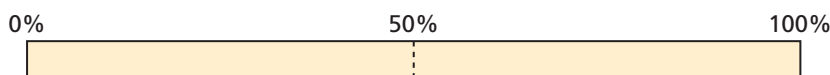


## 4.1 The Percent Equation

**Essential Question** How can you use models to estimate percent questions?

### 1 ACTIVITY: Estimating a Percent

Work with a partner. Estimate the locations of 50%, 75%, 40%, 6%, and 65% on the model. 50% is done for you.



### 2 ACTIVITY: Estimating a Part of a Number

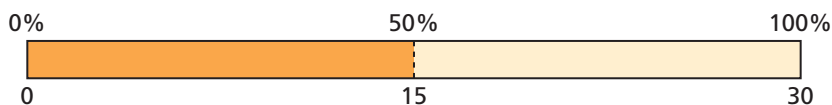
The statement “25% of 12 is 3” has three numbers. In real-life problems, any one of these numbers can be unknown.

$$\begin{array}{c} \text{Part} \rightarrow \frac{3}{12} = 0.25 = 25\% \leftarrow \text{Percent} \\ \text{Whole} \rightarrow \end{array}$$

Which number is missing?	Question	Type of Question
3	What is 25% of 12?	Find a part of a number.
25%	3 is what percent of 12?	Find a percent.
12	3 is 25% of what?	Find the whole.

Work with a partner. Estimate the answer to each question using a model.

a. **Sample:** What number is 50% of 30?



∴ So, from the model, 15 is 50% of 30.

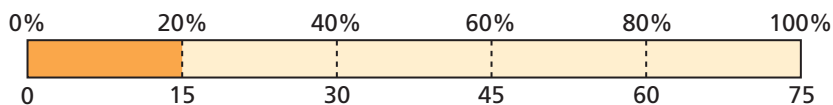
- b. What number is 75% of 30?      c. What number is 40% of 30?  
 d. What number is 6% of 30?      e. What number is 65% of 30?

### 3 ACTIVITY: Estimating a Percent

Work with a partner. Estimate the answer to the question using a model.



a. **Sample:** 15 is what percent of 75?



∴ So, 15 is 20% of 75.

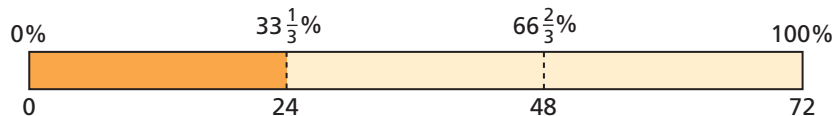
- |                              |                              |
|------------------------------|------------------------------|
| b. 5 is what percent of 20?  | c. 18 is what percent of 40? |
| d. 50 is what percent of 80? | e. 75 is what percent of 50? |

### 4 ACTIVITY: Estimating a Whole

Work with a partner. Estimate the answer to the question using a model.



a. **Sample:** 24 is  $33\frac{1}{3}\%$  of what number?



∴ So, 24 is  $33\frac{1}{3}\%$  of 72.

- |                              |                               |
|------------------------------|-------------------------------|
| b. 13 is 25% of what number? | c. 110 is 20% of what number? |
| d. 75 is 75% of what number? | e. 81 is 45% of what number?  |

## What Is Your Answer?

5. **IN YOUR OWN WORDS** How can you use models to estimate percent questions? Give examples to support your answer.

### Practice

Use what you learned about estimating percent questions to complete Exercises 4–9 on page 162.

## Key Vocabulary

percent, p. 160

A **percent** is a ratio whose denominator is 100. Here are two examples.

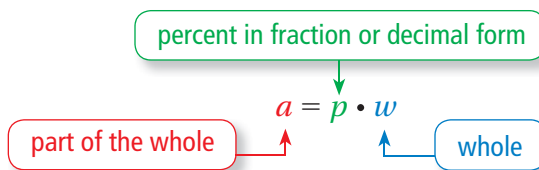
$$4\% = \frac{4}{100} = 0.04$$

$$25\% = \frac{25}{100} = 0.25$$

## Key Idea

### The Percent Equation

**Words** To represent “ $a$  is  $p$  percent of  $w$ ,” use an equation.

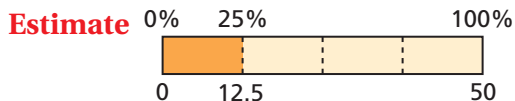


**Numbers**

$$15 = 0.5 \cdot 30$$

## EXAMPLE 1 Finding a Part of a Number

What number is 24% of 50?



$$a = p \cdot w$$

Write percent equation.

$$= \frac{24}{100} \cdot 50$$

Substitute  $\frac{24}{100}$  for  $p$  and 50 for  $w$ .

$$= 12$$

Multiply.

So, 12 is 24% of 50.

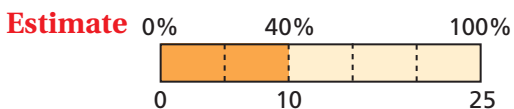
**Reasonable?**  $12 \approx 12.5$  ✓

## Common Error

Remember to convert a percent to a fraction or decimal before using the percent equation. For Example 1, write 24% as  $\frac{24}{100}$ .

## EXAMPLE 2 Finding a Percent

9.5 is what percent of 25?



$$a = p \cdot w$$

Write percent equation.

$$9.5 = p \cdot 25$$

Substitute 9.5 for  $a$  and 25 for  $w$ .

$$0.38 = p$$

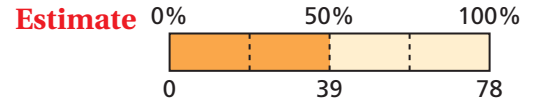
Divide each side by 25.

Because 0.38 equals 38%, 9.5 is 38% of 25.

**Reasonable?**  $38\% \approx 40\%$  ✓

### EXAMPLE 3 Finding a Whole

39 is 52% of what number?



$$a = p \cdot w$$

Write percent equation.

$$39 = 0.52 \cdot w$$

Substitute 39 for  $a$  and 0.52 for  $p$ .

$$75 = w$$

Divide each side by 0.52.

∴ So, 39 is 52% of 75.

**Reasonable?**  $75 \approx 78$  ✓

### On Your Own

**Now You're Ready**  
Exercises 10–17

Write and solve an equation to answer the question.

1. What number is 10% of 20?
2. What number is 150% of 40?
3. 3 is what percent of 600?
4. 18 is what percent of 20?
5. 8 is 80% of what number?
6. 90 is 18% of what number?

### EXAMPLE 4 Real-Life Application

#### 8th Street Cafe

DATE: MAY04'10 05:45PM  
TABLE: 29  
SERVER: CHARITY

<b>Food Total</b>	<b>27.50</b>
<b>Tax</b>	<b>1.65</b>
<b>Subtotal</b>	<b>29.15</b>

TIP: \_\_\_\_\_

TOTAL: \_\_\_\_\_

*Thank You*

- a. Find the percent of sales tax on the food total.
- b. Find the amount of a 16% tip on the food total.

a. Answer the question: \$1.65 is what percent of \$27.50?

$$a = p \cdot w$$

Write percent equation.

$$1.65 = p \cdot 27.50$$

Substitute 1.65 for  $a$  and 27.50 for  $w$ .

$$0.06 = p$$

Divide each side by 27.50.

∴ Because 0.06 equals 6%, the percent of sales tax is 6%.

b. Answer the question: What tip amount is 16% of \$27.50?

$$a = p \cdot w$$

Write percent equation.

$$= 0.16 \cdot 27.50$$

Substitute 0.16 for  $p$  and 27.50 for  $w$ .

$$= 4.40$$

Multiply.

∴ So, the amount of the tip is \$4.40.

### On Your Own

7. **WHAT IF?** In Example 4, find the amount of a 20% tip on the food total.

## Vocabulary and Concept Check

- VOCABULARY** Write the percent equation in words.
- REASONING** A number  $n$  is 150% of number  $m$ . Is  $n$  greater than, less than, or equal to  $m$ ? Explain your reasoning.
- DIFFERENT WORDS, SAME QUESTION** Which is different? Find “both” answers.

What number is 20% of 55?

55 is 20% of what number?

20% of 55 is what number?

$0.2 \cdot 55$  is what number?

## Practice and Problem Solving

Estimate the answer to the question using a model.

- What number is 24% of 80?
- 15 is 30% of what number?
- 20 is what percent of 52?
- 15 is what percent of 40?
- What number is 120% of 70?
- 48 is 75% of what number?

Write and solve an equation to answer the question.

- 20% of 150 is what number?
- 35% of what number is 35?
- 29 is what percent of 20?
- What percent of 300 is 51?
- 45 is what percent of 60?
- 32% of 25 is what number?
- 0.5% of what number is 12?
- 120% of what number is 102?

**ERROR ANALYSIS** Describe and correct the error in using the percent equation.

18. What number is 35% of 20?

$$\begin{aligned} \times \quad a &= p \cdot w \\ &= 35 \cdot 20 \\ &= 700 \end{aligned}$$

19. 30 is 60% of what number?

$$\begin{aligned} \times \quad a &= p \cdot w \\ &= 0.6 \cdot 30 \\ &= 18 \end{aligned}$$

- BASEBALL** A pitcher throws 75 pitches. Of these, 72% were strikes. How many strikes did the pitcher throw?
- FUNDRAISING** Your school raised 125% of its fundraising goal. The school raised \$6750. What was the goal?
- SURFBOARD** The sales tax on a surfboard is \$12. What is the percent of sales tax?

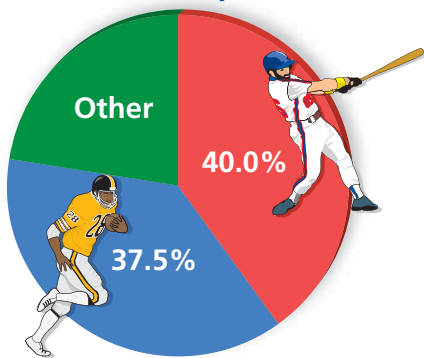


**PUZZLE** There were  $w$  signers of the Declaration of Independence. The youngest was Edward Rutledge, who was  $x$  years old. The oldest was Benjamin Franklin, who was  $y$  years old.

23.  $x$  is 25% of 104. What was Rutledge's age?
24. 7 is 10% of  $y$ . What was Franklin's age?
25.  $w$  is 80% of  $y$ . How many signers were there?
26.  $y$  is what percent of  $(w + y - x)$ ?



### Favorite Sport



27. **REASONING** How can you tell whether the percent of a number will be *greater than*, *less than*, or *equal to* the number?

28. **SURVEY** In a survey, a group of students were asked their favorite sport. "Other" sports were chosen by 18 people.

- a. How many students participated?
- b. How many chose football?

29. **WATER TANK** Water tank  $A$  has a capacity of 550 gallons and is 66% full. Water tank  $B$  is 53% full. The ratio of the capacity of tank  $A$  to tank  $B$  is 11 : 15.

- a. How much water is in tank  $A$ ?
- b. What is the capacity of tank  $B$ ?
- c. How much water is in tank  $B$ ?

30. **TRUE OR FALSE?** Tell whether the statement is *true* or *false*. Explain your reasoning.

If  $W$  is 25% of  $Z$ , then  $Z : W$  is 75 : 25.

31. **Reasoning** The table shows your test results for math class. What test score is needed on the last exam to earn 90% of the total points?

Test Score	Point Value
83%	100
91.6%	250
88%	150
?	300



## Fair Game Review what you learned in previous grades & lessons

**Simplify. Write as a decimal.**

32.  $\frac{10 - 4}{10}$

33.  $\frac{25 - 3}{25}$

34.  $\frac{105 - 84}{84}$

35.  $\frac{170 - 125}{125}$

36. **MULTIPLE CHOICE** There are 160 people in a grade. The ratio of boys to girls is 3 to 5. Which proportion can you use to find the number  $x$  of boys?

(A)  $\frac{3}{8} = \frac{x}{160}$

(B)  $\frac{3}{5} = \frac{x}{160}$

(C)  $\frac{5}{8} = \frac{x}{160}$

(D)  $\frac{3}{5} = \frac{160}{x}$