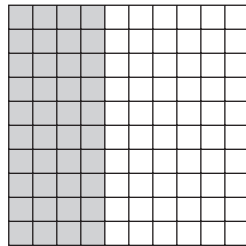


Percents

1 GETTING THE IDEA

The grid below is made of 100 squares. This grid is called a *hundreds grid*. Forty of the 100 squares are shaded. You can write a part-to-whole ratio that compares the number of shaded squares to the total number of squares.



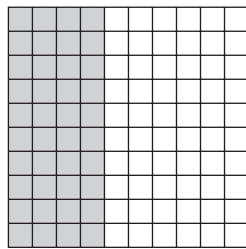
Part-to-whole ratios:

40 to 100

40:100

$$\frac{40}{100}$$

Another way to write a ratio is as a **percent**. A percent is a ratio that compares a number to 100. The word *percent* means “for every 100.” Because 40 out of 100 squares are shaded, the part-to-whole ratio for the grid is 40 per 100, or 40 percent. The symbol % is used for the word *percent*.



40 percent = 40%

Notice that the ratios 40% and $\frac{40}{100}$ are equivalent. It is common to write a percent as a fraction. Because a percent is a part-to-whole ratio, it can be used to find the part or the whole in an equivalent part-to-whole ratio.

Example 1

Twenty percent of the students at Drew's school walk to school. There are 300 students in Drew's school. How many students walk to school?

Strategy Use an equation.

Step 1

Write the percent as a fraction.

$$20\% = 20 \text{ for every } 100 = \frac{20}{100}$$

Step 2

Write an equation of two equivalent ratios.

The first ratio is the given percent written as a fraction: $\frac{20}{100}$.

The second ratio is the number of students who walk to the total number of students at Drew's school. The number of students who walk is unknown.

The total number of students is 300:

$$\frac{\text{Number of students who walk}}{\text{Total number of students}} = \frac{?}{300}$$

$$\text{Write the equation: } \frac{20}{100} = \frac{?}{300}$$

Step 3

Use multiplication to find the missing number.

Because $100 \times 3 = 300$, multiply the numerator and denominator by 3.

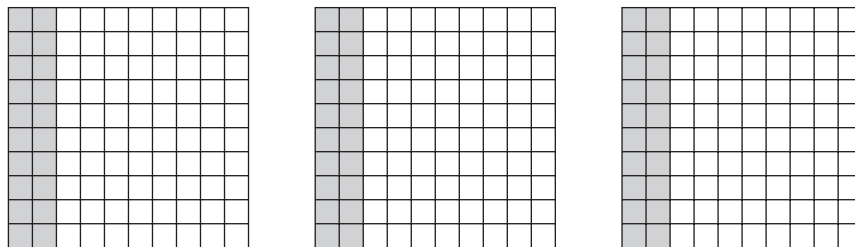
$$\begin{array}{c} \times 3 \\ \curvearrowright \\ \frac{20}{100} = \frac{60}{300} \\ \curvearrowleft \\ \times 3 \end{array}$$

The equivalent ratios show that 20% of 300 students is 60 students.

Step 4

Use a diagram to check your answer.

Use three hundreds grids to model the 300 students in Drew's school. Then model 20% by shading 20 squares in each grid.



Count the shaded squares. Sixty out of 300 squares are shaded, so the answer checks.

Solution

Sixty students in Drew's school walk to school.

Example 2

There are 9 oak trees in a park. The oak trees make up 45% of all the trees in the park. How many trees are in the park?

Strategy Use an equation.

Step 1 Write the percent as a fraction.

$$45\% = 45 \text{ for every } 100 = \frac{45}{100}$$

Step 2 Write an equation of two equivalent ratios.

The first ratio is the given percent written as a fraction: $\frac{45}{100}$.

This second ratio is the part-to-whole ratio comparing the number of oak trees to the total number of trees. There are 9 oak trees and an unknown number of total trees:

$$\frac{\text{Number of oak trees}}{\text{Total number of trees}} = \frac{9}{?}$$

Write the equation: $\frac{45}{100} = \frac{9}{?}$

Step 3 Use division to find the missing number.

Because $45 \div 5 = 9$, divide the numerator and denominator by 5.

$$\begin{array}{c} \div 5 \\ \curvearrowright \\ \frac{45}{100} = \frac{9}{20} \\ \curvearrowleft \\ \div 5 \end{array}$$

The equivalent ratios show that 9 trees are 45% of 20 trees.

Solution There are 20 trees in the park.

When solving percent problems, it can be helpful to write the percent as a fraction in simplest form. The table below shows some common percents and their fraction equivalents.

| Percent | Equivalent Fraction with a Denominator of 100 | Equivalent Fraction in Simplest Form |
|---------|---|--------------------------------------|
| 20% | $\frac{20}{100}$ | $\frac{1}{5}$ |
| 25% | $\frac{25}{100}$ | $\frac{1}{4}$ |
| 40% | $\frac{40}{100}$ | $\frac{2}{5}$ |
| 50% | $\frac{50}{100}$ | $\frac{1}{2}$ |
| 60% | $\frac{60}{100}$ | $\frac{3}{5}$ |
| 75% | $\frac{75}{100}$ | $\frac{3}{4}$ |
| 80% | $\frac{80}{100}$ | $\frac{4}{5}$ |

Example 3

Aisha plays her guitar for 60 minutes each day. She uses 25% of her practice time to practice chords. How many minutes does Aisha practice chords each day?

Strategy Use a tape diagram.

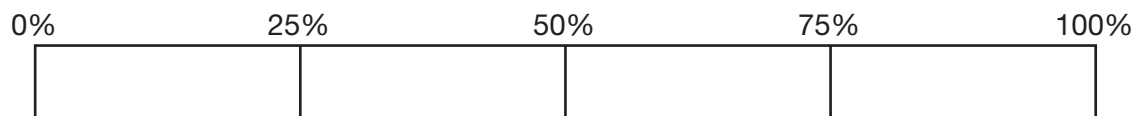
Step 1 Write the percent as a fraction in simplest form.

$$25\% = \frac{25}{100} = \frac{1}{4}$$

Step 2 Represent the percent on a tape diagram.

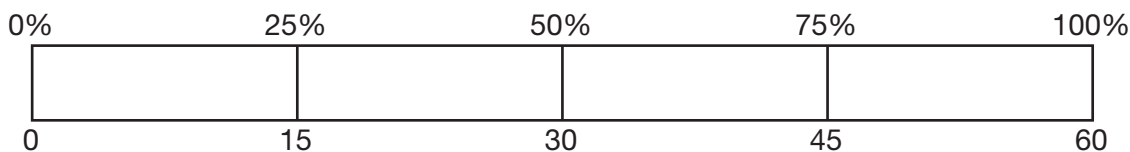
The entire tape represents 100%. Because $25\% = \frac{1}{4}$, divide the tape into equal fourths.

Use $50\% = \frac{2}{4}$ and $75\% = \frac{3}{4}$ to label the diagram with percents.

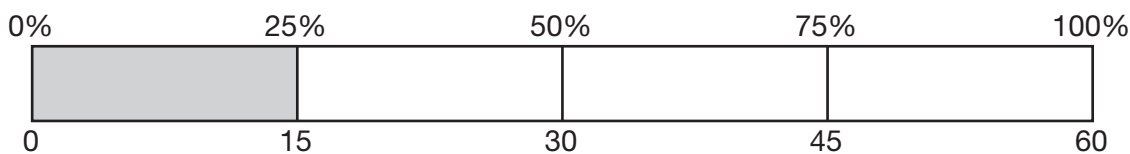


Step 3 Represent the total practice time on the diagram.

Aisha's total practice time is 60 minutes, so the entire tape represents 60. Divide 60 into 4 equal parts. This means that each equal part must be $60 \div 4$, or 15. Label the diagram with the four equal parts of 60.



Step 4 Use the diagram to answer the question.



So, 25% of 60 minutes is 15 minutes.

Solution Aisha practices chords for 15 minutes.

Example 4

Jamie is saving money to buy a video game system. So far, he has saved \$16, which is 5% of the total cost of the system. What is the cost of the video game system?

Strategy Use an equation.

Step 1 Write the percent as a fraction in simplest form.

$$5\% = \frac{5}{100} = \frac{1}{20}$$

Step 2 Write an equation.

The first ratio is the given percent written as a fraction: $\frac{1}{20}$.

The second ratio is the part-to-whole ratio comparing the amount Jamie has saved to the total cost of the system. Jamie has saved \$16 and the cost of the system is unknown:

$$\frac{\text{Amount saved}}{\text{Cost of system}} = \frac{16}{?}$$

Write the equation: $\frac{1}{20} = \frac{16}{?}$

Step 3

Use multiplication to find the missing number.

$$\begin{array}{c} \times 16 \\ \curvearrowright \\ \frac{1}{20} = \frac{16}{320} \\ \curvearrowleft \\ \times 16 \end{array}$$

So, \$16 is 5% of \$320.

Solution The video game system costs \$320.**2 COACHED EXAMPLE**

Laura has \$80 saved for a new laptop. This is 20% of the total amount she needs for the laptop. How much does the new laptop cost?

First, I need to write _____ as a fraction: $\frac{\square}{100}$

Next, I need to write an equation. Does \$80 represent the part or the whole in the problem?

Use ? for the unknown amount: $\frac{\text{Amount saved}}{\text{Total amount needed}} = \frac{\square}{\square}$

Write the equation.

$$\frac{\square}{100} = \frac{\square}{\square}$$

To solve the equation, I need to _____ the numerator and denominator by _____.

$$\frac{\square}{100} = \frac{\square}{\square}$$

The solution of the equation is _____.

So, \$80 is 20% of \$_____.

The new laptop costs \$_____.

3 LESSON PRACTICE

- 1 Write each percent from the table as a fraction in simplest form. Use the numbers from the box to complete the table.

| Percent | Equivalent Fraction in Simplest Form |
|---------|--------------------------------------|
| 16% | $\frac{\square}{\square}$ |
| 45% | $\frac{\square}{\square}$ |
| 8% | $\frac{\square}{\square}$ |
| 28% | $\frac{\square}{\square}$ |

2
4
7
8
9
10
20
25
50

- 2 There are 40 vehicles in a parking lot. Twenty percent of the vehicles are pickup trucks. How many pickup trucks are in the parking lot? Use the model to solve the problem.



There are _____ pickup trucks in the parking lot.

- 3 Draw a line from each statement to its equation.

- | | |
|------------------------|-------------------------------------|
| A. 40 is 25% of 160. • | • $\frac{25}{100} = \frac{10}{40}$ |
| B. 10 is 40% of 25. • | • $\frac{40}{100} = \frac{64}{160}$ |
| C. 64 is 40% of 160. • | • $\frac{25}{100} = \frac{40}{160}$ |
| D. 10 is 25% of 40. • | • $\frac{40}{100} = \frac{10}{25}$ |

- 4 There are 20 students in Mark's homeroom class. Ten percent of the students in Mark's homeroom class are also in art class. He finds the number of students in his homeroom class who are also in art class like this:

$$\begin{array}{c} \times 2 \\ \curvearrowright \\ \frac{10}{100} = \frac{20}{200} \\ \curvearrowleft \\ \times 2 \end{array}$$

Explain Mark's error. Then find the correct solution to the problem. Show your work.

- 5 A bakery makes 200 bagels each day. Forty-five percent of these bagels are plain. Circle the number that makes the statement true.

The bakery makes 9 80 90 plain bagels each day.

- 6 Sanjay read 56 pages of his book this weekend. This is 35% of the pages in the book. How many pages are in Sanjay's book? Show your work.

7 Select True or False for each statement.

- A.** 60 is 50% of 120. True False
- B.** 120 is 25% of 30. True False
- C.** 60 is 30% of 200. True False
- D.** 30 is 75% of 40. True False
- E.** 20 is 10% of 120. True False

8 Bianca has to drive 180 miles to her aunt’s house. She drove 30% of the total distance before lunch. How many miles did Bianca drive before lunch? Show your work.

9 Nina wants to buy a bicycle that costs \$150. She has saved 6% of the total cost of the bicycle.

Part A

How much money has Nina saved? Show your work.

Part B

What percent of the total cost of the bicycle does Nina still have to save? Explain how you found your answer.

10 Is the missing number a part or a whole? Select Part or Whole.

- A.** What number is 18% of 50? Part Whole
- B.** Two percent of what number is 400? Part Whole
- C.** Sixty-eight percent of 56 is what number? Part Whole
- D.** Eighteen is 75% of what number? Part Whole

11 Two hundred tickets were sold for a concert. Forty percent of the tickets were pre-sold. The remaining tickets were sold at the door.

Sasha finds the number of tickets sold at the door in the following way:

- First, she subtracts 40% from 100% to get 60%.
- Then she finds the number that is 60% of 200.

Is Sasha correct? Explain your reasoning.

How many tickets were sold at the door? Show your work.