2.3 Adding Real Numbers

Goal

Add real numbers using a number line or the rules of addition.

Key Words

- closure property
- commutative property
- associative property
- identity property
- inverse property

What is the profit or loss of a company?

In business a profit can be represented by a positive number and a loss can be represented by a negative number. In Example 4 you will add several profits and losses to find the overall profit of a summer excursion company.

The sum of any two real numbers is itself a unique real number. We say that the real numbers are *closed* under addition. This fact is called the **closure property of real number addition**. Addition can be modeled with movements on a number line.

- You add a **positive** number by moving to the **right** on the number line.
- You add a **negative** number by moving to the **left** on the number line.

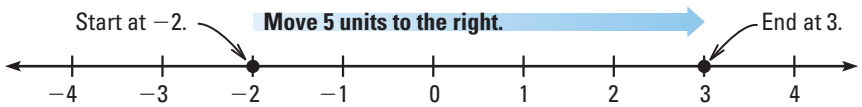
EXAMPLE 1 Add Using a Number Line

Use a number line to find the sum.

a. $-2 + 5$ **b.** $2 + (-6)$

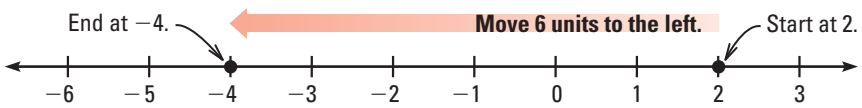
Solution

a.



ANSWER The sum can be written as $-2 + 5 = 3$.

b.



ANSWER The sum can be written as $2 + (-6) = -4$.

Checkpoint Add Using a Number Line

Use a number line to find the sum.

1. $-4 + 5$ **2.** $-1 + (-2)$ **3.** $4 + (-5)$ **4.** $0 + (-4)$

RULES OF ADDITION

To add two numbers with the *same sign*:

STEP 1 ***Add*** their absolute values.

STEP 2 ***Attach*** the common sign.

To add two numbers with *opposite signs*:

STEP 1 ***Subtract*** the smaller absolute value from the larger one.

STEP 2 ***Attach*** the sign of the number with larger absolute value.

Student Help

LOOK BACK
For help with absolute value, see p. 71.

EXAMPLE 2 Add Using Rules of Addition

a. Add -4 and -5, which have the same sign.

1. ***Add*** their absolute values. $4 + 5 = 9$
2. ***Attach*** the common (negative) sign. $-(9) = -9$

ANSWER $-4 + (-5) = -9$

b. Add 3 and -9, which have opposite signs.

1. ***Subtract*** their absolute values. $9 - 3 = 6$
2. ***Attach*** the sign of the number with larger absolute value. $-(6) = -6$

ANSWER $3 + (-9) = -6$

Checkpoint ✓ Add Using Rules of Addition

Use the rules of addition to find the sum.

5. $-3 + (-7)$ **6.** $-1 + 3$ **7.** $8 + (-3)$ **8.** $2 + 3$

The rules of addition are a consequence of the following properties of addition.

PROPERTIES OF ADDITION

CLOSURE PROPERTY The sum of any two real numbers is a unique real number.

$a + b$ is a unique real number **Example:** $4 + 2 = 6$

COMMUTATIVE PROPERTY The order in which two numbers are added does not change the sum.

$a + b = b + a$ **Example:** $3 + (-2) = -2 + 3$

ASSOCIATIVE PROPERTY The way three numbers are grouped when adding does not change the sum.

$(a + b) + c = a + (b + c)$ **Example:** $(-5 + 6) + 2 = -5 + (6 + 2)$

IDENTITY PROPERTY The sum of a number and 0 is the number.

$a + 0 = a$ **Example:** $-4 + 0 = -4$

INVERSE PROPERTY The sum of a number and its opposite is 0.

$a + (-a) = 0$ **Example:** $5 + (-5) = 0$

Student Help

MORE EXAMPLES

More examples are available at www.mcdougallittell.com

EXAMPLE 3 Add Using Properties of Addition

a. $4 + (-6) + 9 = 4 + (-6 + 9)$ Use associative property.

$= 4 + 3$ Add -6 and 9.

$= 7$ Add 4 and 3.

b. $-0.5 + 3 + 0.5 = -0.5 + 0.5 + 3$ Use commutative property.

$= (-0.5 + 0.5) + 3$ Use associative property.

$= 0 + 3$ Use inverse property.

$= 3$ Use identity property.

Checkpoint ✓ Add Using Properties of Addition

Use the properties of addition to find the sum.

9. $-7 + 11 + 7$ **10.** $-5 + 1 + 2$ **11.** $3 + \left(-\frac{1}{3}\right) + \left(-\frac{2}{3}\right)$

PROFIT AND LOSS A company has a *profit* if its income is greater than its expenses. It has a *loss* if its income is less than its expenses. Income and expenses are always positive, but business losses can be indicated by negative numbers.

EXAMPLE 4 Use Addition in Real Life

BUSINESS A summer excursion company had the monthly profits and losses shown. Add them to find the overall profit or loss of the company.

JANUARY	FEBRUARY	MARCH
-$13,143	-$6,783	-$4,735
APRIL	MAY	JUNE
$3,825	$7,613	$12,933

Student Help

KEYSTROKE HELP

To enter -5 on a calculator with a [+/-] key, enter 5 [+/-]. To enter -5 on a calculator with a [−] key, enter [−] 5.

Solution With this many large numbers, you may want to use a calculator.

13143 [+/-] [+] 6783 [+/-] [+] 4735 [+/-] [+] 3825 [+] 7613 [+] 12933 [=] −290

ANSWER The company had an overall loss of $290.

Checkpoint ✓ Use Addition in Real Life

12. Find the total profit or loss of the company in Example 4 during the first quarter (January through March).

13. Find the total profit or loss of the company in Example 4 during the spring months (March through May).

2.3 Exercises

Guided Practice

Vocabulary Check

Match the property with the statement that illustrates it.

1. Commutative property

2. Associative property

3. Identity property

4. Inverse property

A. $-8 + 0 = -8$

B. $5 + (-9) = -9 + 5$

C. $-8 + 8 = 0$

D. $5 + (4 + 9) = (5 + 4) + 9$

Skill Check

5. Write an addition equation for the sum modeled on the number line.

Use a number line to find the sum.

6. $7 + (-3)$ **7.** $0 + (-10)$ **8.** $-7 + 3$

Use the rules of addition to find the sum.

9. $12 + (-5)$ **10.** $-4 + 5$ **11.** $-7 + (-3)$

Use the properties of addition to find the sum.

12. $-4 + 3 + (-2)$ **13.** $5 + (-5) + 7$ **14.** $-3 + 0 + 7$

Practice and Applications

ADDING REAL NUMBERS **Match the exercise with its answer.**

15. $-1 + (-2)$ **16.** $3 + (-5)$ **17.** $-2 + 2$

A. -2 **B.** 0 **C.** -3

NUMBER LINES **Use a number line to find the sum.**

18. $-6 + 2$ **19.** $2 + (-8)$ **20.** $-3 + (-3)$

21. $-4 + (-7)$ **22.** $-4 + 5$ **23.** $3 + (-7)$

24. $-10 + 1$ **25.** $15 + (-9)$ **26.** $-12 + (-5)$

Student Help

HOMEWORK HELP
Example 1: Exs. 15–26
Example 2: Exs. 27–35
Example 3: Exs. 36–49
Example 4: Exs. 50–55

RULES OF ADDITION **Find the sum.**

27. $9 + (-2)$ **28.** $-6 + (-11)$ **29.** $-7 + (-4)$

30. $-5 + 2$ **31.** $8 + (-5)$ **32.** $-6 + (-3)$

33. $-10 + (-21)$ **34.** $49 + (-58)$ **35.** $-62 + 27$

Link to Sports

GOLF If you complete a round of golf in 68 strokes at a course with a par of 71 strokes, you have shot "3 under par," or −3.

NAMING PROPERTIES **Name the property shown by the statement.**

36. $-16 + 0 = -16$

37. $-3 + (-5) = -5 + (-3)$

38. $(-4 + 3) + 5 = -4 + (3 + 5)$

39. $16 + (-16) = 0$

40. There is only one real number that is the sum of 4 and 6.

PROPERTIES OF ADDITION **Find the sum.**

41. $6 + 10 + (-6)$

42. $7 + (-2) + (-9)$

43. $8 + (-4) + (-4)$

44. $-24.5 + 6 + 8$

45. $5.4 + 2.6 + (-3)$

46. $2.2 + (-2.2) + (2.2)$

47. $4 + \frac{1}{10} + \left(-\frac{1}{10}\right)$

48. $9 + (-4) + \left(-\frac{1}{2}\right)$

49. $\frac{1}{7} + (-2) + \left(-\frac{5}{7}\right)$

FINDING SUMS **Find the sum. Use a calculator if you wish.**

50. $-2.95 + 5.76 + (-88.6)$

51. $10.97 + (-51.14) + (-40.97)$

52. $20.37 + 190.8 + (-85.13)$

53. $300.3 + (-22.24) + 78.713$

54. PROFIT AND LOSS A company had the following profits and losses over a 4-month period: April, \$3,515; May, \$5,674; June, −\$8,993; July, −\$907. Did the company make an overall profit or loss? Explain.

55. GOLF In golf *par* is the expected number of strokes needed to finish a hole. A *bogey* is a score of one stroke over par. A *birdie* is a score of one stroke under par. An *eagle* is a score of two strokes under par. Using the table find the number of strokes you are off from par at the end of a round of golf.

Hole	1	2	3	4	5	6	7	8	9
Score	Birdie	Par	Birdie	Par	Eagle	Bogey	Bogey	Bogey	Birdie

56. CHALLENGE Determine whether the following statement is *true* or *false*. If it is true, give two examples. If it is false, give a counterexample.

The opposite of the sum of two numbers is equal to the sum of the opposites of the numbers.

Standardized Test Practice

In Exercises 57 and 58, use the financial data in the table.

Month	$ Earned	$ Spent	$ Saved
Jan.	1676	1427	?
Feb.	1554	1771	?
Mar.	1851	1556	?
Apr.	1567	1874	?
May	1921	1602	?
June	1667	1989	?

57. MULTIPLE CHOICE In which month was the most money saved?

Ⓐ January Ⓑ March

Ⓒ May Ⓓ June

58. MULTIPLE CHOICE In which month did the money spent most exceed the money earned?

Ⓕ January Ⓖ February

Ⓗ April Ⓙ June

Mixed Review

WRITING POWERS **Write the expression in exponential form.** *(Lesson 1.2)*

59. four squared **60.** k to the ninth power **61.** x cubed

NUMERICAL EXPRESSIONS **Evaluate the expression.** *(Lesson 1.3)*

62. $15 - 5 + 5^2$ **63.** $18 \cdot 2 - 1 \cdot 3$ **64.** $1 + 3 \cdot 5 - 8$

65. $2(9 - 6 - 1)$ **66.** $10 - (3 + 2) + 4$ **67.** $2 \cdot (6 + 10) - 8$

CHECKING SOLUTIONS OF EQUATIONS **Check to see if the given value of the variable is or is not a solution of the equation.** *(Lesson 1.4)*

68. $x + 5 = 10$; $x = 7$ **69.** $7y - 15 = 6$; $y = 3$ **70.** $17 - 3w = 2$; $w = 5$

71. $a^2 - 3 = 5$; $a = 4$ **72.** $1 + p^3 = 9$; $p = 2$ **73.** $2n^2 + 10 = 14$; $n = 1$

Maintaining Skills

ESTIMATING **Round the values to the nearest hundred and estimate the answer.** *(Skills Review p. 774)*

74. $422 + 451$ **75.** $8362 + 941$ **76.** $27 + 159$

77. $675 - 589$ **78.** $1084 - 179$ **79.** $3615 - 663$

Quiz 1

Graph the numbers on a number line. Then write two inequalities that compare the numbers. *(Lesson 2.1)*

1. $7, -2$ **2.** $-2, -3$ **3.** $1, -6$

Write the numbers in increasing order. *(Lesson 2.1)*

4. $-8, 2, -10, -3, 9$ **5.** $-5.2, 5, -7, 7.1, 3.3$ **6.** $-1, -\frac{2}{5}, 2, 0, \frac{1}{10}$

Evaluate the expression. *(Lesson 2.2)*

7. $|5|$ **8.** $|-13|$ **9.** $-|0.56|$

Use mental math to solve the equation. If there is no solution, write *no solution*. *(Lesson 2.2)*

10. $|x| = -10$ **11.** $|x| = 2.7$ **12.** $|x| = \frac{3}{5}$

Find the sum. *(Lesson 2.3)*

13. $-6 + (-7)$ **14.** $4 + (-10)$ **15.** $-5 + 9$

16. $-5 + 1 + (-3)$ **17.** $-6 + 2.9 + 1.1$ **18.** $\frac{1}{5} + 0 + \left(-\frac{1}{5}\right)$

19. FOOTBALL Your high school football team needs 9 yards to score a touchdown. The last four plays result in a 5 yard gain, a 2 yard gain, a 12 yard loss, and a 15 yard gain. Does your team score a touchdown? If not, how many yards do they still need? *(Lesson 2.3)*