

Lesson 22: Solving Equations Using Algebra

Classwork

In this lesson, you will transition from solving equations using tape diagrams to solving equations algebraically by *making zero* (using the additive inverse) and *making one* (using the multiplicative inverse). Justify your work by identifying which algebraic property you used for each step in solving the problems. Explain your work by writing out how you solved the equations step by step and relate each step to those used with a tape diagram.

Example 1: Yoshiro's New Puppy

Yoshiro has a new puppy. She decides to create an enclosure for her puppy in her backyard. The enclosure is in the shape of a hexagon (six-sided polygon) with one pair of opposite sides running the same distance along the length of two parallel flower beds. There are two boundaries at one end of the flower beds that are 10 ft. and 12 ft., respectively, and at the other end, the two boundaries are 15 ft. and 20 ft., respectively. If the perimeter of the enclosure is 137 ft., what is the length of each side that runs along the flower bed?

Example 2: Swim Practice

Jenny is on the local swim team for the summer and has swim practice four days per week. The schedule is the same each day. The team swims in the morning and then again for 2 hours in the evening. If she swims 12 hours per week, how long does she swim each morning?

Exercises

Solve each equation algebraically using if–then statements to justify each step.

1. $5x + 4 = 19$

2. $15x + 14 = 19$

3. Claire’s mom found a very good price on a large computer monitor. She paid \$325 for a monitor that was only \$65 more than half the original price. What was the original price?

4. $2(x + 4) = 18$

5. Ben's family left for vacation after his dad came home from work on Friday. The entire trip was 600 mi. Dad was very tired after working a long day and decided to stop and spend the night in a hotel after 4 hours of driving. The next morning, Dad drove the remainder of the trip. If the average speed of the car was 60 miles per hour, what was the remaining time left to drive on the second part of the trip? Remember: Distance = rate multiplied by time.

Lesson Summary

We work backward to solve an algebraic equation. For example, to find the value of the variable in the equation $6x - 8 = 40$:

1. Use the addition property of equality to add the opposite of -8 to each side of the equation to arrive at $6x - 8 + 8 = 40 + 8$.
2. Use the additive inverse property to show that $-8 + 8 = 0$; thus, $6x + 0 = 48$.
3. Use the additive identity property to arrive at $6x = 48$.
4. Then use the multiplication property of equality to multiply both sides of the equation by $\frac{1}{6}$ to get:
$$\left(\frac{1}{6}\right)6x = \left(\frac{1}{6}\right)48.$$
5. Then use the multiplicative inverse property to show that $\frac{1}{6}(6) = 1$; thus, $1x = 8$.
6. Use the multiplicative identity property to arrive at $x = 8$.

Problem Set

For each problem below, explain the steps in finding the value of the variable. Then find the value of the variable, showing each step. Write if-then statements to justify each step in solving the equation.

1. $7(m + 5) = 21$
2. $-2v + 9 = 25$
3. $\frac{1}{3}y - 18 = 2$
4. $6 - 8p = 38$
5. $15 = 5k - 13$