Lesson 2: Real-World Positive and Negative Numbers and Zero

Classwork

Example 1: Take It to the Bank

For Tim's 13th birthday, he received $150 in cash from his mom. His dad took him to the bank to open a savings account. Tim gave the cash to the banker to deposit into the account. The banker credited Tim's new account $150 and gave Tim a receipt. One week later, Tim deposited another $25 that he had earned as allowance. The next month, Tim's dad gave him permission to withdraw $35 to buy a new video game. Tim's dad explained that the bank would charge a $5 fee for each withdrawal from the savings account and that each withdrawal and charge results in a debit to the account.

Words I Already Know:	Words I Want to Know:	Words I Learned:

Exercises 1–2

1. Number the events in the same story problem below. Write the number above each sentence to show the order of the events.

For Tim's 13th birthday, he received $150 in cash from his mom. His dad took him to the bank to open a savings account. Tim gave the cash to the banker to deposit into the account. The banker credited Tim's new account $150 and gave Tim a receipt. One week later, Tim deposited another $25 that he had earned as allowance. The next month, Tim's dad gave him permission to withdraw $35 to buy a new video game. Tim's dad explained that the bank would charge a $5 fee for each withdrawal from the savings account and that each withdrawal and charge results in a debit to the account.

2. Write each individual description below as an integer. Model the integer on the number line using an appropriate scale.

EVENT	INTEGER	NUMBER LINE MODEL
Open a bank account with $0.		
Make a $150 deposit.		
Credit an account for $150.		
Make a deposit of $25.		
A bank makes a charge of $5.		
Tim withdraws $35.		

Example 2: How Hot, How Cold?

Temperature is measured using one of two scales, Celsius or Fahrenheit. In the United States, we use Fahrenheit. All other countries have adopted Celsius as the primary scale in use. The thermometer shows how both scales are related.

a. The boiling point of water is $100°C$. Where is 100 degrees Celsius located on the thermometer to the right?

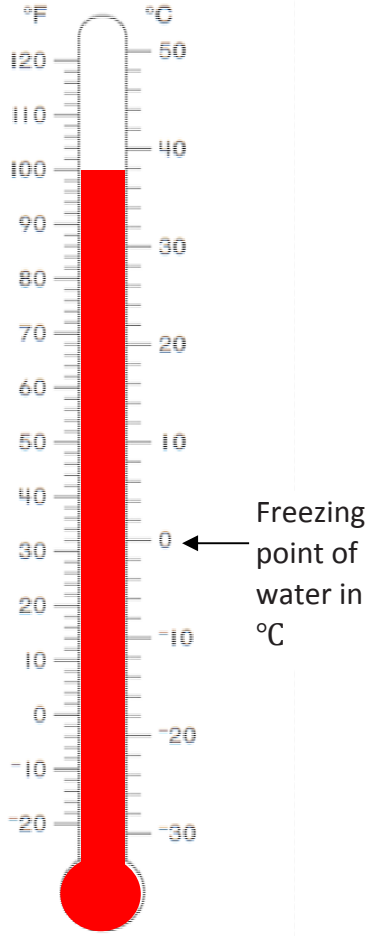
b. On a vertical number line, describe the position of the integer that represents $100°C$.

c. Write each temperature as an integer.

i. The temperature shown on the thermometer in degrees Fahrenheit:

ii. The temperature shown on the thermometer in degrees Celsius:

iii. The freezing point of water in degrees Celsius:



d. If someone tells you your body temperature is $98.6°$, what scale is being used? How do you know?

e. Does the temperature 0 degrees mean the same thing on both scales?

Exercises 3–5

3. Write each word under the appropriate column, "Positive Number" or "Negative Number."

   Gain Loss Deposit Credit Debit Charge Below Zero Withdraw Owe Receive

Positive Number	Negative Number

4. Write an integer to represent each of the following situations:

   a. A company loses $\$345{,}000$ in 2011. _____

   b. You earned $\$25$ for dog sitting. _____

   c. Jacob owes his dad $\$5$. _____

   d. The temperature at the sun's surface is about $5{,}500°C$. _____

   e. The temperature outside is 4 degrees below zero. _____

   f. A football player lost 10 yards when he was tackled. _____

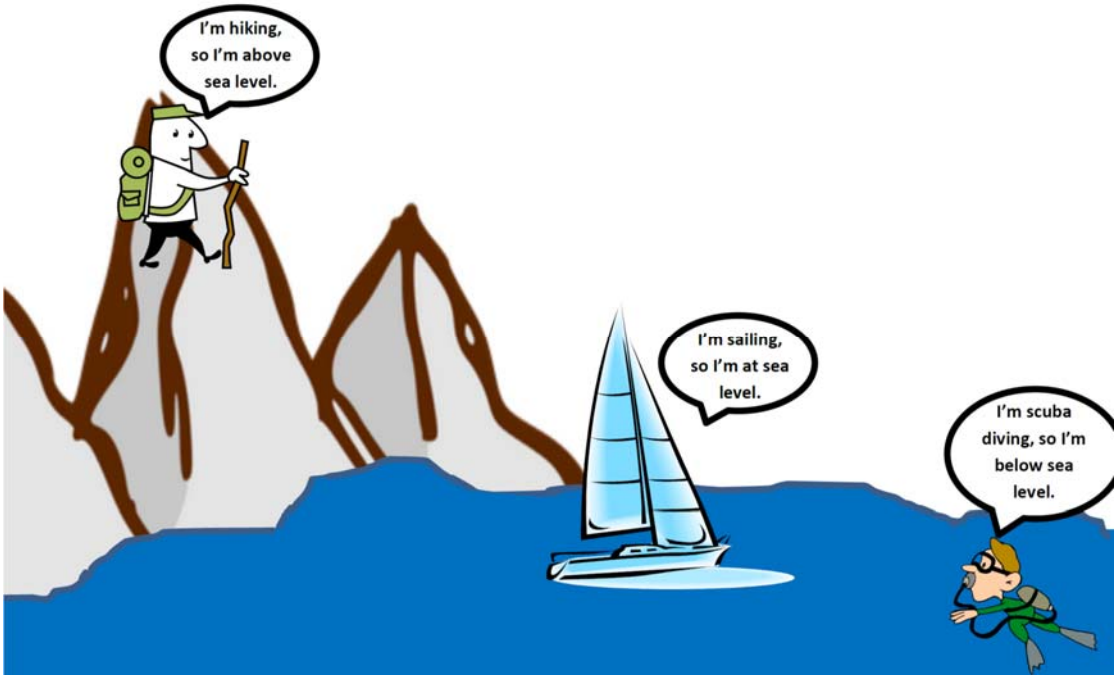
5. Describe a situation that can be modeled by the integer -15. Explain what zero represents in the situation.

Lesson 3: Real-World Positive and Negative Numbers and Zero

Classwork

Example 1: A Look at Sea Level

The picture below shows three different people participating in activities at three different elevations. With a partner, discuss what you see. What do you think the word *elevation* means in this situation?



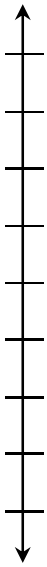
Exercises

Refer back to Example 1. Use the following information to answer the questions.

- The scuba diver is 30 feet below sea level.
- The sailor is at sea level.
- The hiker is 2 miles (10,560 feet) above sea level.

1. Write an integer to represent each situation.

2. Use an appropriate scale to graph each of the following situations on the number line to the right. Also, write an integer to represent both situations.



   a. A hiker is 15 feet above sea level.

   b. A diver is 20 feet below sea level.

3. For each statement, there are two related statements: (i) and (ii). Determine which related statement ((i) or (ii)) is expressed correctly, and circle it. Then, correct the other related statement so that both parts, (i) and (ii), are stated correctly.

   a. A submarine is submerged 800 feet below sea level.

      i. The depth of the submarine is -800 feet below sea level.

      ii. 800 feet below sea level can be represented by the integer -800.

   b. The elevation of a coral reef with respect to sea level is given as -150 feet.

      i. The coral reef is 150 feet below sea level.

      ii. The depth of the coral reef is -150 feet below sea level.

Name _____ Date _____

Exploratory Challenge Station Record Sheet

Poster # _____

Integers: _____

Number Line Scale: _____

Poster # _____

Integers: _____

Number Line Scale: _____

Poster # _____

Integers: _____

Number Line Scale: _____

Poster # _____

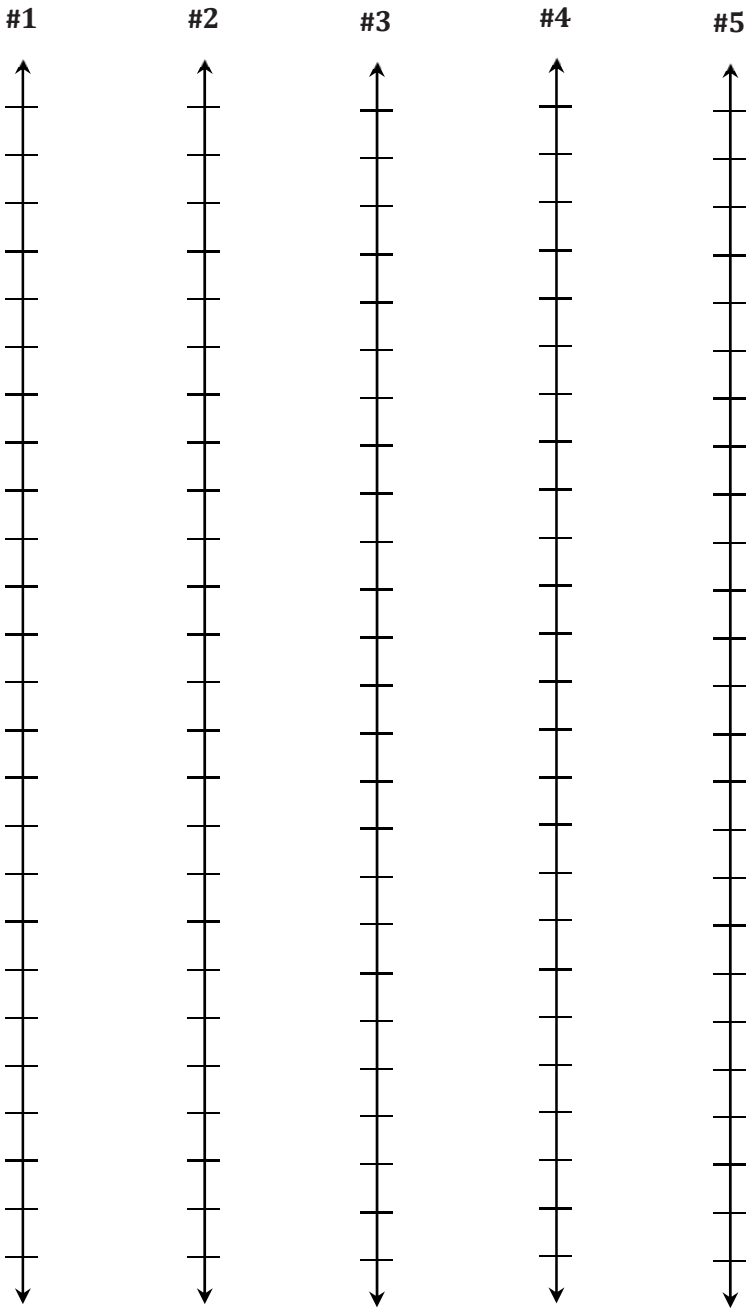
Integers: _____

Number Line Scale: _____

Poster # _____

Integers: _____

Number Line Scale: _____



Lesson 4: The Opposite of a Number

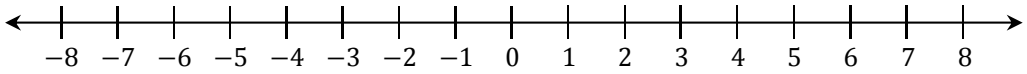
Classwork

Exercise 1: Walk the Number Line

1. Each nonzero integer has an opposite, denoted $-a$. The numbers a and $-a$ are opposites if they are on opposite sides of zero and the same distance from zero on the number line.

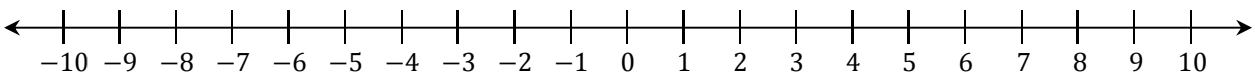
Example 1: Every Number Has an Opposite

Locate the number 8 and its opposite on the number line. Explain how they are related to zero.



Exercises 2–3

2. Locate and label the opposites of the numbers on the number line.
   a. 9
   b. -2
   c. 4
   d. -7



3. Write the integer that represents the opposite of each situation. Explain what zero means in each situation.

   a. 100 feet above sea level

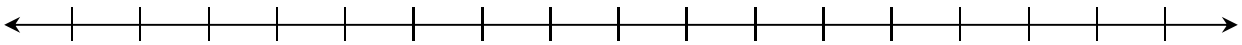
   b. 32°C below zero

   c. A withdrawal of $25

Example 2: A Real-World Example

Maria decides to take a walk along Central Avenue to purchase a book at the bookstore. On her way, she passes the Furry Friends Pet Shop and goes in to look for a new leash for her dog. Furry Friends Pet Shop is seven blocks west of the bookstore. She leaves Furry Friends Pet Shop and walks toward the bookstore to look at some books. After she leaves the bookstore, she heads east for seven blocks and stops at Ray's Pet Shop to see if she can find a new leash at a better price. Which location, if any, is the farthest from Maria while she is at the bookstore?

Determine an appropriate scale, and model the situation on the number line below.

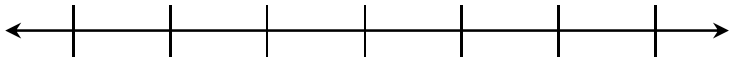


Explain your answer. What does zero represent in the situation?

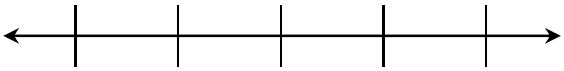
Exercises 4–6

Read each situation carefully, and answer the questions.

4. On a number line, locate and label a credit of $\$15$ and a debit for the same amount from a bank account. What does zero represent in this situation?



5. On a number line, locate and label $20°C$ below zero and $20°C$ above zero. What does zero represent in this situation?



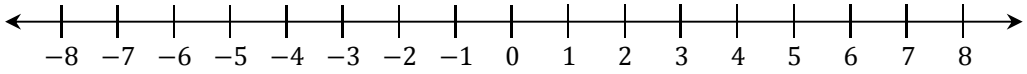
6. A proton represents a positive charge. Write an integer to represent 5 protons. An electron represents a negative charge. Write an integer to represent 3 electrons.

Lesson 5: The Opposite of a Number's Opposite

Classwork

Opening Exercise

a. Locate the number -2 and its opposite on the number line below.



b. Write an integer that represents each of the following.

i. 90 feet below sea level

ii. $\$100$ of debt

iii. $2°C$ above zero

c. Joe is at the ice cream shop, and his house is 10 blocks north of the shop. The park is 10 blocks south of the ice cream shop. When he is at the ice cream shop, is Joe closer to the park or his house? How could the number zero be used in this situation? Explain.

Example 1: The Opposite of an Opposite of a Number

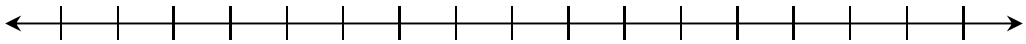
What is the opposite of the opposite of 8? How can we illustrate this number on a number line?

a. What number is 8 units to the right of 0? _____

b. How can you illustrate locating the opposite of 8 on this number line?

c. What is the opposite of 8? _____

d. Use the same process to locate the opposite of -8. What is the opposite of -8? _____



e. The opposite of an opposite of a number is _____.

Example 2: Writing the Opposite of an Opposite of a Number

Explain why $-(-5) = 5$.

Exercises

Complete the table using the cards in your group.

Person	Card (a)	Opposite of Card ($-a$)	Opposite of Opposite of Card $-(-a)$

1. Write the opposite of the opposite of -10 as an equation.

2. In general, the opposite of the opposite of a number is the _____.

3. Provide a real-world example of this rule. Show your work.

Lesson 6: Rational Numbers on the Number Line

Classwork

Opening Exercise

a. Write the decimal equivalent of each fraction.

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

ii. $\frac{4}{5}$

iii. $6\frac{7}{10}$

b. Write the fraction equivalent of each decimal.

i. 0.42

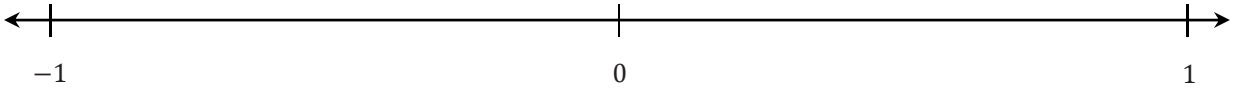
ii. 3.75

iii. 36.90

Example 1: Graphing Rational Numbers

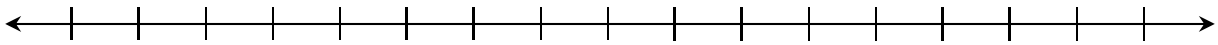
Rational Numbers:

Locate and graph the number $\frac{3}{10}$ and its opposite on a number line.



Exercise 1

Use what you know about the point $-\frac{7}{4}$ and its opposite to graph both points on the number line below. The fraction $-\frac{7}{4}$ is located between which two consecutive integers? Explain your reasoning.



On the number line, each segment will have an equal length of _____. The fraction is located between _____ and _____.

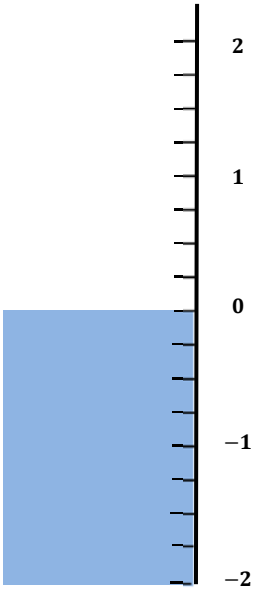
Explanation:

Example 2: Rational Numbers and the Real World

The water level of a lake rose 1.25 feet after it rained. Answer the following questions using the number line below.

a. Write a rational number to represent the situation.

b. What two integers is 1.25 between on a number line?



c. Write the length of each segment on the number line as a decimal and a fraction.

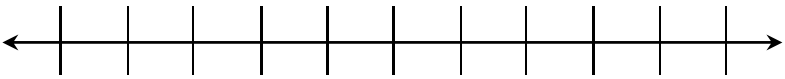
d. What will be the water level after it rained? Graph the point on the number line.

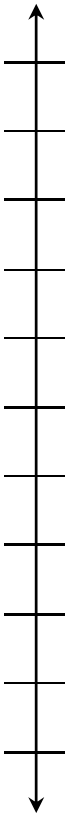
e. After two weeks have passed, the water level of the lake is now the opposite of the water level when it rained. What will be the new water level? Graph the point on the number line. Explain how you determined your answer.

f. State a rational number that is not an integer whose value is less than 1.25, and describe its location between two consecutive integers on the number line.

Exercise 2: Our Story Problem

1. Write a real-world story problem using a rational number and its opposite.
2. Create a horizontal or vertical number line diagram to represent your situation.
   a. Determine an appropriate scale, and label the number line.
   b. Write the units of measurement (if needed).
   c. Graph the rational number and its opposite that represent the situation.
3. Describe what points 0 and the opposite number represent on the number line.
4. Name a rational number to the left and right of the rational number you initially chose.





Lesson 8: Ordering Integers and Other Rational Numbers

Classwork

Example 1: Ordering Rational Numbers from Least to Greatest

Sam has $\$10.00$ in the bank. He owes his friend Hank $\$2.25$. He owes his sister $\$1.75$. Consider the three rational numbers related to this story of Sam's money. Write and order them from least to greatest.

Exercises 2–3

For each problem, list the rational numbers that relate to each situation. Then, order them from least to greatest, and explain how you made your determination.

2. Kadijsha and her sister, Beth, had their vision tested. Kadijsha's vision in her left eye was -1.50, and her vision in her right eye was the opposite number. Beth's vision was -1.00 in her left eye and $+0.25$ in her right eye.

3. There are three pieces of mail in Ms. Thomas's mailbox: a bill from the phone company for $\$38.12$, a bill from the electric company for $\$67.55$, and a tax refund check for $\$25.89$.

4. Monica, Jack, and Destiny measured their arm lengths for an experiment in science class. They compared their arm lengths to a standard length of 22 inches. The listing below shows, in inches, how each student's arm length compares to 22 inches.

   Monica: $-\frac{1}{8}$

   Jack: $1\frac{3}{4}$

   Destiny: $-\frac{1}{2}$

Example 2: Ordering Rational Numbers from Greatest to Least

Jason is entering college and has opened a checking account to use for college expenses. His parents gave him $\$200.00$ to deposit into the account. Jason wrote a check for $\$85.00$ to pay for his math book and a check for $\$25.34$ to pay for miscellaneous school supplies. Write the three rational numbers related to the balance in Jason's checking account in order from greatest to least.

Exercises 5–6

For each problem, list the rational numbers that relate to each situation in order from greatest to least. Explain how you arrived at the order.

5. The following are the current monthly bills that Mr. McGraw must pay:

   $\$122.00$ Cable and Internet

   $\$73.45$ Gas and Electric

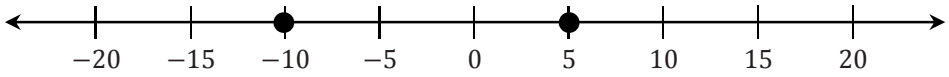
   $\$45.00$ Cell Phone

6. $-\frac{1}{3}, 0, -\frac{1}{5}, \frac{1}{8}$

Lesson 9: Comparing Integers and Other Rational Numbers

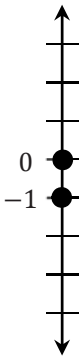
Classwork

Example 1: Interpreting Number Line Models to Compare Numbers



Exercises

1. Create a real-world situation that relates to the points shown in the number line model. Be sure to describe the relationship between the values of the two points and how it relates to their order on the number line.



For each problem, determine if you *agree or disagree* with the representation, then explain why.

2. Felicia needs to write a story problem that relates to the order in which the numbers $-6\frac{1}{2}$ and -10 are represented on a number line. She writes the following:

   "During a recent football game, our team lost yards on two consecutive downs. We lost $6\frac{1}{2}$ yards on the first down. During the second down, our quarterback was sacked for an additional 10-yard loss. On the number line, I represented this situation by first locating $-6\frac{1}{2}$. I located the point by moving $6\frac{1}{2}$ units to the left of zero. Then, I graphed the second point by moving 10 units to the left of 0."

3. Manuel looks at a number line diagram that has the points $-\frac{3}{4}$ and $-\frac{1}{2}$ graphed. He writes the following related story:

   "I borrowed 50 cents from my friend, Lester. I borrowed 75 cents from my friend, Calvin. I owe Lester less than I owe Calvin."

4. Henry located $2\frac{1}{4}$ and 2.1 on a number line. He wrote the following related story:

   "In gym class, both Jerry and I ran for 20 minutes. Jerry ran $2\frac{1}{4}$ miles, and I ran 2.1 miles. I ran a farther distance."

5. Sam looked at two points that were graphed on a vertical number line. He saw the points -2 and 1.5. He wrote the following description:

   "I am looking at a vertical number line that shows the location of two specific points. The first point is a negative number, so it is below zero. The second point is a positive number, so it is above zero. The negative number is -2. The positive number is $\frac{1}{2}$ unit more than the negative number."

6. Claire draws a vertical number line diagram and graphs two points: -10 and 10. She writes the following related story:

   "These two locations represent different elevations. One location is 10 feet above sea level, and one location is 10 feet below sea level. On a number line, 10 feet above sea level is represented by graphing a point at 10, and 10 feet below sea level is represented by graphing a point at -10."

7. Mrs. Kimble, the sixth-grade math teacher, asked the class to describe the relationship between two points on the number line, 7.45 and 7.5, and to create a real-world scenario. Jackson writes the following story:

   "Two friends, Jackie and Jennie, each brought money to the fair. Jackie brought more than Jennie. Jackie brought $\$7.45$, and Jennie brought $\$7.50$. Since 7.45 has more digits than 7.5, it would come after 7.5 on the number line, or to the right, so it is a greater value."

8. Justine graphs the points associated with the following $\frac{1}{2}$ numbers on a vertical number line: $-1\frac{1}{4}$, $-1\frac{1}{2}$, and 1. She then writes the following real-world scenario:

   "The nurse measured the height of three sixth-grade students and compared their heights to the height of a typical sixth grader. Two of the students' heights are below the typical height, and one is above the typical height. The point whose coordinate is 1 represents the student who has a height that is 1 inch above the typical height. Given this information, Justine determined that the student represented by the point associated with $-1\frac{1}{4}$ is the shortest of the three students."

Lesson 10: Writing and Interpreting Inequality Statements Involving Rational Numbers

Classwork

Opening Exercise

"The amount of money I have in my pocket is less than $\$5$ but greater than $\$4$."

a. One possible value for the amount of money in my pocket is _____.

b. Write an inequality statement comparing the possible value of the money in my pocket to $\$4$.

c. Write an inequality statement comparing the possible value of the money in my pocket to $\$5$.

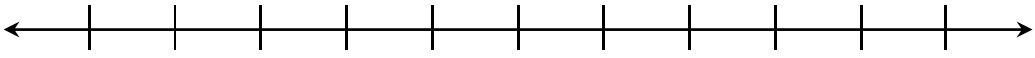
Exercises 1–4

1. Graph your answer from the Opening Exercise part (a) on the number line below.

2. Also, graph the points associated with 4 and 5 on the number line.

3. Explain in words how the location of the three numbers on the number line supports the inequality statements you wrote in the Opening Exercise parts (b) and (c).

4. Write one inequality statement that shows the relationship among all three numbers.



Example 1: Writing Inequality Statements Involving Rational Numbers

Write one inequality statement to show the relationship among the following shoe sizes: $10\frac{1}{2}$, 8, and 9.

a. From least to greatest:

b. From greatest to least:

Example 2: Interpreting Data and Writing Inequality Statements

Mary is comparing the rainfall totals for May, June, and July. The data is shown in the table below. Fill in the blanks below to create inequality statements that compare the Changes in Total Rainfall for each month (the right-most column of the table).

Month	This Year's Total Rainfall (in inches)	Last Year's Total Rainfall (in inches)	Change in Total Rainfall from Last Year to This Year (in inches)
May	2.3	3.7	-1.4
June	3.8	3.5	0.3
July	3.7	3.2	0.5

Write one inequality to order the Changes in Total Rainfall:

From Least to Greatest: From Greatest to Least:

In this case, does the greatest number indicate the greatest change in rainfall? Explain.

Exercises 5–8

5. Mark's favorite football team lost yards on two back-to-back plays. They lost 3 yards on the first play. They lost 1 yard on the second play. Write an inequality statement using integers to compare the forward progress made on each play.

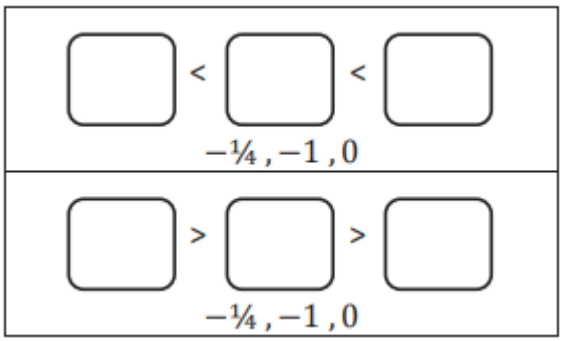
6. Sierra had to pay the school for two textbooks that she lost. One textbook cost $\$55$, and the other cost $\$75$. Her mother wrote two separate checks for each expense. Write two integers that represent the change to her mother's checking account balance. Then, write an inequality statement that shows the relationship between these two numbers.

7. Jason ordered the numbers -70, -18, and -18.5 from least to greatest by writing the following statement:
   $-18 < -18.5 < -70$.
   Is this a true statement? Explain.

8. Write a real-world situation that is represented by the following inequality: $-19 < 40$. Explain the position of the numbers on a number line.

Exercise 9: A Closer Look at the Sprint

9. Look at the following two examples from the Sprint.



a. Fill in the numbers in the correct order.

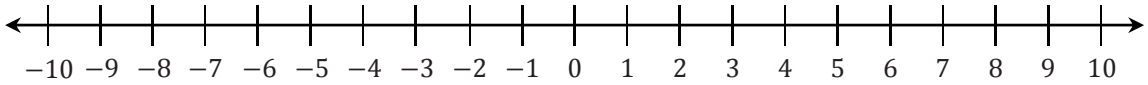
b. Explain how the position of the numbers on the number line supports the inequality statements you created.

c. Create a new pair of greater than and less than inequality statements using three other rational numbers.

Lesson 11: Absolute Value—Magnitude and Distance

Classwork

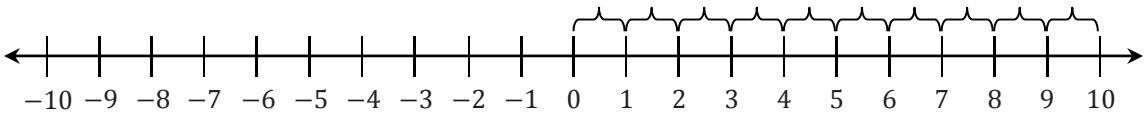
Opening Exercise



Example 1: The Absolute Value of a Number

The absolute value of ten is written as $|10|$. On the number line, count the number of units from 10 to 0. How many units is 10 from 0?

$|10| =$

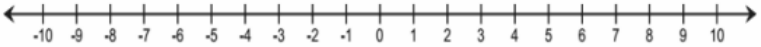
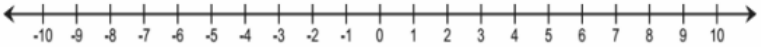
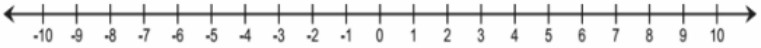


What other number has an absolute value of 10? Why?

Absolute Value:

Exercises 1–3

Complete the following chart.

	Number	Absolute Value	Number Line Diagram	Different Number with the Same Absolute Value
1.	-6			
2.	8			
3.	-1			

Example 2: Using Absolute Value to Find Magnitude

Mrs. Owens received a call from her bank because she had a checkbook balance of $-\$45$. What was the magnitude of the amount overdrawn?

Magnitude:

Exercises 4–19

For each scenario below, use absolute value to determine the magnitude of each quantity.

4. Maria was sick with the flu, and her weight change as a result of it is represented by -4 pounds. How much weight did Maria lose?

5. Jeffrey owes his friend $\$5$. How much is Jeffrey's debt?

6. The elevation of Niagara Falls, which is located between Lake Erie and Lake Ontario, is 326 feet. How far is this above sea level?

7. How far below zero is -16 degrees Celsius?

8. Frank received a monthly statement for his college savings account. It listed a deposit of $\$100$ as $+100.00$. It listed a withdrawal of $\$25$ as -25.00. The statement showed an overall ending balance of $\$835.50$. How much money did Frank add to his account that month? How much did he take out? What is the total amount Frank has saved for college?

9. Meg is playing a card game with her friend, Iona. The cards have positive and negative numbers printed on them. Meg exclaims: "The absolute value of the number on my card equals 8." What is the number on Meg's card?

10. List a positive and negative number whose absolute value is greater than 3. Justify your answer using the number line.

11. Which of the following situations can be represented by the absolute value of 10? Check all that apply.

___ The temperature is 10 degrees below zero. Express this as an integer.

___ Determine the size of Harold's debt if he owes $\$10$.

___ Determine how far -10 is from zero on a number line.

___ 10 degrees is how many degrees above zero?

12. Julia used absolute value to find the distance between 0 and 6 on a number line. She then wrote a similar statement to represent the distance between 0 and -6. Below is her work. Is it correct? Explain.

$$|6| = 6 \text{ and } |-6| = -6$$

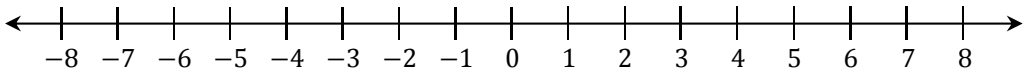
13. Use absolute value to represent the amount, in dollars, of a $\$238.25$ profit.

14. Judy lost 15 pounds. Use absolute value to represent the number of pounds Judy lost.

15. In math class, Carl and Angela are debating about integers and absolute value. Carl said two integers can have the same absolute value, and Angela said one integer can have two absolute values. Who is right? Defend your answer.

16. Jamie told his math teacher: "Give me any absolute value, and I can tell you two numbers that have that absolute value." Is Jamie correct? For any given absolute value, will there always be two numbers that have that absolute value?

17. Use a number line to show why a number and its opposite have the same absolute value.



18. A bank teller assisted two customers with transactions. One customer made a $\$25$ withdrawal from a savings account. The other customer made a $\$15$ deposit. Use absolute value to show the size of each transaction. Which transaction involved more money?

19. Which is farther from zero: $-7\frac{3}{4}$ or $7\frac{1}{2}$? Use absolute value to defend your answer.

Lesson 12: The Relationship Between Absolute Value and Order

Classwork

Opening Exercise

Record your integer values in order from least to greatest in the space below.

Example 1: Comparing Order of Integers to the Order of Their Absolute Values

Write an inequality statement relating the ordered integers from the Opening Exercise. Below each integer, write its absolute value.

Circle the absolute values that are in increasing numerical order and their corresponding integers. Describe the circled values.

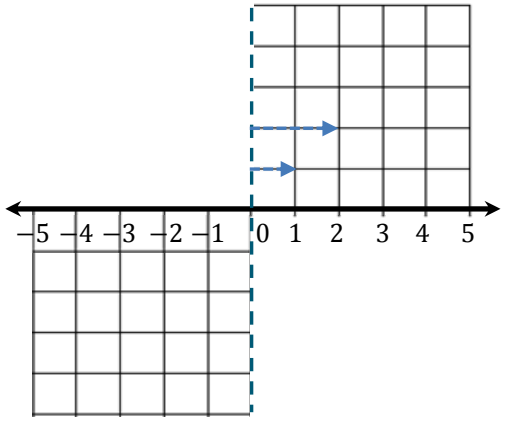
Rewrite the integers that are not circled in the space below. How do these integers differ from the ones you circled?

Rewrite the negative integers in ascending order and their absolute values in ascending order below them.

Describe how the order of the absolute values compares to the order of the negative integers.

Example 2: The Order of Negative Integers and Their Absolute Values

Draw arrows starting at the dashed line (zero) to represent each of the integers shown on the number line below. The arrows that correspond with 1 and 2 have been modeled for you.



As you approach zero from the left on the number line, the integers _____, but the absolute values of those integers _____. This means that the order of negative integers is _____ the order of their absolute values.

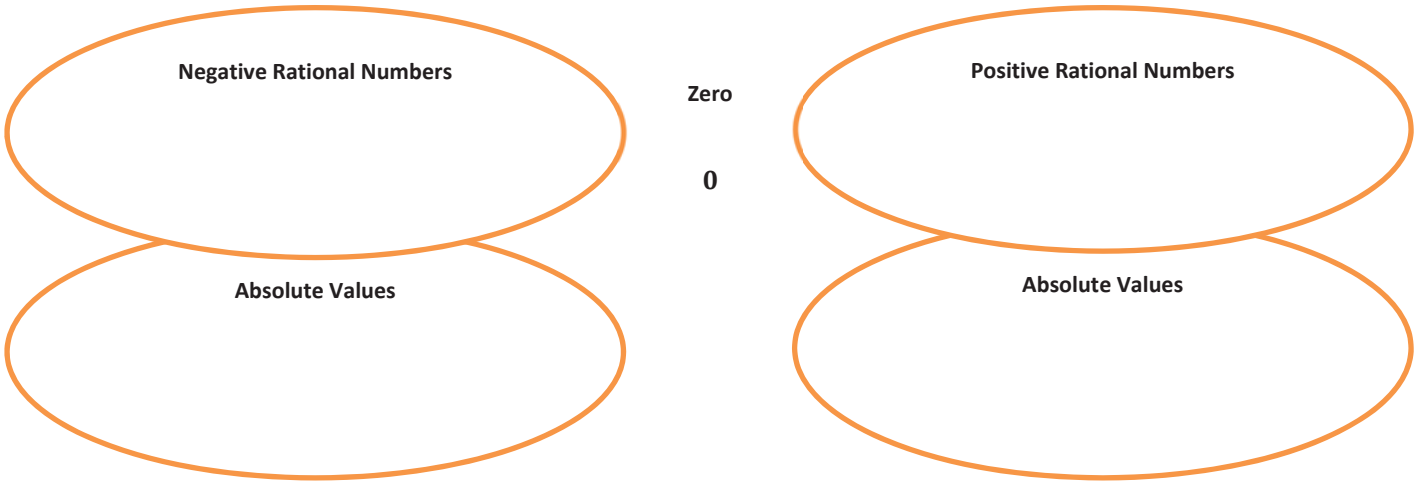
Exercise 1

Complete the steps below to order these numbers:

$$\left\{2.1, -4\frac{1}{2}, -6, 0.25, -1.5, 0, 3.9, -6.3, -4, 2\frac{3}{4}, 3.99, -9\frac{1}{4}\right\}$$

a. Separate the set of numbers into positive rational numbers, negative rational numbers, and zero in the top cells below (order does not matter).

b. Write the absolute values of the rational numbers (order does not matter) in the bottom cells.



c. Order each subset of absolute values from least to greatest.

0

d. Order each subset of rational numbers from least to greatest.

0

e. Order the whole given set of rational numbers from least to greatest.

Exercise 2

a. Find a set of four integers such that their order and the order of their absolute values are the same.

b. Find a set of four integers such that their order and the order of their absolute values are opposite.

c. Find a set of four non-integer rational numbers such that their order and the order of their absolute values are the same.

d. Find a set of four non-integer rational numbers such that their order and the order of their absolute values are opposite.

e. Order all of your numbers from parts (a)–(d) in the space below. This means you should be ordering 16 numbers from least to greatest.

Lesson 13: Statements of Order in the Real World

Classwork

Opening Exercise

A radio disc jockey reports that the temperature outside his studio has changed 10 degrees since he came on the air this morning. Discuss with your group what listeners can conclude from this report.

Example 1: Ordering Numbers in the Real World

A $\$25$ credit and a $\$25$ charge appear similar, yet they are very different.

Describe what is similar about the two transactions.

How do the two transactions differ?

Exercises

1. Scientists are studying temperatures and weather patterns in the Northern Hemisphere. They recorded temperatures (in degrees Celsius) in the table. Represent each reported temperature using a rational number. Order the rational numbers from least to greatest. Explain why the rational numbers that you chose appropriately represent the given temperatures.

Temperatures as Reported	8 below zero	12	-4	13 below zero	0	2 above zero	6 below zero	-5
Temperature (°C)								

2. Jami's bank account statement shows the transactions below. Represent each transaction as a rational number describing how it changes Jami's account balance. Then, order the rational numbers from greatest to least. Explain why the rational numbers that you chose appropriately reflect the given transactions.

Listed Transactions	Debit \$12.20	Credit \$4.08	Charge \$1.50	Withdrawal \$20.00	Deposit \$5.50	Debit \$3.95	Charge \$3.00
Change to Jami's Account							

3. During the summer, Madison monitors the water level in her parents' swimming pool. The table below shows the numbers she recorded in July and August to represent how the water levels compare to normal. Order the rational numbers from least to greatest. Explain why the rational numbers that you chose appropriately reflect the given water levels.

Madison's Readings	$\frac{1}{2}$ in above normal	$\frac{1}{4}$ in above normal	$\frac{1}{2}$ in below normal	$\frac{1}{8}$ in above normal	$1\frac{1}{4}$ in below normal	$\frac{3}{8}$ in below normal	$\frac{3}{4}$ in below normal
Compared to Normal							

4. Changes in the weather can be predicted by changes in the barometric pressure. Over several weeks, Stephanie recorded changes in barometric pressure seen on her barometer to compare to local weather forecasts. Use rational numbers to record the indicated changes in the pressure in the table. Order the rational numbers from least to greatest. Explain why the rational numbers that you chose appropriately represent the given pressure changes.

Barometric Pressure Change (Inches of Mercury)	Rise 0.04	Fall 0.21	Rise 0.2	Fall 0.03	Rise 0.1	Fall 0.09	Fall 0.14
Barometric Pressure Change (Inches of Mercury)							

Example 2: Using Absolute Value to Solve Real-World Problems

The captain of a fishing vessel is standing on the deck at 23 feet above sea level. He holds a rope tied to his fishing net that is below him underwater at a depth of 38 feet.

Draw a diagram using a number line, and then use absolute value to compare the lengths of rope in and out of the water.

Example 3: Making Sense of Absolute Value and Statements of Inequality

A recent television commercial asked viewers, "Do you have over $\$10{,}000$ in credit card debt?"

What types of numbers are associated with the word *debt*, and why? Write a number that represents the value from the television commercial.

Give one example of "over $\$10{,}000$ in credit card debt." Then, write a rational number that represents your example.

How do the debts compare, and how do the rational numbers that describe them compare? Explain.

Lesson 14: Ordered Pairs

Classwork

Example 1: The *Order* in Ordered Pairs

The first number of an ordered pair is called the _____.

The second number of an ordered pair is called the _____.

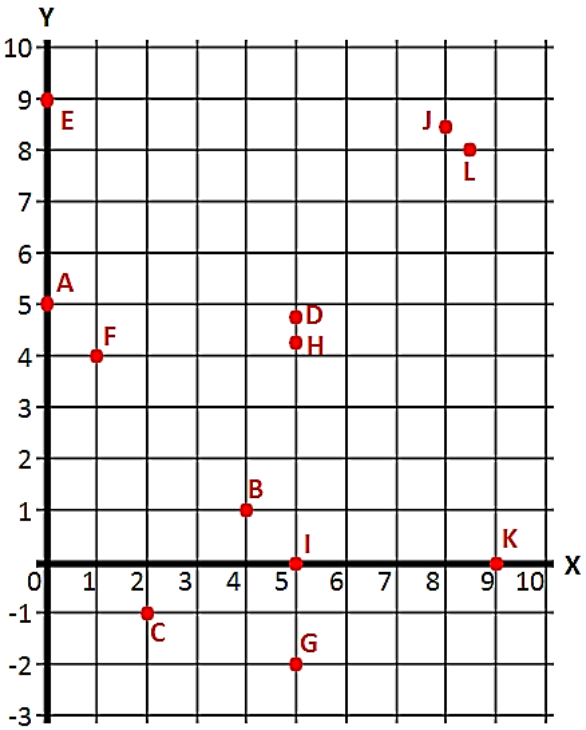
Example 2: Using Ordered Pairs to Name Locations

Describe how the ordered pair is being used in your scenario. Indicate what defines the first coordinate and what defines the second coordinate in your scenario.

Exercises

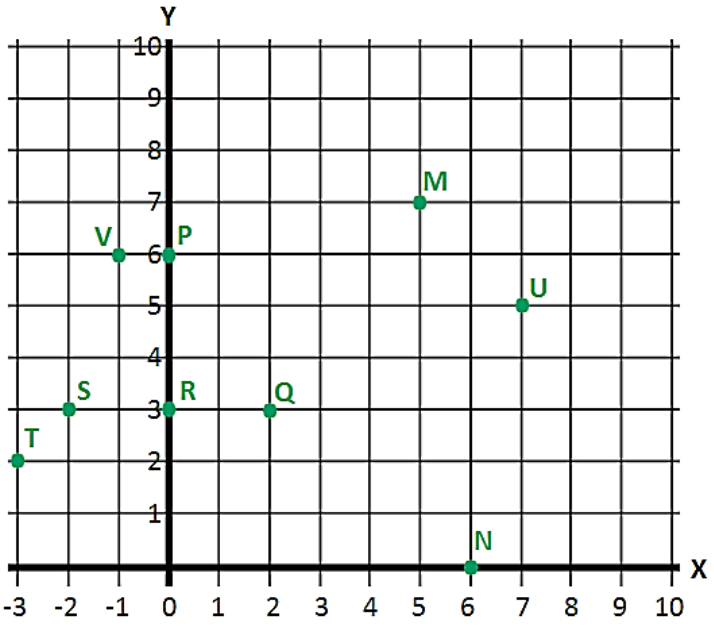
The first coordinates of the ordered pairs represent the numbers on the line labeled x, and the second coordinates represent the numbers on the line labeled y.

1. Name the letter from the grid below that corresponds with each ordered pair of numbers below.



   a. $(1, 4)$
   b. $(0, 5)$
   c. $(4, 1)$
   d. $(8.5, 8)$
   e. $(5, -2)$
   f. $(5, 4.2)$
   g. $(2, -1)$
   h. $(0, 9)$

2. List the ordered pair of numbers that corresponds with each letter from the grid below.



   a. Point M
   b. Point S
   c. Point N
   d. Point T
   e. Point P
   f. Point U
   g. Point Q
   h. Point V
   i. Point R

Lesson 15: Locating Ordered Pairs on the Coordinate Plane

Classwork

Example 1: Extending the Axes Beyond Zero

The point below represents zero on the number line. Draw a number line to the right starting at zero. Then, follow directions as provided by the teacher.

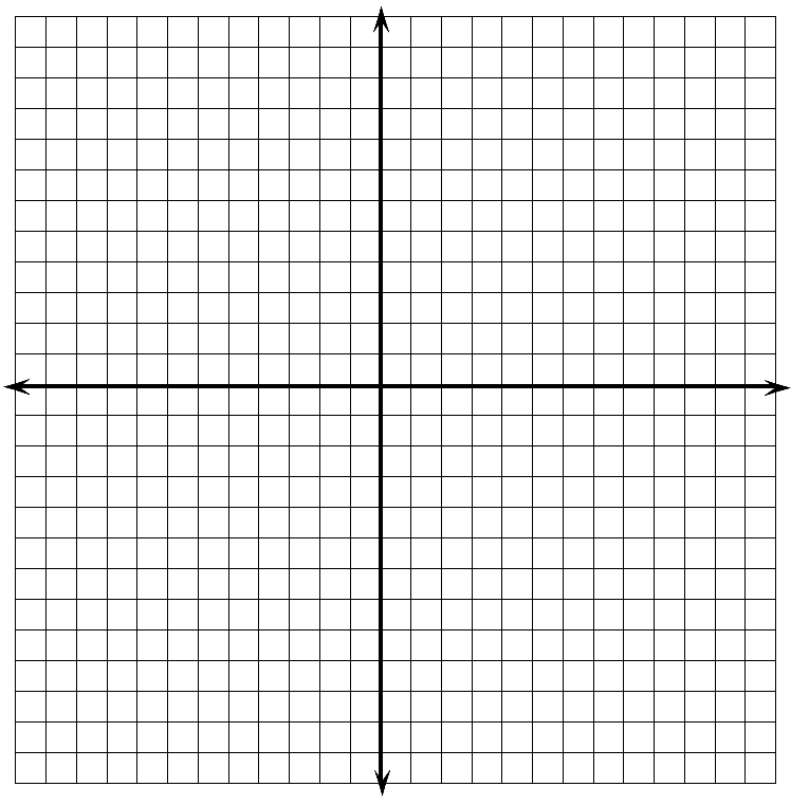
Example 2: Components of the Coordinate Plane

All points on the coordinate plane are described with reference to the origin. What is the origin, and what are its coordinates?

To describe locations of points in the coordinate plane, we use _____ of numbers. Order is important, so on the coordinate plane, we use the form (_____). The first coordinate represents the point's location from zero on the _____-axis, and the second coordinate represents the point's location from zero on the _____-axis.

Exercises 1–3

1. Use the coordinate plane below to answer parts (a)–(c).



   a. Graph at least five points on the x-axis, and label their coordinates.

   b. What do the coordinates of your points have in common?

   c. What must be true about any point that lies on the x-axis? Explain.

2. Use the coordinate plane to answer parts (a)–(c).

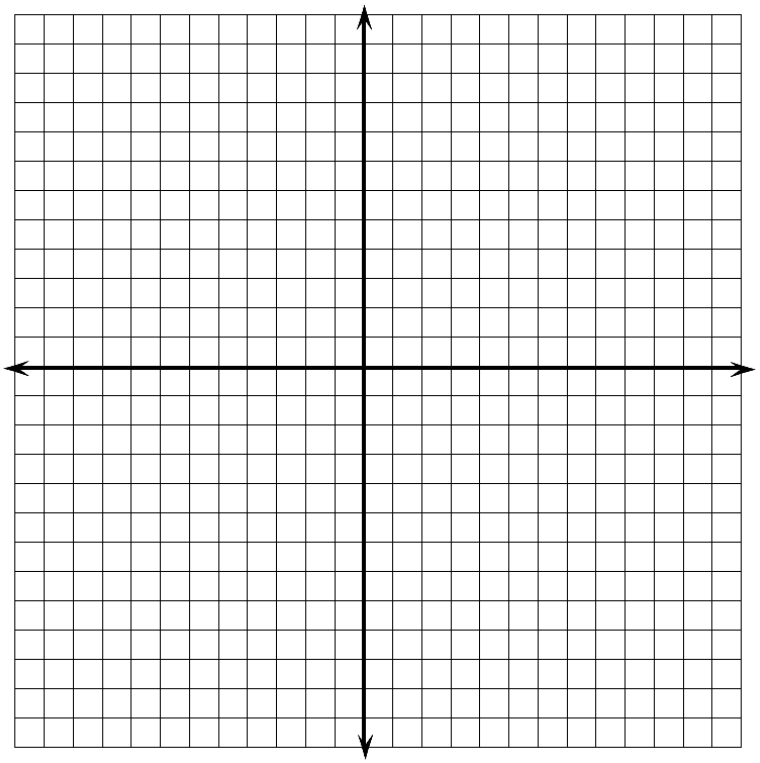
   a. Graph at least five points on the y-axis, and label their coordinates.

   b. What do the coordinates of your points have in common?

   c. What must be true about any point that lies on the y-axis? Explain.

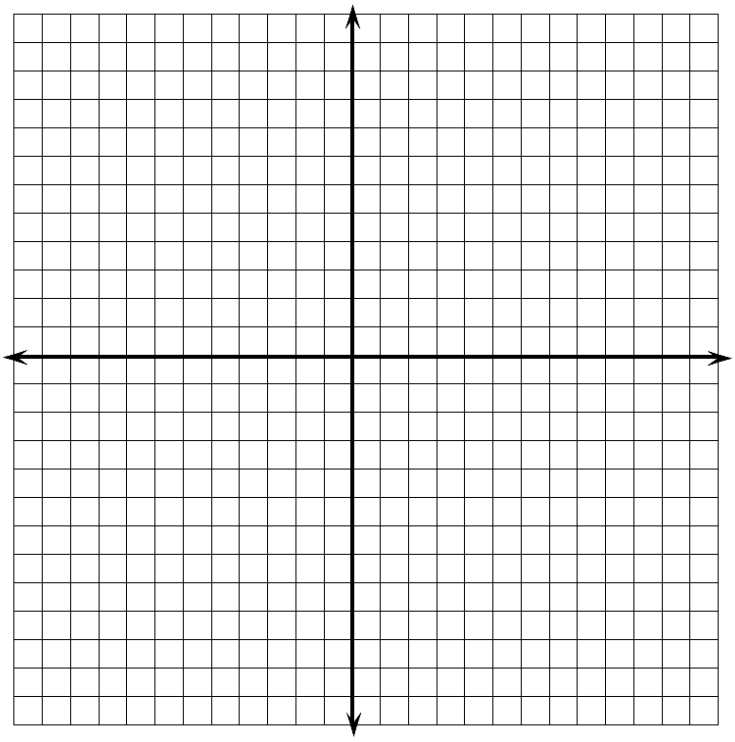
3. If the origin is the only point with 0 for both coordinates, what must be true about the origin?

Example 3: Quadrants of the Coordinate Plane



Exercises 4–6

4. Locate and label each point described by the ordered pairs below. Indicate which of the quadrants the points lie in.



a. $(7, 2)$

b. $(3, -4)$

c. $(1, -5)$

d. $(-3, 8)$

e. $(-2, -1)$

5. Write the coordinates of at least one other point in each of the four quadrants.
   a. Quadrant I

   b. Quadrant II

   c. Quadrant III

   d. Quadrant IV

6. Do you see any similarities in the points within each quadrant? Explain your reasoning.

Lesson 16: Symmetry in the Coordinate Plane

Classwork

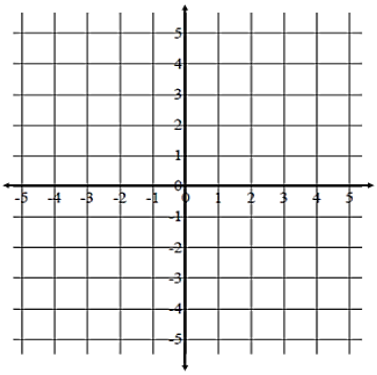
Opening Exercise

Give an example of two opposite numbers, and describe where the numbers lie on the number line. How are opposite numbers similar, and how are they different?

Example 1: Extending Opposite Numbers to the Coordinate Plane

Extending Opposite Numbers to the Coordinates of Points on the Coordinate Plane

Locate and label your points on the coordinate plane to the right. For each given pair of points in the table below, record your observations and conjectures in the appropriate cell. Pay attention to the absolute values of the coordinates and where the points lie in reference to each axis.



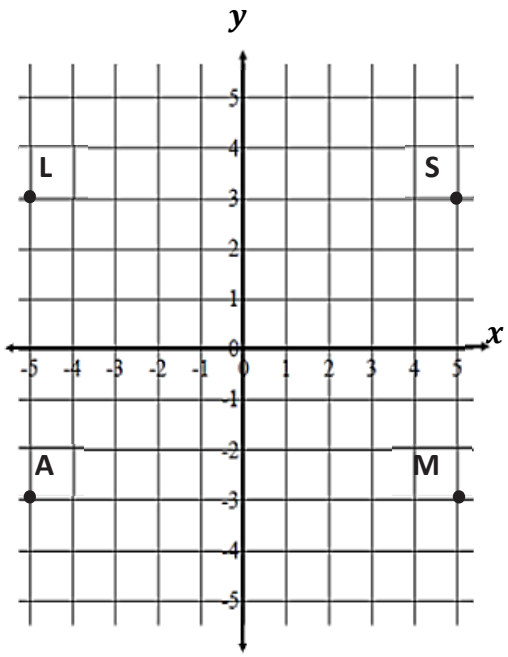
	$(3,4)$ and $(-3,4)$	$(3,4)$ and $(3,-4)$	$(3,4)$ and $(-3,-4)$
Similarities of Coordinates			
Differences of Coordinates			
Similarities in Location			

Differences in Location			
Relationship Between Coordinates and Location on the Plane			

Exercises

In each column, write the coordinates of the points that are related to the given point by the criteria listed in the first column of the table. Point $S(5, 3)$ has been reflected over the x- and y-axes for you as a guide, and its images are shown on the coordinate plane. Use the coordinate grid to help you locate each point and its corresponding coordinates.

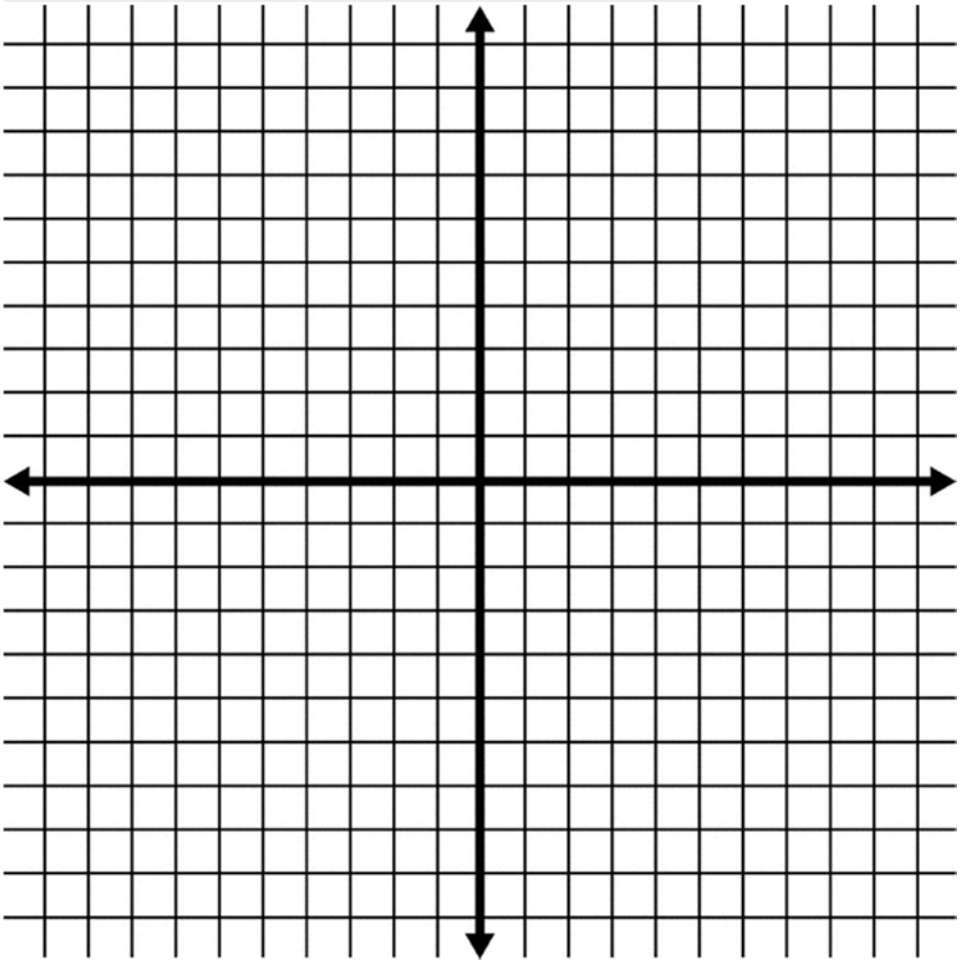
Given Point:	$S(5, 3)$	$(-2, 4)$	$(3, -2)$	$(-1, -5)$
The given point is reflected across the x-axis.				
The given point is reflected across the y-axis.				
The given point is reflected first across the x-axis and then across the y-axis.				
The given point is reflected first across the y-axis and then across the x-axis.				



1. When the coordinates of two points are (x, y) and $(-x, y)$, what line of symmetry do the points share? Explain.

2. When the coordinates of two points are (x, y) and $(x, -y)$, what line of symmetry do the points share? Explain.

Examples 2–3: Navigating the Coordinate Plane

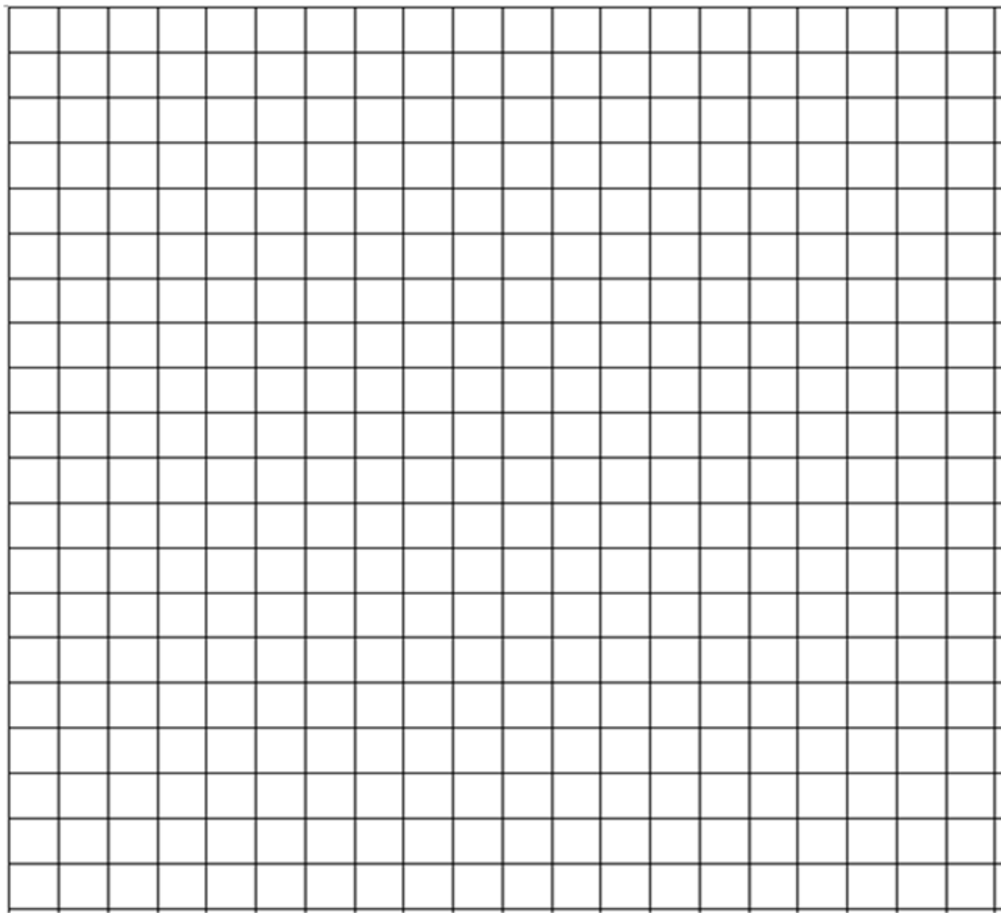


Lesson 17: Draw the the Coordinate Plane and Points on the Plane

Classwork

Opening Exercise

Draw all necessary components of the coordinate plane on the blank 20×20 grid provided below, placing the origin at the center of the grid and letting each grid line represent 1 unit.



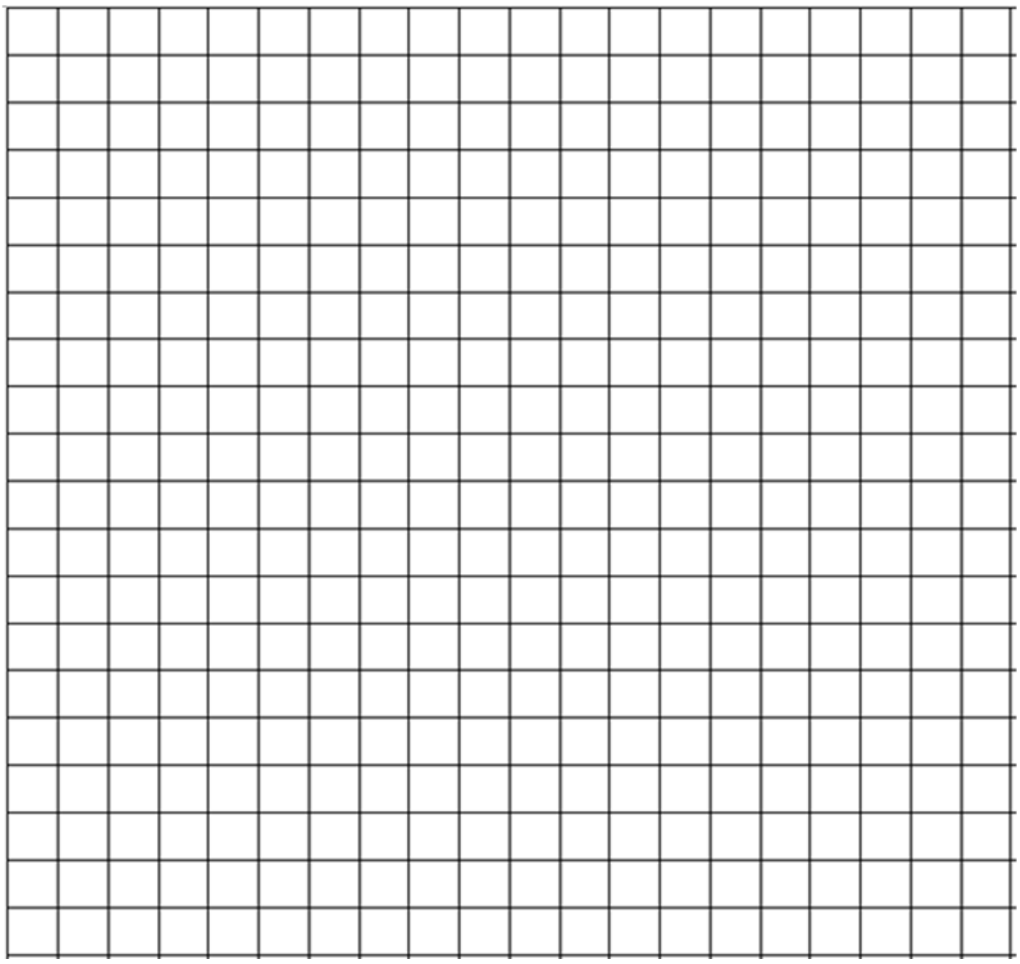
Example 1: Drawing the Coordinate Plane Using a $1:1$ Scale

Locate and label the points $\{(3,2), (8,4), (-3,8), (-2,-9), (0,6), (-1,-2), (10,-2)\}$ on the grid above.

Example 2: Drawing the Coordinate Plane Using an Increased Number Scale for One Axis

Draw a coordinate plane on the grid below, and then locate and label the following points:

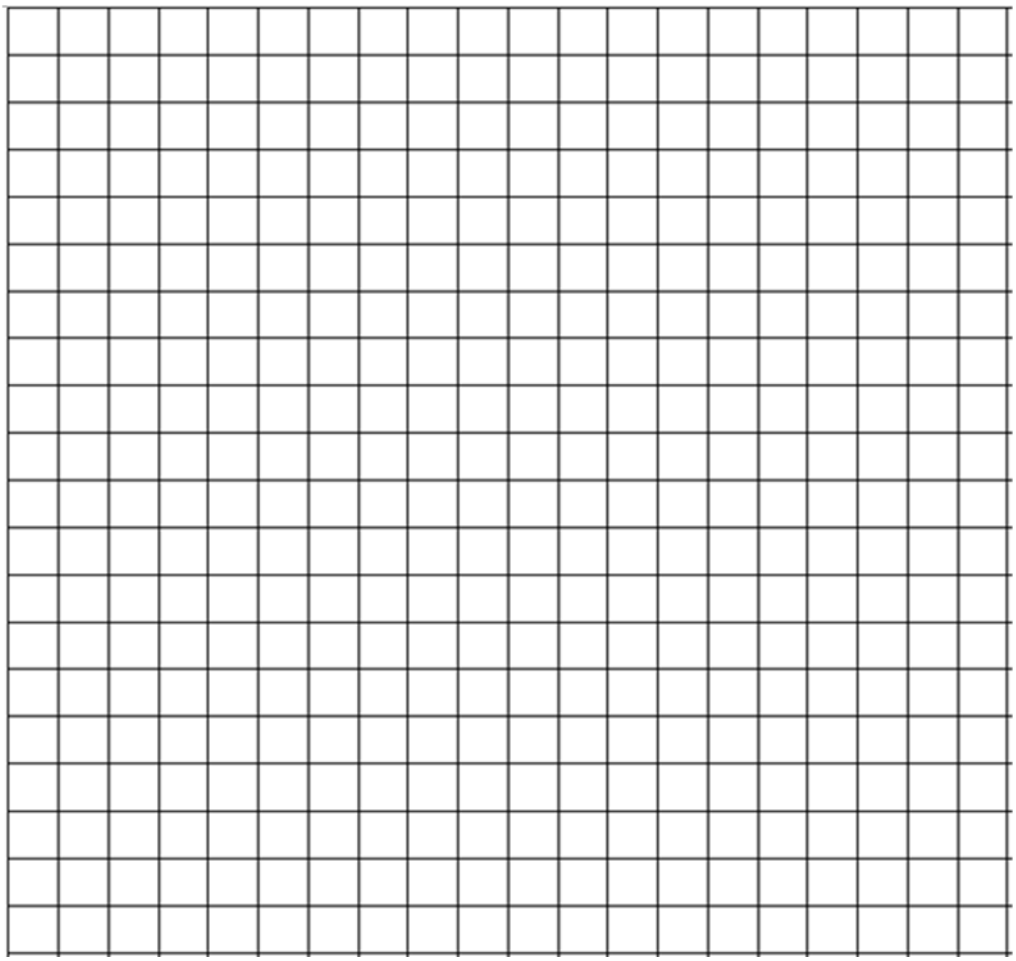
$$\{(-4, 20), (-3,35), (1, -35), (6, 10), (9, -40)\}.$$



Example 3: Drawing the Coordinate Plane Using a Decreased Number Scale for One Axis

Draw a coordinate plane on the grid below, and then locate and label the following points:

$$\{(0.1, 4), (0.5, 7), (-0.7, -5), (-0.4, 3), (0.8, 1)\}.$$



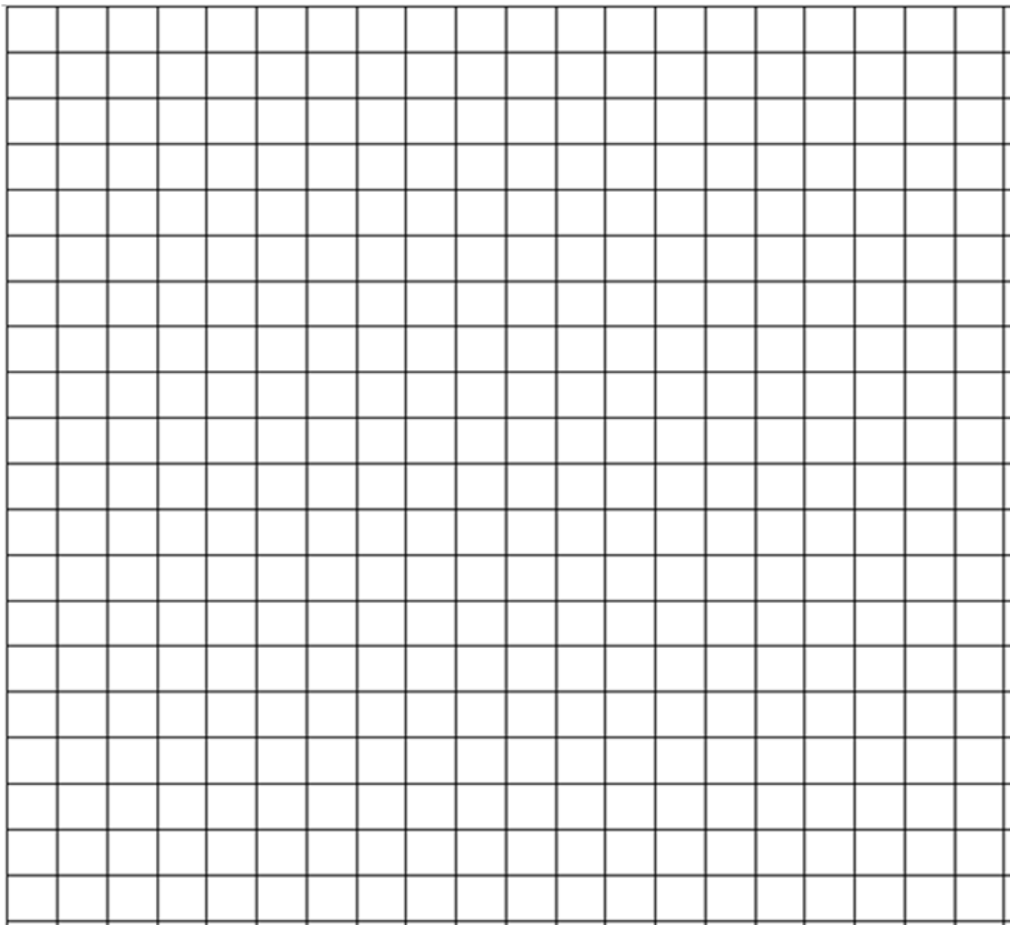
Example 4: Drawing the Coordinate Plane Using a Different Number Scale for Both Axes

Determine a scale for the x-axis that will allow all x-coordinates to be shown on your grid.

Determine a scale for the y-axis that will allow all y-coordinates to be shown on your grid.

Draw and label the coordinate plane, and then locate and label the set of points.

$$\{(-14, 2), (-4, -0.5), (6, -3.5), (14, 2.5), (0, 3.5), (-8, -4)\}$$



Lesson 18: Distance on the Coordinate Plane

Classwork

Opening Exercise

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 a map/diagram of the roads, and use it and the information on the sign to answer the following questions:

Albertsville ← 8 mi.
Blossville ↑ 3 mi.
Cheyenne ↑ 12 mi.
Dewey Falls → 6 mi.

What is the distance between Albertsville and Dewey Falls?

What is the distance between Blossville and Cheyenne?

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

Example 1: The Distance Between Points on an Axis

Consider the points $(-4, 0)$ and $(5, 0)$.

What do the ordered pairs have in common, and what does that mean about their location in the coordinate plane?

How did we find the distance between two numbers on the number line?

Use the same method to find the distance between $(-4, 0)$ and $(5, 0)$.

Example 2: The Length of a Line Segment on an Axis

Consider the line segment with end points $(0, -6)$ and $(0, -11)$.

What do the ordered pairs of the end points have in common, and what does that mean about the line segment's location in the coordinate plane?

Find the length of the line segment described by finding the distance between its end points $(0, -6)$ and $(0, -11)$.

Example 3: Length of a Horizontal or Vertical Line Segment That Does Not Lie on an Axis

Consider the line segment with end points $(-3, 3)$ and $(-3, -5)$.

What do the end points, which are represented by the ordered pairs, have in common? What does that tell us about the location of the line segment on the coordinate plane?

Find the length of the line segment by finding the distance between its end points.

Exercise

Find the lengths of the line segments whose end points are given below. Explain how you determined that the line segments are horizontal or vertical.

a. $(-3, 4)$ and $(-3, 9)$

b. $(2, -2)$ and $(-8, -2)$

c. $(-6, -6)$ and $(-6, 1)$

d. $(-9, 4)$ and $(-4, 4)$

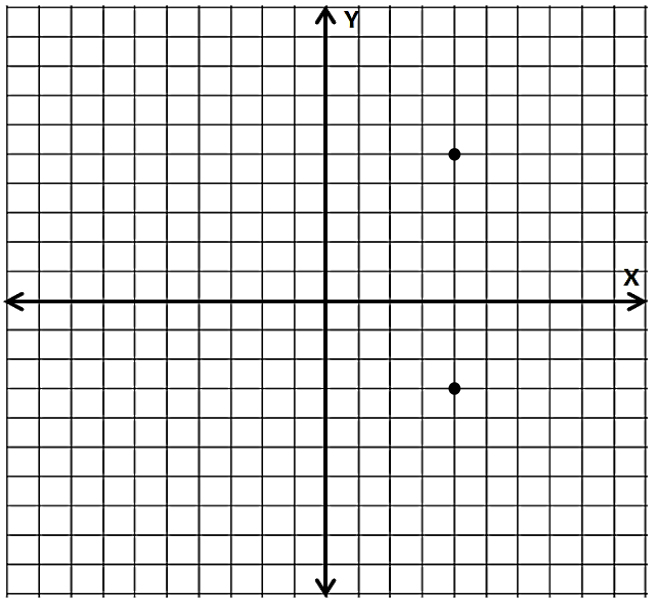
e. $(0, -11)$ and $(0, 8)$

Lesson 19: Problem Solving and the Coordinate Plane

Classwork

Opening Exercise

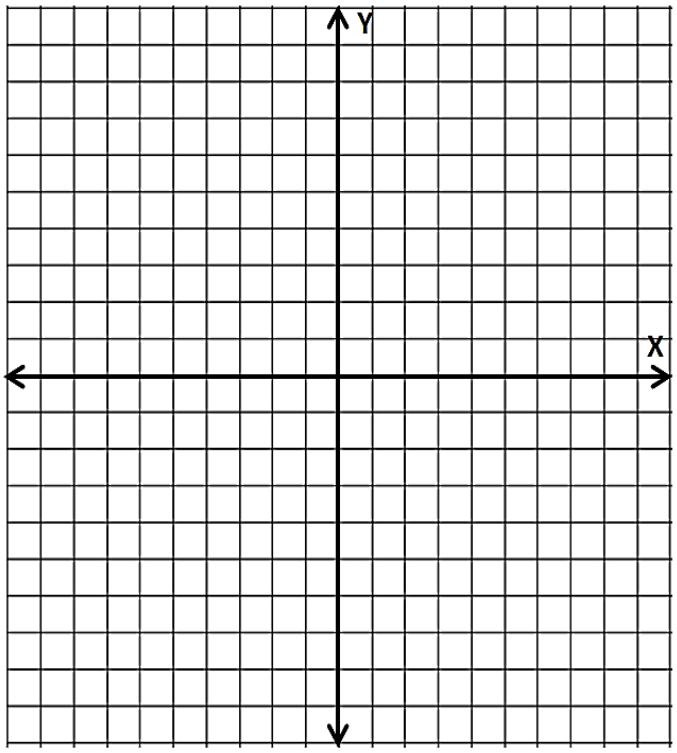
In the coordinate plane, find the distance between the points using absolute value.



Exploratory Challenge

Exercises 1–2: The Length of a Line Segment Is the Distance Between Its End Points

1. Locate and label $(4, 5)$ and $(4, -3)$. Draw the line segment between the end points given on the coordinate plane. How long is the line segment that you drew? Explain.



2. Draw a horizontal line segment starting at $(4, -3)$ that has a length of 9 units. What are the possible coordinates of the other end point of the line segment? (There is more than one answer.)

Which point did you choose to be the other end point of the horizontal line segment? Explain how and why you chose that point. Locate and label the point on the coordinate grid.

Exercise 3: Extending Lengths of Line Segments to Sides of Geometric Figures

3. The two line segments that you have just drawn could be seen as two sides of a rectangle. Given this, the end points of the two line segments would be three of the vertices of this rectangle.
   a. Find the coordinates of the fourth vertex of the rectangle. Explain how you find the coordinates of the fourth vertex using absolute value.

   b. How does the fourth vertex that you found relate to each of the consecutive vertices in either direction? Explain.

   c. Draw the remaining sides of the rectangle.

Exercises 4–6: Using Lengths of Sides of Geometric Figures to Solve Problems

4. Using the vertices that you have found and the lengths of the line segments between them, find the perimeter of the rectangle.

5. Find the area of the rectangle.

6. Draw a diagonal line segment through the rectangle with opposite vertices for end points. What geometric figures are formed by this line segment? What are the areas of each of these figures? Explain.

Exercise 7

7. Construct a rectangle on the coordinate plane that satisfies each of the criteria listed below. Identify the coordinate of each of its vertices.
   - Each of the vertices lies in a different quadrant.
   - Its sides are either vertical or horizontal.
   - The perimeter of the rectangle is 28 units.

   Using absolute value, show how the lengths of the sides of your rectangle provide a perimeter of 28 units.