

# 2.4

# Ratios

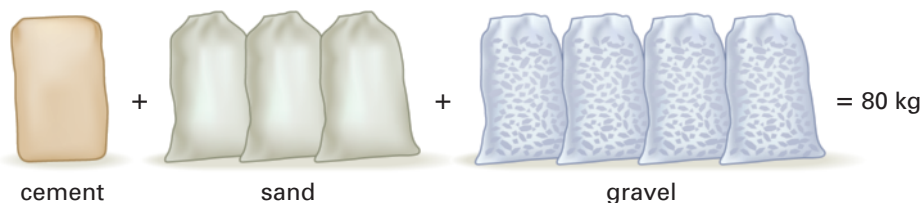
**You will need**  
• a calculator

► **GOAL**

Solve problems that involve ratios.

## Learn about the Math

Michael has a summer job as a bricklayer's assistant. He is responsible for mixing the concrete. Concrete is made of cement, sand, and gravel in a **ratio** of 1 : 3 : 4 by mass. Michael needs to make 80 kg of concrete.



### ? How much cement, sand, and gravel does Michael need to mix together to make 80 kg of concrete?

- How many parts, in total, are in a mixture of concrete?
- Write each ratio.
  - the ratio of cement to sand
  - the ratio of sand to gravel
  - the ratio of cement to gravel
- All the parts must total 80 kg. Write a **proportion** that compares 80 kg of concrete to the mass of the sand.
- What is the **scale factor** in the proportion you wrote? Solve the proportion to determine the mass of sand that Michael needs.
- Calculate the mass of gravel and the mass of cement that Michael needs to make 80 kg of cement.

#### proportion

a number sentence that shows two equivalent ratios; for example,  $1:2:3 = 3:6:9$

#### scale factor

a number that you can multiply or divide each term in a ratio by to get the equivalent terms in another ratio; it can be a whole number or a decimal; for example,

$$\frac{2}{3} = \frac{10}{15} \text{ or } \frac{2 \times 5}{3 \times 5} = \frac{10}{15}$$

$\begin{array}{c} \times 5 \\ \nearrow \\ \frac{2}{3} \end{array}$ 
 $\begin{array}{c} \nwarrow \\ \frac{10}{15} \\ \times 5 \end{array}$

#### Communication Tip

The ratio 1 : 3 : 4 is a three-term ratio, or a comparison between three quantities. It compares the number of equal parts in a mixture that consists of three different items. It is read as 1 part to 3 parts to 4 parts.

## Reflecting

1. How can you calculate the total number of parts when you know the ratio of the parts?
2. How can you use the total number of parts and the total mass to determine the mass of each part?
3. How can your solution to the cement problem be expressed as a ratio that is equivalent to 1 : 3 : 4?

## Work with the Math

### Example: Using proportions with three-term ratios

The chart below is printed on a box of pancake mix.



Number of pancakes	Amount of mix	Amount of water
6	1 cup	$\frac{3}{4}$ cup



Daniel is making 120 pancakes for an athletic awards breakfast. How much mix and water does he need?

### Denis's Solution

number of pancakes : mix : water = 6 : 1 : 0.75

6 : 1 : 0.75 = 120 :  : 

$$120 \div 6 = 20$$

$$6 \times 20 : 1 \times 20 : 0.75 \times 20 = 120 : \text{mix} : \text{water}$$

$$= 120 : 20 : 15$$



$$6 : 1 : 0.75 = 120 : 20 : 15$$

Daniel needs 20 cups of mix and 15 cups of water.

I wrote a three-term ratio that relates the number of pancakes to the required ingredients.

I changed  $\frac{3}{4}$  to its decimal equivalent, 0.75.

I used a proportion to solve the problem.

I used  to represent the amount of mix needed and  to represent the amount of water needed.

I knew the first term in each ratio in the proportion. To calculate the scale factor, I divided 120 by 6 on my calculator.

I multiplied by the scale factor, 20, to determine the missing terms in the proportion.

I expressed the amounts in cups.



## A Checking

4. The ratio for concrete on page 58 is 1 : 3 : 4. Michael now needs to make 64 kg of concrete. Determine the mass of cement, sand, and gravel he needs to mix together.
5. What are the missing terms in each proportion?
  - a)  $2 : 3 = \square : 15$
  - b)  $2 : 5 : 8 = \square : 15 : \square$
  - c)  $\square : \square : 5 = 56 : 24 : 40$
  - d)  $\square : 5 : 9 = 6 : \square : 27$
6. There are 30 students in Cassandra's art class. The ratio of boys to girls is 2 : 3.
  - a) How many boys and girls are in the class?
  - b) What percent of the class are boys? What percent are girls?

## B Practising

7. Calculate the missing terms.
  - a)  $3 : 7 = 12 : \square$
  - b)  $\square : 45 = 3.2 : 15$
  - c)  $\square : 2 : 7 = 7 : 14 : \square$
  - d)  $\square : 3.2 : 11.6 = 10 : 12.8 : \square$
8. The following chart is printed on a package of cookie mix. Marina wants to make six dozen cookies for the school bake sale. How much mix and milk does she need?

Number of cookies	Amount of mix	Amount of milk
24	$2\frac{1}{2}$ cups	$1\frac{1}{4}$ cups

9. In a 500 g bag of trail mix, the ratio of raisins to peanuts to cashews is 9 : 6 : 1 by mass. Determine the masses of raisins, peanuts, and cashews in a 2 kg bag.

10. The aspect ratio of a television or movie screen is the ratio of the width of the screen to its height. A high-definition television has an aspect ratio of 16 : 9. The movie *Star Wars* was filmed in cinemascope, which has an aspect ratio of 2.35 : 1. Are these aspect ratios equivalent? Explain.
11. Costas and Sheila bought a raffle ticket for a charity. The grand prize is \$1000.00. Costas contributed \$3.50 and Sheila contributed \$1.50 to the price of the ticket. If they win the grand prize, they will share the money in the same proportion that they paid for the ticket. How much of the money should each person receive?
12. One brand of horse feed is made of oats and barley. The ratio of oats to barley is 4 : 11 by mass. How many kilograms of each grain are needed to make 150 kg of feed?
13. In a 2 kg bag of building blocks, the ratio of red blocks to green blocks to yellow blocks is 5 : 3 : 2 by mass. Determine the masses of the red, green, and yellow blocks in the bag.
14. In Heavenly Hash ice cream, the ratio of cashews to marshmallows to chocolate ice cream is 1 : 3 : 36 by volume.
  - a) What is the ratio of marshmallows to ice cream?
  - b) What percent of Heavenly Hash ice cream is chocolate ice cream?
  - c) How much of each ingredient is needed to make a 20 L tub of Heavenly Hash ice cream?
15. To make a batch of four dozen cookies, Denis needs  $1\frac{3}{4}$  cups of flour, 1 cup of sugar, and  $\frac{1}{3}$  cup of milk. Calculate the amount of each ingredient that Denis needs to make 12 dozen cookies.

16. A snack mix contains toasted oat cereal, pretzels, and nuts in a ratio of 2 : 2 : 1 by mass. What mass of each ingredient is needed to make the following amounts of snack mix?

- a) 330 g                      c) 500 g  
b) 210 g                      d) 750 g

17. Katie collects stamps. She has stamps from Canada, the United States, and the rest of the world in a ratio of 1 : 1.2 : 1.5. She has 135 stamps from the rest of the world.

- a) How many stamps are from Canada?  
b) How many stamps are from the United States?  
c) What is the total number of stamps in Katie's collection?

18. The longest glacier in the world is Lambert Glacier in Antarctica. It is 403 km long. The longest glacier in the Himalayas is the Siachen. It is 76 km long.



- a) Write a ratio to compare the lengths of the glaciers.  
b) Round off the terms of the ratio to make a ratio that is approximately equivalent.  
c) About how many times as long as the Siachen Glacier is the Lambert Glacier?  
d) Write a ratio to compare your height with the length of the Lambert Glacier. About how many times as long as you is the glacier?

19. Park rangers captured, tagged, and released 82 grizzly bears in Banff National Park. A month later, when the rangers captured 20 bears, 2 had tags. Estimate the park's grizzly bear population.

20. Two numbers are in the ratio of 4 to 7. Their sum is 55. What are the numbers?

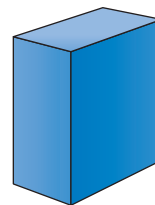
## C Extending

21. a) Follow these steps.

- Draw a square.
- Measure one side and one diagonal to the nearest millimetre.
- Determine the ratio of side length to diagonal length.

- b) Repeat part (a) for three different-sized squares. What do you notice?

22. A rectangular prism has a volume of  $960 \text{ cm}^3$ . Its width, length, and height are in the ratio 3 : 5 : 8.



- a) Determine the dimensions of the prism.  
b) What is the ratio of the left side to the front to the top of the prism by surface area?  
c) Calculate the surface area of the prism.

23. The measures of the angles in  $\triangle ABC$  are in the ratio 3 : 7 : 8. Determine the measure of each angle.

