4 Percents

"Here's my sales strategy. I buy each dog bone for $0.05."

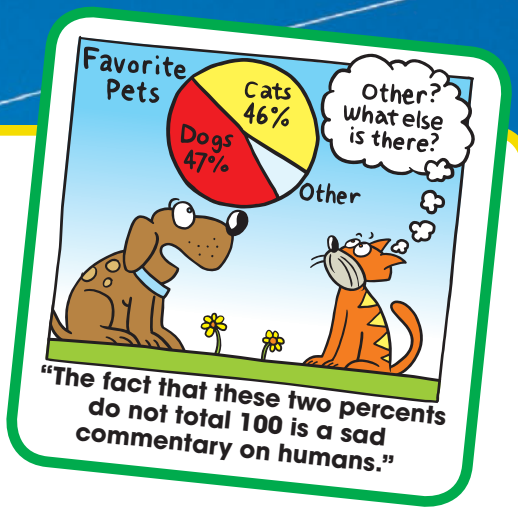
"Then I mark each one up to $1. Then, I have a 75% off sale. Cool, huh?"

"Dear Vet: I have this strange feeling that I am wagging my tail 15% fewer times than I used to wag it."

"Oh look. He already answered me."

"Dear Newton, I only practice general vet work. I need to refer you to a dog tail specialist."

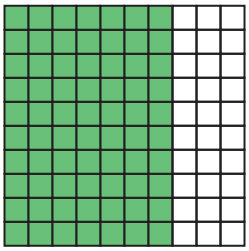
What You Learned Before



Writing Percents Using Models (6.RP.3c)

What percent of the model is shaded?

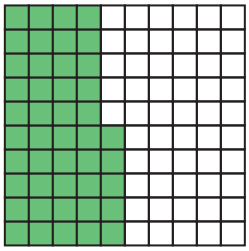
Example 1



$= \frac{70}{100}$

$= 70\%$

Example 2



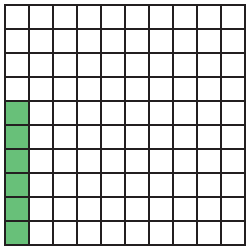
$= \frac{45}{100}$

$= 45\%$

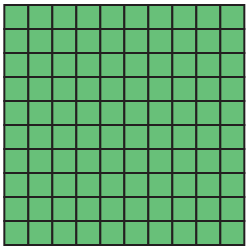
Try It Yourself

What percent of the model is shaded?

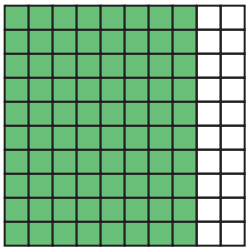
1.



2.



3.



Writing Decimals, Percents, and Fractions (6.RP.3c)

Example 3 Write $\frac{3}{5}$ as a decimal.

$$\frac{3}{5} = \frac{3 \cdot 2}{5 \cdot 2} = \frac{6}{10} = 0.6$$

Example 4 Write $\frac{3}{5}$ as a percent.

$$\frac{3}{5} = \frac{3 \cdot 20}{5 \cdot 20} = \frac{60}{100} = 60\%$$

Multiply to make the denominator 100.

Try It Yourself

Copy and complete the table.

	Percent	Decimal	Fraction
4.	35%		
5.		0.6	
6.			$\frac{13}{25}$

	Percent	Decimal	Fraction
7.	10%		
8.		0.85	
9.			$\frac{1}{5}$

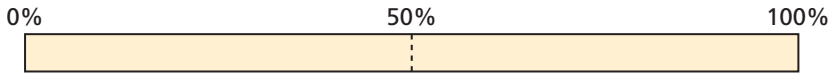
4.1 The Percent Equation

COMMON CORE STATE STANDARDS
7.EE.3
7.RP.3

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.

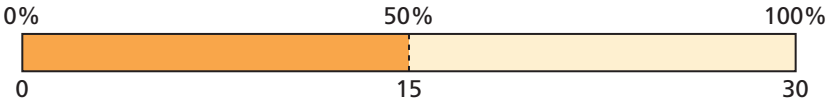
Part → $\frac{3}{12} = 0.25 = 25\%$ ← Percent

Whole → 12

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?

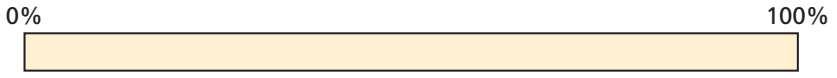
c. What number is 40% of 30?

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?

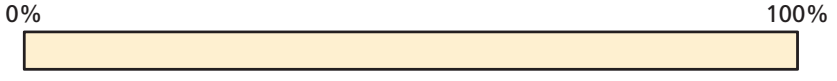
c. 18 is what percent of 40?

d. 50 is what percent of 80?

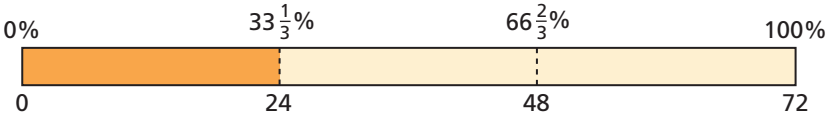
e. 75 is what percent of 50?

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.

4.1 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
percent, *p. 160*

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

$$4\% = \frac{4}{100} = 0.04 \qquad 25\% = \frac{25}{100} = 0.25$$

Key Idea

The Percent Equation

Words To represent "a is p percent of w," use an equation.

percent in fraction or decimal form

$$a = p \cdot w$$

part of the whole

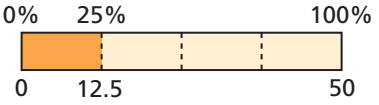
whole

Numbers $15 = 0.5 \cdot 30$

EXAMPLE 1 Finding a Part of a Number

What number is 24% of 50?

Estimate



$a = p \cdot w$ 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?** $12 \approx 12.5$ ✓

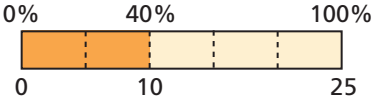
Common Error

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?

Estimate



$a = p \cdot w$ 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.

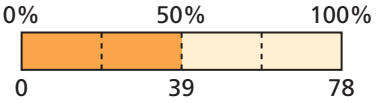
Because 0.38 equals 38%, 9.5 is 38% of 25. **Reasonable?** $38\% \approx 40\%$ ✓

Multi-Language Glossary at BigIdeasMath.com.

EXAMPLE 3 Finding a Whole

39 is 52% of what number?

Estimate



$a = p \cdot w$	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?** $75 \approx 78$ ✓

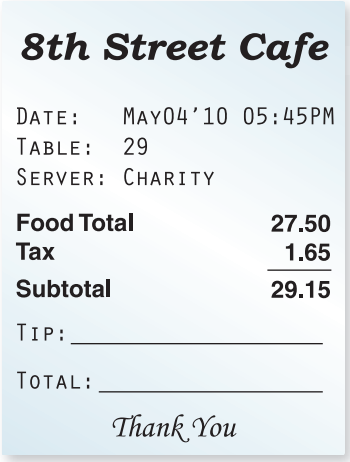
On Your Own

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

Food Total	27.50
Tax	1.65
Subtotal	29.15

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.

4.1 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **VOCABULARY** Write the percent equation in words.
2. **REASONING** A number n is 150% of number m. Is n *greater than*, *less than*, or *equal to* m? Explain your reasoning.
3. **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 • 55 is what number?

Practice and Problem Solving

Estimate the answer to the question using a model.

4. What number is 24% of 80?
5. 15 is what percent of 40?
6. 15 is 30% of what number?
7. What number is 120% of 70?
8. 20 is what percent of 52?
9. 48 is 75% of what number?

Write and solve an equation to answer the question.

1 10. 20% of 150 is what number?
11. 45 is what percent of 60?
2 12. 35% of what number is 35?
13. 32% of 25 is what number?
3 14. 29 is what percent of 20?
15. 0.5% of what number is 12?
16. What percent of 300 is 51?
17. 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?

$$a = p \cdot w$$
$$= 35 \cdot 20$$
$$= 700$$

19. 30 is 60% of what number?

$$a = p \cdot w$$
$$= 0.6 \cdot 30$$
$$= 18$$

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

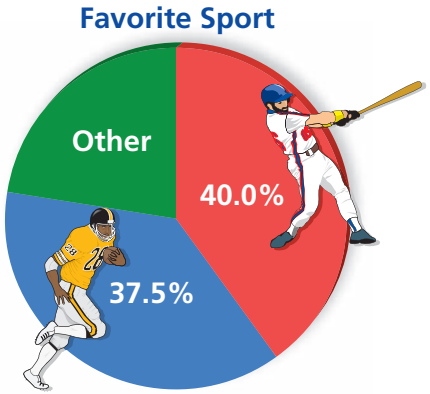
PUZZLE **There were w signers of the Declaration of Independence. The youngest was Edward Rutledge, who was x years old. The oldest was Benjamin Franklin, who was y years old.**

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 $(w + y - x)$?



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. **PROBLEM SOLVING** 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. *(Skills Review Handbook)*

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? *(Section 3.4)*

Ⓐ $\frac{3}{8} = \frac{x}{160}$ Ⓑ $\frac{3}{5} = \frac{x}{160}$ Ⓒ $\frac{5}{8} = \frac{x}{160}$ Ⓓ $\frac{3}{5} = \frac{160}{x}$

4.2 Percents of Increase and Decrease

COMMON CORE STATE STANDARDS
7.EE.3
7.RP.3

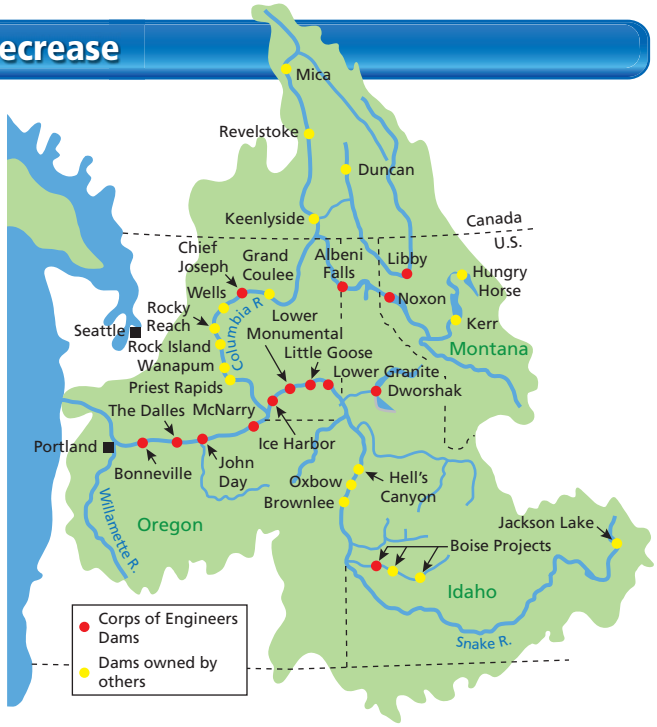
Essential Question What is a percent of decrease? What is a percent of increase?

1 ACTIVITY: Percent of Decrease

Each year in the Columbia River Basin, adult salmon swim up river to streams to lay eggs and hatch their young.

To go up the river, the adult salmon use fish ladders. But, to go down the river, the young salmon must pass through several dams.

There are electric turbines at each of the eight dams on the main stem of the Columbia and Snake Rivers. About 88% of the young salmon pass through these turbines unharmed.

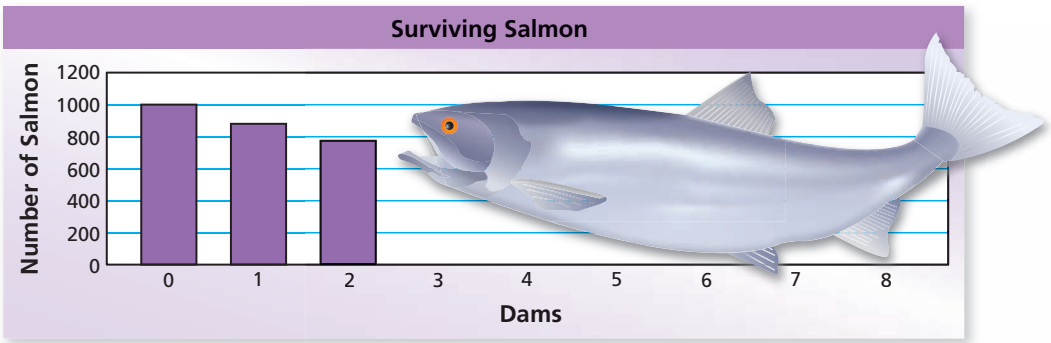


Copy and complete the table and the bar graph to show the number of young salmon that make it through the dams.

Dam	0	1	2	3	4	5	6	7	8
Salmon	1000	880	774						

88% of 1000 $= 0.88 \cdot 1000$
$= 880$

88% of 880 $= 0.88 \cdot 880$
$= 774.4 \approx 774$



2 ACTIVITY: Percent of Increase

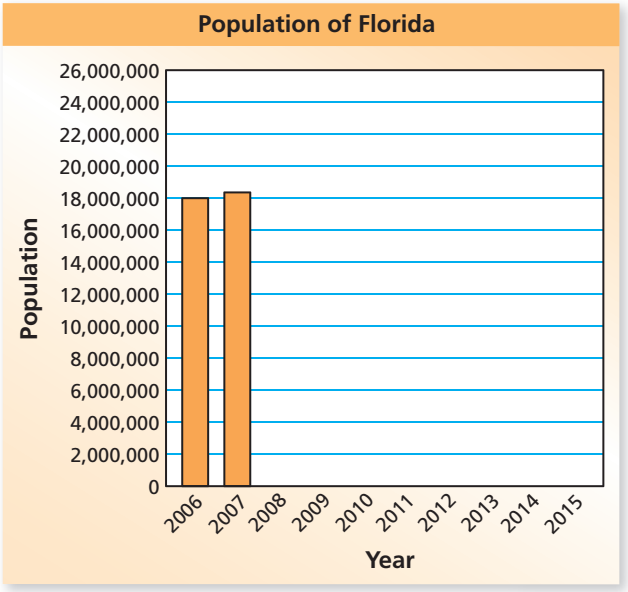
From 2000 to 2006, the population of Florida increased about 2% each year. Copy and complete the table and the bar graph using this pattern. Predict the population in 2015.

For 2007:

$$2\% \text{ of } 18{,}000{,}000 = 0.02 \cdot 18{,}000{,}000$$
$$= 360{,}000$$

$$\underbrace{18{,}000{,}000}_{\text{2006 Population}} + \underbrace{360{,}000}_{\text{Increase}} = \underbrace{18{,}360{,}000}_{\text{2007 Population}}$$

Year	Population
2006	18,000,000
2007	18,360,000
2008	
2009	
2010	
2011	
2012	
2013	
2014	
2015	



What Is Your Answer?

3. In Activity 1, by what percent does the number of young salmon decrease with each dam?

4. Describe real-life examples of a percent of decrease and a percent of increase.

5. **IN YOUR OWN WORDS** What is a percent of decrease? What is a percent of increase?

Practice Use what you learned about percent of increase and percent of decrease to complete Exercises 13–18 on page 168.

4.2 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
percent of change, *p. 166*
percent of increase, *p. 166*
percent of decrease, *p. 166*

A **percent of change** is the percent that a quantity changes from the original amount.

$$\text{percent of change} = \frac{\text{amount of change}}{\text{original amount}}$$

Key Idea

Percents of Increase and Decrease

When the original amount increases, the percent of change is called a **percent of increase**.

$$\text{percent of increase} = \frac{\text{new amount} - \text{original amount}}{\text{original amount}}$$

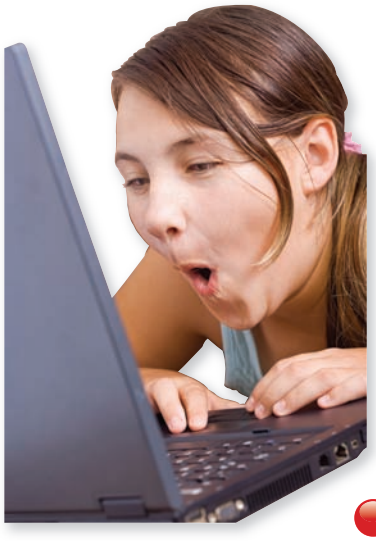
When the original amount decreases, the percent of change is called a **percent of decrease**.

$$\text{percent of decrease} = \frac{\text{original amount} - \text{new amount}}{\text{original amount}}$$

EXAMPLE 1 Finding a Percent of Increase

The table shows the number of hours you spent online last weekend. What is the percent of change in your online time from Saturday to Sunday?

Day	Hours Online
Saturday	2
Sunday	4.5



The number of hours on Sunday is greater than the number of hours on Saturday. So, the percent of change is a percent of increase.

$$\text{percent of increase} = \frac{\text{new amount} - \text{original amount}}{\text{original amount}}$$

$$= \frac{4.5 - 2}{2} \quad \text{Substitute.}$$

$$= \frac{2.5}{2} \quad \text{Subtract.}$$

$$= 1.25, \text{ or } 125\% \quad \text{Write as a percent.}$$

Your online time increased 125% from Saturday to Sunday.

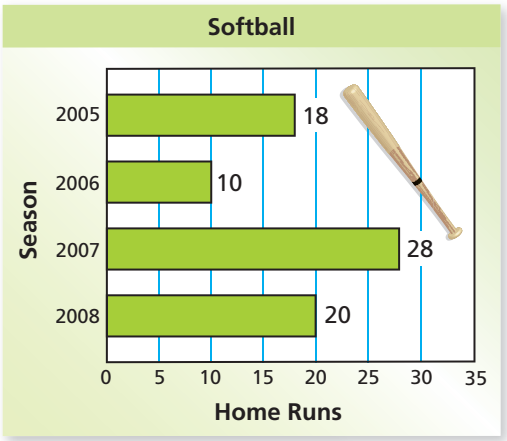
On Your Own

Find the percent of change. Round to the nearest tenth of a percent, if necessary.

1. 10 inches to 25 inches
2. 57 people to 65 people

EXAMPLE 2 Finding a Percent of Decrease

The bar graph shows a softball player's home run totals. What was the percent of change from 2007 to 2008?



The number of home runs decreased from 2007 to 2008. So, the percent of change is a percent of decrease.

$$\text{percent of decrease} = \frac{\text{original amount} - \text{new amount}}{\text{original amount}}$$

$$= \frac{28 - 20}{28} \quad \text{Substitute.}$$

$$= \frac{8}{28} \quad \text{Subtract.}$$

$$\approx 0.286, \text{ or } 28.6\% \quad \text{Write as a percent.}$$

The number of home runs decreased about 28.6%.

On Your Own

Now You're Ready
Exercises 4–11

3. What was the percent of change from 2005 to 2006?

EXAMPLE 3 Standardized Test Practice

You have 250 songs on your MP3 player. You delete 20% of the songs. How many songs are left?

Ⓐ 50 Ⓑ 150 Ⓒ 200 Ⓓ 300

Find the amount of decrease.

$$20\% \text{ of } 250 = 0.2 \cdot 250 \quad \text{Write as multiplication.}$$

$$= 50 \quad \text{Multiply.}$$

The decrease is 50 songs. So, there are $250 - 50 = 200$ songs left.

The correct answer is Ⓒ.

On Your Own

Now You're Ready
Exercises 13–22

4. **WHAT IF?** After deleting the 50 songs in Example 3, you add 10% more songs. How many songs are on the MP3 player?

4.2 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **VOCABULARY** How do you know whether a percent of change is a *percent of increase* or a *percent of decrease*?

2. **NUMBER SENSE** Without calculating, which has a greater percent of increase?
   - 5 bonus points on a 50-point exam
   - 5 bonus points on a 100-point exam

3. **WRITING** What does it mean to have a 100% decrease?

Practice and Problem Solving

Identify the percent of change as an *increase* or *decrease*. Then find the percent of change. Round to the nearest tenth of a percent, if necessary.

1 2

4. 12 inches to 36 inches
5. 75 people to 25 people
6. 50 pounds to 35 pounds
7. 24 songs to 78 songs
8. 10 gallons to 24 gallons
9. 72 paper clips to 63 paper clips
10. 16 centimeters to 44.2 centimeters
11. 68 miles to 42.5 miles

12. **ERROR ANALYSIS** Describe and correct the error in finding the percent increase from 18 to 26.

✗ $\frac{26 - 18}{26} \approx 0.31 = 31\%$

Find the new amount.

3

13. 8 meters increased by 25%
14. 15 liters increased by 60%
15. 50 points decreased by 26%
16. 25 penalties decreased by 32%
17. 68 students increased by 125%
18. 1000 grams decreased by 94%
19. 62 kilograms decreased by 32%
20. 124 ounces decreased by 67%

21. **ERROR ANALYSIS** Describe and correct the error in using the percent of change to find a new amount.

✗ 25 is decreased by 40%.
40% of 25 = 0.4 • 25
= 10
So, 25 + 10 = 35.

22. **VIDEO GAME** Last week, you finished Level 2 of a video game in 32 minutes. Today, you finish Level 2 in 28 minutes. What is your percent of change?

Identify the percent of change as an *increase* or *decrease*. Then find the percent of change. Round to the nearest tenth of a percent, if necessary.

23. $\frac{1}{4}$ to $\frac{1}{2}$ **24.** $\frac{4}{5}$ to $\frac{3}{5}$ **25.** $\frac{3}{8}$ to $\frac{7}{8}$ **26.** $\frac{5}{4}$ to $\frac{3}{8}$

27. **CRITICAL THINKING** Explain why a change from 20 to 40 is a 100% increase, but a change from 40 to 20 is a 50% decrease.

28. **POPULATION** The table shows population data for a community.

Year	Population
2000	118,000
2006	138,000

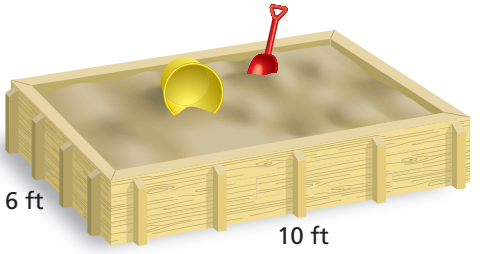
a. What is the percent of change from 2000 to 2006?

b. Use this percent of change to predict the population in 2012.

29. **GEOMETRY** Suppose the length and width of the sandbox are doubled.

a. Find the percent of change in the perimeter.

b. Find the percent of change in the area.



30. **RUNNING** Find the percent of change in the time to run a mile from June to September.

31. **CRITICAL THINKING** A number increases by 10% and then decreases by 10%. Will the result be *greater than*, *less than*, or *equal to* the original number? Explain.

32. **DONATIONS** Donations to an annual fundraiser are 15% greater this year than last year. Last year, donations were 10% greater than the year before. The amount raised this year is $10,120. How much was raised 2 years ago?

33. **Reasoning** Forty students are in the science club. Of those, 45% are girls. This percent increases to 56% after new girls join the club. How many new girls join?

Fair Game Review What you learned in previous grades & lessons

Write and solve an equation to answer the question. *(Section 4.1)*

34. What number is 25% of 64?

35. 39.2 is what percent of 112?

36. 5 is 5% of what number?

37. 18 is 32% of what number?

38. **MULTIPLE CHOICE** Which equation shows direct variation? *(Section 3.7)*

Ⓐ $y - x = 1$ Ⓑ $\frac{y}{x} = 10$ Ⓒ $y = \frac{4}{x}$ Ⓓ $xy = 5$

4 Study Help

Check It Out
Graphic Organizer
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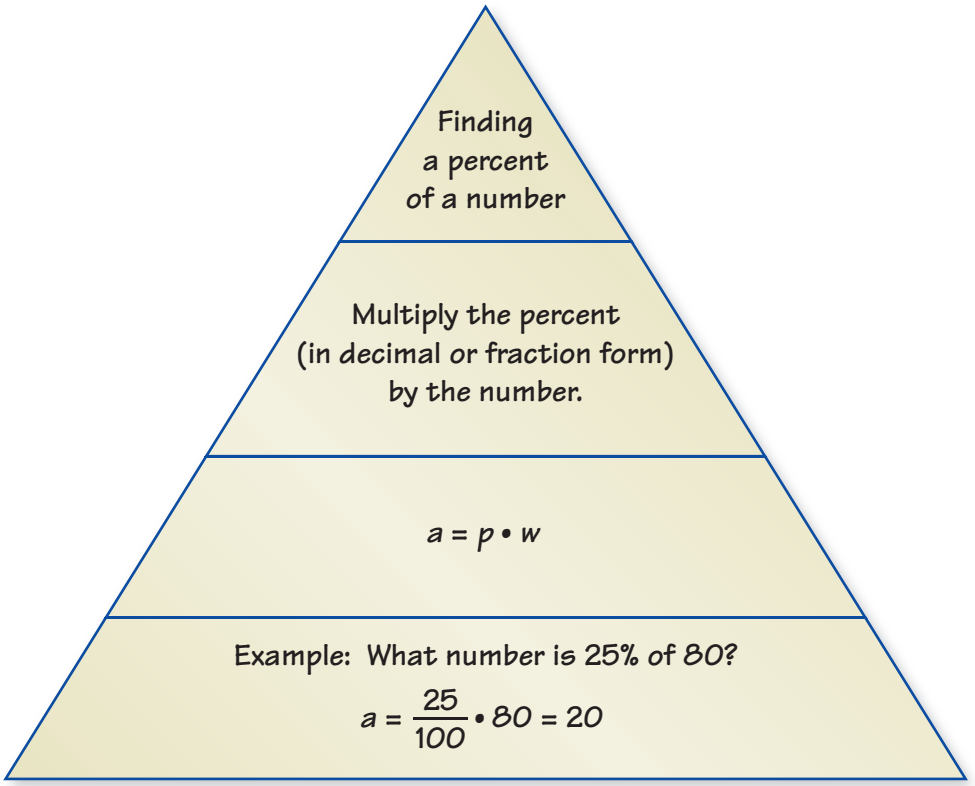
You can use a **summary triangle** to explain a concept. Here is an example of a summary triangle for finding a percent of a number.



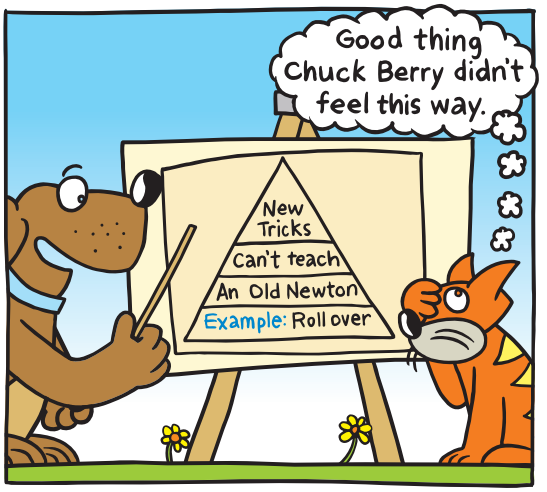
On Your Own

Make a summary triangle to help you study these topics.

1. finding the percent given a number and a part of the number
2. finding the number given a part of the number and a percent
3. percent of increase
4. percent of decrease

After you complete this chapter, make summary triangles for the following topics.

5. discount
6. markup
7. simple interest



"I hope my owner sees my summary triangle. I just can't seem to learn 'roll over'."

4.1–4.2 Quiz

Check It Out
Progress Check
BigIdeasMath.com

Write and solve an equation to answer the question. *(Section 4.1)*

1. What number is 28% of 75?
2. 42 is 21% of what number?
3. 36 is what percent of 45?
4. What number is 68% of 12?
5. 66 is what percent of 55?

Identify the percent of change as an *increase* or *decrease*. Then find the percent of change. Round to the nearest tenth of a percent, if necessary. *(Section 4.2)*

6. 8 inches to 24 inches
7. 300 miles to 210 miles
8. $42.00 to $16.00
9. 32 points to 46 points
10. 185 pounds to 153 pounds
11. 35 people to 70 people

12. **TEXT MESSAGES** You have 44 text messages in your inbox. How many messages can your cell phone hold? *(Section 4.1)*

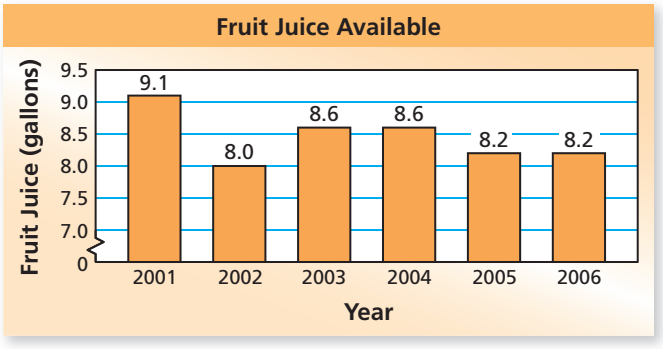
13. **COMPLETIONS** A quarterback completed 68% of his passes in a game. He threw 25 passes. How many passes did the quarterback complete? *(Section 4.1)*

14. **QUIZ** You answered 14 questions correctly on a 15-question quiz. What percent did you receive on the quiz? Round to the nearest hundredth. *(Section 4.1)*

15. **FRUIT JUICE** The graph shows the amount of fruit juice available per person in the United States during a six-year period. *(Section 4.2)*

    a. What is the percent of change from 2002 to 2005?

    b. What is the percent of change from 2002 to 2003?



16. **CAR** A car loses 15% of its original value each year. After one year, a car has a value of $13,600. What is the original value of the car? *(Section 4.2)*

4.3 Discounts and Markups

COMMON CORE STATE STANDARDS
7.EE.3
7.RP.3

Essential Question How can you find discounts and markups efficiently?

1 ACTIVITY: Comparing Discounts

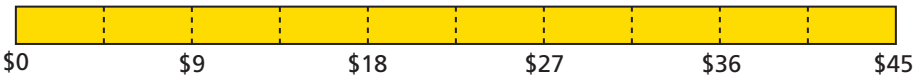
Work with a partner. The same pair of sneakers is on sale at three stores. Which one is the best buy?

a. Regular Price: $45

b. Regular Price: $49

c. Regular Price: $39

a.

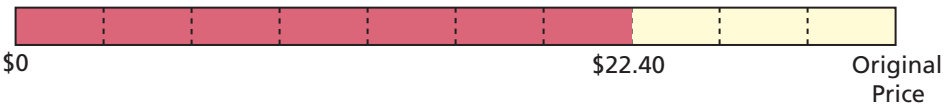


b.

c.

2 ACTIVITY: Finding the Original Price

Work with a partner. You buy a shirt that is on sale for 30% off. You pay $22.40. Your friend wants to know the original price of the shirt. How can your friend find the original price?

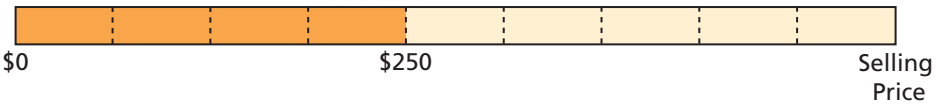


3 ACTIVITY: Calculating Markup

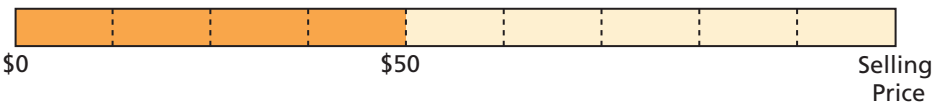
You own a small jewelry store. You increase the price of the jewelry by 125%.

Work with a partner. Use a model to estimate the selling price of the jewelry. Then use a calculator to find the selling price.

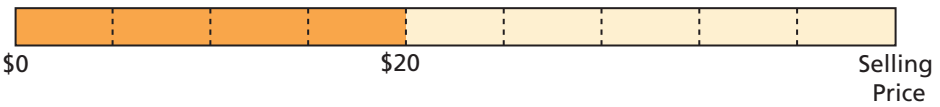
a. Your cost is $250.



b. Your cost is $50.



c. Your cost is $20.



What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you find discounts and markups efficiently? Give examples of each.

Practice Use what you learned about discounts and markups to complete Exercises 4, 9, 14, and 18–20 on pages 176 and 177.

4.3 Lesson

Check It Out
Lesson Tutorials
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Key Vocabulary
discount, *p. 174*
markup, *p. 174*

Key Ideas

Discounts

A **discount** is a decrease in the original price of an item.

Markups

To make a profit, stores charge more than what they pay. The increase from what the store pays to the selling price is called a **markup**.

EXAMPLE 1 Finding a Sale Price

The original price of the shorts is $35. What is the sale price?

Method 1: First, find the discount. The discount is 25% of $35.

$a = p \cdot w$ Write percent equation.

$= 0.25 \cdot 35$ Subsitute 0.25 for p and 35 for w.

$= 8.75$ Multiply.

Next, find the sale price.

sale price	=	original price	−	discount
	=	35	−	8.75
	= 26.25			

The sale price is $26.25.

Method 2: First, find the percent of the original price.

$100\% - 25\% = 75\%$

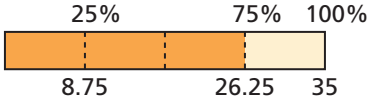
Next, find the sale price.

sale price = 75% of $35

$= 0.75 \cdot 35$

$= 26.25$

The sale price is $26.25. **Check**



✓

Study Tip

A 25% discount is the same as paying 75% of the original price.

On Your Own

Now You're Ready
Exercises 4–8

1. The original price of a skateboard is $50. The sale price includes a 20% discount. What is the sale price?

Multi-Language Glossary at BigIdeasMath.com.

EXAMPLE 2 Finding an Original Price

What is the original price of the shoes?

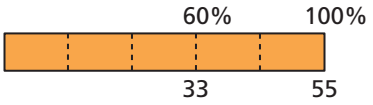
The sale price is
$100\% - 40\% = 60\%$
of the original price.

Answer the question: 33 is 60% of what number?

$a = p \cdot w$	Write percent equation.
$33 = 0.6 \cdot w$	Substitute 33 for a and 0.6 for p.
$55 = w$	Divide each side by 0.6.

The original price of the shoes is \$55.

Check



✓

EXAMPLE 3 Finding a Selling Price

A store pays \$70 for a bicycle. The percent of markup is 20%. What is the selling price?

First, find the markup. The markup is 20% of \$70.

$a = p \cdot w$	Write percent equation.
$= 0.20 \cdot 70$	Substitute 0.20 for p and 70 for w.
$= 14$	Multiply.

Next, find the selling price.

selling price	=	cost to store	+	markup
	=	70	+	14
	= 84			

The selling price is \$84.

On Your Own

Now You're Ready
Exercises 9–20

2. The discount on a DVD is 50%. It is on sale for \$10. What is the original price of the DVD?
3. A store pays \$75 for an aquarium. The markup is 20%. What is the selling price?
4. Solve Example 3 using a different method.

4.3 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **WRITING** Describe how to find the sale price of an item that has been discounted 25%.

2. **WRITING** Describe how to find the selling price of an item that has been marked up 110%.

3. **REASONING** Which would you rather pay? Explain your reasoning.

   a. 6% tax on a discounted price or 6% tax on the original price

   b. 30% markup on a $30 shirt or $30 markup on a $30 shirt

Practice and Problem Solving

Copy and complete the table.

	Original Price	Percent of Discount	Sale Price
1 **4.**	$80	20%	
5.	$42	15%	
6.	$120	80%	
7.	$112	32%	
8.	$69.80	60%	
2 **9.**		25%	$40
10.		5%	$57
11.		80%	$90
12.		64%	$72
13.		15%	$146.54
14.	$60		$45
15.	$82		$65.60
16.	$95		$61.75

17. **YOU BE THE TEACHER** The cost to a store for an MP3 player is $60. The selling price is $105. A classmate says that the markup is 175% because $\frac{\$105}{\$60} = 1.75$. Is your classmate correct? If not, explain how to find the correct percent of markup.

Find the cost to store, percent of markup, or selling price.

3 **18.** Cost to store: $70
Markup: 10%
Selling price: ____

19. Cost to store: ____
Markup: 75%
Selling price: $63

20. Cost to store: $75
Markup: ____
Selling price: $180

21. **SCOOTER** The scooter is on sale for 90% off the original price. Which of the methods can you use to find the sale price? Which method do you prefer? Explain.

- Multiply $45.85 by 0.9.
- Multiply $45.85 by 0.1.
- Multiply $45.85 by 0.9, then add to $45.85.
- Multiply $45.85 by 0.9, then subtract from $45.85.

22. **GAMING** You are shopping for a video game system.

a. At which store should you buy the system?

b. Store A has a weekend sale. How can this change your decision in part (a)?

Store	Cost to Store	Markup
A	$162	40%
B	$155	30%
C	$160	25%

23. **STEREO** A $129.50 stereo is discounted 40%. The next month, the sale price is discounted 60%. Is the stereo now "free"? If not, what is the sale price?

24. **CLOTHING** You buy a pair of jeans at a department store.

a. What is the percent of discount to the nearest percent?

b. What is the percent of sales tax to the nearest tenth of a percent?

c. The price of the jeans includes a 60% markup. After the discount, what is the percent of markup to the nearest percent?

25. Critical Thinking You buy a bicycle helmet for $22.26, which includes 6% sales tax. The helmet is discounted 30% off the selling price. What is the original price?

Fair Game Review What you learned in previous grades & lessons

Evaluate. *(Skills Review Handbook)*

26. 2000(0.085) **27.** 1500(0.04)(3) **28.** 3200(0.045)(8)

29. **MULTIPLE CHOICE** Which measurement is greater than 1 meter? *(Section 3.6)*

Ⓐ 38 inches Ⓑ 1 yard Ⓒ 3.4 feet Ⓓ 98 centimeters

4.4 Simple Interest

COMMON CORE STATE STANDARDS
7.EE.3
7.RP.3

Essential Question How can you find the amount of simple interest earned on a savings account? How can you find the amount of interest owed on a loan?

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Simple interest is money earned on a savings account or an investment. It can also be money you pay for borrowing money.

Write the annual interest rate in decimal form.

Simple Interest	=	Principal	×	Annual Interest Rate	×	Time
($)		($)		(% per yr)		(Years)

$I = Prt$

1 ACTIVITY: Finding Simple Interest

Work with a partner. You put $100 in a savings account. The account earns 6% simple interest per year. (a) Find the interest earned and the balance at the end of 6 months. (b) Copy and complete the table. Then make a bar graph that shows how the balance grows in 6 months.

a. $I = Prt$ — Write simple interest formula

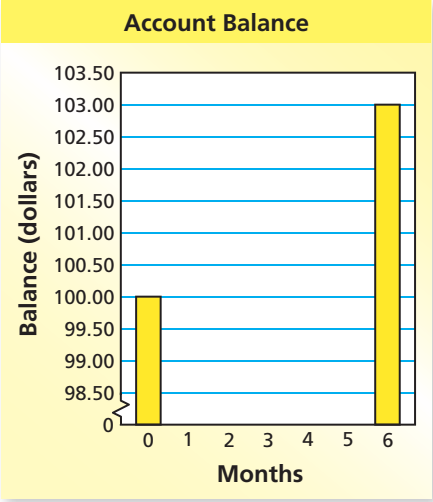
$= 100(0.06)\left(\frac{6}{12}\right)$ — Substitute values.

$= 3$ — Multiply.

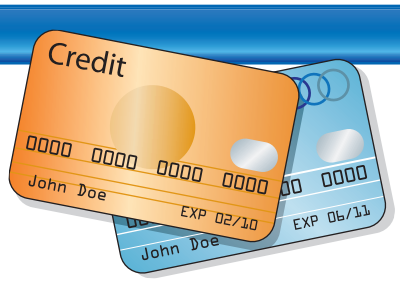
At the end of 6 months, you earn $3 in interest. So, your balance is $100 + $3 = $103.

b.

Time	Interest	Balance
0 month	$0	$100
1 month		
2 months		
3 months		
4 months		
5 months		
6 months	$3	$103



2 ACTIVITY: Financial Literacy



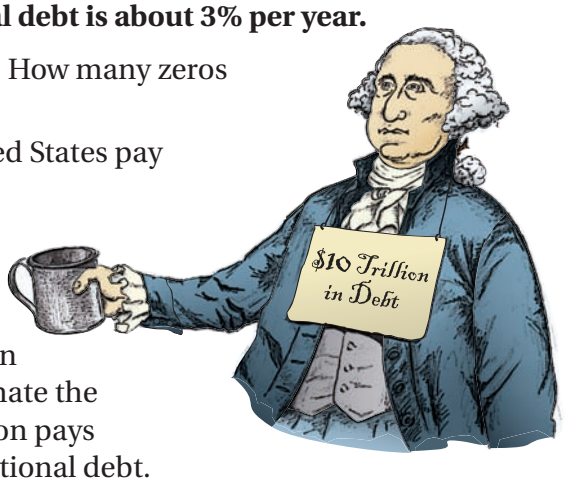
Work with a partner. Use the following information to write a report about credit cards. In the report, describe how a credit card works. Include examples that show the amount of interest paid each month on a credit card.

U.S. Credit Card Data

- A typical family in the United States owes about $5000 in credit card debt.
- A typical credit card interest rate is 18% to 20% per year. This is called the annual percentage rate.

3 ACTIVITY: The National Debt

Work with a partner. In 2010, the United States owed about $10 trillion in debt. The interest rate on the national debt is about 3% per year.



a. Write $10 trillion in decimal form. How many zeros does this number have?

b. How much interest does the United States pay each year on its national debt?

c. How much interest does the United States pay each day on its national debt?

d. The United States has a population of about 300 million people. Estimate the amount of interest that each person pays per year toward interest on the national debt.

What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you find the amount of simple interest earned on a savings account? How can you find the amount of interest owed on a loan? Give examples with your answer.

Practice Use what you learned about simple interest to complete Exercises 4–7 on page 182.

4.4 Lesson

Check It Out
Lesson Tutorials
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Key Vocabulary
interest, *p. 180*
principal, *p. 180*
simple interest, *p. 180*

Interest is money paid or earned for the use of money. The **principal** is the amount of money borrowed or deposited.

Key Idea

Simple Interest

Words **Simple interest** is money paid or earned only on the principal.

Algebra

$$I = Prt$$

Simple interest → I; Principal → P; Annual interest rate (in decimal form) → r; Time (in years) → t

EXAMPLE 1 Finding Interest Earned

You put \$500 in a savings account. The account earns 3% simple interest per year. (a) What is the interest earned after 3 years? (b) What is the balance after 3 years?

a. $I = Prt$ — Write simple interest formula.

$= 500(0.03)(3)$ — Substitute 500 for P, 0.03 for r, and 3 for t.

$= 45$ — Multiply.

The interest earned is \$45 after 3 years.

b. To find the balance, add the interest to the principal.

So, the balance is \$500 + \$45 = \$545 after 3 years.

EXAMPLE 2 Finding an Annual Interest Rate

You put \$1000 in an account. The account earns \$100 simple interest in 4 years. What is the annual interest rate?

$I = Prt$ — Write simple interest formula.

$100 = 1000(r)(4)$ — Substitute 100 for I, 1000 for P, and 4 for t.

$100 = 4000r$ — Simplify.

$0.025 = r$ — Divide each side by 4000.

The annual interest rate of the account is 0.025, or 2.5%.

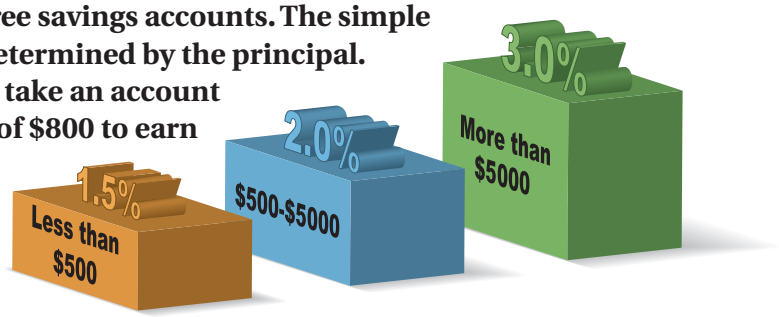
On Your Own

Now You're Ready
Exercises 4–16

1. In Example 1, what is the balance of the account after 9 months?
2. You put \$350 in an account. The account earns \$17.50 simple interest in 2.5 years. What is the annual interest rate?

EXAMPLE 3 Finding an Amount of Time

A bank offers three savings accounts. The simple interest rate is determined by the principal. How long does it take an account with a principal of \$800 to earn \$100 interest?



The pictogram shows that the interest rate for a principal of \$800 is 2%.

$I = Prt$	Write simple interest formula.
$100 = 800(0.02)(t)$	Substitute 100 for I, 800 for P, and 0.02 for r.
$100 = 16t$	Simplify.
$6.25 = t$	Divide each side by 16.

The account earns \$100 in interest in 6.25 years.

EXAMPLE 4 Finding Amount Paid on a Loan

You borrow \$600 to buy a violin. The simple interest rate is 15%. You pay off the loan after 5 years. How much do you pay for the loan?

$I = Prt$	Write simple interest formula.
$= 600(0.15)(5)$	Substitute 600 for P, 0.15 for r, and 5 for t.
$= 450$	Multiply.

To find the amount you pay, add the interest to the loan amount.

So, you pay \$600 + \$450 = \$1050 for the loan.

On Your Own

Now You're Ready
Exercises 17–27

3. In Example 3, how long does it take an account with a principal of \$10,000 to earn \$750 interest?
4. **WHAT IF?** In Example 4, you pay off the loan after 2 years. How much money do you save?

4.4 Exercises

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Vocabulary and Concept Check

1. **VOCABULARY** Define each variable in $I = Prt$.

2. **WRITING** In each situation, tell whether you would want a *higher* or *lower* interest rate. Explain your reasoning.

   a. You borrow money

   b. You open a savings account

3. **REASONING** An account earns 6% simple interest. You want to find the interest earned on \$200 after 8 months. What conversions do you need to make before you can use the formula $I = Prt$?

Practice and Problem Solving

An account earns simple interest. (a) Find the interest earned. (b) Find the balance of the account.

1

4. \$600 at 5% for 2 years
5. \$1500 at 4% for 5 years
6. \$350 at 3% for 10 years
7. \$1800 at 6.5% for 30 months
8. \$700 at 8% for 6 years
9. \$1675 at 4.6% for 4 years
10. \$925 at 2% for 2.4 years
11. \$5200 at 7.36% for 54 months

12. **ERROR ANALYSIS** Describe and correct the error in finding the simple interest earned on \$500 at 6% for 18 months.

$$I = (500)(0.06)(18)$$
$$= \$540$$

Find the annual simple interest rate.

2

13. $I = \$24$, $P = \$400$, $t = 2$ years
14. $I = \$562.50$, $P = \$1500$, $t = 5$ years
15. $I = \$54$, $P = \$900$, $t = 18$ months
16. $I = \$160.67$, $P = \$2000$, $t = 8$ months

Find the amount of time.

3

17. $I = \$30$, $P = \$500$, $r = 3\%$
18. $I = \$720$, $P = \$1000$, $r = 9\%$
19. $I = \$54$, $P = \$800$, $r = 4.5\%$
20. $I = \$450$, $P = \$2400$, $r = 7.5\%$

21. **BANKING** A savings account earns 5% annual simple interest. The principal is \$1200. What is the balance after 4 years?

22. **SAVINGS** You put \$400 in an account. The account earns \$18 simple interest in 9 months. What is the annual interest rate?

23. **CD** You put \$3000 in a CD (certificate of deposit) at the promotional rate. How long will it take to earn \$336 in interest?

Find the amount paid for the loan.

4 **24.** \$1500 at 9% for 2 years

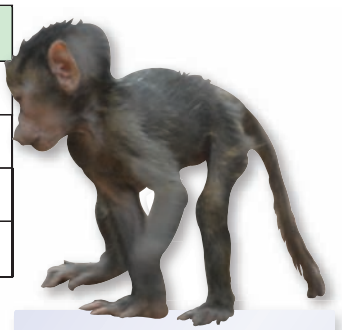
25. \$2000 at 12% for 3 years

26. \$2400 at 10.5% for 5 years

27. \$4800 at 9.9% for 4 years

Copy and complete the table.

	Principal	Interest Rate	Time	Simple Interest
28.	\$12,000	4.25%	5 years	
29.		6.5%	18 months	\$828.75
30.	\$15,500	8.75%		\$5425.00
31.	\$18,000		54 months	\$4252.50



32. **ZOO** A family charges a trip to the zoo on a credit card. The simple interest rate is 12%. The charges are paid after 3 months. What is the total amount paid for the trip?

Zoo Trip

Tickets	*67.70*
Food	*62.34*
Gas	*45.50*
Total Cost	*?*

33. **MONEY MARKET** You deposit \$5000 in an account earning 7.5% simple interest. How long will it take for the balance of the account to be \$6500?

34. **LOANS** A music company offers a loan to buy a drum set for \$1500. What is the monthly payment?

35. **REASONING** How many years will it take for \$2000 to double at a simple interest rate of 8%? Explain how you found your answer.

36. **LOANS** You have two loans, for 2 years each. The total interest for the two loans is \$138. On the first loan, you pay 7.5% simple interest on a principal of \$800. On the second loan, you pay 3% simple interest. What is the principal for the second loan?

37. Critical Thinking You put \$500 in an account that earns 4% annual interest. The interest earned each year is added to the principal to create a new principal. Find the total amount in your account after each year for 3 years.

Fair Game Review What you learned in previous grades & lessons

Solve the proportion. *(Section 3.5)*

38. $\frac{4}{9} = \frac{12}{x}$

39. $\frac{15}{36} = \frac{n}{12}$

40. $\frac{m}{6.5} = \frac{14}{26}$

41. $\frac{2.4}{z} = \frac{3}{11.25}$

42. **MULTIPLE CHOICE** What is the solution of $4x + 5 = -11$? *(Section 2.6)*

Ⓐ -4 Ⓑ -1.5 Ⓒ 1.5 Ⓓ 4

4.3–4.4 Quiz

Check It Out
Progress Check
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Find the price, discount, markup, or cost to store. *(Section 4.3)*

1. Original price: $30
   Discount: 10%
   Sale price: ?

2. Original price: $55
   Discount: ?
   Sale price: $46.75

3. Original price: ?
   Discount: 75%
   Sale price: $74.75

4. Cost to store: $152
   Markup: 50%
   Selling price: ?

5. Cost to store: $20
   Markup: ?
   Selling price: $32

6. Cost to store: ?
   Markup: 80%
   Selling price: $21.60

An account earns simple interest. Find the interest earned, principal, interest rate, or time. *(Section 4.4)*

7. Interest earned: ?
   Principal: $1200
   Interest rate: 2%
   Time: 5 years

8. Interest earned: $25
   Principal: $500
   Interest rate: 5%
   Time: ?

9. Interest earned: $76
   Principal: $800
   Interest rate: ?
   Time: 2 years

10. Interest earned: $119.88
    Principal: ?
    Interest rate: 3.6%
    Time: 3 years

11. **DIGITAL CAMERA** A digital camera costs $229. The camera is on sale for 30% off and you have a coupon for an additional 15% off the original price. What is the final price? *(Section 4.3)*

12. **WATER SKIS** The original price of the water skis was $200. What is the percent of discount? *(Section 4.3)*

13. **SAXOPHONE** A saxophone costs $1200. A store offers two loan options. Which option saves more money if you pay the loan in 2 years? *(Section 4.4)*

14. **LOAN** You borrow $200. The simple interest rate is 12%. You pay off the loan after 2 years. How much do you pay for the loan? *(Section 4.4)*

4 Chapter Review

Check It Out
Vocabulary Help
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Review Key Vocabulary

Review Examples and Exercises

4.1 The Percent Equation *(pp. 158–163)*

What number is 72% of 25?

$a = p \cdot w$	Write percent equation.
$= 0.72 \cdot 25$	Substitute 0.72 for p and 25 for w.
$= 18$	Multiply.

So, 72% of 25 is 18.

28 is what percent of 70?

$a = p \cdot w$	Write percent equation.
$28 = p \cdot 70$	Substitute 28 for a and 70 for w.
$0.4 = p$	Divide each side by 70.

Because 0.4 = 40%, 28 is 40% of 70.

22.1 is 26% of what number?

$a = p \cdot w$	Write percent equation.
$22.1 = 0.26 \cdot w$	Substitute 22.1 for a and 0.26 for p.
$85 = w$	Divide each side by 0.26.

So, 22.1 is 26% of 85.

Exercises

Write and solve an equation to answer the question.

1. What number is 24% of 25?
2. 9 is what percent of 20?
3. 85% of what number is 10.2?
4. 83% of 20 is what number?
5. **PARKING** 15% of the school parking spaces are handicap spaces. The school has 18 handicap spaces. How many parking spaces are there?

4.2 Percents of Increase and Decrease *(pp. 164–169)*

The table shows the number of skim boarders at a beach on Saturday and Sunday. What was the percent of change in boarders from Saturday to Sunday?

The number of skim boarders on Sunday is less than the number of skim boarders on Saturday. So, the percent of change is a percent of decrease.

Day	Number of Skim Boarders
Saturday	12
Sunday	9

$$\text{percent of decrease} = \frac{\text{original amount} - \text{new amount}}{\text{original amount}}$$

$$= \frac{12 - 9}{12} \quad \text{Substitute.}$$

$$= \frac{3}{12} \quad \text{Subtract.}$$

$$= 0.25 = 25\% \quad \text{Write as a percent.}$$

The number of skim boarders decreased by 25% from Saturday to Sunday.

Exercises

Identify the percent of change as an *increase* or *decrease*. Then find the percent of change. Round to the nearest tenth of a percent, if necessary.

6. 6 yards to 36 yards

7. 6 hits to 3 hits

8. 120 meals to 52 meals

9. 35 words to 115 words

4.3 Discounts and Markups *(pp. 172–177)*

What is the original price of the tennis racquet?

The sale price is 100% − 30% = 70% of the original price.

Answer the question: 21 is 70% of what number?

$$a = p \cdot w \quad \text{Write percent equation.}$$

$$21 = 0.7 \cdot w \quad \text{Substitute 21 for } a \text{ and 0.7 for } p.$$

$$30 = w \quad \text{Divide each side by 0.7.}$$

The original price of the tennis racquet is $30.

Exercises

Find the price.

10. Original price: $50
Discount: 15%
Sale price: ?

11. Original price: ?
Discount: 20%
Sale price: $75

4.4 Simple Interest *(pp. 178–183)*

You put \$200 in a savings account. The account earns 2% simple interest per year.

a. What is the interest after 4 years?

b. What is the balance after 4 years?

a.

$I = Prt$	Write simple interest formula.
$= 200(0.02)(4)$	Substitute 200 for P, 0.02 for r, and 4 for t.
$= 16$	Multiply.

The interest earned is \$16 after 4 years.

b. The balance is the principal plus the interest.

So, the balance is \$200 + \$16 = \$216 after 4 years.

You put \$500 in an account. The account earns \$55 simple interest in 5 years. What is the annual interest rate?

$I = Prt$	Write simple interest formula.
$55 = 500(r)(5)$	Substitute 55 for I, 500 for P, and 5 for t.
$55 = 2500r$	Simplify.
$0.022 = r$	Divide each side by 2500.

The annual interest rate of the account is 0.022, or 2.2%.

Exercises

An account earns simple interest.

a. Find the interest earned.

b. Find the balance of the account.

12. \$300 at 4% for 3 years

13. \$2000 at 3.5% for 4 years

Find the annual simple interest rate.

14. $I = \$17$, $P = \$500$, $t = 2$ years

15. $I = \$426$, $P = \$1200$, $t = 5$ years

Find the amount of time.

16. $I = \$60$, $P = \$400$, $r = 5\%$

17. $I = \$237.90$, $P = \$1525$, $r = 2.6\%$

18. **SAVINGS** You put \$100 in an account. The account earns \$2 simple interest in 6 months. What is the annual interest rate?

4 Chapter Test

Check It Out
Test Practice
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Write and solve an equation to answer the question.

1. 16% of 150 is what number?
2. 10 is 40% of what number?
3. 27 is what percent of 75?
4. What number is 35% of 56?

Identify the percent of change as an *increase* or *decrease*. Then find the percent of change. Round to the nearest tenth of a percent, if necessary.

5. 4 strikeouts to 10 strikeouts
6. $24.00 to $18.00

Find the price, discount, or markup.

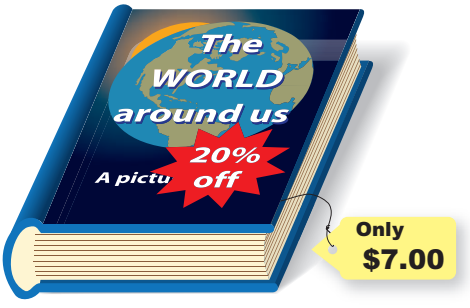
7. Original price: $15
   Discount: 5%
   Sale price: ?
8. Original price: $189
   Discount: ?
   Sale price: $75.60
9. Cost to store: $15
   Markup: ?
   Selling price: $24.75
10. Cost to store: $5.50
    Markup: 75%
    Selling price: ?

An account earns simple interest. Find the interest earned, principal, interest rate, or time.

11. Interest earned: ?
    Principal: $450
    Interest rate: 6%
    Time: 8 years
12. Interest earned: $27
    Principal: ?
    Interest rate: 1.5%
    Time: 2 years
13. Interest earned: $116.25
    Principal: $1550
    Interest rate: ?
    Time: 9 months
14. Interest earned: $45.60
    Principal: $2400
    Interest rate: 3.8%
    Time: ?

15. **MOVIE PREVIEWS** There are eight previews before a movie. Seventy-five percent of the previews are for comedies. How many previews are for comedies?

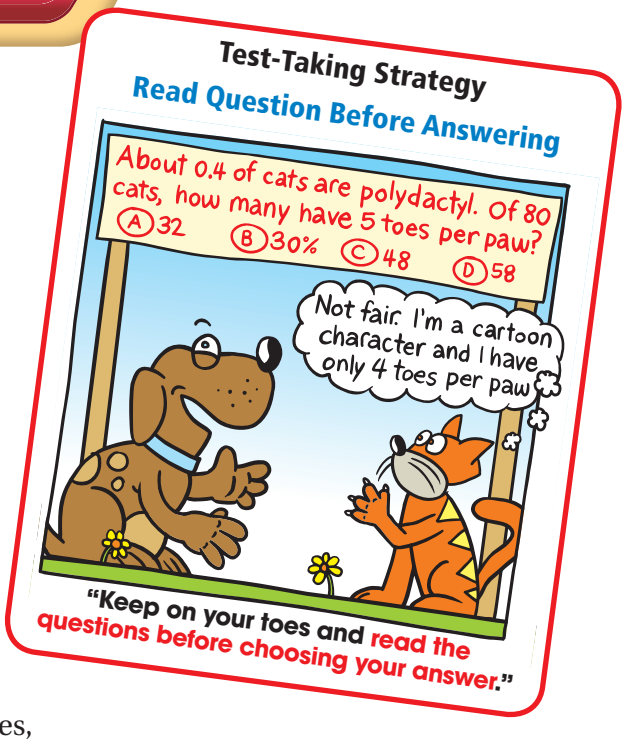
16. **BOOK** What was the original price of the book?



17. **TEXT MESSAGES** The cost of a text message increases from $0.10 per message to $0.25 per message. What is the percent increase in the cost of sending a text message?

18. **INVESTMENT** You put $800 in an account that earns 4% simple interest. Find the total amount in your account after each year for 3 years.

4 Standardized Test Practice



1. A movie theatre offers 30% off the price of a movie ticket to students from your school. The regular price of a movie ticket is $8.50. What is the discounted price that you would pay for a ticket? *(7.RP.3)*

A. $2.55 **C.** $5.95

B. $5.50 **D.** $8.20

2. You are comparing the prices of four boxes of cereal. Two of the boxes contain free extra cereal.

- Box F costs $3.59 and contains 16 ounces.
- Box G costs $3.79 and contains 16 ounces, plus an additional 10% for free.
- Box H costs $4.00 and contains 500 grams.
- Box I costs $4.69 and contains 500 grams, plus an additional 20% for free.

Which box has the least unit cost? (1 ounce = 28.35 grams) *(7.RP.3)*

F. Box F **H.** Box H

G. Box G **I.** Box I

3. James is getting ready for wrestling season. As part of his preparation, he plans to lose 5% of his body weight. James currently weighs 160 pounds. How much will he weigh, in pounds, after he loses 5% of his weight? *(7.RP.3)*

4. Which proportion represents the problem below? *(7.RP.3)*

"17% of a number is 43. What is the number?"

A. $\frac{17}{43} = \frac{n}{100}$ **C.** $\frac{n}{43} = \frac{17}{100}$

B. $\frac{n}{17} = \frac{43}{100}$ **D.** $\frac{43}{n} = \frac{17}{100}$

5. Betty was simplifying the expression in the box below.

$$
\begin{aligned}
-|8 + (-13)| &= -(|8| + |-13|) \\
&= -|8 + 13| \\
&= -|21| \\
&= -21
\end{aligned}
$$

What should Betty do to correct the error that she made? *(7.EE.3)*

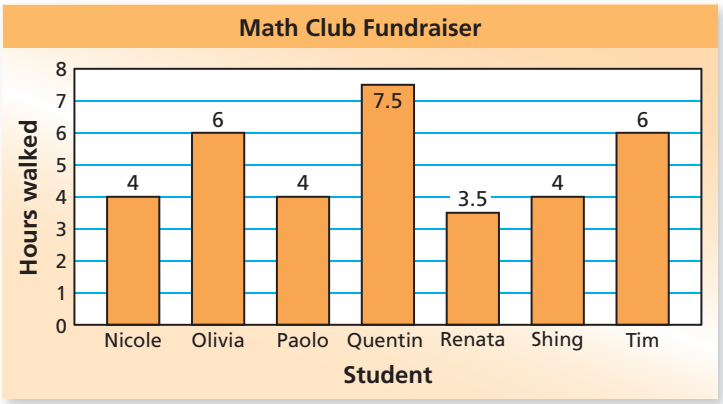
F. Simplify $-|8 + (-13)|$ to get $-|-5|$.

G. Find the opposite of $|21|$, which is 21.

H. Find the absolute value of 8, which is -8.

I. Distribute the negative sign to get $|-8 + (-13)|$.

6. The students from the Math Club participated in a long-distance walk as a fundraiser. The number of hours each club member took to complete the walk is shown in the bar graph below.



What is the mean number of hours the club members took to complete the walk? *(7.NS.3)*

A. 3.5 h

B. 4 h

C. 5 h

D. 7.5 h

7. A lighting store is holding a clearance sale. The store is offering discounts on all the lamps it sells. As the sale progresses, the store will increase the percent of discount it is offering.

You want to buy a lamp that has an original price of \$40. You will buy the lamp when its price is marked down to \$10. What percent discount will you have received? *(7.RP.3)*

8. A student scored 600 the first time she took the mathematics portion of her college entrance exam. The next time she took the exam, she scored 660. Her second score represents what percent increase over her first score? *(7.RP.3)*

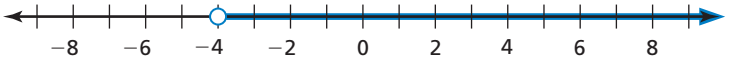
F. 9.1%

G. 10%

H. 39.6%

I. 60%

9. Which inequality is represented by the graph on the number line below? *(7.EE.4b)*



A. $x < -4$

B. $x \leq -4$

C. $x > -4$

D. $x \geq -4$

10. You are planning to deposit $4000 into an account that earns 5% simple interest per year. You will not make any other deposits or withdrawals. *(7.RP.3)*

Think Solve Explain

Part A How long would it take for your account to contain $4500? Show your work and explain your reasoning.

Part B You would like the account to contain $5100 after 4 years. Would your initial $4000 deposit be large enough? Show your work and explain your reasoning.

11. Brad was solving the equation in the box shown.

$$-3(2 - 5w) = -45$$
$$-6 + 15w = -45$$
$$9w = -45$$
$$\frac{9w}{9} = \frac{-45}{9}$$
$$w = -5$$

What should Brad do to correct the error that he made? *(7.EE.4a)*

F. Distribute -3 to get $6 - 15w$.

G. Distribute -3 to get $-6 - 15w$.

H. Add 6 to both sides to get $15w = -51$.

I. Add 6 to both sides to get $15w = -39$.

12. Which integer is closest to the value of the expression below? *(7.NS.2c)*

$$-7\frac{1}{4} \cdot \left(-9\frac{7}{8}\right)$$

A. -70

B. -63

C. 63

D. 70