

Section 7.7 Applications Using Rational Equations and Proportions

Solving Application Problems

Follow these steps to properly show your work when solving an application problem.

Step 1: Let x represent one of the unknown quantities.

Step 2: Represent any other unknown quantities in terms of x .

Step 3: Write an equation that describes the conditions.

Step 4: Solve the equation and answer the question.

Step 5: Check the proposed solution in the original wording of the problem.

Problems Involving Motion

To solve problems involving motion, the formula that relates time traveled to the distance traveled and the rate of travel is needed. The formula is:

$$\text{Time traveled} = \frac{\text{Distance traveled}}{\text{Rate of travel}}$$

Use a chart to organize the information in the problem.

Example 1: You can travel 40 miles on a motorcycle in the same time that it takes to travel 15 miles on a bicycle. If your motorcycle's rate is 20 miles per hour faster than your bicycle's, find the average rate for each.

Let x be the rate of the bicycle.

	Distance	Rate	Time = $\frac{\text{Distance}}{\text{Rate}}$
Motorcycle	40	$x + 20$	$\frac{40}{x + 20}$
Bicycle	15	x	$\frac{15}{x}$

Note: Portions of this document are excerpted from the textbook *Introductory and Intermediate Algebra for College Students* by Robert Blitzer.

Now, write your equation by setting the times equal to each other:

$$\frac{40}{x+20} = \frac{15}{x}$$

Solve this equation, and then express your result in English words.

Example 2: The water's current is 2 miles per hour. A canoe can travel 6 miles downstream, with the current, in the same amount of time it travels 2 miles upstream, against the current. What is the canoe's average rate in still water?

Write a statement identifying what x represents, set up a chart to organize the given information, then use the information in the problem and the chart to write an equation. Solve the equation and write your result in English words.

Problems Involving Work

To solve problems involving work, the formula that relates the sum of the portions of the job done by each participant to the complete job is needed. The formula is:

$$\begin{array}{l} \text{Fractional part} \\ \text{of the job done by} \\ \text{the first person} \end{array} + \begin{array}{l} \text{Fractional part} \\ \text{of the job done by} \\ \text{second person} \end{array} = 1$$

Use charts to organize the information in the problem.

Example 3: A pool can be filled by one pipe in 3 hours and by a second pipe in 6 hours. How long will it take using both pipes to fill the pool?

Let x be the number of hours to fill the pool when both pipes are in use.

	Fractional part of pool filled in one hour	Time working together	Fractional part of pool filled in x hours
Pipe #1	$\frac{1}{3}$	x	$\frac{x}{3}$
Pipe #2	$\frac{1}{6}$	x	$\frac{x}{6}$

Now write an equation, solve the equation, and write your result in English words.

Problems Involving Proportions

A proportion is a statement that equates two ratios.

Cross-Products Principle for Proportions

$$\text{If } \frac{a}{b} = \frac{c}{d}, \text{ then } ad = bc \quad (b \neq 0 \text{ and } d \neq 0)$$

The cross products ad and bc are equal.

Solving Applied Problems Using Proportions

1. Read the problem, identify the quantity that you are solving for, and let x stand for that quantity.
2. Set up a proportion using the given ratio on one side and the ratio containing the unknown quantity on the other side.
3. Ignoring units, apply the cross-products principle.
4. Solve for x and answer the question in English words.

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Example 4: The maintenance bill for a shopping center containing 180,000 square feet is \$45,000. What is the bill for a store in the center that has 4800 square feet? (Assume the bill is shared proportionally by all of the stores.)

Let x be the bill for the 4800 square foot store.

$$\frac{\$45,000}{180,000} = \frac{x}{4800}$$

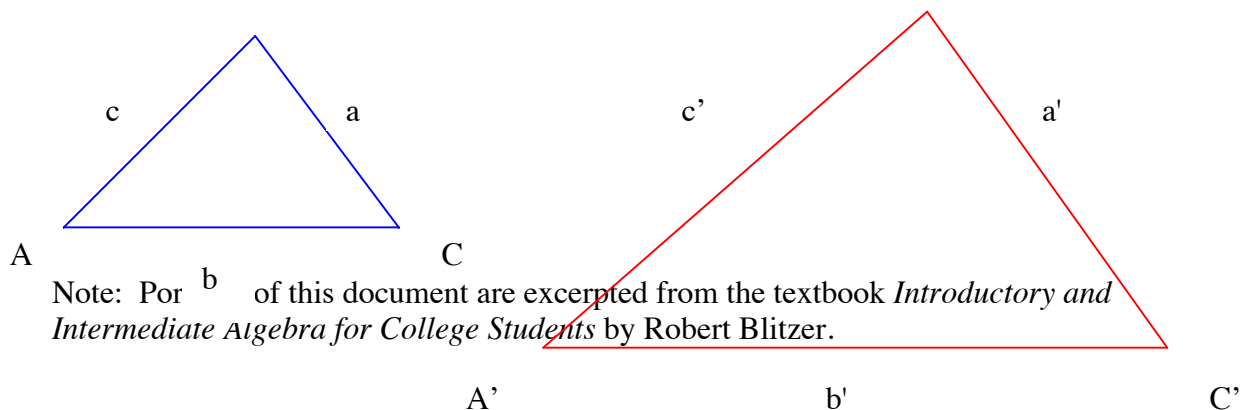
Solve the equation and write your result in English words.

Problems Involving Similar Triangles

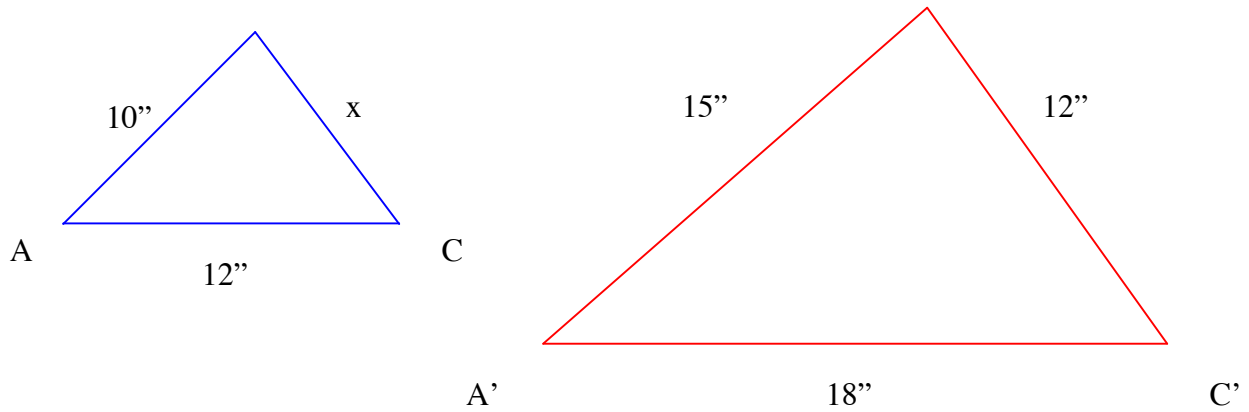
In similar triangles, the measures of corresponding angles are equal, and corresponding sides are proportional.

In the similar triangles below, the angles A and A' are equal, the angles B and B' are equal and the angles C and C' are equal. The corresponding sides are proportional:

$$\frac{a}{a'} = \frac{b}{b'} = \frac{c}{c'}$$



Example 5: Use similar triangles and the fact that corresponding sides are proportional to find the length of the side marked with an "X".



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Answers Section 7.7

Example 1: The rate of the motorcycle is 32 mph, and the rate of the bicycle is 12 mph.

Example 2: The rate of the canoe in still water is 4 mph.

Example 3: Together the pipes fill the pool in 2 hours.

Example 4: The maintenance bill for the 4800 square foot store is \$1200.

Example 5: The length of side “x” is 8”.