Lesson 2-1

Integers and Absolute Value

Interactive Study Guide

See pages 29–30 for:
- Getting Started
- Vocabulary Start-Up
- Notes

Essential Question

What happens when you add, subtract, multiply, and divide integers?

Common Core State Standards

Content Standards
Preparation for 7.NS.1, 7.NS.1a

Mathematical Practices
1, 2, 3, 4, 7

Vocabulary

negative number
positive number
integer
opposites
coordinate
inequality
absolute value

Math Symbols

< is less than
> is greater than

What You'll Learn

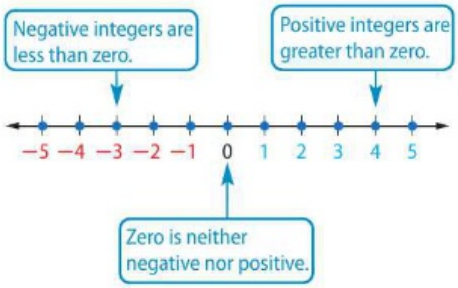
- Compare and order integers.
- Find the absolute value of an expression.

Real-World Link

Geocaching Geocaching is an outdoor treasure hunting game. Some treasures, or geocaches, are located hundreds of feet above sea level. Others are hidden in lakes and can only be reached by snorkeling or scuba diving.

Compare and Order Integers

A **negative number** is a number less than zero. A **positive number** is a number greater than zero. Negative numbers like −3 and positive numbers like +3 are members of the set of integers. An **integer** is any number from the set {…, −3, −2, −1, 0, 1, 2, 3, …}, where … means continues indefinitely.



Integers such as +3 and −3 are called **opposites**, because they are the same distance from zero on the number line.

Example 1

Tutor

Write an integer for each situation. Then identify its opposite and describe what it means.

a. 23°F below zero

Because it is *below* zero, the integer is −23. Its opposite is +23 or 23, which means 23°F above zero.

b. 11 inches more than normal

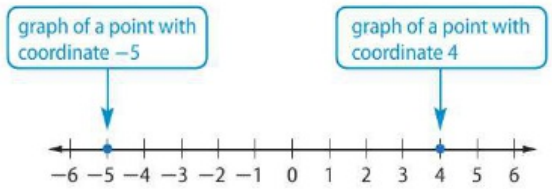
Because it is *more than* normal, the integer is +11 or 11. Its opposite is −11, which means 11 inches less than normal.

Got It? Do these problems to find out.

1a. a loss of 8 yards

1b. a deposit of $15

To graph an integer, locate the point named by the integer on a number line. The **coordinate** is the number that corresponds to the point on a number line.

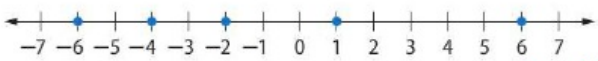


Any mathematical sentence containing < or > is called an inequality. An **inequality** compares numbers or quantities. When two numbers are graphed on a number line, the number to the left is always less than the number to the right.

Example 2

Tools Tutor

Use the integers graphed on the number line below.



Inequalities
The inequality symbol always points to the lesser number.

a. Write two inequalities involving 1 and −2.

Since 1 is to the right of −2, 1 is greater than −2. So, $1 > -2$.

Since −2 is to the left of 1, −2 is less than 1. So, $-2 < 1$.

b. Replace the ● with <, >, or = in −4 ● −6 to make a true sentence.

Since −4 is to the right of −6, −4 is greater. So, $-4 > -6$.

Got It? Do these problems to find out.

2a. Write two inequalities involving −7 and −3.

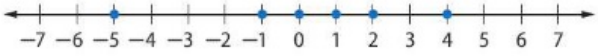
2b. Replace the ● with <, >, or = in −1 ● 2 to make a true sentence.

Example 3

Tools Tutor

Bethany and her friends played a question-and-answer video game. Their scores at the end of the game were 1, −5, 0, −1, 2, and 4. Order the scores from least to greatest.

Graph each integer on a number line.



Write the numbers as they appear from left to right. The scores −5, −1, 0, 1, 2, and 4 are in order from least to greatest.

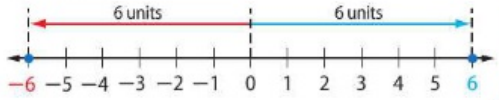
Got It? Do this problem to find out.

3. The recorded highs in degrees Celsius at Niagara Falls from February 21 to 28 of a recent year are 4, 2, 3, −6, −5, −1, 0, and 1. Order the temperatures from greatest to least.

Key Concept Absolute Value

Words The absolute value of a number is the distance the number is from zero on the number line. The absolute value of a number is always greater than or equal to zero.

Example $|6|$ and $|-6|$



Symbols

$|6| = 6$ The absolute value of 6 is 6.

$|-6| = 6$ The absolute value of −6 is 6.

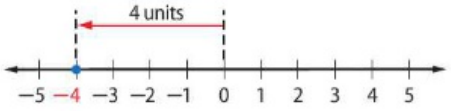
- ABSOLUTE VALUE MEASURES THE DISTANCE BETWEEN A NUMBER AND ZERO
- DISTANCE IS ALWAYS POSITIVE
- ABSOLUTE VALUE IS ALWAYS POSITIVE

Notice on the number line that −6 and 6 are each 6 units from 0, even though they are on opposite sides of 0. The **absolute value** of a number is the distance the number is from zero on a number line. So, −6 and 6 have the same absolute value.

Example 4

Evaluate each expression.

a. $|-4|$



On the number line, the graph of −4 is 4 units from 0.

$|-4| = 4$

b. $|-8| - |5|$ The absolute value of −8 is 8.

$|-8| - |5| = 8 - 5$ The absolute value of 5 is 5.

$= 3$ Simplify.

$|-7| = 7$

$|7| = 7$

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

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

THE OPPOSITE OF → $-|5| = -5$

$-|-5| = -5$

expression
When you evaluate an expression, you find the numerical value of the expression.

Got It? Do these problems to find out.

4a. $|-3|$

4b. $|-4| - |3|$

You can use absolute value notation with algebraic expressions since variables represent numbers.

Example 5

Evaluate $6 + |x|$ if $x = -2$.

$6 + |x| = 6 + |-2|$ Replace x with −2.

$= 6 + 2$ The absolute value of −2 is 2.

$= 8$ Simplify.

Got It? Do these problems to find out.

5a. Evaluate $|y| + 8$ if $y = -7$.

5b. Evaluate $9 - 5|z|$ if $z = 3$.

Guided Practice

NEGATIVES ← 0 → POSITIVES

Write an integer for each situation. Identify its opposite and describe its meaning. (Example 1)

1. a bank withdrawal of $500
2. a gain of 4 pounds

Write two inequalities using the number pairs. Use the symbols < or >. (Example 2)

3. 2 and −5
4. −4 and −8
5. −1 and 1

Replace each ● with <, >, or = to make a true sentence. (Example 2)

6. −9 ● −16
7. −7 ● 7
8. −6 ● 0

9. Order the state temperatures from least to greatest. (Example 3)

State	AL	AK	CA	FL	HI	ME	NJ	OH	TX
Temperature	−27	−80	−45	−2	12	−48	−34	−39	−23

Evaluate each expression. (Example 4)

10. |−12|
11. |−14| + |3|
12. |18| − |−5|

Evaluate each expression if $x = 7$ and $y = -6$. (Example 5)

13. $15 - |y|$
14. $|y| + x$
15. $3|y|$

Independent Practice

Go online for Step-by-Step Solutions

Write an integer for each situation. Identify its opposite and describe its meaning. (Example 1)

16. 5 strokes above par
17. 200 feet below sea level
18. an elevator descent of 18 floors
19. no gain on fourth down = 0

Write two inequalities using the number pairs. Use the symbols < or >. (Example 2)

20. 5 and −11
21. −8 and 14
22. −6 and −1
23. 0 and −4
24. |51| and |50|
25. |−27| and |−30|

Replace each ● with <, >, or = to make a true sentence. (Example 2)

26. −11 ● −9
27. −14 ● −17
28. 15 ● −6
29. −2 ● 16
30. 21 ● 0
31. 0 ● −35
32. |13| ● |−13|
33. |−27| ● |−27|

34. In a recent year, Jimmy Johnson was the point leader in NASCAR's Chase to the Cup. Other drivers' standings are shown in the table. (Example 3)

Chase to the Cup	
Driver	Number of Points Behind the Leader
K. Busch	40
K. Harvick	50
J. Gordon	20
T. Stewart	30

   a. Write an integer to describe each driver's standing with respect to the leader.

   b. Order the integers from least to greatest.

35. The top fourth-round scores of a recent PGA Championship were +4, −2, +6, +1, −4, −3, +5, −1, +2, and +3. Order the scores from least to greatest. (Example 3)

+6, +5, +4, +3, +2, +1, −1, −2, −3, −4

Glow Images/Getty Images

Evaluate each expression. (Example 4)

36. $|8|$

37. $|-17|$

38. $|-21|$

39. $-|15|$

40. $|0| + -|4|$

41. $-|-7| + |12|$

42. $|12| - |-2|$

43. $|-32| - |-6|$

44. $|18 - 4| - |5|$

Evaluate each expression if $x = -3$, $y = 4$, and $z = 2$. (Example 5)

45. $10 - |x|$

46. $2y - |x|$

47. $|z| + 19$

48. $3y + 3z + |x|$

49. $|4yz| - 3|x|$

50. $2(z + y) - |x|$

51. **Justify Conclusions** Movies are ranked based on ticket sales. The top movies for one week are listed in the table showing the change in position from the previous week. Which movie had the greatest absolute change in position? Explain.

Movie	A	B	C	D	E	F	G	H
Change in Position	−2	−7	+1	−3	+2	−8	−4	0

STEM **The table at the right shows the freezing point of various elements.**

Element	Freezing Point (°C)
chlorine	−101
helium	−272
krypton	−157
neon	−249
nitrogen	−201

52. Write two inequalities using the freezing point of neon and helium.

53. Order the temperatures from least to greatest.

54. Is the absolute value of the freezing point of chlorine greater than or less than the absolute value of the freezing point of nitrogen?

55. The average temperature of Saturn is −218°F while the average temperature of Jupiter is −162°F. Which planet has the lower average temperature? Explain.

Order the integers in each set from greatest to least.

56. $\{4, -2, -10, 3\}$

57. $\{-13, 5, 0, -5\}$

58. $\{7, -26, -15, 32, -19\}$

59. $\{-28, 62, -35, 20, -59\}$

60. $\{-42, 1, -6, 74, 0, -11\}$

61. $\{88, -72, -83, 232, -165, -94\}$

H.O.T. Problems Higher Order Thinking

62. **Model with Mathematics** Write a real-world situation in which you compare two negative integers.

Persevere with Problems **Determine whether each statement is *always*, *sometimes*, or *never* true. Explain your reasoning.**

63. $|x| = |-x|$

64. $|x| = -|x|$

65. $|-x| = -|x|$

66. **Reason Abstractly** Write a vocabulary term that completes the analogy: The symbol = is related to an equation in the same way as > is related to *a*(*n*) ___?___.

67. **Identify Structure** What is the least integer value of n such that $n > 0$?

68. **Building on the Essential Question** Order the integers −12, −5, −15, −10, −3 from least to greatest without using a number line. Explain your method.

Standardized Test Practice

69. Which of the following statements is false if $a = 3$ and $b = -3$?

A $|b| = a$ **C** $|b| = |a|$

B $|b| > 0$ **D** $|b| < 0$

70. If $|x| = 1$, what is the value of x?

F 1 **H** -1 and 0

G -1 **J** 1 and -1

71. **Short Response** Order $|-5|$, $-|9|$, -4, 0, $-|10|$, and 7 from least to greatest. Explain how you determined the order.

72. The table shows the number of points selected players have at the end of a game.

Player	Points
A	−10
B	−50
C	−5
D	0
E	−15

Which list shows the order of the players from greatest to least points?

A D, C, A, E, B **C** D, C, A, B, E

B B, E, A, C, D **D** B, C, A, D, E

Common Core Review

Name the property shown by each statement. 7.EE.1

73. $42 + 36 = 36 + 42$ **74.** $16 + 0 = 16$ **75.** $(19 \cdot 15) \cdot 2 = 19 \cdot (15 \cdot 2)$

76. $33 \cdot 0 = 0$ **77.** $(7 + 9) + 6 = 7 + (9 + 6)$ **78.** $25 \cdot 1 = 25$

Translate each phrase into an algebraic expression. 6.EE.2a

79. nine less than twice the number of boys

80. the distance Darren ran plus four more miles

81. three times the difference of the number of video games sold and two

82. **Multiple Representations** A roll of wrapping paper costs \$3. 7.EE.4

a. Symbols Write an equation that can be used to find the cost y of buying x number of rolls of wrapping paper.

b. Table Make a table to find the cost of 3, 4, 5, and 6 rolls.

c. Graph Graph the ordered pairs.

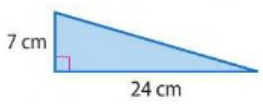
Find each quotient. 6.NS.2

83. $14\overline{)2730}$ **84.** $54\overline{)4736}$ **85.** $63\overline{)19{,}278}$

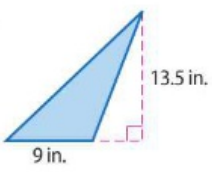
86. $45\overline{)20{,}250}$ **87.** $8\overline{)122{,}628}$ **88.** $103\overline{)21{,}129}$

Find the area of each figure. 6.G.1

89.



90.



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