Solving equations with parentheses

Equations often contain parentheses. When asked to solve equations such as these, first use the distributive property and then combine like terms, solving the rest of the equation using the properties of equality.

\[
6x - 4(2 - 3x) = 28 \\
6x - 8 + 12x = 28 \\
18x - 8 = 28 \\
18x - 8 + 8 = 28 + 8 \\
\frac{18x}{18} = \frac{36}{18} \\
x = 2
\]

Thus, the solution is 2.

Use the distributive property to remove the parentheses.

1. \(3(5x - 10)\)
2. \((6x + 5)(-2)\)
3. \(-4(x - 6) = 2(7 - 7x)\)

4. \(-5(2 - 5x)\)
5. \((-12 - 7x)(4)\)
6. \(8(-9x + 4) = -3(6x + 9)\)

Solve each equation for \(x\). Check your answers.

7. \(3(x + 7) = 30\)
8. \(2(x + 3) = 12 - x\)
9. \(-(x + 7) - 5 = 4(x + 3) - 6x\)

10. \(-5(x + 4) = 20\)
11. \(5(5 - x) = 4(x - 5)\)
12. \(5(x - 1) = 2x + 4(x - 1)\)

Translate each problem into an equation. Solve each equation.

13. Four times the sum of a number and 7 is 44 less than the number. Find the number.

14. Sixteen more than a number is the same as 8 times the sum of the number and 9.
Solving equations with fractions

When solving equations with fractions, it is important to remember how to find the least common multiple and the least common denominator. The least common multiple of a group of fractions is the least number divisible by each of the fractions in the group. A least common multiple (LCM) can also be referred to as the least common denominator (LCD)—they are the same number.

Solve \( \frac{2}{3} x - \frac{1}{4} = \frac{1}{2} \)

\[ 12\left(\frac{2}{3} x - \frac{1}{4}\right) = \frac{1}{2}(12) \]

\[ 8x - 3 = 6 \]

\[ 8x = 9 \]

\[ x = \frac{9}{8} \]

Thus, the solution is \( \frac{9}{8} \).

The LCM, or LCD, is 12.

Multiply both sides by 12.

Now, solve for \( x \).

Check \( \frac{2}{3} \left(\frac{9}{8}\right) - \frac{1}{4} = \frac{1}{2} \).

\[ \frac{18}{24} - \frac{6}{24} = \frac{12}{24} \]

\[ \frac{3}{4} - \frac{1}{4} = \frac{2}{4} = \frac{1}{2} \]

true statement

Find the least common denominator of each group of fractions.

1. \( \frac{1}{2}, \frac{1}{6}, \frac{5}{7} \)

2. \( \frac{2}{3}, \frac{3}{4}, \frac{1}{8} \)

3. \( \frac{5}{6}, \frac{3}{5}, \frac{2}{9}, \frac{1}{3} \)

4. \( \frac{3}{10}, \frac{2}{5}, \frac{1}{6}, \frac{2}{3} \)

Solve each equation.

5. \( \frac{1}{3} x - 2 = \frac{3}{4} \)

6. \( \frac{1}{2} x - 5 = \frac{1}{3} x + 8 \)

7. \( \frac{3}{2} x + \frac{4}{3} = 9 \)

8. \( \frac{3}{2} x - 6 = \frac{3}{5} x + 4 \)

9. \( \frac{1}{4} - \frac{1}{6} x = \frac{3}{8} \)

10. \( \frac{1}{4} x - 1 = \frac{3}{5} x + 4 \)

Solve each problem.

11. Eight years more than \( \frac{1}{2} \) of Johnny’s age is 24 years. Find Johnny’s age.

12. Five less than \( \frac{3}{4} \) of a number equals twice the number. Find the number.

Solve each equation.

13. \( \frac{3x + 5}{12} - \frac{3}{4} = \frac{-2x - 1}{3} \)

14. \( \frac{4x}{5} + \frac{3x - 2}{10} = \frac{x + 6}{4} \)
Solving equations with decimals

The easiest way to solve equations that involve decimals is to multiply by powers of 10.

Solve $0.2x + 0.004 = 0.12$.

First, count the number of digits to the right of each decimal point.

$0.2$ has 1; $0.004$ has 3; $0.12$ has 2. The greatest number of digits to the right of any of these decimal points is 3; therefore, multiply both sides of the equation by $1,000$ (or $10^3$) and then solve for $x$.

\[
1,000(0.2x + 0.004) = 1,000(0.12)\\
200x + 4 = 120\\
200x = 116\\
x = 0.58
\]

Thus, the solution is $0.58$.

State the power of 10 you would need to multiply by to eliminate each set of decimals. Round to the nearest hundredth when necessary.

1. $0.12, 0.4, 0.45$
2. $0.34, 0.415, 0.002$
3. $0.1156, 0.004, 0.012$

Solve each equation.

4. $0.03x = 0.009$
5. $8.8 - 2.5x = 3.3$

6. $2.4x = 9.6$
7. $0.06 - 0.3x = 1.8$

8. $0.05x = 8.95$
9. $2.145 + 0.02x = 3.1005$

Solve each problem.

10. A number decreased by 0.08 of a number is 1.38. Find the number.

11. A number increased by 0.35 times the number is 0.675. Find the number.


Equations

An equation that contains more than one letter as a variable is called an equation. Any one of the letters can be expressed in terms of the others.

\[ mx + n = y \] for x

\[ mx + n - n = y - n \] Subtract n from both sides of equation.

\[ mx = y - n \] Divide by m on both sides of equation.

\[ x = \frac{y - n}{m} \] Simplify to solve for x.

\[ P = 2l + 2w \] for w, where P is the perimeter of a rectangle, l is the length, and w is the width.

\[ 2l = 2l - 2l + 2w \] Subtract 2l from both sides of equations.

\[ 2l \div 2 = \frac{2w}{2} \] Simplify and divide by 2 on both sides.

\[ \frac{2l}{2} = w \] Solve for w.

Use this result to find the width of a rectangle whose length is 16m and perimeter is 56m.

\[ \frac{P - 2l}{2} \] Formula for width

\[ \frac{56 - 2(16)}{2} \] Substitute in values for the variables.

\[ \frac{56 - 32}{2} \] Simplify.

\[ \frac{12m}{2} \] Solve for x.

Width of the rectangle using this literal equation is 12m.

Solve each equation.

2. \[ x + 3y = z \]
3. \[ -7x + y = -4x - 11y \]
4. \[ z = xy - wx \]

6. \[ -xy = z \]
7. \[ kl - 2bc = 5y + 2 \]
8. \[ a = bx + c \]

The formula for the perimeter of a rectangle is \[ P = 2l + 2w \]. Solve for l. Then find l if the length is 84 in., and the width is 18 in.

An example of a literal equation. Give a step-by-step description of how to solve it.
Page 49
1. (5, -2) y
2. (-2, 1) y
3. (3, 4) y
4. (-4, -1) y
5. 6. yes; 7. no; 8.-11. Solutions will vary.
9. (1, 1) x
10. (0, -3)
11. (3/2, 0)
12. m = -1, falls from left to right; 13. m = 4, falls from left to right; 14. m = 1, rises from left to right; 15. y = 3x + 4, m = 3, y-int. = 4; 16. y = x - 3, m = 1, y-int. = -3; 17. y = -4/5x - 4, m = -4/5, y-int. = -4; 18. x = 5y - 3, y-int. = -5; 19. x = 7, y-int. = 3; 20. x = 8, y-int. = 8; 21. x = 15, y-int. = -5. 22-24. Methods will vary.

Page 50
1. y = -3/4x - 6
2. x = 7. Answers will vary; 4. No, because -3(4) - (-3) = 10, -10 + 10 = 0; 5. x-int. = -12, y-int. = -3; 6. x-int. = -2, y-int. = 5; 7. x-int. = -4, y-int. = 8; 8. m = 0, horizontal; 9. m = 4, rises from left to right; 10. m is undefined, vertical; 11. y = 7x - 1, m = 7, y-int. = -1; 12. y = -x + 5, m = -1, y-int. = 5; 13. y = -2x + 4, m = -2, y-int. = 4; 14.-16. Methods and explanations will vary.

Page 51
1. m = Sherr's matches won, m + 4 = Mary's matches won; 2. s = John's stickers, 7s - 3 = Joey's stickers; 3. f = length of second board, 2f + 2 = length of first board; 4. p = price of football ticket last year; p + 1/3 price of football ticket this year; 5. d = dollars Sarah raised, 4d - 75 = dollars Kent raised; 6. blue pens; 7. n = 8, n.

Page 52
1. mom's age = 3y - 7, Steve's age = y; y + (3y - 7) = 65; Steve is 18 years old. Steve's mom is 47 years old.; 2. T = Tim's score, T + 8 = Brianne's score; T + (T + 8) = 96; Tim's score is 44. Brianne's score is 52; 3. n = smaller number, 8n = larger number; 8n - n = 42; Smaller number is 6. Larger number is 48.; 4. J = Julie's hours, J + 12 = Shelley's hours; J + (J + 12) = 72, Julie worked 30 hours. Shelley worked 42 hours.; 5. p = people in second group, 3p - 8 = people in first group; p + (3p - 8) = 89; There are 58 people in each group and 22 people in the second group.; 6. Kevin's cards = c, Jake's cards = 3c - 20; c + 3c = 1240; Kevin has 315 cards. Jake has 925 cards.

Page 53
1. 2(x) + 2(x - 2) = 12, length = 4 in., width = 2 in.; 2. 3(2x - 3) = 33, side = 11 in.; 3. 4(2x) = 56, side = 14 in.; 4. 2x + 2(4w) = 50, width = 6 cm, length = 20 cm; 5. 5 + 8 + s + (26 - 5) = 55, 12 in., 6 in., 7 in.; 6. 2(3b - 8) + b = 33, base = 7 cm, leg = 13 cm, leg = 13 cm; 7. 3(2x - 3) = 51, side = 17 in.

Page 54
1. 42; 2. 24; 3. 90; 4. 30; 5. 334/8 = 1 1/4; 6. 78; 7. 46/9 = 5 1/9; 8. 100/9 = 11 1/9; 9. -3/4; 10. -100/7 = -14 2/7; 11. 1/2a + 8 = 24; 12. 3/4n + 5 = 2n + 8; 13. 0; 14. 2.

Page 55
1. 10%; 2. 10%; 3. 10%; 4. 0.3; 5. 2.2; 6. 4; 7. -5.8; 8. 179; 9. 47.775; 10. n = 0.08n = 1.38, 1.5; 11. n + 0.35n = 0.675, 0.5

Page 56
1. 0.47, 47/100; 2. 0.185, 31/200; 3. 0.33, 33/100; 4. 0.005, 1/200; 5. 0.1275, 51/400; 7. 35%; 8. 50%; 9. 1.5%; 10. 60%; 11. 150%; 12. 37.5%; 13. 16; 14. 12 1/2%; 15. 20%; 16. 100; 17. 112.5; 18. 6; 19. 25%; 20. 40.

Page 57
1. original price $1000, discount $250; 2. $728; 3. 62, 250; 4. 12, 500; 5. 5, 000; 6. 440

Page 58
1. n = 5 - 6n = -7; 2. b = second part, 3b + 8 = first part, b + (3b + 8) = 56; first part = 44 in., second part = 12 in.; 3. 2w + 2(2w + 10) = 50, length = 20 cm, width = 6 cm; 4. 15/18 = 175/18; 5. -1.68; 6. 1, 14; 7. 0.47; 8. 130; 9. 48.1; 10. 9 3/8; 11. $50

Page 59
1. 13/28, 2, 17/28; 2. 10.324, -1.91; 5. x = second piece, 2x + 6 = first piece; x + 2x + 6 = 60; first piece 42 in., second piece 12 in.; 6. x = side, 4x - 5 = base; 2x + 4x - 5 = 67, base = 43 m, side = 12 m, side = 12 m; 7. f = length, 2f + 12 = width, 2f + 2(2f + 12) = 90; length = 11 ft., width = 54 ft., 8. 7, 2; 9. 20%; 10. 12 1/2%; 11. $500; 12. $5,500

Page 60
1. 3.
2. 0
3. -4
4. 0
5. 0
6. 0
7. x = 1
8. x ≤ 7
9. x = 1
10. x < 11
11. x ≥ 6
12. x < -1
13. y > 150, y > 145; Don already rushed more than 145 yards.; 14. c = 24 > 50, c > 74; Tara had more than 74 cookies.

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Answer Key

14. \((2x - 6)(5x + 4)\); 15. \((5x - 1)(x + 2)\); 16. \((7x - 5)(2x - 7)\); 17. \((3x + 7)(2x - 8)\); 18. Problems will vary.

Page 101
1. \(\{1, 2, 3, 4, 5\}\); 2. \(\{1, 2, 3, 4, 6\}\); 3. \(\{1, 3, 5\}\); 4. \(\{1, 2, 3, 4\}\); 5. \(\{1, 2, 3, 4, 5\}\);
6. \(\{1, 2, 3, 4, 5, 6\}\); 7. \(\{1, 2, 3, 4, 5, 6, 7\}\); 8. \(\{1, 2, 3, 4, 5, 6, 8\}\); 9. \(\{1, 2, 3, 4, 5, 6, 7, 8\}\); 10. \(\{1, 2, 3, 4, 5, 6, 7, 8, 9\}\).

Page 102
1. \(-2, 3\); 2. \(-2, 3\); 3. \(\{0, 1, 2\}\); 4. \(\{0, 1, 2, 3, 4\}\); 5. \(\{0, 1, 2, 3\}\); 6. \(\{0, 1, 2, 3, 4\}\); 7. \(\{0, 1, 2, 3, 4, 5\}\); 8. \(\{0, 1, 2, 3, 4, 5, 6\}\); 9. \(\{0, 1, 2, 3, 4, 5, 6, 7\}\); 10. \(\{0, 1, 2, 3, 4, 5, 6, 7, 8\}\); 11. \(\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}\).

Page 103
1. \(3x - 6 = 2x - 12\); 2. \(x^2 + x - 2\); 3. \(x + 4 = 12\); 4. \(2x + 3 = 2x + 1\); 5. \(x + 6 = 2x - 13\); 6. \(2x - 1 = 0\); 7. \(2x + 5 = 3x - 2\); 8. \(x + 1 = 3\); 9. \(x + 2 = 5\); 10. \(x - 1 = 6\).

Page 104
1. \(1, 2, 3, 4, 5\); 2. \(1, 2, 3, 4\); 3. \(3, 4, 5\); 4. \(1, 2, 3, 4, 5, 6\); 5. \(1, 2, 3, 4, 5, 6, 7\); 6. \(1, 2, 3, 4, 5, 6, 7, 8\); 7. \(1, 2, 3, 4, 5, 6, 7, 8, 9\); 8. \(1, 2, 3, 4, 5, 6, 7, 8, 9, 10\).

Page 105
1. \(2x - 6 = 12\); 2. \(x^2 + x - 2\); 3. \(x + 4 = 12\); 4. \(2x + 3 = 2x + 1\); 5. \(x + 6 = 2x - 13\); 6. \(2x - 1 = 0\); 7. \(2x + 5 = 3x - 2\); 8. \(x + 1 = 3\); 9. \(x + 2 = 5\); 10. \(x - 1 = 6\).

Page 106
1. \(-2, 3\); 2. \(-2, 3\); 3. \(-1, 2\); 4. \(-1, 2\); 5. \(-1, 2\); 6. \(-1, 2\); 7. \(-1, 2\); 8. \(-1, 2\); 9. \(-1, 2\); 10. \(-1, 2\);
11. \(-1, 2\); 12. \(-1, 2\); 13. \(-1, 2\); 14. \(-1, 2\); 15. \(-1, 2\); 16. \(-1, 2\).

Page 107

Page 108
1. \(\frac{1}{4}\); 2. \(\frac{1}{4}\); 3. \(\frac{1}{4}\); 4. \(\frac{1}{4}\); 5. \(\frac{1}{4}\); 6. \(\frac{1}{4}\); 7. \(\frac{1}{4}\); 8. \(\frac{1}{4}\); 9. \(\frac{1}{4}\); 10. \(\frac{1}{4}\); 11. \(\frac{1}{4}\); 12. \(\frac{1}{4}\); 13. \(\frac{1}{4}\); 14. \(\frac{1}{4}\); 15. \(\frac{1}{4}\); 16. \(\frac{1}{4}\).

Page 109
1. \(x^2 + 2x + 4\); 2. \(x^2 + 2x + 4\); 3. \(x^2 + 2x + 4\); 4. \(x^2 + 2x + 4\); 5. \(x^2 + 2x + 4\); 6. \(x^2 + 2x + 4\); 7. \(x^2 + 2x + 4\); 8. \(x^2 + 2x + 4\); 9. \(x^2 + 2x + 4\); 10. \(x^2 + 2x + 4\); 11. \(x^2 + 2x + 4\); 12. \(x^2 + 2x + 4\); 13. \(x^2 + 2x + 4\); 14. \(x^2 + 2x + 4\); 15. \(x^2 + 2x + 4\); 16. \(x^2 + 2x + 4\); 17. \(x^2 + 2x + 4\); 18. \(x^2 + 2x + 4\); 19. \(x^2 + 2x + 4\); 20. \(x^2 + 2x + 4\); 21. \(x^2 + 2x + 4\); 22. \(x^2 + 2x + 4\); 23. \(x^2 + 2x + 4\); 24. \(x^2 + 2x + 4\); 25. \(x^2 + 2x + 4\); 26. \(x^2 + 2x + 4\); 27. \(x^2 + 2x + 4\); 28. \(x^2 + 2x + 4\); 29. \(x^2 + 2x + 4\); 30. \(x^2 + 2x + 4\); 31. \(x^2 + 2x + 4\); 32. \(x^2 + 2x + 4\); 33. \(x^2 + 2x + 4\); 34. \(x^2 + 2x + 4\); 35. \(x^2 + 2x + 4\); 36. \(x^2 + 2x + 4\); 37. \(x^2 + 2x + 4\); 38. \(x^2 + 2x + 4\); 39. \(x^2 + 2x + 4\); 40. \(x^2 + 2x + 4\); 41. \(x^2 + 2x + 4\); 42. \(x^2 + 2x + 4\); 43. \(x^2 + 2x + 4\); 44. \(x^2 + 2x + 4\); 45. \(x^2 + 2x + 4\); 46. \(x^2 + 2x + 4\); 47. \(x^2 + 2x + 4\); 48. \(x^2 + 2x + 4\); 49. \(x^2 + 2x + 4\); 50. \(x^2 + 2x + 4\).