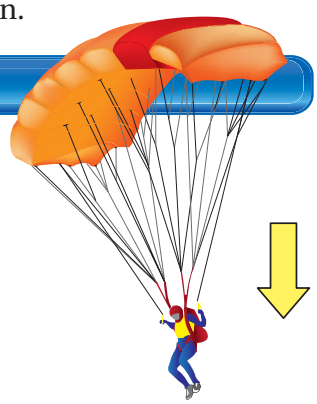
1.1 Integers and Absolute Value

Essential Question How can you use integers to represent the velocity and the speed of an object?

On these two pages, you will investigate vertical motion (up or down).

- Speed tells how fast an object is moving, but it does not tell the direction.
- Velocity tells how fast an object is moving, and it also tells the direction.
  When velocity is positive, the object is moving up.
  When velocity is negative, the object is moving down.

1 ACTIVITY: Falling Parachute



Work with a partner. You are gliding to the ground wearing a parachute. The table shows your height above the ground at different times.

Time (seconds)	0	1	2	3
Height (feet)	90	75	60	45

a. Describe the pattern in the table. How many feet do you move each second? After how many seconds will you land on the ground?

b. What integer represents your speed? Give the units.

c. Do you think your velocity should be represented by a positive or negative integer? Explain your reasoning.

d. What integer represents your velocity? Give the units.

2 ACTIVITY: Rising Balloons

Work with a partner. You release a group of balloons. The table shows the height of the balloons above the ground at different times.

Time (seconds)	0	1	2	3
Height (feet)	8	12	16	20

a. Describe the pattern in the table. How many feet do the balloons move each second? After how many seconds will the balloons be at a height of 40 feet?

b. What integer represents the speed of the balloons? Give the units.

c. Do you think the velocity of the balloons should be represented by a positive or negative integer? Explain your reasoning.

d. What integer represents the velocity of the balloons? Give the units.

Integers

In this lesson, you will

- define the absolute value of a number.
- find absolute values of numbers.
- solve real-life problems.

3 ACTIVITY: Firework Parachute

Work with a partner. The table shows the height of a firework's parachute above the ground at different times.

Math Practice

Use Clear Definitions

What information can you use to support your answer?

Time (seconds)	Height (feet)
0	480
1	360
2	240
3	120
4	0

a. Describe the pattern in the table. How many feet does the parachute move each second?

b. What integer represents the speed of the parachute? What integer represents the velocity? How are these integers similar in their relation to 0 on a number line?

Inductive Reasoning

4. Copy and complete the table.

Velocity (feet per second)	−14	20	−2	0	25	−15
Speed (feet per second)						

5. Find two different velocities for which the speed is 16 feet per second.

6. Which number is greater: −4 or 3? Use a number line to explain your reasoning.

7. One object has a velocity of −4 feet per second. Another object has a velocity of 3 feet per second. Which object has the greater speed? Explain your answer.

What Is Your Answer?

8. **IN YOUR OWN WORDS** How can you use integers to represent the velocity and the speed of an object?

9. **LOGIC** In this lesson, you will study *absolute value*. Here are some examples:

$|-16| = 16$ $\quad |16| = 16$ $\quad |0| = 0$ $\quad |-2| = 2$

Which of the following is a true statement? Explain your reasoning.

$|\text{velocity}| = \text{speed}$ $\quad |\text{speed}| = \text{velocity}$

Practice Use what you learned about absolute value to complete Exercises 4–11 on page 6.

1.1 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
integer, *p. 4*
absolute value, *p. 4*

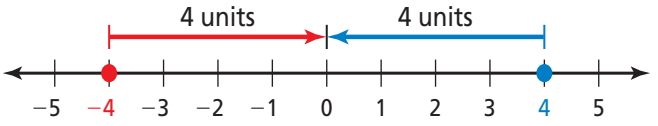
The following numbers are **integers:**

$\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots$

Key Idea

Absolute Value

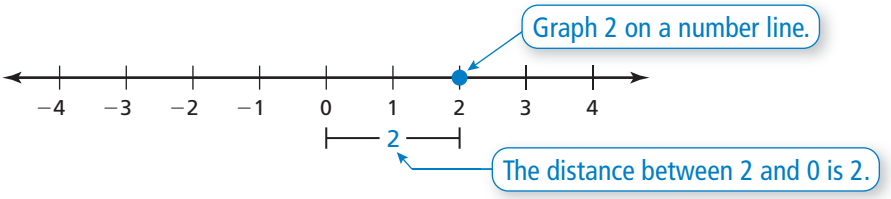
Words The **absolute value** of an integer is the distance between the number and 0 on a number line. The absolute value of a number a is written as $|a|$.



Numbers $|-4| = 4$ $|4| = 4$

EXAMPLE 1 Finding Absolute Value

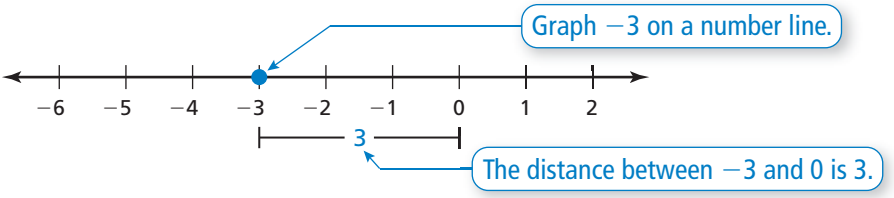
Find the absolute value of 2.



So, $|2| = 2$.

EXAMPLE 2 Finding Absolute Value

Find the absolute value of −3.



So, $|-3| = 3$.

On Your Own

Now You're Ready
Exercises 4–19

Find the absolute value.

1. $|7|$ **2.** $|-1|$ **3.** $|-5|$ **4.** $|14|$

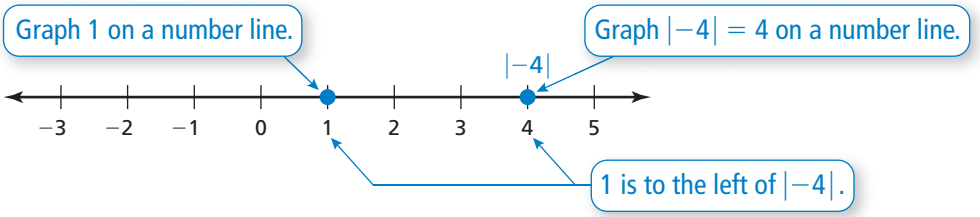
Multi-Language Glossary at BigIdeasMath.com

EXAMPLE 3 Comparing Values

Remember

A number line can be used to compare and order integers. Numbers to the left are less than numbers to the right. Numbers to the right are greater than numbers to the left.

Compare 1 and $|-4|$.



So, $1 < |-4|$.

On Your Own

Now You're Ready
Exercises 20–25

Copy and complete the statement using <, >, or =.

5. $|-2|$ ☐ -1

6. -7 ☐ $|6|$

7. $|10|$ ☐ 11

8. 9 ☐ $|-9|$

EXAMPLE 4 Real-Life Application

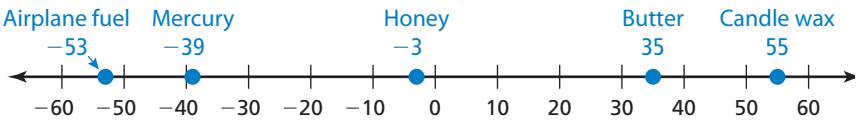
Substance	Freezing Point (°C)
Butter	35
Airplane fuel	−53
Honey	−3
Mercury	−39
Candle wax	55

The *freezing point* is the temperature at which a liquid becomes a solid.

a. Which substance in the table has the lowest freezing point?

b. Is the freezing point of mercury or butter closer to the freezing point of water, 0°C?

a. Graph each freezing point.



Airplane fuel has the lowest freezing point, −53°C.

b. The freezing point of water is 0°C, so you can use absolute values.

Mercury: $|-39| = 39$ **Butter:** $|35| = 35$

Because 35 is less than 39, the freezing point of butter is closer to the freezing point of water.

On Your Own

9. Is the freezing point of airplane fuel or candle wax closer to the freezing point of water? Explain your reasoning.

1.1 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **VOCABULARY** Which of the following numbers are integers?

$$9,\ 3.2,\ -1,\ \frac{1}{2},\ -0.25,\ 15$$

2. **VOCABULARY** What is the absolute value of an integer?

3. **WHICH ONE DOESN'T BELONG?** Which expression does *not* belong with the other three? Explain your reasoning.

$|6|$ $\quad$ 6 $\quad$ -6 $\quad$ $|-6|$

Practice and Problem Solving

Find the absolute value.

1 2 **4.** $|9|$ **5.** $|-6|$ **6.** $|-10|$ **7.** $|10|$

8. $|-15|$ **9.** $|13|$ **10.** $|-7|$ **11.** $|-12|$

12. $|5|$ **13.** $|-8|$ **14.** $|0|$ **15.** $|18|$

16. $|-24|$ **17.** $|-45|$ **18.** $|60|$ **19.** $|-125|$

Copy and complete the statement using <, >, or =.

3 **20.** $2 \ \square\ |-5|$ **21.** $|-4| \ \square\ 7$ **22.** $-5 \ \square\ |-9|$

23. $|-4| \ \square\ -6$ **24.** $|-1| \ \square\ |-8|$ **25.** $|5| \ \square\ |-5|$

ERROR ANALYSIS **Describe and correct the error.**

26. ✗ $|10| = -10$

27. ✗ $|-5| < 4$

28. **SAVINGS** You deposit \$50 in your savings account. One week later, you withdraw \$20. Write each amount as an integer.

29. **ELEVATOR** You go down 8 floors in an elevator. Your friend goes up 5 floors in an elevator. Write each amount as an integer.

Order the values from least to greatest.

30. $8, |3|, -5, |-2|, -2$

31. $|-6|, -7, 8, |5|, -6$

32. $-12, |-26|, -15, |-12|, |10|$

33. $|-34|, 21, -17, |20|, |-11|$

Simplify the expression.

34. $|-30|$ **35.** $-|4|$ **36.** $-|-15|$

37. PUZZLE Use a number line.

a. Graph and label the following points on a number line: $A = -3$, $E = 2$, $M = -6$, $T = 0$. What word do the letters spell?

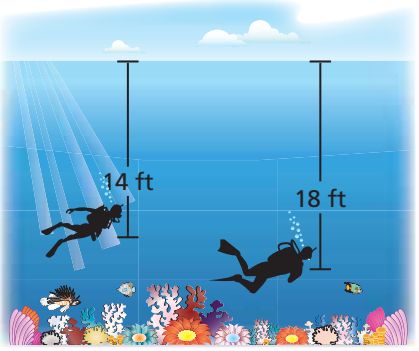
b. Graph and label the absolute value of each point in part (a). What word do the letters spell now?

38. OPEN-ENDED Write a negative integer whose absolute value is greater than 3.

REASONING Determine whether $n \geq 0$ or $n \leq 0$.

39. $n + |-n| = 2n$

40. $n + |-n| = 0$



41. CORAL REEF The depths of two scuba divers exploring a living coral reef are shown.

a. Write an integer for the position of each diver relative to sea level.

b. Which integer in part (a) is greater?

c. Which integer in part (a) has the greater absolute value? Compare this absolute value with the depth of that diver.

42. VOLCANOES The *summit elevation* of a volcano is the elevation of the top of the volcano relative to sea level. The summit elevation of the volcano Kilauea in Hawaii is 1277 meters. The summit elevation of the underwater volcano Loihi in the Pacific Ocean is −969 meters. Which summit is closer to sea level?

43. MINIATURE GOLF The table shows golf scores, relative to *par*.

Player	Score
1	+5
2	0
3	−4
4	−1
5	+2

a. The player with the lowest score wins. Which player wins?

b. Which player is at par?

c. Which player is farthest from par?

True or False? Determine whether the statement is *true* or *false*. Explain your reasoning.

44. If $x < 0$, then $|x| = -x$.

45. The absolute value of every integer is positive.

Fair Game Review What you learned in previous grades & lessons

Add. *(Skills Review Handbook)*

46. 19 + 32 **47.** 50 + 94 **48.** 181 + 217 **49.** 1149 + 2021

50. MULTIPLE CHOICE Which value is *not* a whole number? *(Skills Review Handbook)*

Ⓐ −5 Ⓑ 0 Ⓒ 4 Ⓓ 113