3 How to • • • • • • Work with Algebraic Expressions

Facts to Know

Algebra is a branch of mathematics that uses numbers and letters that stand for numbers to solve problems. In algebra, if a number is unknown, any letter of the alphabet can be used to stand for that number. Letters are called *variables* because the values of the letters vary from one problem to another. In one problem, x may stand for -2. In another problem, it may stand for 43.

Writing Algebraic Expressions

An *algebraic expression* is a statement made up of numbers, variables, and signs of operation (+, –, ÷, x). The phrase "a number" indicates the use of the variable.

Statement in Words	*Algebraic Expression*
a number increased by 6	$x + 6$
7 decreased by a number	$7 - y$
a number divided by 12	$\frac{x}{12}$
a number multiplied by 4	$4(n)$
the sum of 7 and a number, divided by 3	$\frac{7 + y}{3}$
the sum of 4 times a number and 2	$4x + 2$
20 divided by the sum of 5 and a number	$\frac{20}{5 + y}$
4 times a number minus 2 times the same number	$4x - 2x$
two-fifths of a number	$\frac{2}{5}\ x$

Combining Like Terms

Sometimes algebraic expressions can be shortened by combining like terms making them simpler to understand. An expression is made up of smaller parts called *terms*. A term can be made up of numbers, variables, or numbers and variables. In an expression, terms are separated by only plus and minus signs.

Examples: 15, x, xy, $5xy$, $\frac{4x}{y}$

Facts to Know *(cont.)*

A *numerical coefficient* is any number in front of a variable in a term. If there is no number in front of a varible, the numerical coefficient is understood to be 1.

Examples: 4*a*, 5*x*, 6*xy*

numerical coefficients

An *exponent* tells how many times a number has been multiplied by itself. **Examples: 4^2, $8w^3$, $10n^3$**

Terms that have all of the same variables (xy, $3xy$, $5xy$, etc.) or variables with the same exponents ($4a^2 + a^2$), are called *like* or *similar terms.* Like terms can be combined by combining the numerical coefficients.

Examples

$5b + b \longrightarrow 5b + 1b \longrightarrow (5 + 1)b \longrightarrow 6b$

$9a - 2a \longrightarrow (9 - 2)a \longrightarrow 7a$

$5n + 3r - 2n \longrightarrow (5n - 2n) + 3r \longrightarrow (5 - 2)n + 3r \longrightarrow 3n + 3r$

But an algebraic expression like $9y^2 + 2y$ cannot be combined because y^2 and $2y$ are not like terms. One has an exponent of 2 and the other has a coefficient of 2.

Evaluating Algebraic Expressions

Remember that in algebra a variable can stand for any number. However, sometimes in an algebraic expression, you are given the value of the letter. Then you must replace the variables with the numbers they represent to solve for the value of the whole expression.

Example: Find the value of $\frac{a}{b}$, when $a = 20$ and $b = 4$.

Step 1: Replace a with its value, 20. $\mathbf{\frac{20}{b}}$

Step 2: Replace b with its value. $\mathbf{\frac{20}{4}}$

Step 3: Complete the division problem. $\mathbf{\frac{20}{4} = 5}$

3 Practice • • • Working with Algebraic Expressions

Directions: Write the algebraic expression. If there is one variable, use x. If there are two variables, use x and y.

1. fourteen divided by a number _____
2. seven times a number _____
3. 10 less than a number _____
4. 12 more than a number _____
5. one number added to another number _____
6. a number divided by 6 _____
7. 4 times a number plus 5 times the same number _____
8. 4 times a number plus 5 times another number _____
9. 7 more than one-third of a number _____
10. 25 divided by a number _____
11. the sum of 6 and a number divided by 10 _____
12. one-half the product of 8 and a number _____
13. the sum of 5 and a number divided by 7 _____
14. the sum of 4 and a number divided by 10 _____
15. 20 decreased by 4 times a number _____
16. the sum of 20 and a number divided by 5 _____
17. The length of the gym floor is 5 feet longer than its width. Using w for the width, write an expression for the length of the room. _____
18. Three carnival tickets cost c cents. What is the cost of one? _____

Directions: Change the algebraic expressions to statements in words.

Algebraic Expression	**Statement in Words**
19. $a + b$	_____
20. $s - r$	_____
21. $4y$	_____
22. $\frac{8}{y}$	_____
23. $2y - 5$	_____
24. $8 + y$	_____
25. xy	_____
26. $22 - t$	_____
27. $t - 22$	_____

3 Practice • • • Working with Algebraic Expressions

Directions: Combine the like terms to simplify each expression.

28. $3y + y =$ _____

29. $b + b =$ _____

30. $5r - 2r =$ _____

31. $3c - 4c =$ _____

32. $\frac{2}{3}d + 3b + d =$ _____

33. $12r^2 - 3s + r =$ _____

34. $4x - 3x + 1 =$ _____

35. $2 + 3n - 7 =$ _____

36. $9x + 2y^3 - 4y - 6x =$ _____

37. $\frac{8}{2}x - 9y - 6x + 12y =$ _____

Directions: Evaluate the following expressions. Let $r = 3$ and $t = 9$.

38. $\frac{r}{t} =$ _____

39. $rt =$ _____

40. $\frac{r}{3} + \frac{t}{3} =$ _____

41. $r + t =$ _____

42. $\frac{t}{r} =$ _____

Directions: Evaluate the following expressions. Let $a = 5$, $b = -4$, and $c = 10$.

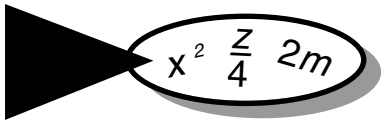
43. $ab =$ _____

44. $b + c =$ _____

45. $\frac{c}{5} =$ _____

46. $c - 5 =$ _____

47. $\frac{b}{c} =$ _____



Answer Key

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1. -2
2. 3
3. -4
4. -9
5. 9
6. -110
7. -43
8. 2.7
9. 23
10. 7.89
11. -6
12. 4
13. -13
14. 15
15. -6
16. 12
17. 50
18. 12
19. 4
20. 7
21. -7
22. 4.4
23. -4.4
24. 18
25. 12
26. 17
27. -9
28. 16
29. -10
30. 7
31. 24
32. 5
33. -19
34. 15

Page 12

1. 63
2. 68.2
3. 46.2
4. 100
5. 54
6. 924
7. 60
8. -24
9. -70
10. -36
11. 24
12. -90
13. -4
14. -5
15. -3
16. 11
17. 3
18. 9
19. 3
20. 1
21. 3
22. 7
23. -2
24. 3
25. -27
26. 54
27. 28
28. -65
29. -13
30. 35
31. 2/9
32. -5
33. 4
34. -5

Pages 15 and 16

1. $14/x$
2. $7x$
3. $x - 10$
4. $x + 12$
5. $x + y$ or $y + x$
6. $x/6$
7. $4x + 5x$
8. $4x + 5y$
9. $x/3 + 7$ or $1/3x + 7$
10. $25/x$
11. $\frac{6 + x}{10}$
12. $1/2\ (8x)$ or $8x/2$
13. $\frac{5 + x}{7}$
14. $\frac{4 + x}{10}$
15. $20 - 4x$
16. $\frac{20 + x}{5}$
17. $w + 5$ or $5 + w$
18. $c/3$ or $1/3c$
19. one number added to another number
20. one number decreased by another number
21. 4 times a number
22. 8 divided by a number
23. 2 times a number, decreased by 5
24. 8 increased by a number
25. a number times another number
26. 22 decreased by a number
27. 22 less than a number
28. $4y$
29. $2b$
30. $3r$
31. $-c$
32. $1\ 2/3d + 3b$
33. $12r^2 - 3s + r$
34. $x + 1$
35. $3n - 5$ or $-5 + 3n$
36. $3x + 2y^3 - 4y$
37. $-2x + 3y$
38. $\frac{3}{9} = \frac{1}{3}$
39. $3(9) = 27$
40. $3/3 + 9/3 = 12/3 = 4$
41. $3 + 9 = 12$
42. $\frac{9}{3} = 3$
43. $5(-4) = -20$
44. $-4 + 10 = 6$
45. $\frac{10}{5} = 2$
46. $10 - 5 = 5$
47. $\frac{-4}{10} = \frac{-2}{5}$

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1. 48
2. 55
3. 46
4. 112
5. -5
6. 2
7. -1 1/3 or -4/3
8. 29
9. 14
10. 5
11. 15º C
12. 135 miles
13. $280
14. 360 feet
15. $b = -12$
16. $y = 80$
17. $a = 42$
18. $t = 144$
19. $n = 35$
20. $x = -8$
21. $a = -125$
22. $c = 18$