Lesson 7-2

Simplifying Algebraic Expressions

ISG Interactive Study Guide

See pages 151–152 for:
- Getting Started
- Vocabulary Start-Up
- Notes

Essential Question

Why are algebraic rules useful?

CCSS Common Core State Standards

Content Standards
7.EE.1, 7.EE.2

Mathematical Practices
1, 3, 4, 5, 7

Vocabulary

term
coefficient
like terms
constant
simplest form
simplifying the expression

What You'll Learn
- Identify parts of an algebraic expression.
- Use the Distributive Property to simplify algebraic expressions.

Real-World Link

Recycling Two middle school classes are having a competitive week-long recycling drive. At the end of the week, whichever class collects more recyclables wins and is treated to a pizza party! Algebraic expressions can be used to represent the results of the drive.
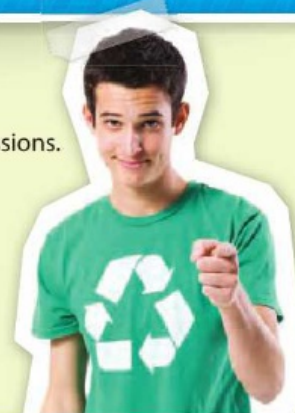
Parts of Algebraic Expressions

When addition or subtraction signs separate an algebraic expression into parts, each part is a **term**. The numerical part of a term that contains a variable is called the **coefficient** of the variable.

This expression has four terms.

$$3x + 7 + x + 2$$

The coefficient of x is 3. The coefficient of x is 1, because $x = 1x$.
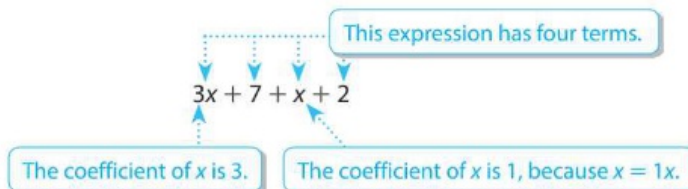
In this chapter, we will work only with terms with an exponent of 1. In this case, **like terms** are terms that contain the same variables, such as $2n$ and $5n$ or $6xy$ and $4xy$. A term without a variable is called a **constant**.

Like terms

$$5y + 3 + 2y$$
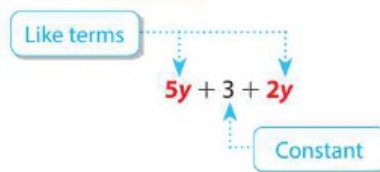
Constant

Example 1

Identify the like terms in the following expressions.

a. $3x + 4y + 4x$
   $3x$ and $4x$ are like terms since the variables are the same.

b. $5x + 3 + 7x + 4$
   $5x$ and $7x$ are like terms since the variables are the same. Constant terms 3 and 4 are also like terms.

Got It? Do this problem to find out.

1. Identify the like terms in the expression $-4x + 2y + 3y + 2x$.

[Handwritten notes: LIKE TERMS 2x, −4x 2y, 3y]

Rewriting a subtraction expression using addition will help you identify the terms of an expression.

Example 2

[Tutor]

Identify the terms, like terms, coefficients, and constants in the expression $6x - 2y + x - 5$.

$$6x - 2y + x - 5 = 6x + (-2y) + x + (-5) \quad \text{Definition of subtraction}$$
$$= 6x + (-2y) + 1x + (-5) \quad \text{Identity Property}$$

The terms are $6x$, $-2y$, x, and -5. The like terms are $6x$ and x. The coefficients are 6, -2, and 1. The constant is -5.

[handwritten: $3a + 1$ ↑ |]

Got It? Do this problem to find out.

2. Identify the terms, like terms, coefficients, and constants in the expression $3n + 5m - 6m + 2$.

[handwritten: $n + n + n + m + m + m + m + m + (-m) + (-m) + (-m) + (-m) + (-m) + (-m) + 2$]

[handwritten: $\rightarrow 3n + 5m + (-6m) + 2$]

Simplify Algebraic Expressions

An algebraic expression is in **simplest form** if it has no like terms and no parentheses. When you use the Distributive Property to combine like terms, you are **simplifying the expression**.

Example 3

[Tools] [Tutor]

Simplify each expression.

a. $4x + 6 + 2x$

$$4x + 6 + 2x = 4x + 2x + 6 \quad \text{Commutative Property}$$
$$= (4 + 2)x + 6 \quad \text{Distributive Property}$$
$$= 6x + 6 \quad \text{Simplify.}$$

b. $5n + 2 - n - 6$

$$5n + 2 - n - 6 = 5n + 2 + (-n) + (-6) \quad \text{Definition of Subtraction}$$
$$= 5n + 2 + (-1n) + (-6) \quad \text{Identity Property}$$
$$= 5n + (-1n) + 2 + (-6) \quad \text{Commutative Property}$$
$$= [5 + (-1)]n + 2 + (-6) \quad \text{Distributive Property}$$
$$= 4n + (-4) \text{ or } 4n - 4 \quad \text{Simplify.}$$

c. $6y - 3(x - 2y)$

$$6y - 3(x - 2y) = 6y + (-3)[x + (-2y)] \quad \text{Definition of Subtraction}$$
$$= 6y + (-3x) + (-3 \cdot -2)y \quad \text{Distributive Property}$$
$$= 6y + (-3x) + 6y \quad \text{Simplify.}$$
$$= 6y + 6y + (-3x) \quad \text{Commutative Property}$$
$$= (6 + 6)y + (-3x) \quad \text{Distributive Property}$$
$$= 12y + (-3x) \text{ or } 12y - 3x \quad \text{Simplify.}$$

> ⚠️ **Watch Out!**
>
> **Distributive Property** In Example 3c, remember to distribute -3, not $+3$, to the terms in the parentheses.

[handwritten:
$4(q + 8p) + p$
$4(q) + 4(8p)$
$4q + 32p + 1p$
$4q + 33p$
]

Got It? Do these problems to find out.

3a. $4x + 6 - 3x$

3b. $2m + 3 - 7m - 4$

3c. $4(q + 8p) + p$

[handwritten 3a: $(4x - 3x) + 6$, $x + 6$]

[handwritten 3b: $+ (-7m)$, $2m + (-7m) = -5m$, $3 - 4 = -1$, $-5m + (-1) = -5m - 1$]

Example 4

Financial Literacy You have some money in a savings account. Your sister has $25 more than you have in her account. Write an expression in simplest form that represents the total amount of money in both accounts.

Words	amount of your money plus amount of your sister's money
Variable	Let x = amount of your money. Let $x + 25$ = amount of your sister's money.
Expression	$x + (x + 25)$

$$x + (x + 25) = (x + x) + 25 \quad \text{Associative Property}$$
$$= (1x + 1x) + 25 \quad \text{Identity Property}$$
$$= (1 + 1)x + 25 \quad \text{Distributive Property}$$
$$= 2x + 25 \quad \text{Simplify.}$$

The expression $2x + 25$ represents the total amount of money you and your sister have in your accounts.

Got It? Do these problems to find out.

4a. Mato and Lola both collect stamps. Lola has 16 more stamps in her collection than Mato. Write an expression in simplest form that represents the total number of stamps in both collections.

4b. Derek has as many stamps as Mato. Write an expression to represent the total of all 3 collections.

[Handwritten notes:]
$M = MATO'S\ STAMPS$
$M + 16 = LOLA'S\ STAMPS$
$M + M + 16 = 2m + 16$

Guided Practice

Check ✓

Identify the terms, like terms, coefficients, and constants in each expression.
(Examples 1 and 2)

1. $-2a + 3a + 5b$
2. $2x + 3x + 4 + 4x$
3. $mn + 4m + 6n + 2mn$
4. $3a + 5b + 4 + 6a$
5. $3x + 4x + 5y$
6. $-4p - 6q - 5$

Simplify each expression. (Example 3)

7. $6x + 2x + 3$
8. $-2a + 3a + 6$
9. $7x + 4 - 5x - 8$
10. $5a - 2 - 3a + 7$
11. $-3(m - 1) + 4m + 2$
12. $4a - 6 - 2(a - 1)$

13. Marena is using a certain number of blue beads in a bracelet design. She will use 7 more red beads than blue beads. Write an expression in simplest form that represents the total number of beads in her bracelet design. (Example 4)

14. Kyung bought 3 CDs that cost x dollars each, 2 DVDs that cost $10 each; and a book that cost $15. Write an expression in simplest form that represents the total amount that Kyung spent. (Example 4)

Go online for Step-by-Step Solutions [eHelp]

Identify the terms, like terms, coefficients, and constants in each expression. (Examples 1 and 2)

15. $3a + 2 + 3a + 7$

16. $4m + 3 + m + 1$

17. $3c + 4d + 5c + 8$

18. $7j + 11jk + k + 9$

19. $4x + 4y + 4z + 4$ ← CANNOT SIMPLIFY

$x + x + x + x + y + y + y + y + z + z + z + z + |+|+|+|$

20. $3m + 3n + 2p + 4r$

Simplify each expression. (Example 3)

21. $4a + 3a$

22. $9x + 2x$

23. $-5m + m + 5$

24. $6x - x + 3$

25. $7p + 3 + 4p + 5$

26. $2a + 4 + 2a + 9$

27. $4a - 3b - 7a - 3b$

28. $-x - 2y - 8x - 2y$

29. $x + 5(6 + x)$

30. $2a + 3(2 + a)$

31. $-3(6 - 2r) - 3r$

32. $-2(2x - 5) - 4x$

For each situation, write an expression in simplest form that represents the total amount. (Example 4)

33. Mateo has y pairs of shoes. His brother has 5 fewer pairs.

34. You used p minutes one month on your cell phone. The next month you used 75 fewer minutes.

35. Nathan scored x points in his first basketball game. He scored three times as many points in his second game. In his third game, he scored 6 more than the second game.

36. On Monday, Rebekah spent d dollars on lunch. She spent $0.50 more on Tuesday than she did on Monday. On Wednesday, she spent twice as much as she did on Tuesday.

Simplify each expression.

37. $2(x - y) + 3x$

38. $-3(a - 2b) - 4b$

39. $-4(3m + 2n) - 5m + y$

40. $\frac{2}{3}(6a + 3b) - \frac{1}{2}(a - 2b)$

41. $\frac{1}{4}(m + 2n) - \frac{1}{3}(3m - 3n)$

42. $2(x - y) - (x + y)$

43. $\frac{2}{5}(2a - b) + \frac{2}{3}(a + 2b)$

44. $-\frac{3}{4}(3x + 2y) - \frac{3}{8}(x - 3y)$

45. **CCSS** **Use Math Tools** Write an expression to represent each model. Then simplify the expression using algebra tiles.

a.

b.

c. Use algebra tiles to write and simplify your own expression.

Handwritten work:

$-5m + 6 + (-7) + 2m$

$-5m + 6 - 7 + 2m$

COEFFICIENTS $-5, 2$

CONSTANTS $6, -7$

35.

1	2	3
$1x$	$3x$	$3x + 6$

$7x + 6$

38.

$-3(a - 2b) - 4b$

$-3(a) - (-3)(2b) - 4b$

$-3a - (-6b) - 4b$

$-3a + 6b + (-4b)$

$-3a + 2b$

43.

$\frac{2}{5}(2a - b) + \frac{2}{3}(a + 2b)$

$\frac{2}{5}\left(\frac{2a}{1}\right) - \frac{2}{5}\left(\frac{b}{1}\right) + \frac{2}{3}\left(\frac{a}{1}\right) + \frac{2}{3}\left(\frac{2b}{1}\right)$

$\frac{4a}{5} - \frac{2b}{5} + \frac{2a}{3} + \frac{4b}{3}$

$\frac{3}{3}\left(\frac{4a}{5}\right) - \frac{3}{3}\left(\frac{2b}{5}\right) + \frac{5}{5}\left(\frac{2a}{3}\right) + \frac{5}{5}\left(\frac{4b}{3}\right)$

43.

$$\frac{2}{5}\left(2a-b\right) + \frac{2}{3}\left(a+2b\right)$$

$$\frac{2}{5}\left(\frac{2a}{1}\right) - \frac{2}{5}\left(\frac{b}{1}\right) + \frac{2}{3}\left(\frac{a}{1}\right) + \frac{2}{3}\left(\frac{2b}{1}\right)$$

$$\frac{4a}{5} - \frac{2b}{5} + \frac{2a}{3} + \frac{4b}{3}$$

$$\frac{3}{3}\left(\frac{4a}{5}\right) - \frac{3}{3}\left(\frac{2b}{5}\right) + \frac{5}{5}\left(\frac{2a}{3}\right) + \frac{5}{5}\left(\frac{4b}{3}\right)$$

$$\frac{12a}{15} - \frac{6b}{15} + \frac{10a}{15} + \frac{20b}{15} = \qquad \frac{12a}{15} + \frac{10a}{15} = \frac{22a}{15}$$

$$-\frac{6b}{15} + \frac{20b}{15} = \frac{14b}{15}$$

$$\frac{22a}{15} + \frac{14b}{15}$$

$$\frac{1}{4}(m+2n) - \frac{1}{3}(3m - 3n)$$

$$\frac{1}{4}(m) + \frac{1}{4}(2n) - \frac{1}{3}(3m) - \frac{1}{3}(3n)$$

$$\left(\frac{1}{4}m + \frac{1}{2}n\right) - \left(1m + {}^-1n\right)$$

m	$2n$
$\frac{1}{4}m$	$\frac{1}{2}n$

$m + 2n$

$\frac{1}{4}m + \frac{1}{2}n$

m	n
$\frac{1}{4}m$	$+\frac{1}{2}n$
$-1m$	$-(-1n) = 1n$

$$-\frac{3}{4}m + 1\frac{1}{2}n$$

$$-\frac{3}{4}m + \frac{3}{2}n$$

$$-\frac{3}{4}(3x + 2y) - \frac{3}{8}(x - 3y)$$

$3x + 2y$	
$-\frac{9}{4}x$	$-\frac{6}{4}y$

$-\frac{3}{4}$

$+$

$x + (-3y)$	
$-\frac{3}{8}x$	$\frac{9}{8}y$

$-\frac{3}{8}$

$$-\frac{9}{4}x + \left(-\frac{6}{4}y\right) \qquad + \qquad \left(-\frac{3}{8}x + \frac{9}{8}y\right)$$

$$-\frac{18}{8}x + \left(-\frac{12}{8}y\right)$$

x	y
$-\frac{18}{8}x$	$+\left(-\frac{12}{8}y\right)$
$-\frac{3}{8}x$	$+\frac{9}{8}y$

$$-\frac{21}{8}x + \left(-\frac{3}{8}y\right)$$

Simplify each expression.

37. $2(x - y) + 3x$

38. $-3(a - 2b) - 4b$ $-3a + 2b$

39. $-4(3m + 2n) - 5m + y$

40. $\frac{2}{3}(6a + 3b) - \frac{1}{2}(a - 2b)$ $\frac{1}{2}a + 3b$

41. $\frac{1}{4}(m + 2n) - \frac{1}{3}(3m - 3n)$

42. $2(x - y) - (x + y)$ $x - 3y$

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42. $2(x - y) - 1(x + y)$

$2 \begin{array}{|c|c|} \hline 2x & -2y \\ \hline \end{array}$ $x + (-y)$ $+ \quad -1 \begin{array}{|c|c|} \hline -1x & -1y \\ \hline \end{array}$ $x + y$

x	y
$2x$	$+ (-2y)$
$-1x$	$+ (-1y)$

$x + (-3y) = x - 3y$

$2(x - y) - (x + y)$

$(x - y) + (x - y) - (x + y)$

x	y
x	$-y$
x	$-y$
$-x$	$-y$

$x - 3y$

Simplify each expression.

37. $2(x - y) + 3x$

38. $-3(a - 2b) - 4b$

39. $-4(3m + 2n) - 5m + y$

40. $\frac{2}{3}(6a + 3b) - \frac{1}{2}(a - 2b)$

41. $\frac{1}{4}(m + 2n) - \frac{1}{3}(3m - 3n)$

42. $2(x - y) - (x + y)$

Simplify each expression.

37. $2(x - y) + 3x$

38. $-3(a - 2b) - 4b$

39. $-4(3m + 2n) - 5m + y$

40. $\frac{2}{3}(6a + 3b) - \frac{1}{2}(a - 2b)$

41. $\frac{1}{4}(m + 2n) - \frac{1}{3}(3m - 3n)$

42. $2(x - y) - (x + y)$

46. **CCSS** **Multiple Representations** In this problem, you will investigate the perimeter of a rectangle. Consider a rectangle that has a length that is twice its width.
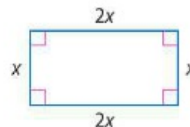
a. **Table** Make a table that shows the width of a rectangle and its perimeter for widths of 1, 2, 3, 4, 5, and 6 units.

b. **Graph** Graph the ordered pairs (width, perimeter).

c. **Symbols** Write an expression in simplest form for the perimeter of the rectangle.

d. **Words** If you double the value of x, what happens to the perimeter? Justify your reasoning.

Write an expression in simplest form for the perimeter of each rectangle.

47.

48.
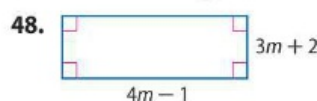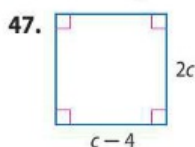
Simplify. Identify the properties you used in each step of your calculation.

49 $16 \cdot (-31) + 16 \cdot 32$

50. $72(38) + (-72)(18)$

51. $24 \cdot (-15) + 36 \cdot 15$

52. $22(-18) - 22(24)$

53. This year Ana's mother is 2 years more than 3 times Ana's age. Write an expression in simplest form for the total of their ages.

🔥 **H.O.T. Problems** Higher Order Thinking

54. **CCSS** **Identify Structure** Write an expression containing at least 2 unlike terms. Then simplify the expression.

55. **CCSS** **Persevere with Problems** Simplify $(2 + x)(y + 5)$.

56. **CCSS** **Justify Conclusions** Classify the following statement as *sometimes*, *always*, or *never* true. Explain your reasoning to a classmate.

When using the Distributive Property, if the term outside the parentheses is negative, then the sign of each term inside the parentheses will change.

57. **CCSS** **Which One Doesn't Belong?** Identify the algebraic expression that does not belong with the other three. Explain your reasoning.

| $-6(x - 2)$ | $x + 12 - 7x$ | $-x - 5x + 12$ | $-6x - 12$ |

58. **CCSS** **Persevere with Problems** In a three-digit number, the second and third digits are the same. The first digit is 4 more than the sum of the second and third digits. Write an expression in simplest form for the total sum of all three digits.

59. ℮ **Building on the Essential Question** Suppose your friend simplifies $4x - 2(x + 5)$ as $2x + 10$. Identify the error and correct it.

60. The perimeter of △DEF is $4x + 3y$. What is the measure of the third side of the triangle?
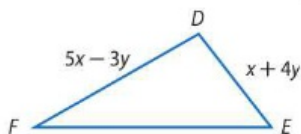
A $-2x + 2y$ **C** $x - y$

B $2x + 2y$ **D** $-x + 2y$

61. Which of the following expressions is equivalent to $4x + 4y$?

F $4xy$ **H** $4x + y$

G $4(x + y)$ **J** $x + 4y$

62. Adriana spent m minutes on her homework on Monday. She spent 45 more minutes doing her homework on Tuesday than on Monday. Which expression represents the total amount of time she spent on her homework on Monday and Tuesday?

A $m + 45$

B $m - 45$

C $2m + 45$

D $2m - 45$

63. Short Response Simplify the following expression.

$$7(3a - 2b) + 5b - 3(4a + 2)$$

Common Core Review

Use the Distributive Property to write each expression as an equivalent expression. 7.EE.1

64. $8(z - 3)$ **65.** $(a - 6)(-5)$ **66.** $15(s + 2)$

67. The table shows the cost of different items at a movie theater. Write two equivalent expressions for the total cost of four movie tickets and four boxes of popcorn. Then find the total cost. 7.EE.1

68. Simon has $1\frac{1}{4}$ cups of margarine. He needs $\frac{1}{2}$ cup for a cake and another $\frac{1}{3}$ cup for the icing. How much margarine will he have left? 7.NS.3

Item	Cost ($)
ticket	7.00
small popcorn	3.00
small drink	2.50
candy bar	1.75

Write two inequalities using the number pairs. Use the symbols $<$ or $>$. 6.NS.7

69. -6 and -2 **70.** -10 and -13

71. 0 and -9 **72.** $|-11|$ and $|-7|$

73. $|15|$ and $|18|$ **74.** $|-12|$ and $|14|$

Find the value of each expression if $a = 6$ and $b = 7$. 7.EE.3

75. $\dfrac{4b + 3a}{b - 5}$ **76.** $\dfrac{6a - 2ab}{a + 2}$ **77.** $\dfrac{3(4a - 3b)}{b - 4}$

Find each sum or difference. 7.NS.1

78. $-21 - 6$ **79.** $62 - (-12)$ **80.** $-32 + 26$

Find each product or quotient. 7.NS.2

81. $-4 \cdot 18$ **82.** $-98 \div (-7)$ **83.** $7 \cdot (-8)$

D. Hurst/Alamy

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$2m + 3 - 7m - 4$

$2m + 3 + (-7m) + (-4)$

$2m + (-7m) + 3 + (-4)$

$3 + (-4) = -1$

$2 + (-7) = -5$

$2m + (-7m) = -5m$

$-5m + (-1)$