

2.5 Multi-Step Equations

So far in this chapter you have learned how to solve one-step equations of the form $y = ax$ and two-step equations of the form $y = ax + b$. This lesson will expand upon solving equations to include solving multi-step equations and equations involving the Distributive Property.

Solving Multi-Step Equations by Combining Like Terms

In the last lesson, you learned the definition of like terms and how to combine such terms. We will use the following situation to further demonstrate solving equations involving like terms.

You are hosting a Halloween party. You will need to provide 3 cans of soda per person, 4 slices of pizza per person, and 37 party favors. You have a total of 79 items. How many people are coming to your party?

This situation has several pieces of information: soda cans, slices of pizza, and party favors. Translate this into an algebraic equation.

$$3p + 4p + 37 = 79$$

This equation requires three steps to solve. In general, to solve any equation you should follow this procedure.

Procedure to Solve Equations:

1. Remove any parentheses by using the Distributive Property or the Multiplication Property of Equality.
2. Simplify each side of the equation by combining like terms.
3. Isolate the ax term. Use the Addition Property of Equality to get the variable on one side of the equal sign and the numerical values on the other.
4. Isolate the variable. Use the Multiplication Property of Equality to get the variable alone on one side of the equation.
5. Check your solution.

Example 1: Determine the number of party-goers in the opening example.

Solution: $3p + 4p + 37 = 79$

Combine like terms: $7p + 37 = 79$.

Apply the Addition Property of Equality: $7p + 37 - 37 = 79 - 37$.

Simplify: $7p = 42$.

Apply the Multiplication Property of Equality: $7p \div 7 = 42 \div 7$.

The solution is $p = 6$.

There are six people coming to the party.

Solving Multi-Step Equations by Using the Distributive Property

When faced with an equation such as $2(5x + 9) = 78$, the first step is to remove the parentheses. There are two options to remove the parentheses. You can apply the Distributive Property or you can apply the Multiplication Property of Equality. This lesson will show you how to use the Distributive Property to solve multi-step equations.

Example 2: Solve for x : $2(5x + 9) = 78$.

Solution: Apply the Distributive Property: $10x + 18 = 78$.

Apply the Addition Property of Equality: $10x + 18 - 18 = 78 - 18$.

Simplify: $10x = 60$.

Apply the Multiplication Property of Equality: $10x \div 10 = 60 \div 10$.

The solution is $x = 6$.

Check: Does $10(6) + 18 = 78$? Yes, so the answer is correct.

Example 3: Kashmir needs to fence in his puppy. He will fence in three sides, connecting it to his back porch. He wants the run to be 12 feet long and he has 40 feet of fencing. How wide can Kashmir make his puppy enclosure?

Solution: Translate the sentence into an algebraic equation. Let w represent the width of the enclosure.

$$w + w + 12 = 40$$

Solve for w .

$$2w + 12 = 40$$

$$2w + 12 - 12 = 40 - 12$$

$$2w = 28$$

$$2w \div 2 = 28 \div 2$$

$$w = 14$$

The dimensions of the enclosure are 14 feet wide by 12 feet long.

Practice Set

Sample explanations for some of the practice exercises below are available by viewing the following video. Note that there is not always a match between the number of the practice exercise in the video and the number of the practice exercise listed in the following exercise set. However, the practice exercise is the same in both. [CK-12 Basic Algebra: Multi-Step Equations \(15:01\)](#)



MEDIA

Click image to the left or use the URL below.

URL: <http://www.ck12.org/flx/render/embeddedobject/67>

In 1 –23, solve the equation.

1. $3(x - 1) - 2(x + 3) = 0$
2. $7(w + 20) - w = 5$
3. $9(x - 2) = 3x + 3$
4. $2(5a - \frac{1}{3}) = \frac{2}{7}$
5. $\frac{2}{9}(i + \frac{2}{3}) = \frac{2}{5}$
6. $4(v + \frac{1}{4}) = \frac{35}{2}$
7. $22 = 2(p + 2)$
8. $-(m + 4) = -5$
9. $48 = 4(n + 4)$
10. $\frac{6}{5}(v - \frac{3}{5}) = \frac{6}{25}$
11. $-10(b - 3) = -100$
12. $6v + 6(4v + 1) = -6$
13. $-46 = -4(3s + 4) - 6$
14. $8(1 + 7m) + 6 = 14$
15. $0 = -7(6 + 3k)$
16. $35 = -7(2 - x)$
17. $-3(3a + 1) - 7a = -35$
18. $-2(n + \frac{7}{3}) = -\frac{14}{3}$
19. $-\frac{59}{60} = \frac{1}{6}(-\frac{4}{3}r - 5)$
20. $\frac{4y+3}{7} = 9$
21. $(c + 3) - 2c - (1 - 3c) = 2$
22. $5m - 3[7 - (1 - 2m)] = 0$
23. $f - 1 + 2f + f - 3 = -4$
24. Find four consecutive even integers whose sum is 244.
25. Four more than two-thirds of a number is 22. What is the number?
26. The total cost of lunch is \$3.50, consisting of a juice, a sandwich, and a pear. The juice cost 1.5 times as much as the pear. The sandwich costs \$1.40 more than the pear. What is the price of the pear?
27. Camden High has five times as many desktop computers as laptops. The school has 65 desktop computers. How many laptops does it have?
28. A realtor receives a commission of \$7.00 for every \$100 of a home's selling price. How much was the selling price of a home if the realtor earned \$5,389.12 in commission?

Mixed Review

29. Simplify $1\frac{6}{7} \times \frac{2}{3}$.
30. Define *evaluate*.
31. Simplify $\sqrt{75}$.
32. Solve for m : $\frac{1}{9}m = 12$.
33. Evaluate: $((-5) - (-7) - (-3)) \times (-10)$.
34. Subtract: $0.125 - \frac{1}{5}$.