Solve for the given variable.

1. $x + 11 = 7$
2. $x - 1.1 = 3.2$
3. $7x = 21$
4. $4x = 1$
5. $\frac{5x}{12} = \frac{2}{3}$
6. $x + \frac{5}{2} = \frac{2}{3}$
7. $x - \frac{5}{6} = \frac{3}{8}$
8. $0.01x = 11$
9. $q - 13 = -13$
10. $z + 1.1 = 3.0001$
11. $21s = 3$
12. $t + \frac{1}{2} = \frac{1}{3}$
13. $\frac{7f}{11} = \frac{7}{11}$
14. $\frac{3}{4} = -\frac{1}{2} \cdot y$
15. $6r = \frac{3}{8}$
16. $\frac{9b}{16} = \frac{3}{8}$
17. Peter is collecting tokens on breakfast cereal packets in order to get a model boat. In eight weeks he has collected 10 tokens. He needs 25 tokens for the boat. Write an equation and determine the following information.
    1. How many more tokens he needs to collect, n.
    2. How many tokens he collects per week, w.
    3. How many more weeks remain until he can send off for his boat, r.
18. Juan has baked a cake and wants to sell it in his bakery. He is going to cut it into 12 slices and sell them individually. He wants to sell it for three times the cost of making it. The ingredients cost him $8.50, and he allowed $1.25 to cover the cost of electricity to bake it. Write equations that describe the following statements.
    1. The amount of money that he sells the cake for (u).
    2. The amount of money he charges for each slice (c).
    3. The total profit he makes on the cake (w).
19. Solve the remaining two questions regarding Takeru Kobayashi in Example 7.

Mixed Review

20. Simplify $\sqrt{48}$.
21. Classify 6.23 according to the real number chart.
22. Reduce $\frac{118}{4}$.
23. Graph the following ordered pairs: $\{(2, -2), (4, -1), (5, -5), (3, -2)\}$.
24. Define *evaluate*.
25. Underline the math verb in this sentence: The difference between m and n is 16.
26. What property is illustrated here? $4(a + 11.2) = 4(a) + 4(11.2)$

Two-Step Equations

Suppose Shaun weighs 146 pounds and wants to lose enough weight to wrestle in the 130-pound class. His

nutritionist designed a diet for Shaun so he will lose about 2 pounds per week. How many weeks will it take Shaun to weigh enough to wrestle in his class?

This is an example that can be solved by working backward (Lesson 2.8). In fact, you may have already found the answer by using this method. *The solution is 8 weeks*.

By translating this situation into an algebraic sentence, we can begin the process of **solving equations**. To solve an equation means to "undo" all the operations of the sentence, leaving a value for the variable.

Translate Shaun's situation into an equation.

$-2w + 146 = 130$

This sentence has two operations: addition and multiplication. To find the value of the variable, we must use both properties of Equality: the Addition Property of Equality and the Multiplication Property of Equality.

Procedure to Solve Equations of the Form $ax + b =$ *some number:*

1. Use the Addition Property of Equality to get the variable term ax alone on one side of the equation:

$ax =$ *some number*

2. Use the Multiplication Property of Equality to get the variable x alone on one side of the equation:

$x =$ *some number*

Example 1: *Solve Shaun's problem*.

Solution: $-2w + 146 = 130$

Apply the Addition Property of Equality: $-2w + 146 - 146 = 130 - 146$.

Simplify: $-2w = -16$.

Apply the Multiplication Property of Equality: $-2w \div -2 = -16 \div -2$.

The solution is $w = 8$.

It will take 8 weeks for Shaun to weigh 130 pounds.

Solving Equations by Combining Like Terms

Michigan has a 6% sales tax. Suppose you made a purchase and paid $95.12, including tax. How much was the purchase before tax?

Begin by determining the noun that is unknown and choose a letter as its representation.

The purchase price is unknown so this is our variable. Call it P. Now translate the sentence into an algebraic equation.

$$price + (0.06)price = total\ amount$$
$$p + 0.06p = 95.12$$

To solve this equation, you must know how to **combine like terms.**

Like terms are expressions that have **identical** variable parts.

According to this definition, you can only combine like terms if they are identical. **Combining like terms only applies to addition and subtraction!** This is not a true statement when referring to multiplication and division.

The numerical part of an algebraic term is called the **coefficient**. To combine like terms, you add (or subtract) the coefficients of the identical variable parts.

Example 2: *Identify the like terms, then combine*.

$10b + 7bc + 4c + (-8b)$

Solution: Like terms have identical variable parts. The only terms having identical variable parts are $10b$ and $-8b$. To combine these like terms, add them together.

$10b + 7bc + 4c + -8b = 2b + 7bc + 4c$

You will now apply this concept to the Michigan sales tax situation.

Example 3: *What was the purchase amount from this section's opening scenario?*

Solution: $p + 0.06p = 95.12$

Combine the like terms: $p + 0.06p = 1.06p$, since $p = 1p$.

Simplify: $1.06p = 95.12$.

Apply the Multiplication Property of Equality: $1.06p \div 1.06 = 95.12 \div 1.06$.

Simplify: $p = 89.74$.

The price before tax was $89.74.

The next several examples show how algebraic equations can be created to solve real-world situations.

Example 4: *An emergency plumber charges $65 as a call-out fee plus an additional $75 per hour. He arrives at a house at 9:30 and works to repair a water tank. If the total repair bill is $196.25, at what time was the repair completed?*

Solution: Translate the sentence into an equation. The number of hours it took to complete the job is unknown, so call it h.

Write the equation: $65 + 75(h) = 196.25$.

Apply the Addition Property and simplify.

$65 + 75(h) - 65 = 196.25 - 65$

$75(h) = 131.25$

Apply the Multiplication Property of Equality: $75(h) \div 75 = 131.25 \div 75.$

Simplify: $h = 1.75.$

The plumber worked for 1.75 hours, or 1 hour, 45 minutes. Since he started at 9:30, the repair was completed at 11:15.

Example 5: *To determine the temperature in Fahrenheit, multiply the Celsius temperature by 1.8 then add 32. Determine the Celsius temperature if it is $89° F$.*

Solution: Translate the sentence into an equation. The temperature in Celsius is unknown; call it C.

Write the equation: $1.8C + 32 = 89.$

Apply the Addition Property and simplify.

$1.8C + 32 - 32 = 89 - 32$
$$1.8C = 57$$

Apply the Multiplication Property of Equality: $1.8C \div 1.8 = 57 \div 1.8.$

Simplify: $C = 31.67.$

If the temperature is $89° F$, then it is $31.67° C$.

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: Two-Step Equations (13:50)

1. Define *like terms*. Give an example of a pair of like terms and a pair of unlike terms.
2. Define *coefficient*.

In 3 – 7, combine the like terms.

3. $-7x + 39x$
4. $3x^2 + 21x + 5x + 10x^2$
5. $6xy + 7y + 5x + 9xy$
6. $10ab + 9 - 2ab$
7. $-7mn - 2mn^2 - 2mn + 8$
8. Explain the procedure used to solve $-5y - 9 = 74$

Solve and check your solution.

9. $1.3x - 0.7x = 12$
10. $6x - 1.3 = 3.2$
11. $5x - (3x + 2) = 1$
12. $4(x + 3) = 1$
13. $5q - 7 = \frac{2}{3}$
14. $\frac{3}{5}x + \frac{5}{2} = \frac{2}{3}$
15. $s - \frac{3s}{8} = \frac{5}{6}$
16. $0.1y + 11 = 0$
17. $\frac{5q-7}{12} = \frac{2}{3}$
18. $\frac{5(q-7)}{12} = \frac{2}{3}$
19. $33t - 99 = 0$
20. $5p - 2 = 32$

21. $14x + 9x = 161$
22. $3m - 1 + 4m = 5$
23. $8x + 3 = 11$
24. $24 = 2x + 6$
25. $66 = \frac{2}{3}k$
26. $\frac{5}{8} = \frac{1}{2}(a + 2)$
27. $16 = -3d - 5$
28. Jayden purchased a new pair of shoes. Including a 7% sales tax, he paid $84.68. How much did his shoes cost before sales tax?
29. A mechanic charges $98 for parts and $60 per hour for labor. Your bill totals $498.00, including parts and labor. How many hours did the mechanic work?
30. An electric guitar and amp set costs $1195.00. You are going to pay $250 as a down payment and pay the rest in 5 equal installments. How much should you pay each month?
31. Jade is stranded downtown with only $10 to get home. Taxis cost $0.75 per mile, but there is an additional $2.35 hire charge. Write a formula and use it to calculate how many miles she can travel with her money. Determine how many miles she can ride.
32. Jasmin's dad is planning a surprise birthday party for her. He will hire a bouncy castle and provide party food for all the guests. The bouncy castle costs $150 dollars for the afternoon, and the food will cost $3.00 per person. Andrew, Jasmin's dad, has a budget of $300. Write an equation to help him determine the maximum number of guests he can invite.
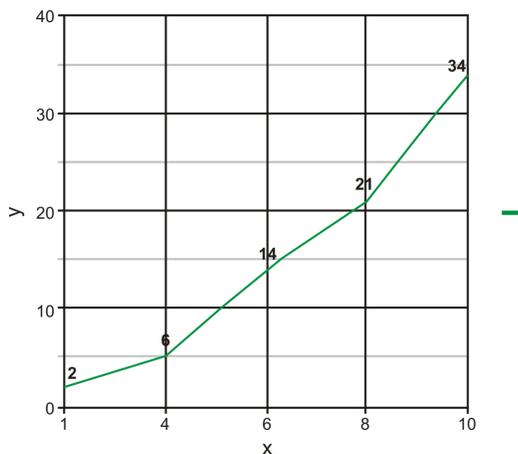
Mixed Review

33. Trish showed her work solving the following equation. What did she do incorrectly?

$$-2c = 36$$
$$c = 18$$

34. Write an expression for the following situation: *Yoshi had d dollars, spent $65, and earned $12. He had $96 left.*
35. Find the domain of the following graph.
36. Is it a function? Explain your answer.

37. Find the difference: $\frac{1}{2} - \frac{15}{9}$.
38. What is the additive identity?
39. Find the opposite of –4.1398.