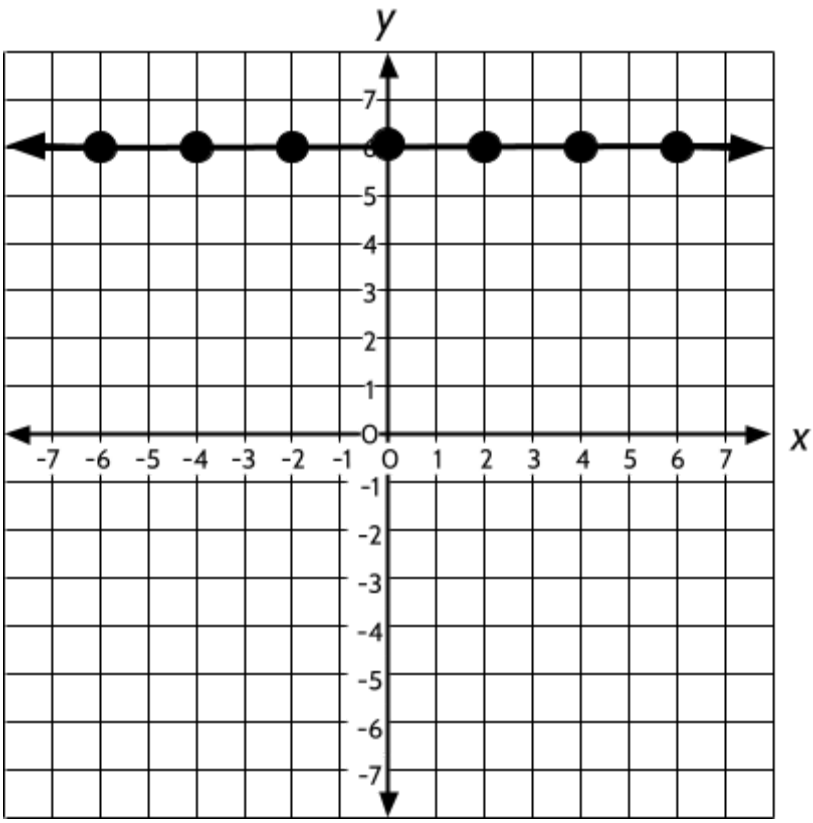
   (32, 6)

   (-19, 6)

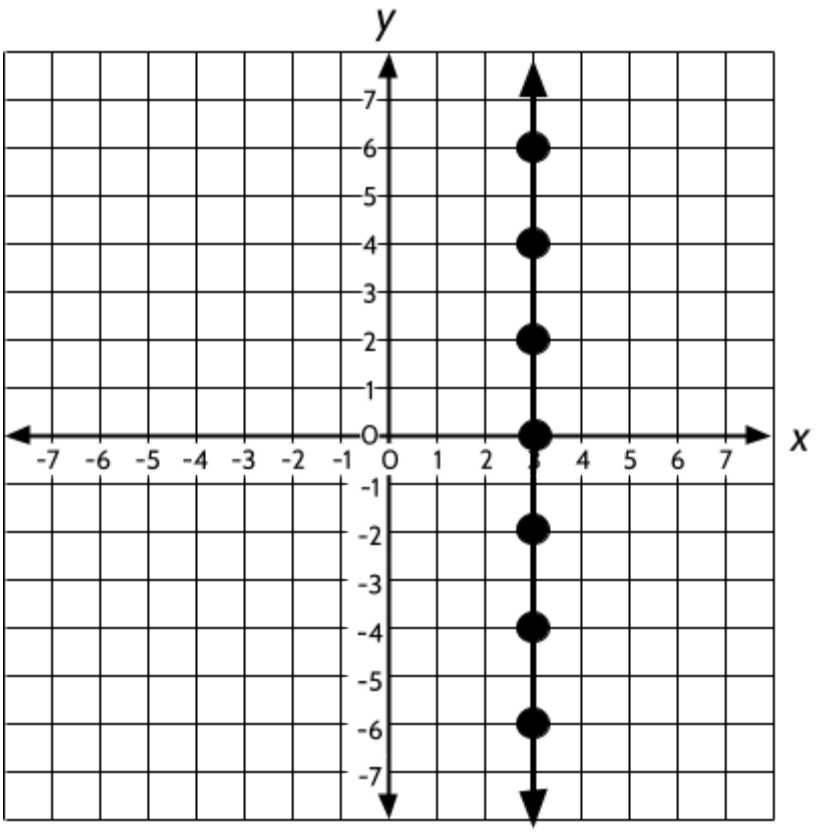
   (6, 12)

   (4, -6)

   How do you know?



Use this coordinate grid to answer question #6.



6) Fill in the blanks.

(___ , ___), (___ , ___), (___ , ___), and (___ , ___) are all examples of points on this line.

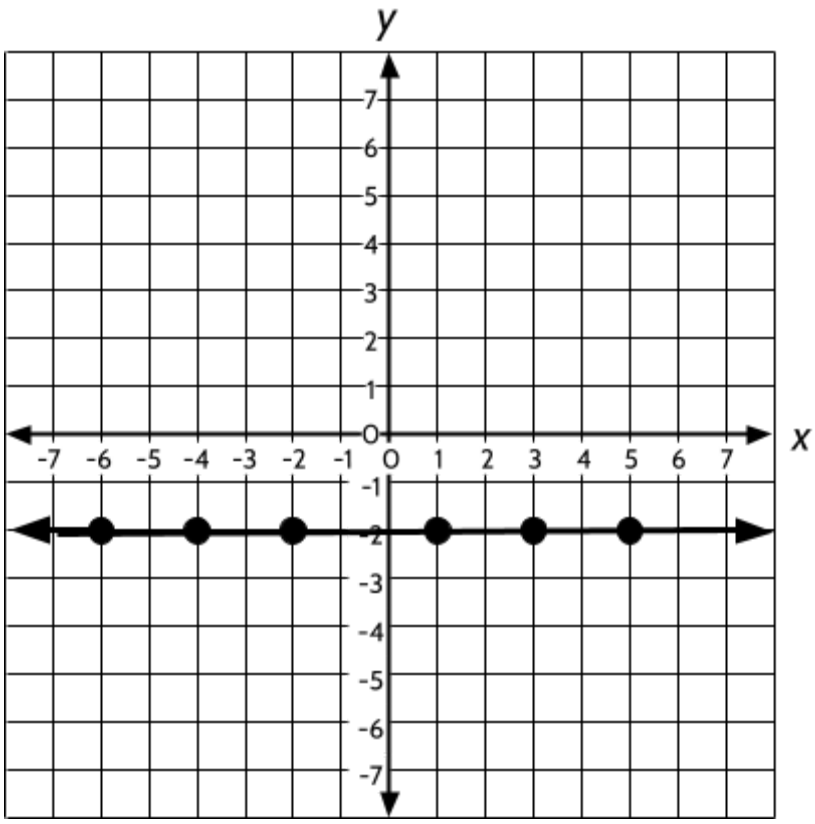
All points on the line have _____ as the value of the _____ coordinate.

This line is parallel to the _____-axis, because each point is _____ units away from that axis.

I think the equation that names this line is _____ because _____

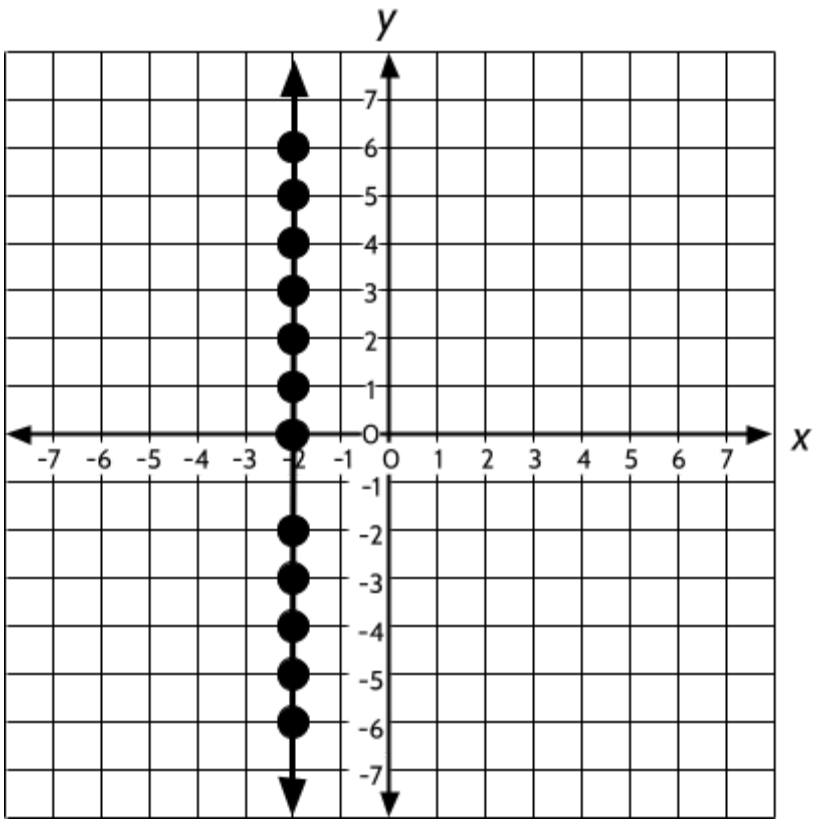
_____.

7) What is the name of the equation for the line on the graph? _____



8) Are the points (3, 6) and (3, 9) on the same horizontal line, the same vertical line, or neither? Explain why you think so.

9) What is the name of the equation for the line on the graph? _____



10) Are the points (-5, 6) and (3, 6) on the same horizontal line, the same vertical line, or neither? Explain why you think so.

$$y = x + 2$$

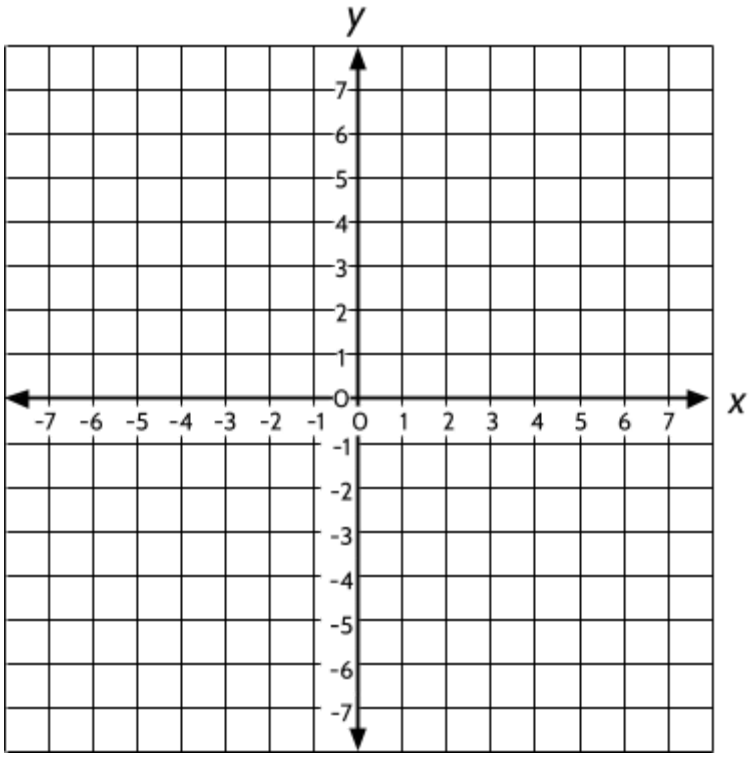
The equation $y = x + 2$ refers to the line where the *y* coordinate is 2 more than the *x* coordinate.

11) Complete the table to the right:

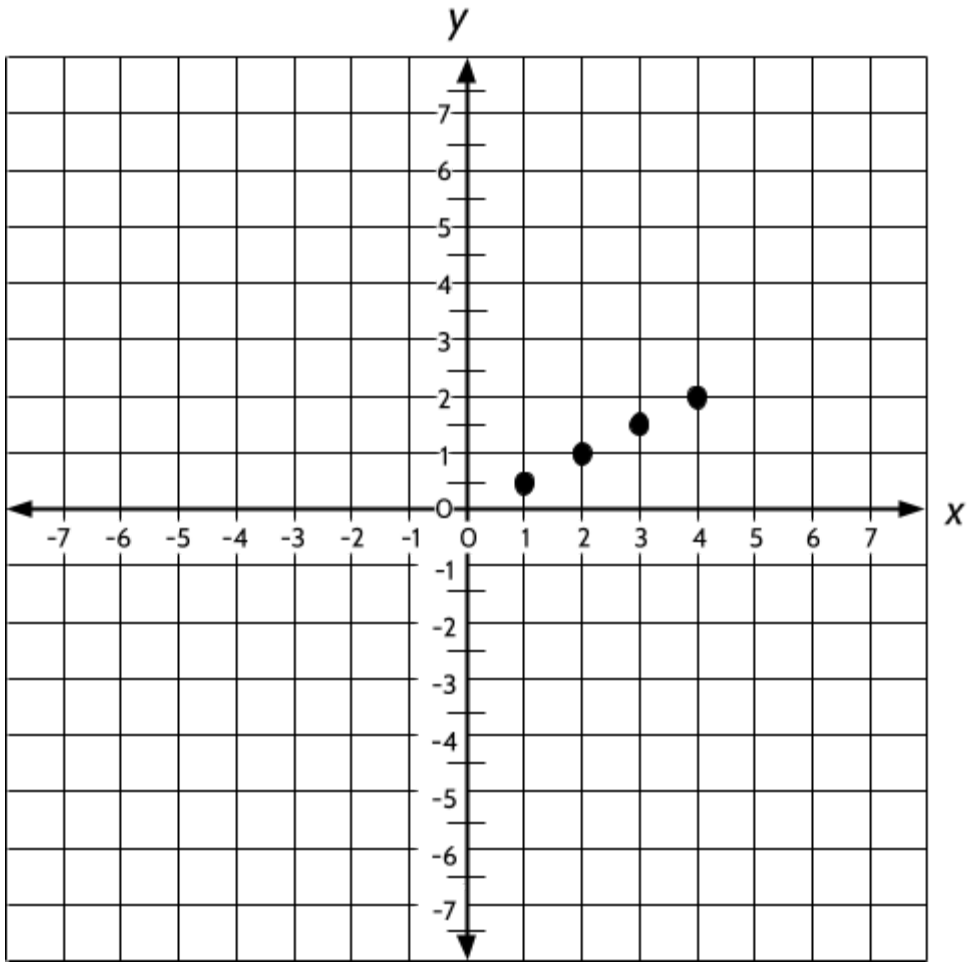
- Add the y coordinate for each given x coordinate.
- Write each ordered pair.

$y = x + 2$		
x	**y**	**(x, y)**
-7		(,)
-6		(,)
-5		(,)
-4		(,)
-3		(,)
-2		(,)
-1		(,)
0		(,)
1		(,)
2	4	(2, 4)
3		(,)
4		(,)
5		(,)

12) Plot the points on the graph below.



There are four points in a line on the graph below.



13) Write the ordered pairs of the four points already on the graph.

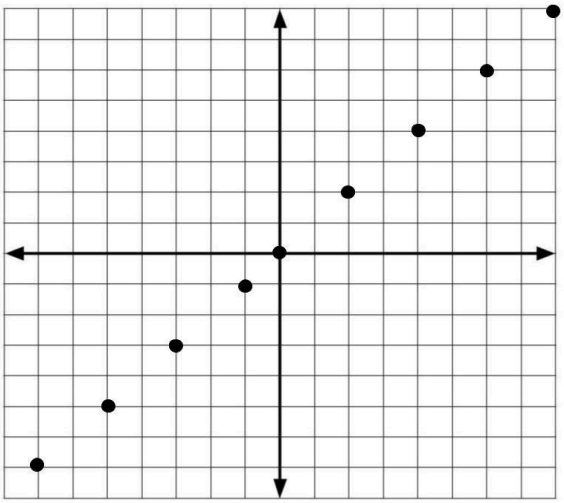
(,) (,) (,) (,)

14) Add the ordered pairs of four *other* points on the line and then add them to the graph.

(,) (,) (,) (,)

Lines on the Coordinate Grid - Answer Key

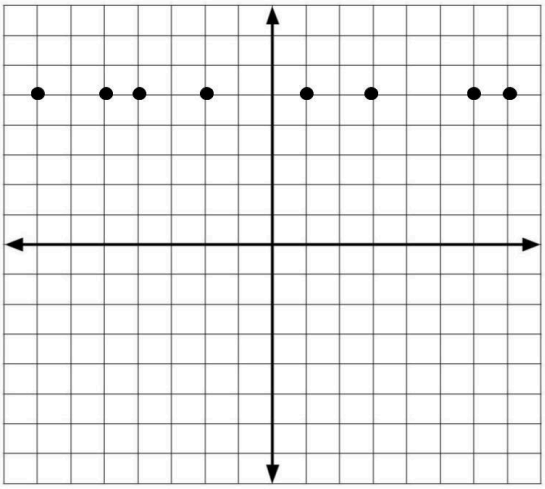
1)



2) $y = x$ would pass through four of the points: (-76, -76), (3, 3), (24, 24) (-9, -9). We can tell because the x and y coordinate is the same. In the ordered pairs (16, -16) and (5, -5) the x and y values are not the same. (16, -16) and (5, -5) would be in Quadrant 4. $y = x$ goes through Quadrants 1 and 3.

3) There are many predictions you might have made. Maybe you thought the points would form a line. Maybe you thought each point would be six hops above the x-axis.

4)



5) Line $y = 6$ would pass through (32, 6) and (-19, 6). Both of those points have 6 as the *y* coordinate.

6)

- There are many correct answers. (3, 0), (3, 3), (3, -2), and (3, -4) are all examples of points on this line.
- All points on the line have 3 as the value of the *x* coordinate.
- This line is parallel to the *y*-axis, because each point is 3 units away from that axis.
- I think the equation that names this line is $x = 3$ because it refers to a line where every ordered pair has a 3 for the *x* coordinate.

7) The equation of the line is $y = -2$. The *y* coordinate for every ordered pair on the line is -2. The line is two units below the *x*-axis.

8) The points (3, 6) and (3, 9) are on the same vertical line. There are several ways we can tell. One way is to recognize they have the same *x*-coordinate, which means they will be the same distance away from the *y*-axis. Both of these points are 3 steps to the right of the *y*-axis.

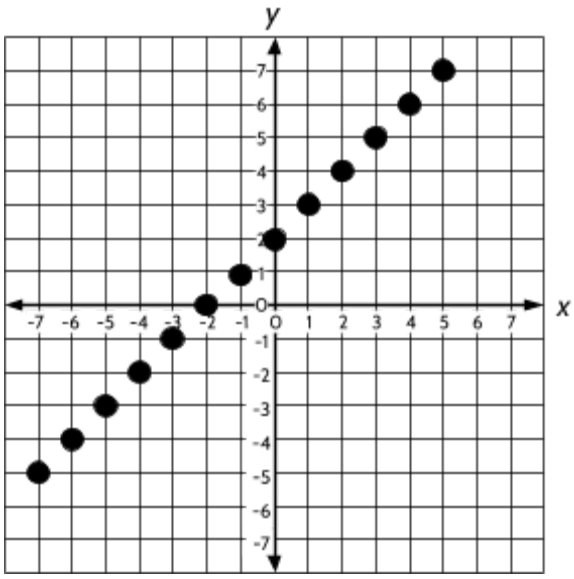
9) The equation of the line is $x = -2$. The *x* coordinate for every ordered pair on the line is -2. The line is 2 units to the left of the *y*-axis.

10) The points (-5, 6) and (3, 6) are on the same horizontal line. There are several ways we can tell. One way is to recognize they have the same *y*-coordinate, which means they will be the same distance away from the *x*-axis. Both of these points are 6 steps above the *x*-axis.

11)

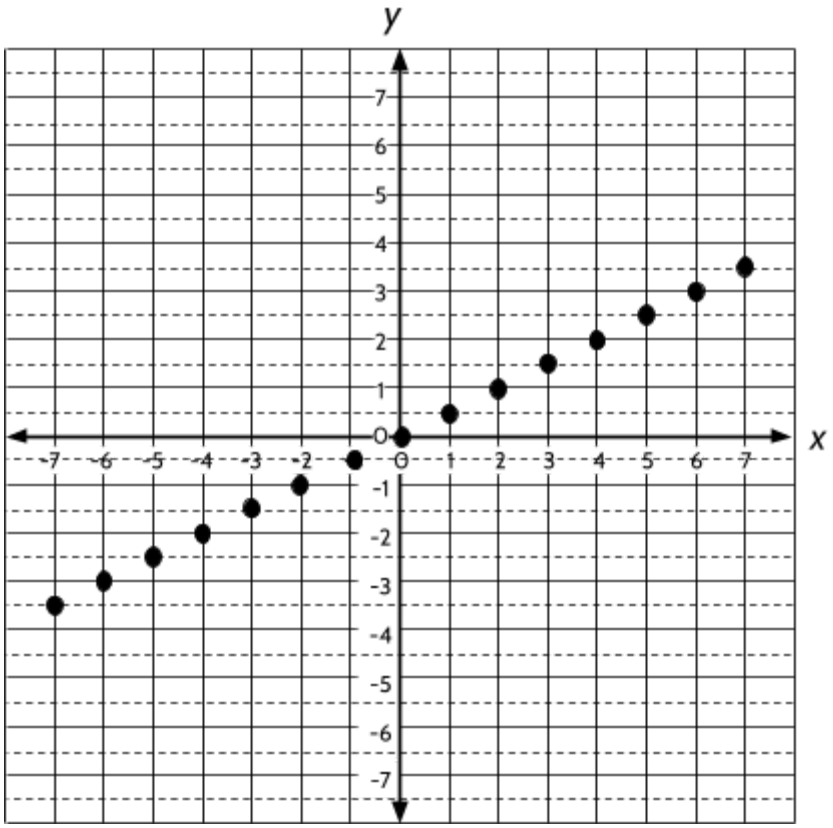
x	y	**Ordered Pair**
-7	-5	(-7, -5)
-6	-4	(-6, -4)
-5	-3	(-5, -3)
-4	-2	(-4, -2)
-3	-1	(-3, -1)
-2	0	(-2, 0)
-1	1	(-1, 1)
0	2	(0, 2)
1	3	(1, 3)
2	4	(2, 4)
3	5	(3, 5)
4	6	(4, 6)
5	7	(5, 7)

12)



13) The ordered pairs already on the graph are: (1, ½), (2, 1) (3, 1 ½) (4, 2)

14)



Data on the Coordinate Grid

Coordinate grids are also useful for displaying data. They allow us to use a single point to show two pieces of information. That means we can collect data about two related quantities and display it on a graph.

Consider this situation. The Ortega family is considering buying a car. One of the things they are worried about is the price of gas. One of the cars they are considering has a gas mileage of 30 miles per gallon. That means for every gallon of gas, the car can travel 30 miles. If the car takes 1 gallon to drive 30 miles, then another gallon would be another 30 miles. So 1 gallon lasts for 30 miles, 2 gallons lasts for 60 miles, 3 gallons lasts for 90 miles, and so on.

The other car they are considering has a gas mileage of 20 miles per gallon. That means with 1 gallon of gas, the car can drive 20 miles, with 2 gallons it can drive 40 miles and so on.

1) Complete the charts below.

Car A: 30 miles per gallon	
Gallons	**Miles**
1	30
2	60
3	90
4	120
5	
6	
7	
8	
9	
10	
11	
12	

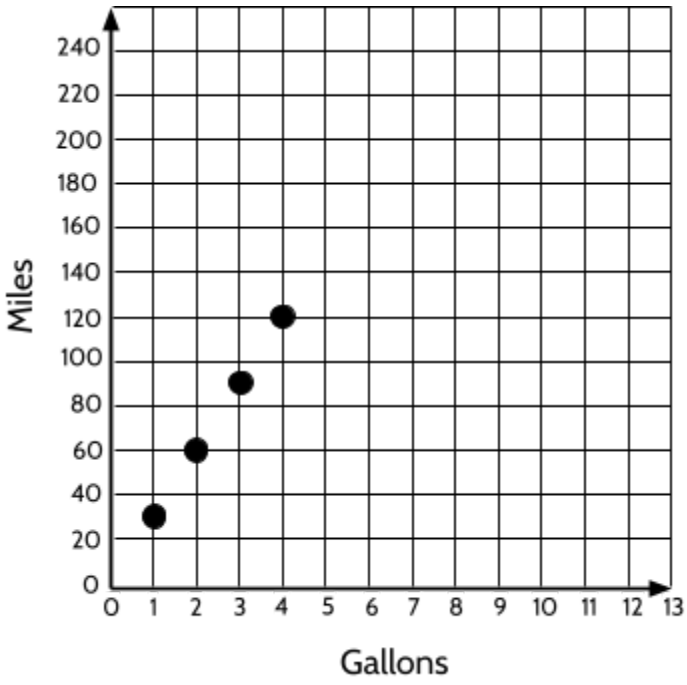
Car B: 20 miles per gallon	
Gallons	**Miles**
1	20
2	40
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

When we have two quantities that are related to each other, we can put the numbers in a table to help us organize the information. We can also add the information to a graph.

The table below is similar to the one you completed for Car A, with a new column for ordered pairs. Those ordered pairs have been added to the graph below.

2) Complete the chart, including the ordered pairs. Then plot the points on the graph.

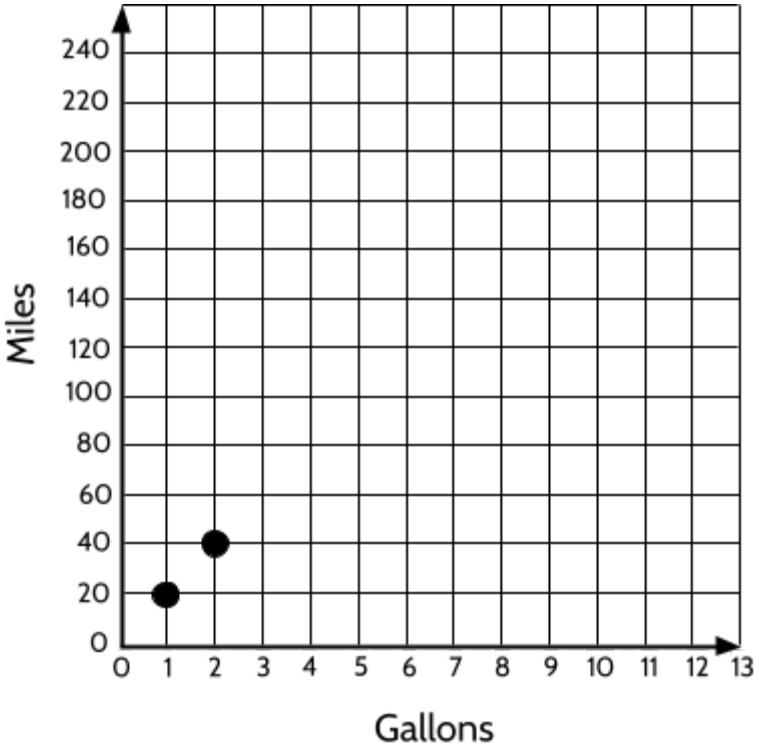
Car A: 30 miles per gallon		
Gallons	**Miles**	**Ordered Pair**
x	**y**	**(x, y)**
1	30	(1, 30)
2	60	(2, 60)
3	90	(3, 90)
4	120	(4, 120)
5		
6		
7		
8		



3) If the national average gas price in the US is $3.60, how much will it cost the Ortega family to buy enough gas to drive 240 miles in Car A?

4) Complete the chart for Car B, including the ordered pairs. Then plot the points on the graph.

Car B: 20 miles per gallon		
Gallons	**Miles**	**Ordered Pair**
x	**y**	**(x, y)**
1	20	(1, 20)
2	40	(2, 40)
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		



5) If the national average gas price in the US is $3.60, how much will it cost the Ortega family to buy enough gas to drive 240 miles in **Car B**?

Points on a coordinate grid do not always form a straight line.

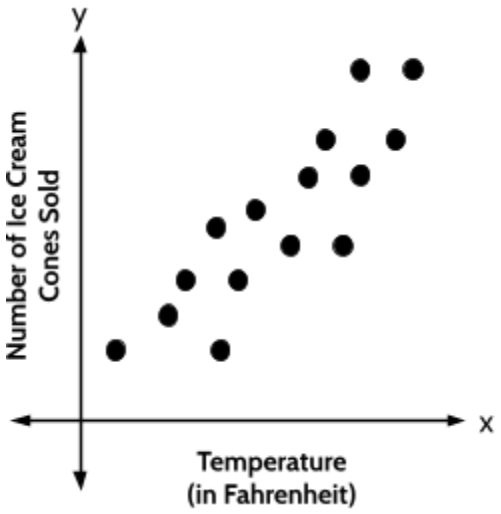
A **scatter plot** is a graph we can use to look for relationships between two sets of data. We plot points from two sets of data and look for a relationship. When two sets of data have a strong connection, we say they have a high ***correlation.*** Correlation is made of *Co-* (meaning "together") and *relation*.

When two sets of data have a high correlation:

- If both *x* and *y*-values are increasing, we say there is a ***positive correlation.***

  For example, imagine we collected data on temperature and ice cream sales. We would expect that as the temperature went up, ice cream sales would also go up.

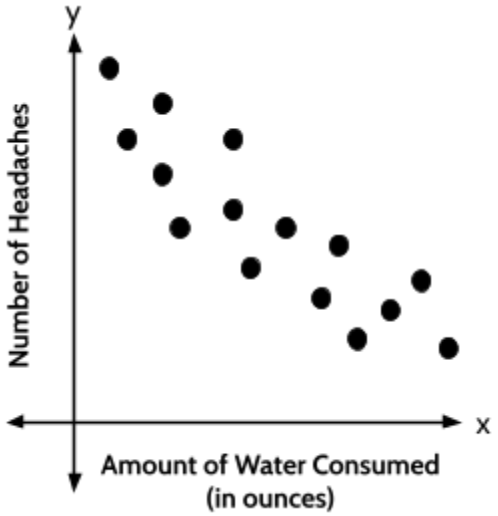
  A scatterplot showing a positive correlation might look something like this, where as the *x*-values increase, the *y*-values also increase.



- If one value is increasing while the other value is decreasing, we say there is a ***negative correlation.***

  For example, if we collected data on the amount of water we drink and the number of headaches we have, we might expect a negative correlation where the more water we drink, the fewer the number of headaches we have.

  A scatterplot showing a negative correlation might look something like this, where as the *x*-values increase, the *y*-values decrease.

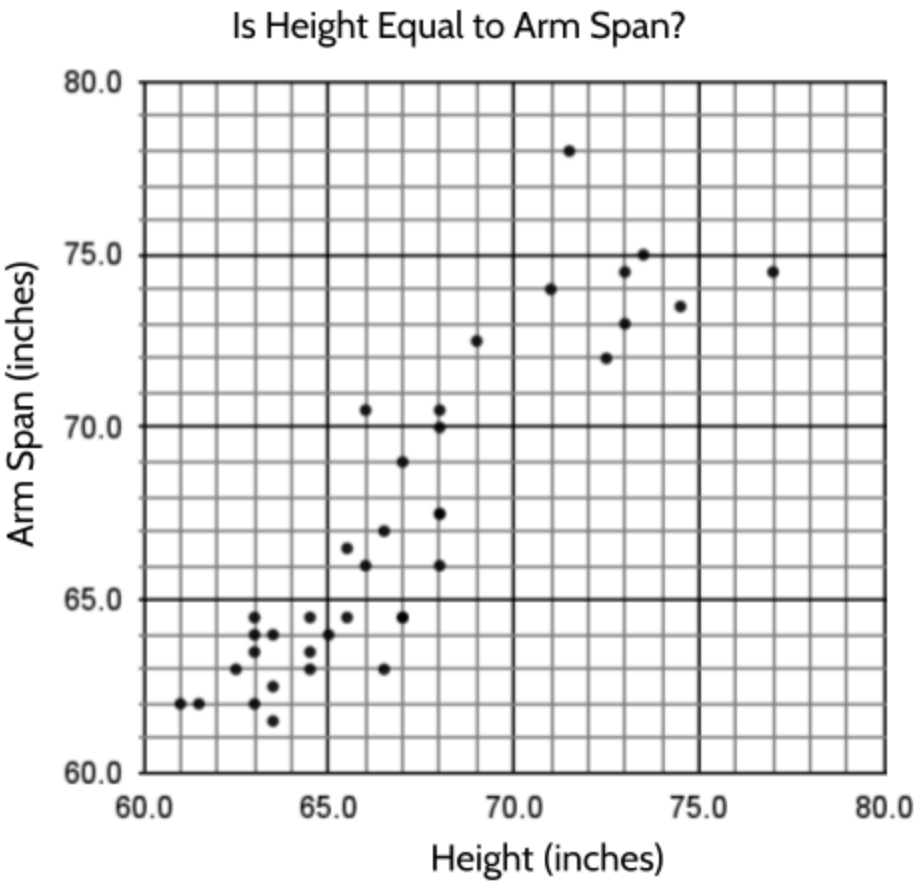


Some people say that a person's height is approximately equal to their arm span.

Arm span is when you stretch both arms out to your sides and measure the length from fingertip to fingertip.

A group of people did an experiment where they measured their heights and arm spans and added the data to a scatter plot.

What do you notice?



6) What type of correlation is there between the heights and arm spans of the people in this experiment?

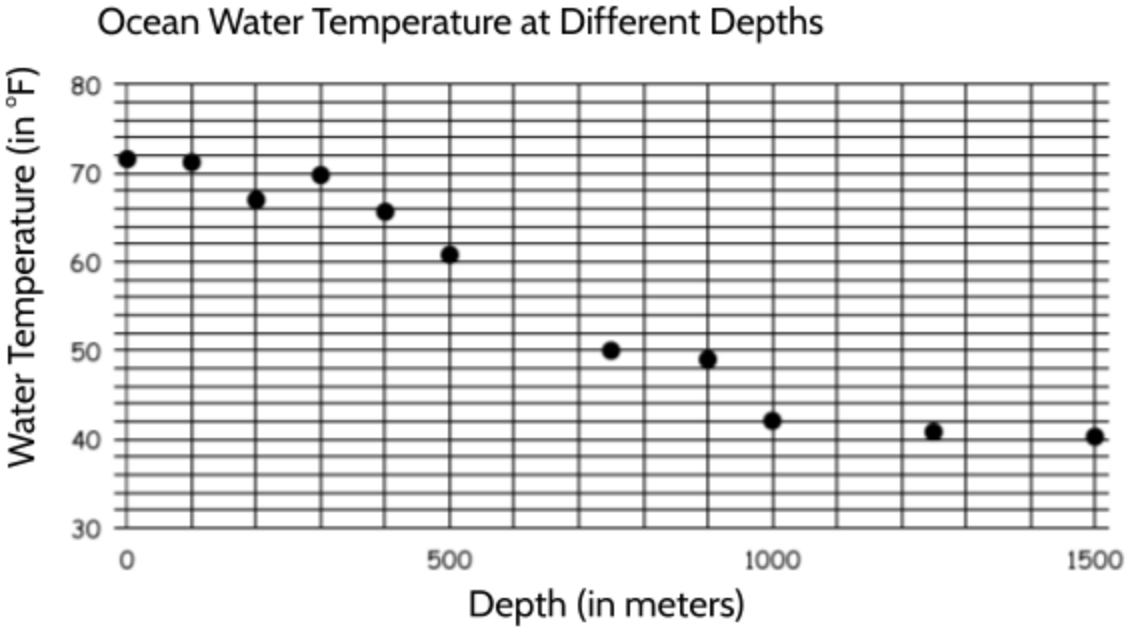
   A. Positive correlation

   B. Negative correlation

   C. No correlation

What makes you think so?

A group of scientists took temperature readings at different depths of the ocean. Their data is represented in the graph.



7) Which of the following statements is true?

   A. There is a positive correlation between the temperature of the ocean and depth.

   B. There is a negative correlation between the temperature of the ocean and depth.

   C. There is no correlation between the temperature of the ocean and depth.

   D. The deeper the reading, the warmer the temperature of the water.

8) What is the most likely temperature for the ocean at a depth of 600 meters?

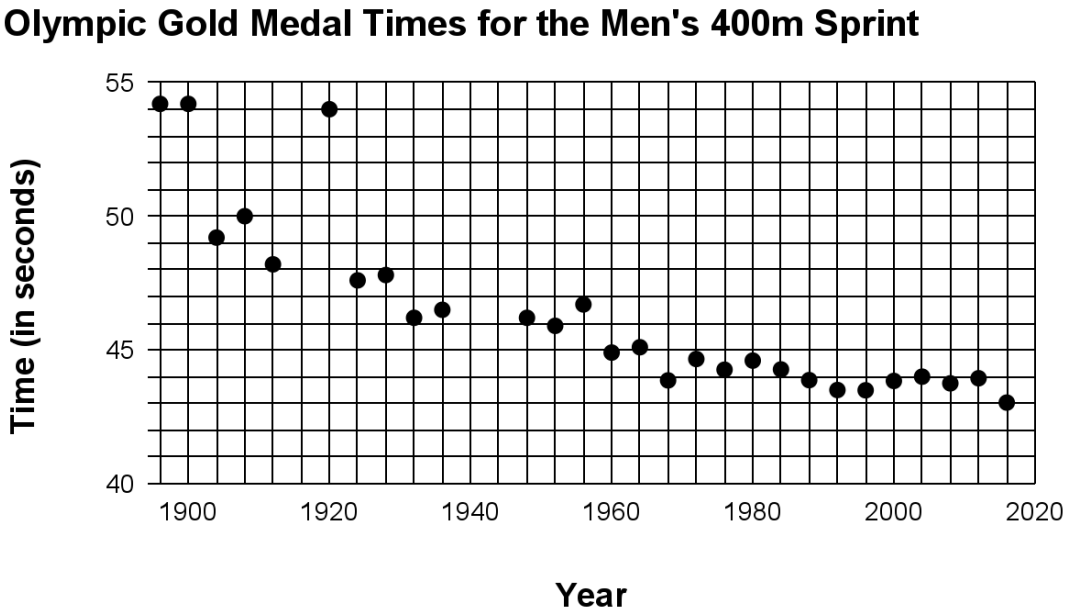
   A. 40℉

   B. 56℉

   C. 64℉

   D. 68℉

9) The graph below shows how many seconds it took to win the final men's 400-meter sprint at the Olympic Games, in the years 1896 to 2016.



Which of the following statements is best supported by the information in the graph?

A. As the years go by, runners have gotten faster.

B. As the years go by, runners have gotten slower.

C. No one has ever run the 400m sprint in less than 44 seconds.

D. There were no Olympic Games in 1952.

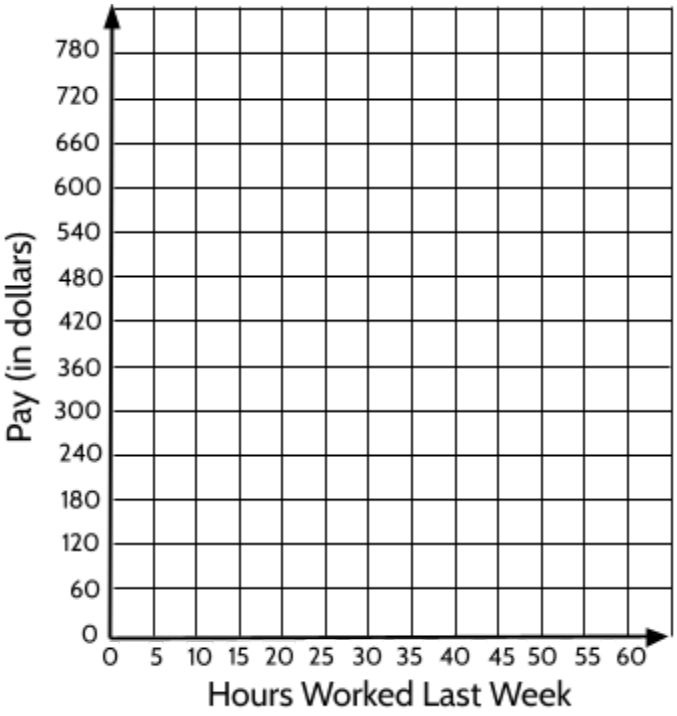
Explain how you know.

A group of 15 employees at a company wanted to see if they were being paid in a fair and equal way. They each wrote the number of hours they worked in a week and their pay. It was anonymous, meaning no one wrote their name. The responses are written in the table below.

Hours	Pay	Ordered Pair
15	$240	(15, 240)
30	$750	(30, 750)
60	$780	(60, 780)
25	$540	(25, 540)
35	$360	(35, 360)
30	$240	(30, 240)
20	$330	(20, 330)
35	$420	(35, 420)
25	$420	(25, 420)
20	$360	(20, 260)
30	$360	(30, 360)
30	$540	(30, 540)
45	$720	(45, 720)
25	$810	(25, 810)
40	$600	(40, 600)

10) What does the point (35, 420) mean in the context of this situation?

11) Add the ordered pairs to the graph.



12) Look at the data in the graph. Do you think the employees are being paid in a fair and equal way? Explain your reasons.

Data on the Coordinate Grid - Answer Key

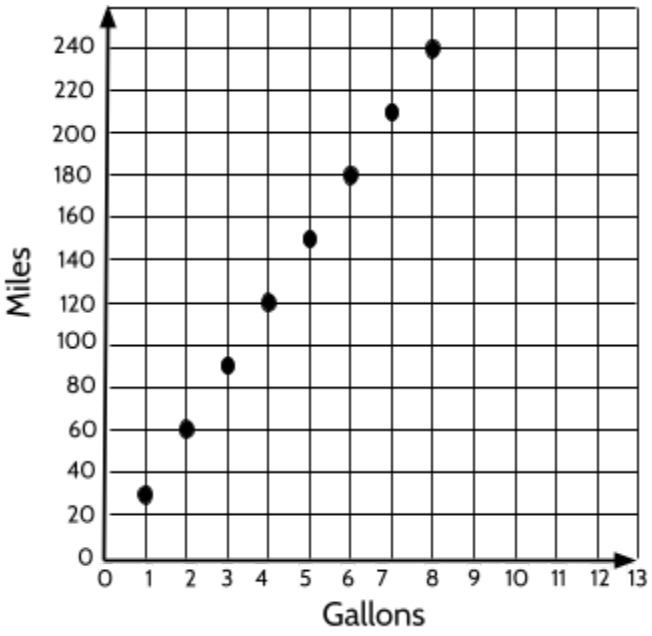
1)

Car A: 30 miles per gallon	
Gallons	**Miles**
1	30
2	60
3	90
4	120
5	150
6	180
7	210
8	240
9	270
10	300
11	330
12	360

Car B: 20 miles per gallon	
Gallons	**Miles**
1	20
2	40
3	60
4	80
5	100
6	120
7	140
8	160
9	180
10	200
11	220
12	240

2)

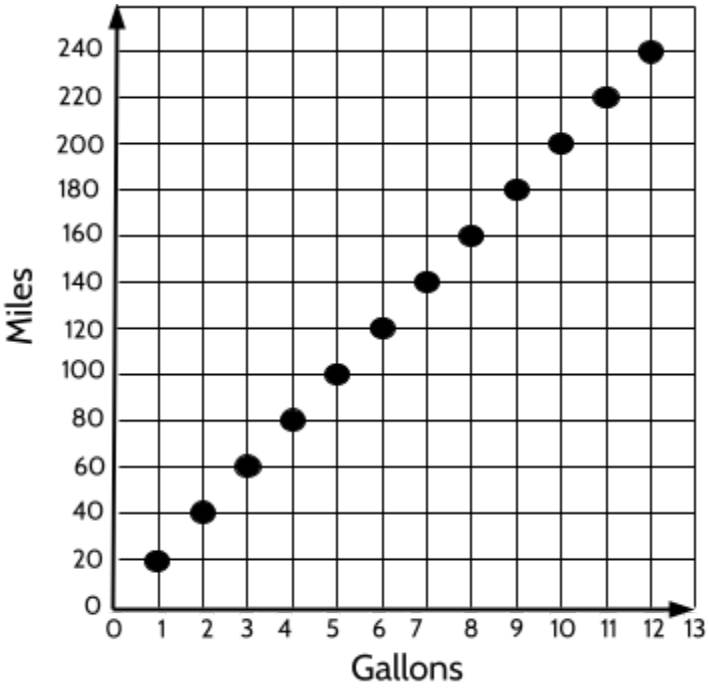
Car A: 30 miles per gallon		
Gallons	**Miles**	**Ordered Pair**
x	**y**	**(x, y)**
1	30	(1, 30)
2	60	(2, 60)
3	90	(3, 90)
4	120	(4, 120)
5	150	(5, 150)
6	180	(6, 180)
7	210	(7, 210)
8	240	(8, 240)



3) **$28.80.** Car A needs 8 gallons of gas to drive 240 miles. $3.60 × 8 = $28.80

4)

Car B: 20 miles per gallon		
Gallons	**Miles**	**Ordered Pair**
x	**y**	**(x, y)**
1	20	(1, 20)
2	40	(2, 40)
3	60	(3, 60)
4	80	(4, 80)
5	100	(5, 100)
6	120	(6, 120)
7	140	(7, 140)
8	160	(8, 160)
9	180	(9, 180)
10	200	(10, 200)
11	220	(11, 220)
12	240	(12, 240)



5) **$43.20.** Car B needs 12 gallons of gas to drive 240 miles. $3.60 × 12 = $43.20

6) There is a positive correlation between height and arm span. In general, as the heights increase, the arm spans also increase.

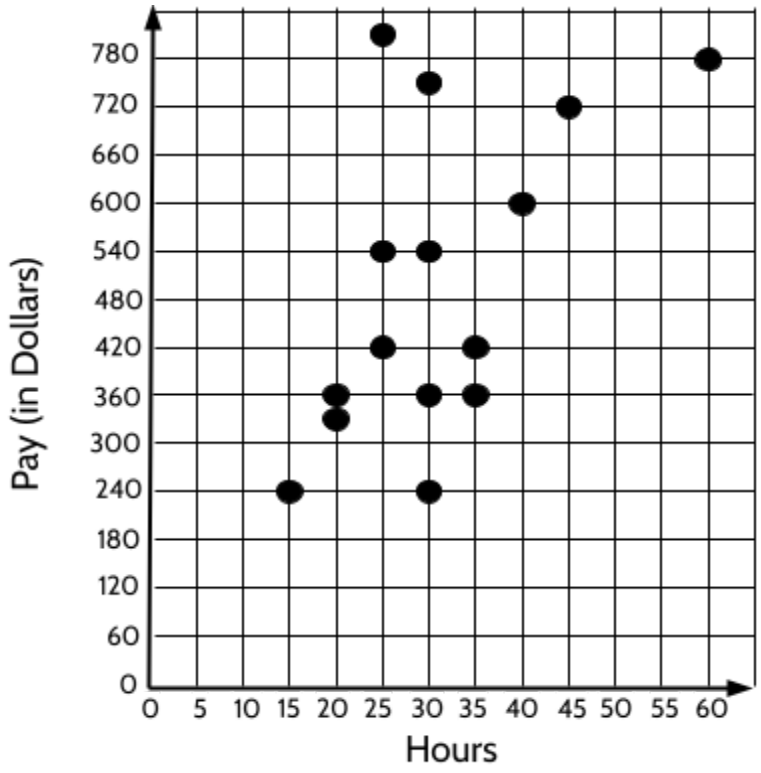
7) B. As the depth increases, the temperature decreases, so there is a negative correlation.

8) B

9) A

10) (35, 420) means that someone worked for **35** hours and earned **$420.**

11)

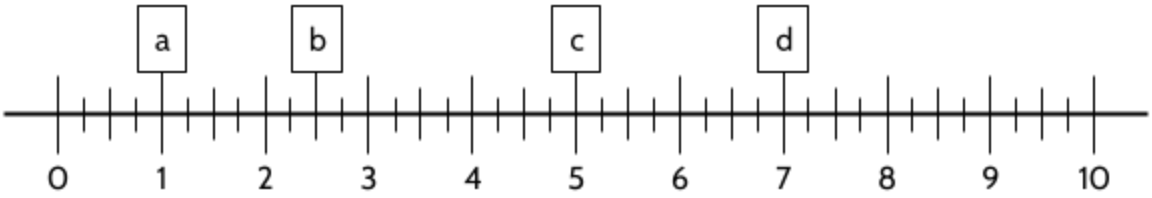


12) There are many ways to answer the question. The point is to explain your reasons based on the graph.
- You might say it is not fair and equal, because there are examples of people working the same number of hours for different amounts of pay. For example, one person worked 30 hours and earned $240 and another person worked 30 hours and earned $750.
- You can also see that some people earned the same amount of money for working a different number of hours. For example, three people earned $360. One of them worked 20 hours, one worked 30 hours, and one worked 35 hours.
- Another example is someone earned $780 for 60 hours of work, and someone else earned $750 for 30 hours of work, which is almost the same amount of money for half as many hours of work.
- An argument could be made that maybe these people do different kinds of work, and that might explain the difference, but there is enough inequity that more questions should be asked and more data collected.

Test Practice Questions

Answer the following questions. You can check your answers in the Answer Key.

1) Which of the following points on the number line shows the number $\frac{5}{2}$?



A. a

B. b

C. c

D. d

2) Which of the following numbers is not represented by the point on the number line?

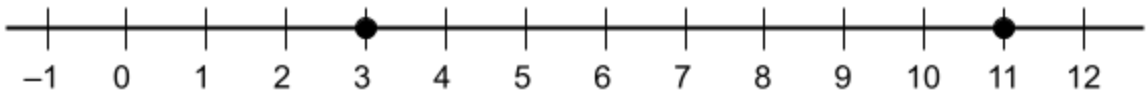
A. $3\frac{1}{2}$

B. $\frac{14}{4}$

C. 3.5

D. 3.2

3) The numbers 3 and 11 are plotted on a number line. What is the distance, in units, between the two points?



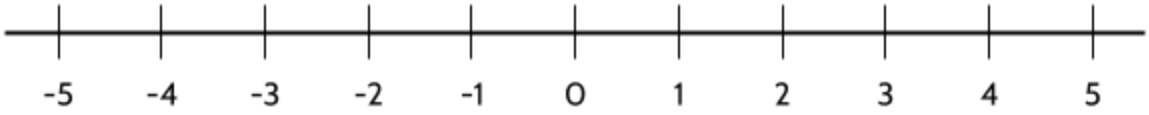
A. 7

B. 8

C. 9

D. 14

4) If the numbers -3 and 2 were plotted on a number line, what would be the distance, in units, between the two points?



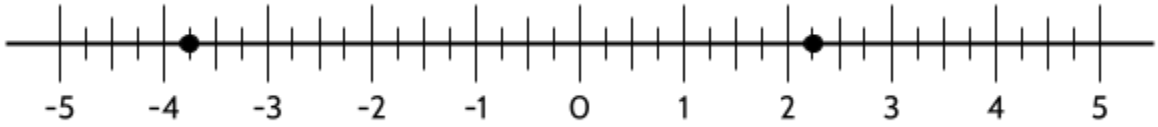
A. -6

B. -5

C. -1

D. 5

5) The numbers -3 ¾ and 2 ¼ are plotted on a number line. What is the distance, in units, between the two points?



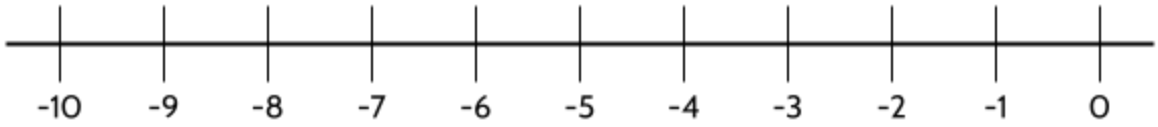
A. $-6\frac{3}{8}$

B. $-1\frac{1}{2}$

C. $1\frac{1}{2}$

D. 6

6) If the numbers -10 and -2 were plotted on a number line, what would be the distance, in units, between the two points?



A. -12

B. -8

C. 8

D. 20

7) A list of numbers is shown.

$\frac{1}{2}, 0.35, \frac{5}{8}, 0.8, \frac{3}{4}$

Which list shows the numbers in order from least to greatest?

A. $0.35, \frac{1}{2}, \frac{5}{8}, \frac{3}{4}, 0.8$

B. $0.35, \frac{1}{2}, \frac{5}{8}, 0.8, \frac{3}{4}$

C. $0.8, 0.35, \frac{1}{2}, \frac{3}{4}, \frac{5}{8}$

D. $0.35, \frac{1}{2}, \frac{3}{4}, \frac{5}{8}, 0.8$

8) A list of numbers is shown.

-5, $\frac{4}{5}$, -0.5, -8, 0

Which list shows the numbers in order from least to greatest?

A. 0, -0.5, $\frac{4}{5}$, -5, -8,

B. -0.5, -5, -8, 0, $\frac{4}{5}$

C. -8, -5, -0.5, 0, $\frac{4}{5}$

D. -8, -5, $\frac{4}{5}$, -0.5, 0

9) Which symbol makes this number sentence true?

$\frac{5}{8}$? $\frac{10}{16}$

A. $>$

B. ≥

C. $<$

D. =

10) Which symbol makes this number sentence true?

$\frac{3}{4}$? $\frac{3}{8}$

A. $>$

B. $<$

C. ≤

D. =

11) Which symbol makes this number sentence true?

$-\frac{3}{5}$? -0.5

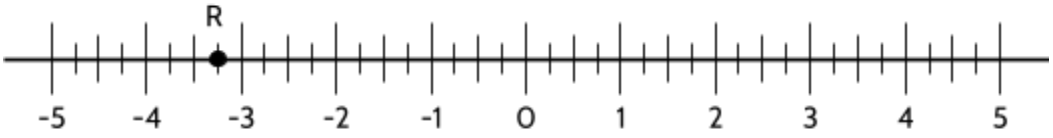
A. $>$

B. ≥

C. $<$

D. =

12) What is the distance between 0 (zero) and point R on the number line?



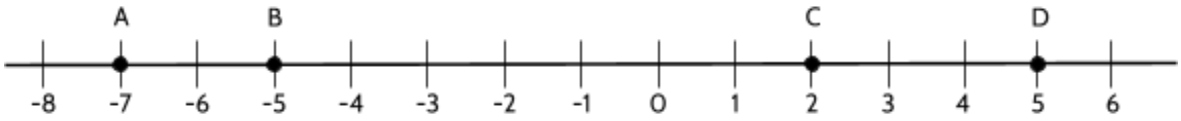
A. -3 ¼

B. -3 ⅓

C. 3 ⅓

D. 3 ¼

13) Which point does *not* have an absolute value of greater than 4?



A. Point A

B. Point B

C. Point C

D. Point D

14) What is the distance between -47 and -23 on the number line?

A. - 70

B. - 24

C. 24

D. 70

15) What is the distance between -13 and 3 on the number line?

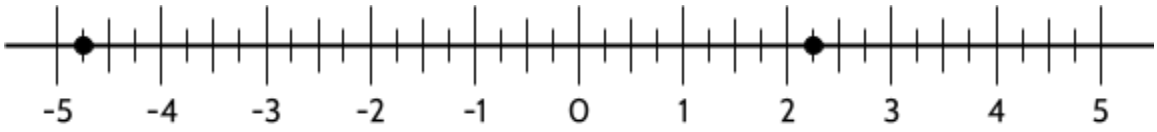
A. - 16

B. - 10

C. 10

D. 16

16) What is the distance between the two points on the number line?



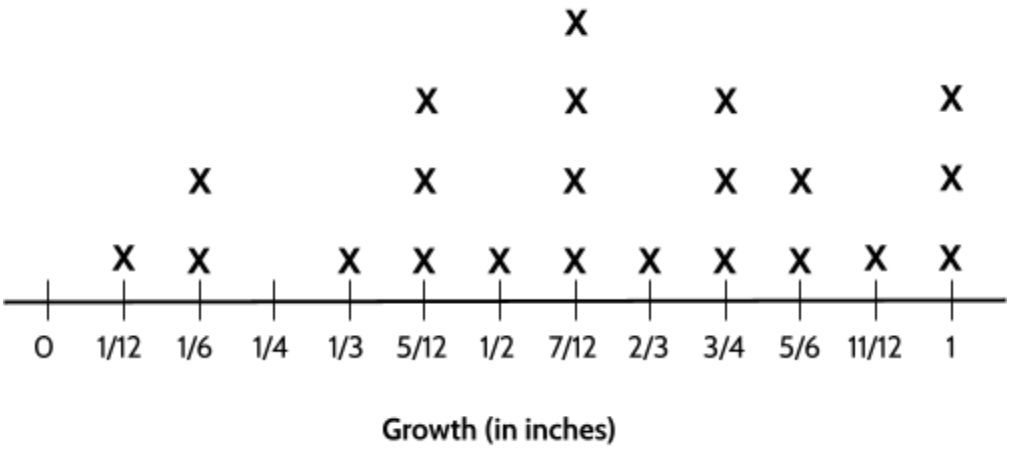
A. -7.5

B. 6

C. 7

D. 28

17) A gardener measured the growth of 22 plants for one week. The line plot below shows the amount of growth for each plant. What is the difference in growth between the plant that showed the most growth and the plant that showed the least growth?



A. $\frac{1}{4}$ inch

B. $\frac{7}{12}$ inch

C. $\frac{11}{12}$ inch

D. 1 inch

18) The temperature reading on a thermometer goes from -12°F to 9°F. What is the change in temperature?

A. -3°F

B. 3°F

C. 21°F

D. 23°F

19) What is the difference between the two points on the number line?

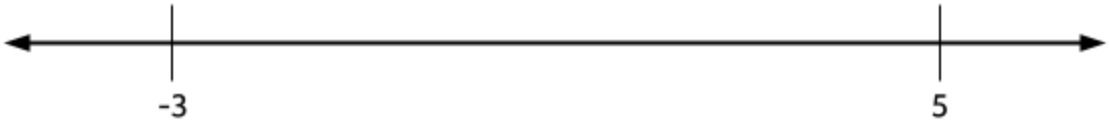
A. 6.5

B. 15

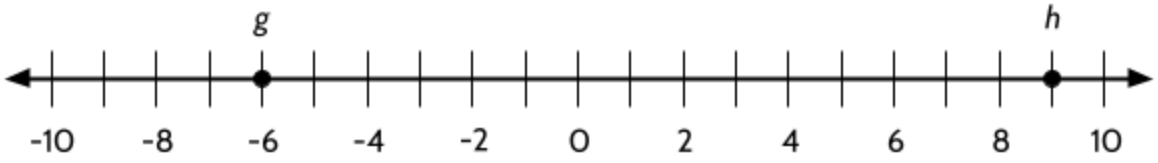
C. 50

D. 65

20) Plot the number 1 on the number line below. Draw a point on the line to represent the number.



21) What is the value of the expression |g| + |h|?



A. -15

B. -3

C. 3

D. 15

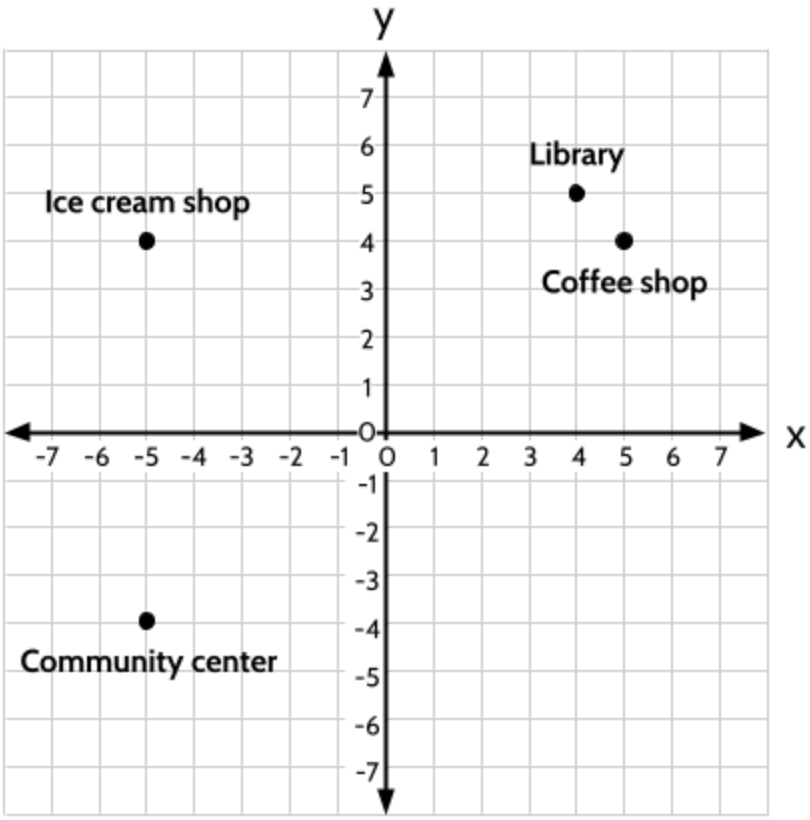
22) The graph below shows different locations in a neighborhood. Which location can be found at point (5, 4)?

A. Library

B. Coffee shop

C. Ice cream shop

D. Community center



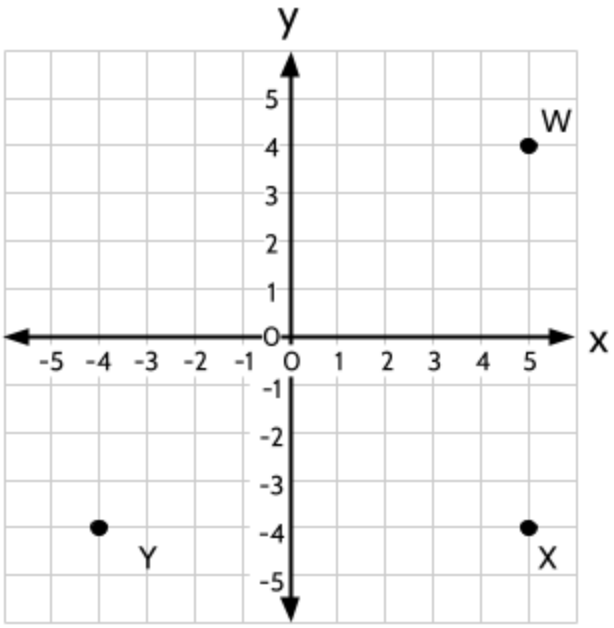
23) Which ordered pair describes the location of the point that would make a square with the other points on the graph?

A. (4, 4)

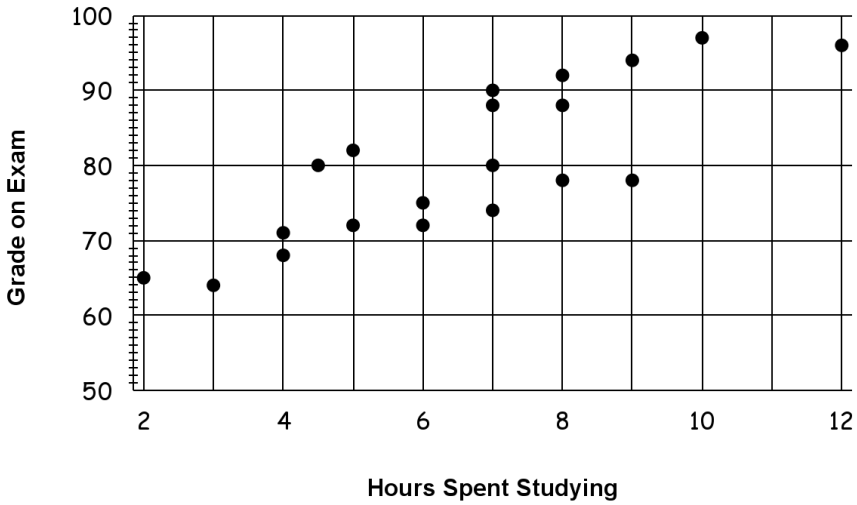
B. (-4, 4)

C. (4, -4)

D. (-4, -4)



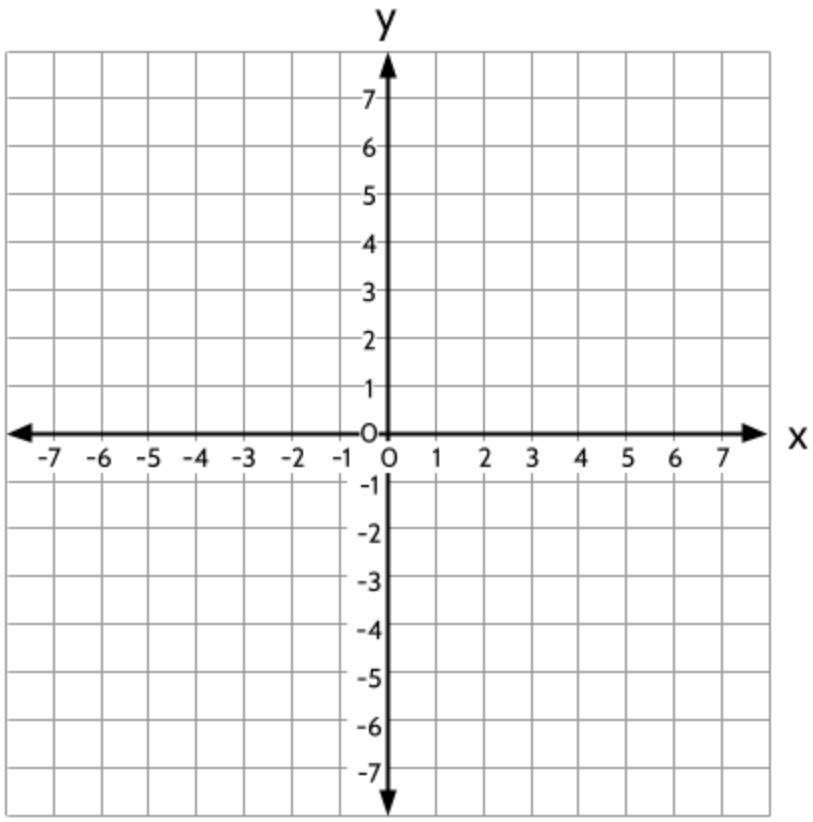
24) This scatter plot is comparing the number of hours spent studying for an exam and the grades students got on the exam.



How would you describe the correlation?

A. Positive correlation
B. Negative correlation
C. No correlation

25) Plot the point (3, -6) on the graph.



26) One day in December, there was a 100°F difference in temperature between Minneapolis, Minnesota and San Juan, Puerto Rico. If it was -12°F in Minneapolis, Minnesota, what was the temperature in San Juan, Puerto Rico?

27) Maurice had a negative balance of -$120 in his bank account. If he deposits $34, how much money is in his account?

A. -$154
B. -$86
C. $86
D. $154

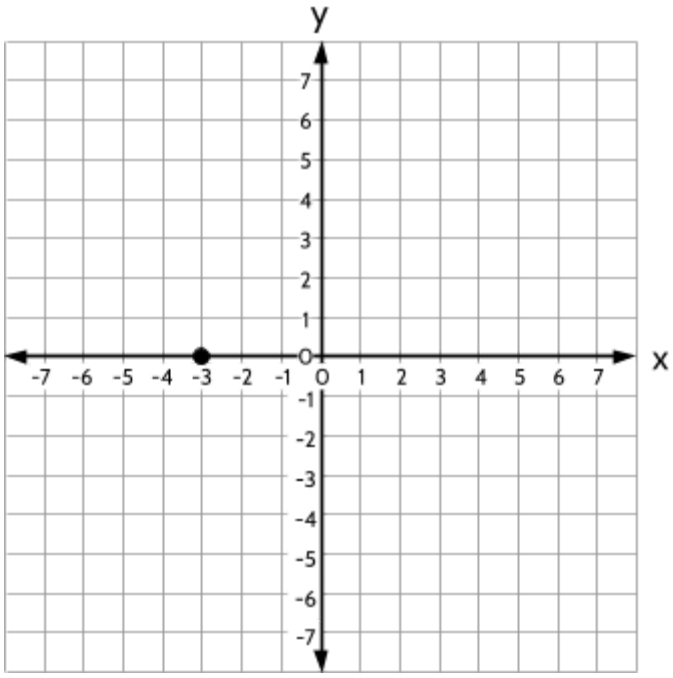
28) Which ordered pair represents the location of the point on the graph?

A. (3, 0)

B. (0, 3)

C. (-3, 0)

D. (0, -3)



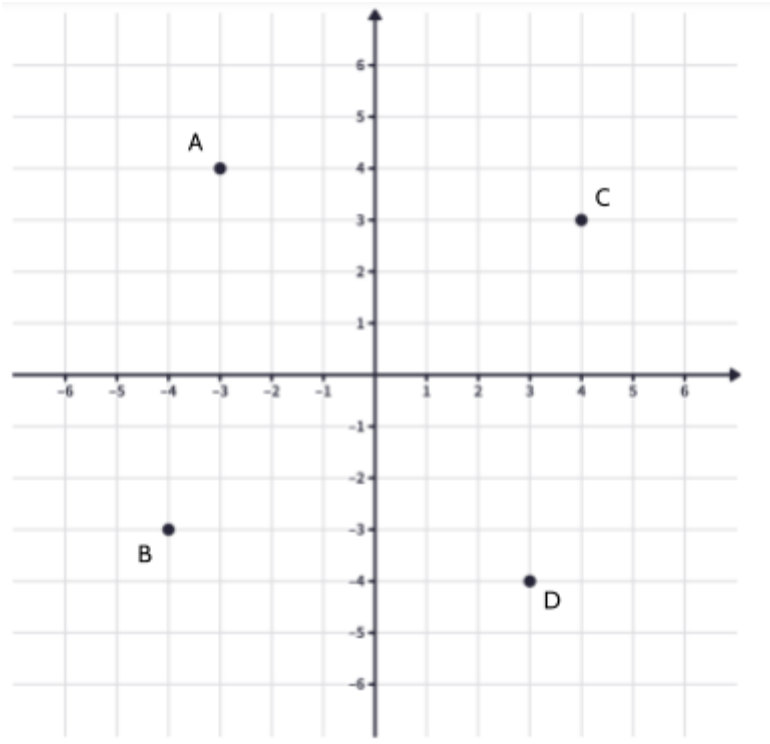
29) Which of the points on the graph represents the point (3, -4)?

A. Point A

B. Point B

C. Point C

D. Point D



30) Which quadrant is the ordered pair (-6, -7) found in?

A. I

B. II

C. III

D. IV

31) What is the distance between the points (4, -6) and (4, 3)?

A. -9 units

B. -3 units

C. 3 units

D. 9 units

32) Mount McKinley in Alaska is the tallest mountain in North America. Its elevation is 20,310 feet above sea level. Death Valley in California is the lowest point in North America. Its elevation is 282 feet below sea level. What is the difference in elevation between Mt. McKinley and Death Valley?

A. -20,592 feet

B. -20,028 feet

C. 20,028 feet

D. 20,592 feet

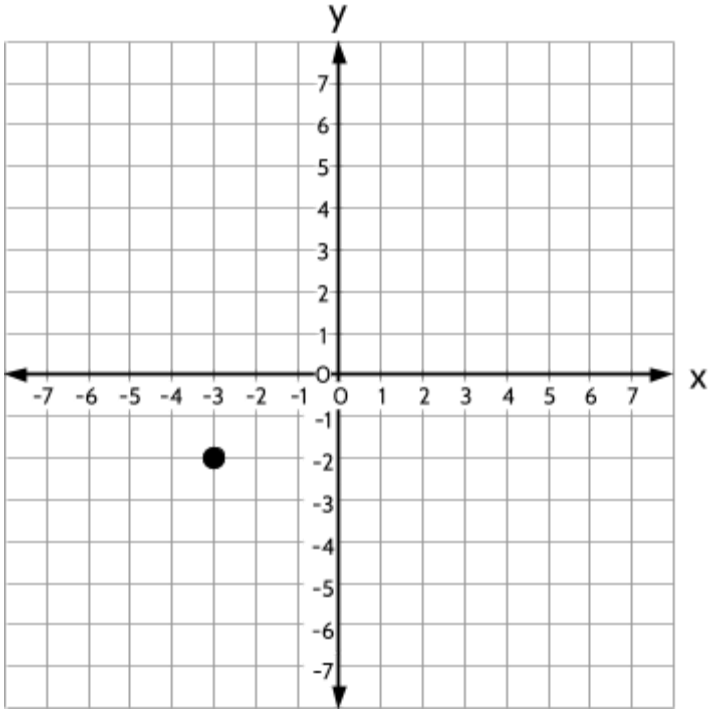
33) A point is placed on the graph below. If 4 is added to the *x* value and 5 is added to the *y*-value, which point represents the new point?

A. (1, 3)

B. (2, 2)

C. (2, 4)

D. (4, 5)



34) Which if the following number lines has been divided into thirds?

35) Which point represents ¾ on the number line?

A. Point A
B. Point B
C. Point C
D. Point D

36) The table below shows the elevation of four places on Earth.

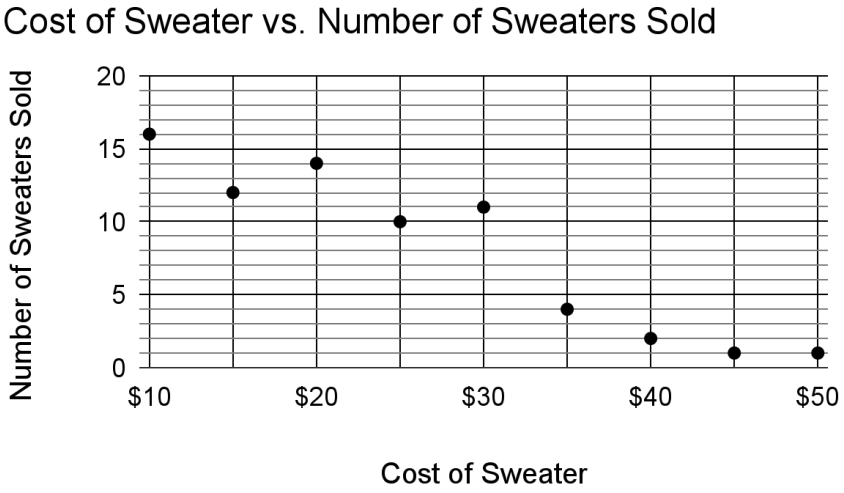
Which elevation is farthest away from sea level?

Location	**Elevation (in feet)**
Puerto Rico Trench	-27,480
Mount Everest	29,029
Challenger Deep	-35,876
Cerro Aconcagua	22,837

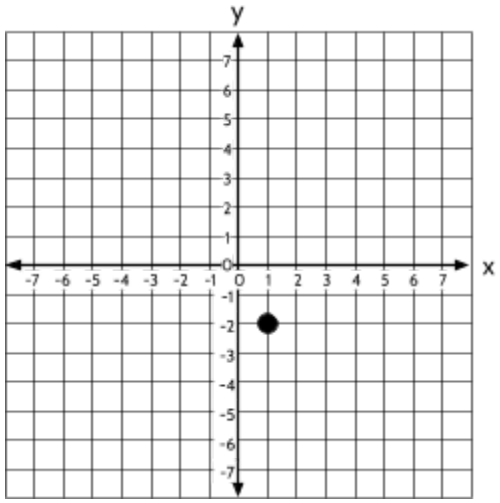
37) A store is investigating how the price of a sweater impacts how many are sold. They sold the same sweater at different prices and kept track of how many sweaters sold at each price.

What kind of correlation is there between the cost of the sweater and the number of sweaters sold?

A. Positive correlation
B. Negative correlation
C. No correlation

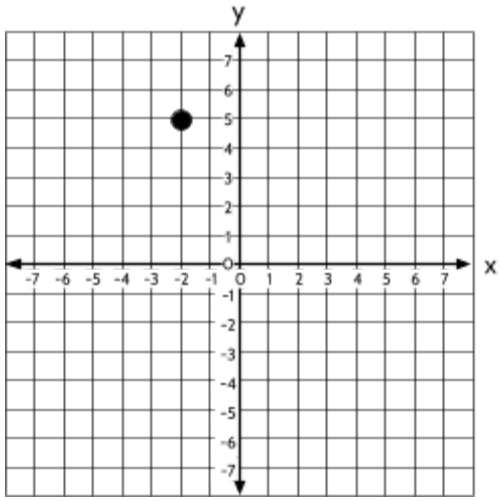


38) Draw a line from each graph to the ordered pair that represents the point on the graph.



(-4, -6)

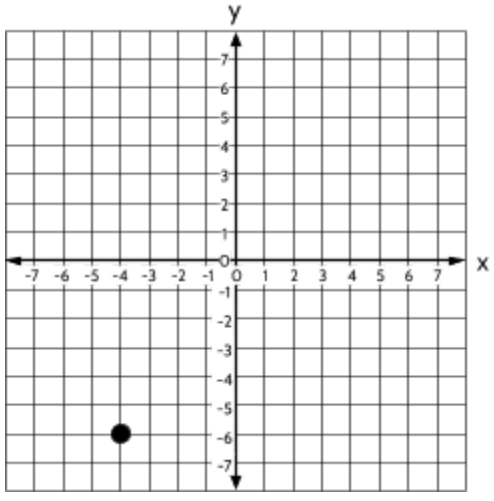
(-2, 5)



(-2, 1)

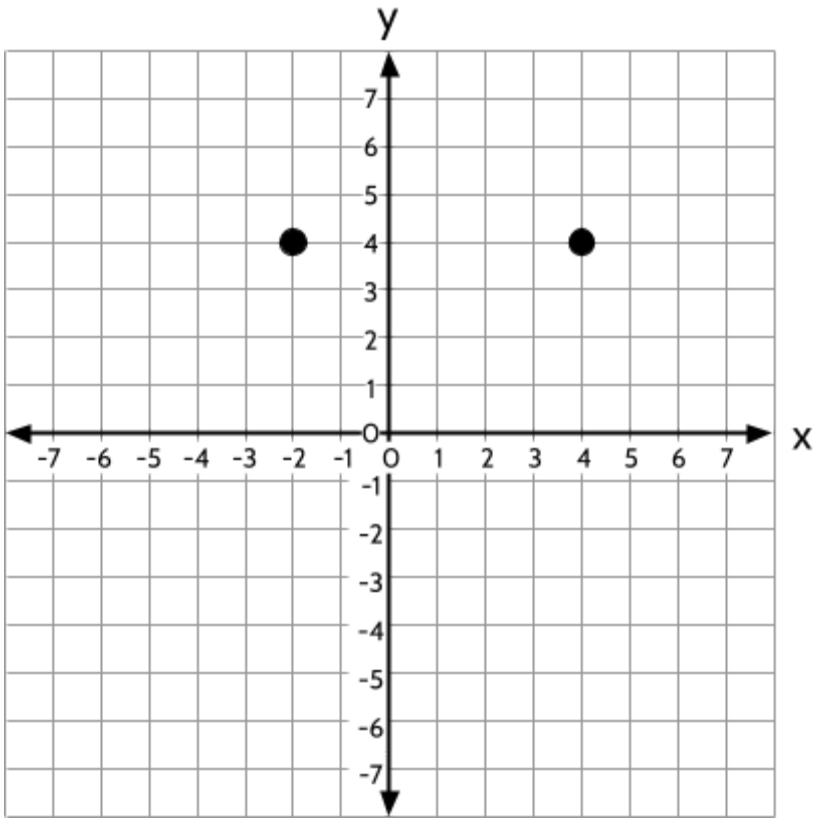
(5, -2)

(-4, 6)



(1, -2)

39) Two points have been plotted on the coordinate grid.



Which two ordered pairs describe two additional points that could be plotted on the coordinate grid to form a 4-sided figure with a perimeter of 24 units?

A. (-2, 0) and (4, 0)

B. (-2, -2) and (4, -2)

C. (-2, -3) and (4, -3)

D. (-2, 7) and (4, 7)

Test Practice Questions - Answer Key

1) B. $\frac{5}{2}$ is equivalent to 2½

2) D

3) B

4) D

5) D

6) C

7) A

8) C

9) D. The fractions $\frac{5}{8}$ and $\frac{10}{16}$ are equivalent.

10) A

11) C

12) D

13) C

14) C

15) D

16) C

17) C

18) C

19) D

20) 1 is halfway between -3 and 5. There are multiple ways to figure out how to plot it on the number line, but your tick mark for 1 should be approximately halfway between -3 and 5

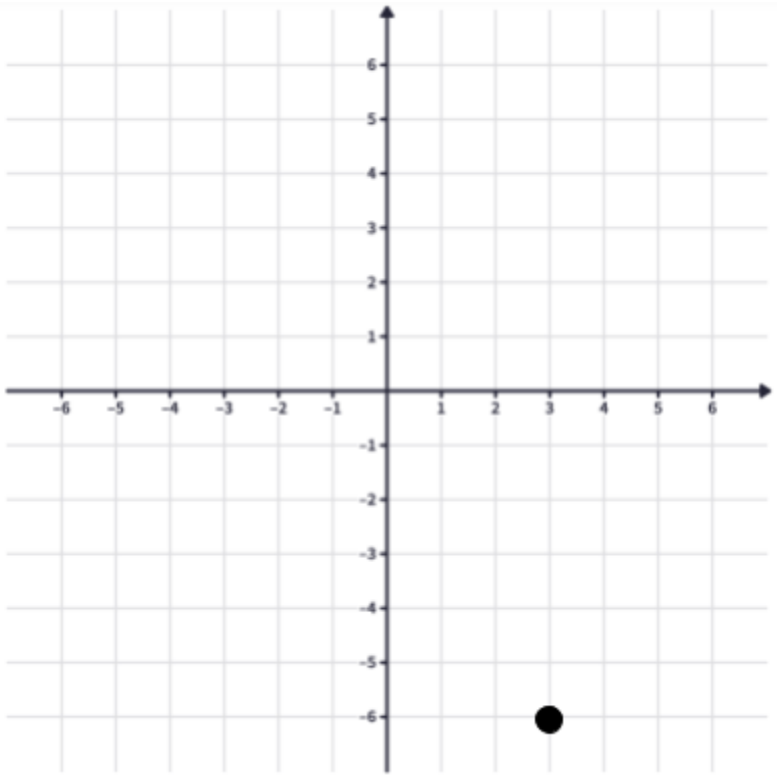
21) D

22) B

23) B

24) There is a positive correlation between studying and grades. In general, as the number of hours spent studying increases, the student grades also increase.

25)



26) 88℉

27) B

28) C

29) D

30) C

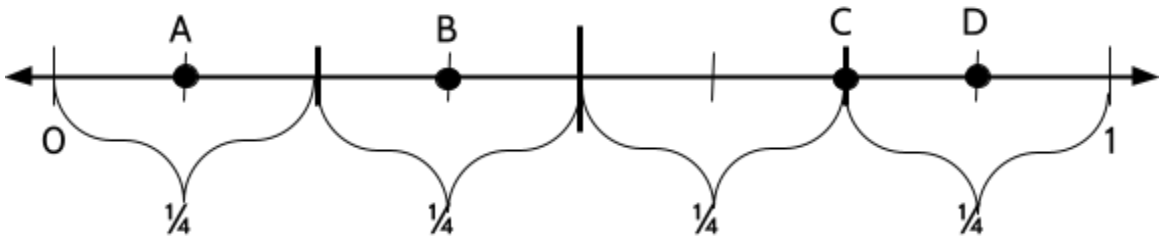
31) D

32) D

33) A

34) B. This is the only number line that is divided up into three equal pieces.

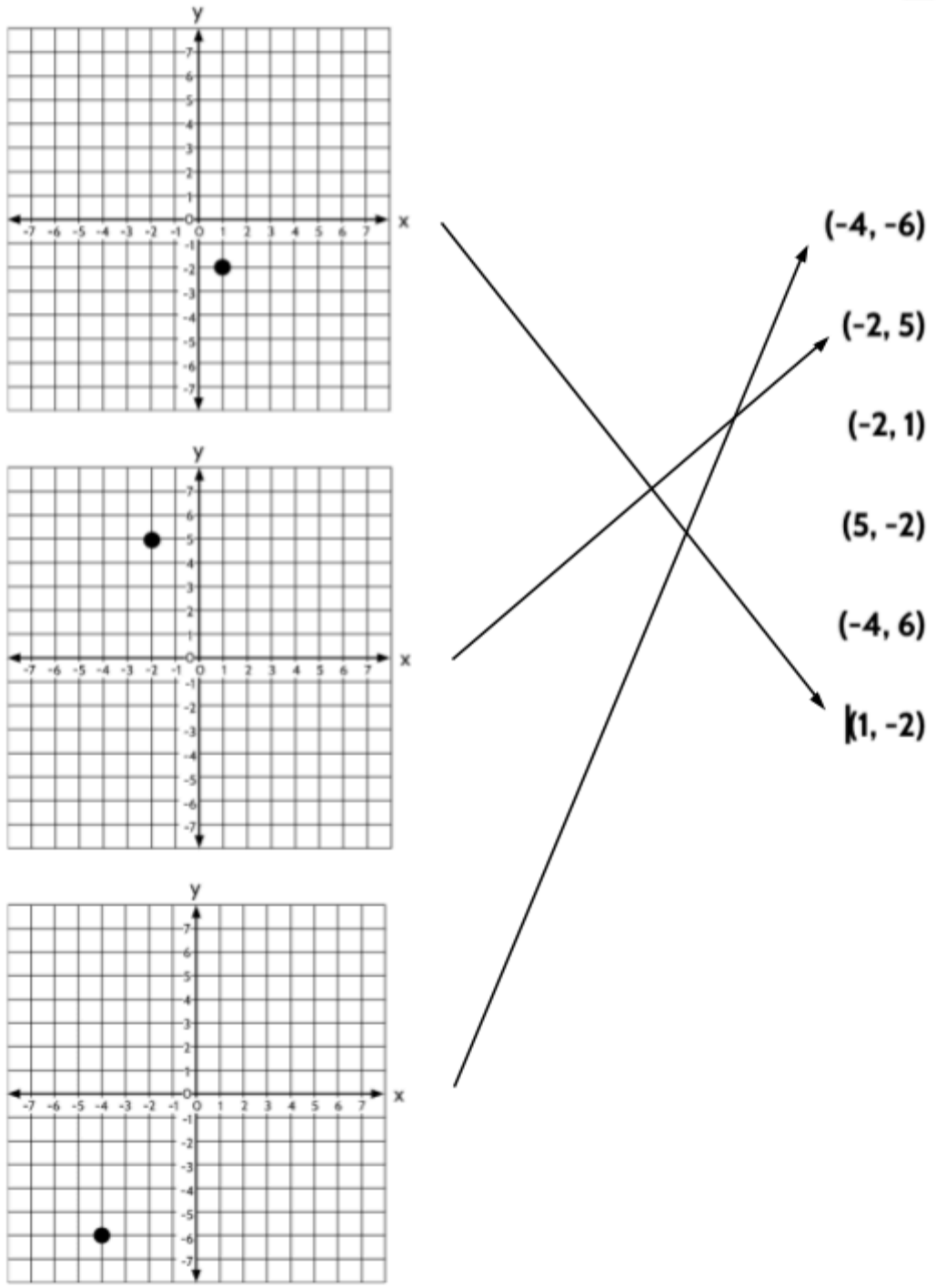
35) C



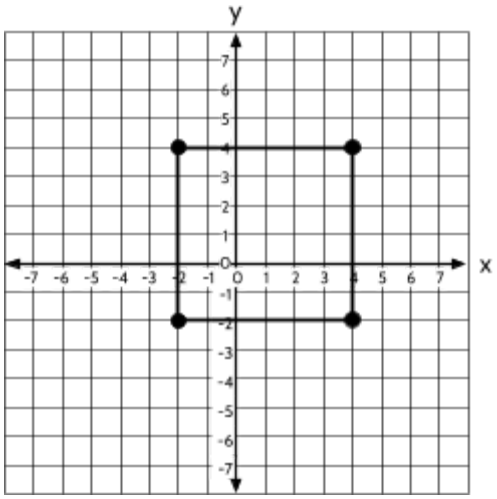
36) Challenger Deep, -35,876 feet.

37) There is a negative correlation between the cost of the sweater and the number of sweaters sold. As the price of the sweater increases, the number of sweaters sold decreases.

38)



39) B. Each side is 6 units long and there are 4 sides, so the perimeter is 24 units.

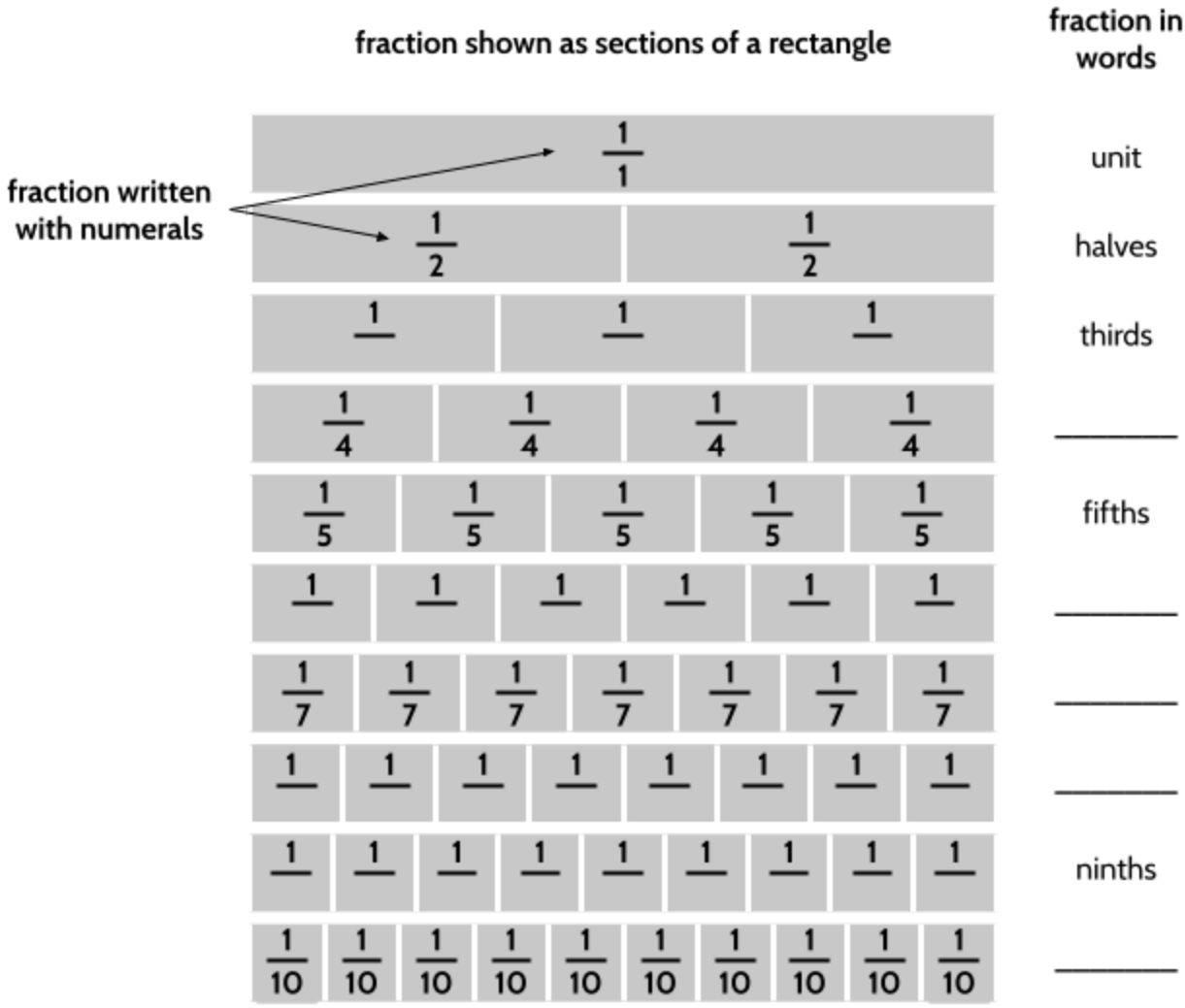


The Language of Number Lines and the Coordinate Grid

Writing Fractions

As we saw in Part 1, fractions can be written in numerals or with words. They can also be shown as sections of a number line or rectangle.

1) In the diagram below, fill in the missing fraction names, written as numerals or words.



On the following page, you will use this diagram to complete sentences that compare the size of fractions.

Complete the sentences using the diagram on the previous page. You may want to use *greater than*, *less than*, and *equal to*.

Note: Some of these have more than one correct answer. The first one is done for you.

2) One-fifth is ___greater than___ one-sixth.

3) One-fourth is _____ one-third.

4) Three-fourths is _____ one-half.

5) Three-fourths is _____ four-fifths.

6) Three-fifths is _____ three-fourths.

7) One-_____ is greater than one-fourth.

8) One-_____ is less than one-eighth.

9) Two-sixths is _____ one-third.

10) One-half is equal to _____ .

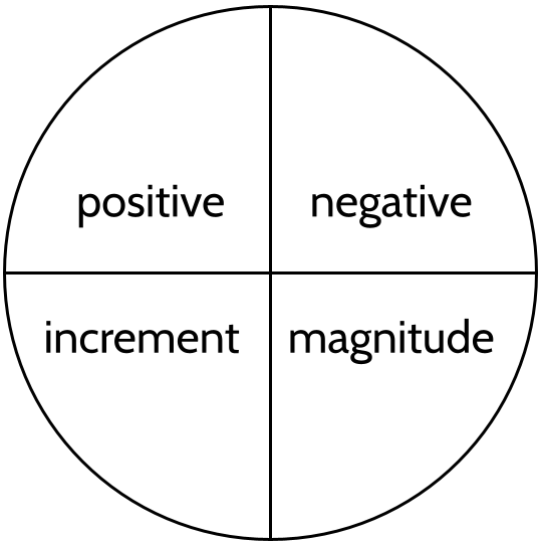
11) Two-fifths is less than two-_____ .

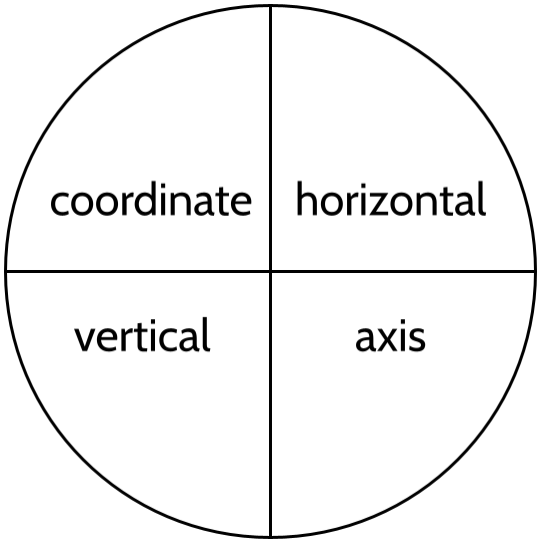
12) Four-sevenths is greater than _____-sevenths.

13) One-fifth is _____ one-tenth.

Concept Circle

14) Explain these words and the connections you see between them.



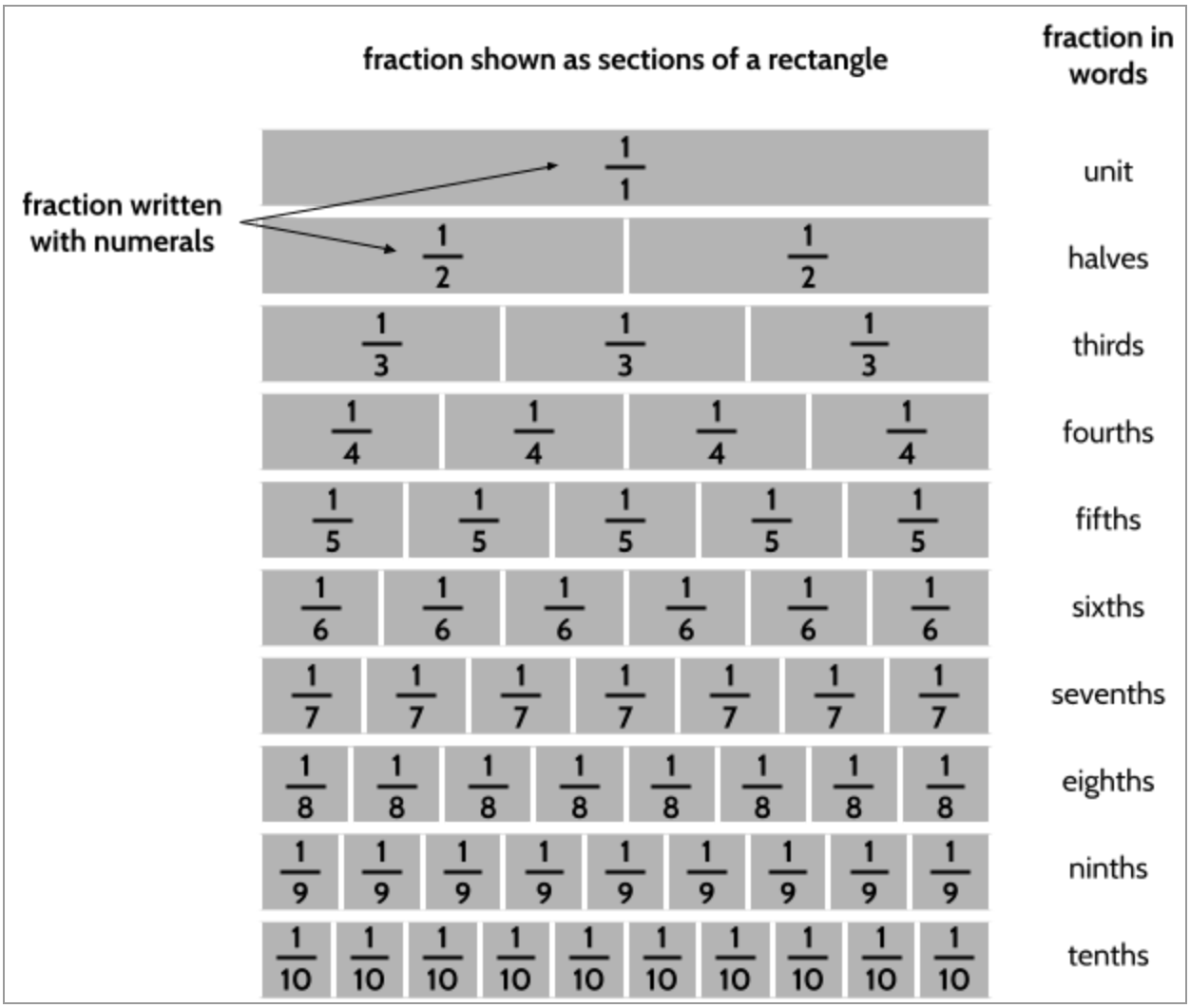


Number Lines and Coordinate Grids in the World

15) Look around you. Where do you see number lines and coordinate grids? Describe some examples from the world.

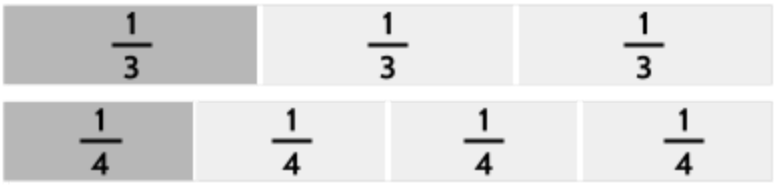
The Language of Number Lines and the Coordinate Grid - Answer Key

1)



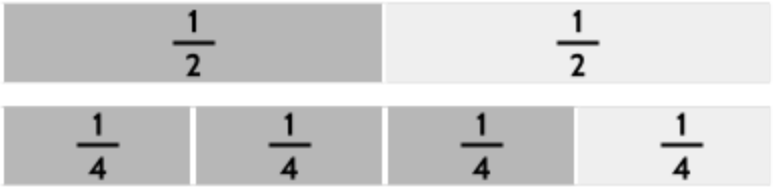
2) greater than: A fifth is something broken into five equal pieces and a sixth is something broken into six equal pieces. We can also look at the diagram to see that one-fifth is bigger than one-sixth.

3) less than: We can look at the diagram to see that one-fourth is smaller than one-third.



There is an interesting story involving the fractions one-third and one-half. In the 1980s, the A&W restaurant released a third-pound burger to compete with a quarter-pound burger at a different fast food restaurant. The A&W one-third pound burger was never very popular even though it was the same price as the one-quarter pounder sold by their competitors. A&W was curious to know why their burgers were not as popular even though they were offering more burger for the same price, so they did research. The firm eventually conducted a focus group to discover the truth: people were concerned about the price of the burger. "Why should we pay the same amount for a third of a pound of meat as we do for a quarter-pound of meat?" they asked. It turns out the majority of participants incorrectly believed that one-fourth of a pound was more than one-third of a pound.

4) greater than: We can look at the diagram to see that three-fourths is larger than one-half.



5) less than: We can look at the diagram to see that three-fourths is smaller than fourt-fifts.

You might also notice that three-fourths is one-fourth less than a whole and four-fifths is one-fifth less than a whole. Since one-fourth is greater than one-fifth, the fraction four-fifths is closer to a whole.

6) less than: We can look at the diagram to see that three-fifths is smaller than three-fourths. One-fifth is smaller than one-fourth, so three-fifths is also smaller than three-fourths.

7) There are multiple correct answers. One-third and one-half are both greater than one-fourth.

8) There are multiple correct answers. One-ninth and one-tenth are both smaller than one-eighth. One-eleventh, one-twelfth, etc. would also be smaller than one-eighth.

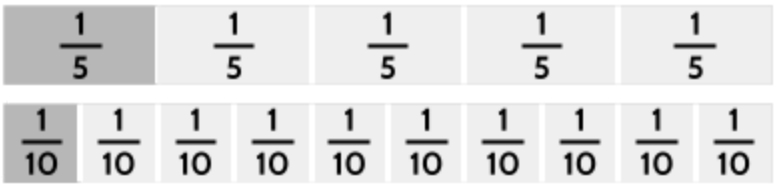
9) equal to: We can see in the diagram that two-sixths is the same size as one-third.

10) There are multiple correct answers. One half is equal to two-fourths, three-sixths, four-eighths, five-tenths, etc.

11) There are multiple correct answers. Two-fifths is less than two-fourths, two-thirds, and two-halves.

12) There are multiple correct answers. Four-sevenths is less than three-sevenths and two-sevenths.

13) Greater than. We can see in the diagram that one-fifth is bigger than one-tenth. In fact, it is twice as big.



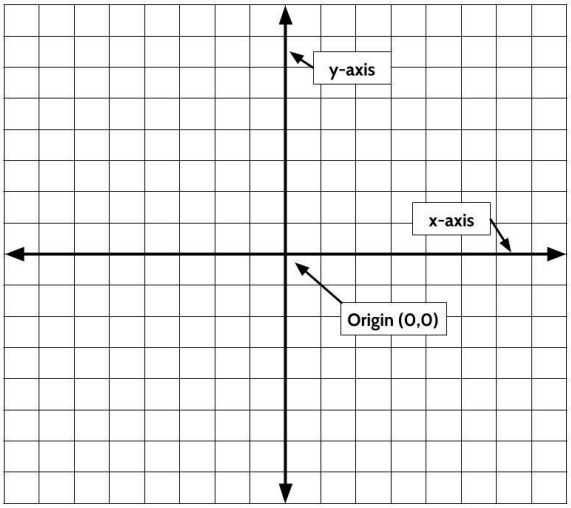
14) Each paragraph should use the 4 vocabulary words in the circle on the left. Be creative.

15) Take your time with this activity. Look around you and look for examples of number lines and coordinate grids. You might even do some research so that you have some examples to include in your writing. This is an opportunity to practice all the vocabulary and math skills you have learned.

Glossary

absolute value (noun): A measurement of the size of a number, equal to the number's distance from zero on the number line. Also called *magnitude.*--

coordinates (noun): On graphs, coordinates are a pair of numbers that show an exact position on the graph. The first number shows the distance right or left away from the origin. The second number shows the distance up or down. *<see ORDERED PAIR>*



coordinate grid (noun): A flat surface formed when two straight number lines cross each other at right angles. The point where the lines intersect is called the origin and represents the zero on each axis. An exact position on the grid can be described using coordinates. The *coordinate grid* is also called the coordinate plane.

correlation (noun): When two sets of data have a strong connection, we say they have a strong correlation. The word *correlation* is made of *co-* (meaning "together"), and *relation* *<See POSITIVE CORRELATION, NEGATIVE CORRELATION and NO CORRELATION>*

> **positive correlation** (noun): When two sets of data are strongly connected we say they have a high correlation. We say that correlation is *positive* when two sets of data are related such that as one increases, the other also increases. Ice cream sales and temperature are two data sets we would expect to have positive correlation. The hotter the temperature, the more ice cream sales we expect. *<See CORRELATION, NEGATIVE CORRELATION and NO CORRELATION>*
>
> **negative correlation** (noun): When two sets of data are strongly connected we say they have a high correlation. We say that correlation is *negative* when two sets of data are related such that as one increases, the other decreases. For example, if there is an increase in the number of rainy days, we expect a decrease in the amount of time we need to spend watering a garden. *<See CORRELATION and POSITIVE CORRELATION and NO CORRELATION>*

no correlation (noun): When there is no easy to see connection between two data sets, we say there is no correlation. *<See CORRELATION and POSITIVE CORRELATION and NEGATIVE CORRELATION>*

difference (noun): How much one number differs from another. One way to visualize the difference is how far one number is from another on a number line. For example, Paulina is 35 and her son is 11, so there is a 24 year age difference between them.

equator (noun): The equator is a horizontal, latitude line halfway between the North Pole and the South Pole.

horizontal (adjective): Flat and level. The *x*-axis is a vertical line on the coordinate grid. Latitude lines are horizontal lines that run East/West.

latitude (noun): Imaginary lines that run east/west around the Earth. The equator is 0° latitude. Latitude lines are used with longitude lines to locate exact positions on the Earth.

longitude (noun): Imaginary lines that run north/south between the North and South Poles. 0° longitude runs through Greenwich, England. Longitude lines are used with latitude lines to locate exact positions on the Earth.

ordered pair (noun): Ordered pairs are numbers written in certain order. They are usually written in parenthesis. For example (8, 1). Ordered pairs are used to show the position of a point on a graph. The first number represents the *x*-value and the second number represents the *y*-value. < *see COORDINATES*>

origin (noun): the point where the *x*-axis and the *y*-axis intersect on the coordinate grid. The origin has the coordinates (0, 0). *<see COORDINATE GRID>*

perimeter (noun): the whole length of the border around an area or shape.

plot (verb): To place a point representing a number or pair of numbers on a graph, such as a number line or coordinate grid.

scatter plot (noun): A graph of points that can help us determine if there is a relationship between two sets of data. *<See CORRELATION, POSITIVE CORRELATION, NEGATIVE CORRELATION, and NO CORRELATION>*

signed number (noun): A number shown as positive or negative. For example, +9 is a signed number that we read as "positive 9." –12 is a signed number that we read as "negative 12."

vertical (adjective): **v**ertical means pointing straight upward. The *y*-axis is a vertical line on the coordinate grid. Longitude lines are vertical lines that run North/South.

***x*-axis** (noun): the line that goes from left to right of a graph. The horizontal axis on the coordinate grid.

***y*-axis** (noun): the line that goes from top to bottom of a graph. The vertical axis on the coordinate grid.

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Version

V. 1.4 10/17/2023: Corrected answer key error

V. 1.2 10/10/2023: Corrected answer key errors

V. 1.1 10/5/2023: Corrected errors, added Language of Number Lines and the Coordinate Grid

V. 1.0 6/30/2023: First version released