Looking Ahead to Chapter 5

Focus In Chapter 5, you will work with ratios, rates, and proportions. You will write ratios, rates, unit rates, and proportions. You will compare ratios, compare rates, and solve proportions.

Chapter Warm-up

Answer these questions to help you review skills that you will need in Chapter 5.

Write a fraction that is equivalent to the given fraction.

1. $\frac{3}{8}$
2. $\frac{16}{24}$
3. $\frac{27}{36}$
4. $\frac{15}{22}$
5. $\frac{9}{11}$
6. $\frac{5}{12}$

Fill in the blank with the correct number.

7. $\underline{?} + 3 = 28$
8. $5 \times \underline{?} = 35$
9. $\frac{?}{9} = 7$

Read the problem scenario below.

Sofia, Marian, Brianna, and Cassandra are comparing the number of dance CDs each person has in her CD collection. Three fifths of Sofia's CD collection are dance CDs. Five sixths of Marian's CD collection are dance CDs. Brianna's dance CDs make up $\frac{2}{9}$ of her CD collection. Cassandra's dance CDs make up $\frac{1}{3}$ of her CD collection.

10. Order the fractions from least to greatest.
11. Who has the greatest fraction of dance CDs in her collection?
12. Who has the least fraction of dance CDs in her collection?

Key Terms

ratio ● p. 145
rate ● p. 150
proportion ● p. 150
means ● p. 151
extremes ● p. 151
unit rate ● p. 156
variable ● p. 160

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Ratio and Proportion

A fluorescent light bulb is approximately four times more efficient than an incandescent light bulb. In Lesson 5.3, you will determine the number of watts of energy saved by switching to fluorescent light bulbs.

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5.1 Heard It and Read It

Ratios and Fractions

Objectives

In this lesson, you will:

- Write ratios as fractions.
- Compare ratios.

Key Terms

- ratio

Problem 1 Overheard in the Hall

On a typical morning before classes begin, you overhear the following comments.

Miss Brunner: Four out of five students passed the test!

Jamul: At the game last night, he made 3 out of every 5 free throws.

Mr. Ellis: For every 8 classes you will have 10 assignments.

Principal Spencer: Eight of ten students are from the city.

Tina: I spend 5 minutes playing scales for every 15 minutes of piano practice.

Janitor Johnson: Three-fourths of the cars in the parking lot are red.

Lee: She scores a goal for every two soccer games that she plays.

In each of these comments, someone is comparing two different numbers. In mathematics, we often use a ratio to make a comparison. A **ratio** is a comparison of two numbers using division. We can write a ratio as a fraction or using a colon. For instance, you can write, "On average in the school store, 3 out of 5 pens are blue" in two ways.

As a fraction: $\frac{\text{3 blue pens}}{\text{5 pens}}$

Using a colon: 3 blue pens : 5 pens

When you use a colon, you read the colon as the word *to*. For instance, the statement "3 blue pens : 5 pens" is read as "3 blue pens to 5 pens." You can see that it is important to include the quantity names in order to be clear about exactly what is being compared.

Write the following comment in two ways.

"I have 7 CDs in my locker and 5 of them are dance music."

As a fraction:

Using a colon:

Investigate Problem 1

1. Work with your partner to write each phase that you overheard in the hall as a ratio in two ways.

Miss Brunner: Four out of five students passed the test!

As a fraction: $\dfrac{\text{4 students who passed the test}}{\boxed{}}$

Using a colon: 4 students who passed the test :

____

Jamul: At the game last night, he made 3 out of every 5 free throws.

As a fraction:

Using a colon:

Mr. Ellis: For every 8 classes you will have 10 assignments.

As a fraction:

Using a colon:

Principal Spencer: Eight of ten students are from the city.

As a fraction:

Using a colon:

Tina: I spend 5 minutes playing scales for every 15 minutes of piano practice.

As a fraction:

Using a colon:

Janitor Johnson: Three fourths of the cars in the parking lot are red.

As a fraction:

Using a colon:

Lee: She scores a goal for every two soccer games that she plays.

As a fraction:

Using a colon:

Problem 2 Ratios in the News

In the school newspaper, you read the following paragraph of a story:

So far in the baseball season, James has gotten 5 hits out of every 6 times that he was up to bat. Mannie has gotten 10 hits out of every 12 times that he was up to bat.

A. James says that he does better than Mannie, but Mannie disagrees and says that he does better. Write each statement in the story as a ratio, including the quantity names. Then use complete sentences to explain whether you agree with James or Mannie and why.

B. When are different ratios equivalent? Use a complete sentence in your answer.

C. Suppose that you are writing for the sports column of the school paper. Write two sentences for the column with information that could be written as two equivalent ratios.

D. Because ratios can be written as fractions, sometimes people try to add and subtract them just like fractions. Suppose that Janitor Johnson observed the following.

3 out of every 4 cars are red.

1 out of every 4 drivers is a man.

Write these two statements as ratios. Be sure to include the quantity names.

E. Herman says that you can just add these ratios to get 1, but Kendra says that you can't add them because the quantities are not the same. Do you agree with Herman, Kendra, or neither person? Use complete sentences to explain.

Investigate Problem 2

1. In the newspaper club, there are 20 boys and 30 girls.

   Write the ratio of the number of boys to the number of girls.

   Write the ratio of the number of boys to the total number of club members.

   Write the ratio of the number of girls to the total number of club members. Is this ratio greater than or less than the ratio of the number of boys to the total number of club members?

   Write the ratio of the total number of club members to the number of girls.

   Write the ratio of the total number of club members to the number of boys.

   Write the ratio of the number of girls to the number of boys. Is this ratio greater than or less than the ratio of the number of boys to the number of girls?

2. For each statement below, write at least three different ratios. Be sure to include the quantity names. If possible, simplify the ratio by writing it as a fraction in simplest form. Then order the ratios that you wrote from least to greatest.

   Five teachers out of every ten male teachers are over six feet tall.

   At the high school, there are 300 male students and 400 female students.

   I got 45 questions correct on a 60-question test.

5.2 Equal or Not, That Is the Question

Writing and Solving Proportions

Objectives

In this lesson, you will:

- Write proportions.
- Solve proportions using equivalent ratios and rates.
- Find the means and extremes of a proportion.

Key Terms

- rate
- proportion
- means
- extremes

Problem 1 Scholastic Quiz

As team members of your school's Scholastic Quiz, students must answer academic questions. Henry answered 5 out of 6 questions correctly, Janine answered 10 out of 12 questions correctly, and Kenton answered 9 out of 10 questions correctly. For the final question, you as the captain need to decide who should answer based on past performance.

A. Write each team member's performance as a ratio.

B. Use the ratios to decide who should answer the question. Explain your reasoning using complete sentences.

C. If your first choice is unavailable, who should be your second choice? Use complete sentences to explain.

D. Compare your answer to Part (C) with your partner. Do you and your partner agree? If you do agree, could another team member possibly be your second choice? Use complete sentences to explain why or why not.

Investigate Problem 1

1. In the Lightning Round of the Scholastic Quiz, one member of the team is chosen to answer as many questions as possible in ten minutes. The table shows the performance of the team members during practice.

Team Member	Number of Questions Answered Correctly in a Time Period
Henry	3 questions correctly in 5 minutes
Janine	12 questions correctly in 20 minutes
Kenton	1 question correctly in 2 minutes

Each quantity in the table is a **rate,** a ratio of two quantities that are measured in different units. In this case the units are "number of questions" and "minutes."

Write the rate for each team member. Then find another rate that is equal to this rate.

Henry: $\dfrac{\square \text{ correct questions}}{\square \text{ minutes}}$ $\dfrac{\square \text{ correct questions}}{10 \text{ minutes}}$

Janine: $\dfrac{\square \text{ correct questions}}{\square \text{ minutes}}$ $\dfrac{\square \text{ correct questions}}{10 \text{ minutes}}$

Kenton: $\dfrac{\square \text{ correct question}}{\square \text{ minutes}}$ $\dfrac{\square \text{ correct questions}}{10 \text{ minutes}}$

2. Math Path: Proportions

When two ratios or rates are equal, we can write them as a proportion. A **proportion** is an equation that states that two ratios or rates are equivalent, or equal. You write a proportion by placing an equals sign between two equivalent ratios or rates or by using a double colon in place of the equals sign.

$$\frac{8 \text{ correct questions}}{4 \text{ minutes}} = \frac{2 \text{ correct questions}}{1 \text{ minute}}$$

8 correct questions : 4 minutes :: 2 correct questions : 1 minute

Write a proportion for each of the team members in Question 1.

Henry:

Janine:

Kenton:

Take Note

You can read the proportion at the right in two ways:

"Eight correct questions in four minutes is the same as two correct questions in one minute."

"Eight correct questions is to four minutes as two correct questions is to one minute."

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Problem 2 Essay Questions

For the last part of the Scholastic Quiz, the team members must answer different essay questions worth different numbers of points. You are competing with another team who has received 30 points out of a possible 36 points. Your team has answered three essay questions that are worth a total of 18 points. You need to determine the number of points that your team must receive in order to tie the first team.

When you do not know a quantity in one of the ratios, you can use a question mark to represent what is not known. In the proportion below, a question mark represents the number of points that you must receive in order to tie the other team.

$$\frac{30 \text{ points}}{36 \text{ possible points}} = \frac{? \text{ points}}{18 \text{ possible points}}$$

When you find the unknown quantity in the proportion above, you are solving the proportion. What number of points will make the proportion true? Determine the number of points by finding an equivalent ratio.

$$\frac{30 \text{ points}}{36 \text{ possible points}} = \frac{\square \text{ points}}{18 \text{ possible points}}$$

Investigate Problem 2

1. For each proportion, find an equivalent ratio to determine the unknown quantity.

$$\frac{12 \text{ cans of dog food}}{7 \text{ days}} = \frac{\square \text{ cans of dog food}}{21 \text{ days}} \qquad \frac{7 \text{ lawns}}{14 \text{ days}} = \frac{\square \text{ lawns}}{6 \text{ days}}$$

2. **Math Path: Means and Extremes**

   When we write a proportion such as 7 lawns : 14 days :: 3 lawns : 6 days, the two quantities in the middle are called the **means** and the two quantities at the beginning and the end of the proportion are called the **extremes.** For this proportion, what are the means?

   For this proportion, what are the extremes?

   What is the result if we find the product of the means? Use a complete sentence in your answer.

   What is the result if we find the product of the extremes? Use a complete sentence in your answer.

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Investigate Problem 2

3. In the following proportion, what are the means? What are the extremes?

$$\frac{2 \text{ red marbles}}{5 \text{ blue marbles}} = \frac{8 \text{ red marbles}}{20 \text{ blue marbles}}$$

What is the product of the means?

What is the product of the extremes?

4. Decide whether the following proportion is correct.

3 misses : 8 hits :: 9 misses : 20 hits

What is the product of the means?

What is the product of the extremes?

How can you determine if a proportion is correct? Use complete sentences to explain your reasoning.

5. In each proportion, find the missing quantity in two ways. First, use equivalent ratios. Then use what you learned about means and extremes. Write complete sentences to explain how you used each method to find the missing quantity.

$$\frac{10 \text{ quarts}}{3 \text{ pounds}} = \frac{\square}{21 \text{ pounds}}$$

5 miles : 2 gallons of gas :: 20 miles : $\square$

Investigate Problem 2

3 hours : 54 copies :: _____ : 216 copies

$$\frac{10 \text{ cars}}{\$45{,}000} = \frac{100 \text{ cars}}{\square}$$

16 trees : 6 lots :: _____ : 36 lots

$$\frac{21 \text{ beaches}}{50 \text{ people}} = \frac{\square}{1000 \text{ people}}$$

$$\frac{14}{18} = \frac{21}{\square}$$

9 : 20 :: 81: _____

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5.3 The Survey Says

Using Ratios and Rates

Objectives

In this lesson, you will:

- Find unit rates.
- Write and solve proportions.

Key Terms

- unit rate

Problem 1 Smart Consumer Survey

A. The economics club in your school is conducting a survey about being a smart consumer. There are 5 girls for every 4 boys who complete the survey. Write all of the different ratios involving the survey respondents that you can. Be sure to include the quantity names.

B. Compare the ratios that you wrote with those that your partner wrote. Write the ones that either of you are missing.

C. Suppose that your school has a total of 90 students who completed the survey. How many of the students who completed the survey are boys? How many of the students who completed the survey are girls? Use complete sentences to explain how you got your answers.

D. Write as many ratios using the information in Part (C) as you can.

E. Suppose that your school has a total of 450 students who completed the survey. How many of the students who completed the survey are boys? How many of the students who completed the survey are girls?

Investigate Problem 1

1. Math Path: Unit Rate

A **unit rate** is a rate that has a denominator of 1 unit. Write each of the rates as a unit rate.

$$\frac{340 \text{ miles}}{10 \text{ gallons}} = \frac{(340 \div 10) \text{ miles}}{(10 \div 10) \text{ gallons}} = \frac{\boxed{}}{1 \text{ gallon}}$$

$$\frac{\$240}{20 \text{ pounds}} = \frac{\$(240 \div 20)}{(20 \div 20) \text{ pounds}} = \frac{\boxed{}}{1 \text{ pound}}$$

Problem 2A Smart Energy Consumption

The smart consumer survey states that for every 100 watts of energy that a regular light bulb uses, a compact fluorescent bulb uses 32 watts. The average student who answers the survey has 10 regular light bulbs in his or her home. How many watts of energy would each student use on average if he or she switched to compact fluorescent bulbs? How many watts of energy would each student save on average by switching to compact fluorescent bulbs? Use proportions to help you solve this problem. Use complete sentences to explain your reasoning. Be prepared to share your solution with the class.

Problem 2B Smart Driving

The smart consumer survey states that a hybrid car gets 1200 miles for every 20 gallons of gasoline used. If the average student who answers the survey drove a hybrid car 300 miles on vacation in the summer, how many gallons of gas would he or she use? If a hybrid car used 30 gallons of gasoline, how far could a student drive on vacation? Use proportions to help you solve this problem. Use complete sentences to explain your reasoning. Be prepared to share your solution with the class.

Problem 2C Smart Eating

The smart consumer survey asks students to name the better buy—a 14-ounce box of corn flakes that costs $2.52 or a 20-ounce box that costs $3.00. What would the price of the 14-ounce box need to be in order for the 14-ounce box to have the same unit price as the 20-ounce box? If a box had the same unit price as the 14-ounce box and cost $4.50, how many ounces would be in the box? Use proportions to help you solve this problem. Use complete sentences to explain your reasoning. Be prepared to share your solution with the class.

Problem 2D Smart Working

The smart consumer survey asks students to decide which is the better-paying part-time job—a job that pays $130 per week for 20 hours of work or a job that pays $28 per day for 4 hours of work. What would the payment per hour need to be in order for the weekly wage to be the same as the daily wage? If a full-time job paid the same wage as the 20-hour per week job, and the worker received $260, how many hours would the worker be working? Use proportions to help you solve this problem. Use complete sentences to explain your reasoning. Be prepared to share your solution with the class.

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5.4 Who's Got Game?

Using Proportions to Solve Problems

Objectives

In this lesson, you will:

- Solve problems using proportions.

Key Terms

- variable

Problem 1 Video Games

A company designs and produces video games. For every 8 games that the company designs, only 3 on average become great sellers. If they design 48 games, how many of these would the company expect to become great sellers?

A. Write a proportion to help you find the answer.

B. With your partner, compare the steps that you used to solve the proportion and find the answer. List all of the steps in your method below.

C. Check that your method will work for any proportion by finding the number of games that the company needs to design in order to have 21 great sellers.

D. In Lesson 3.8, we learned about the customary system of measurement and in Lesson 4.7, we learned about the metric system of measurement. Sometimes we must convert from one measurement system to the other. Suppose that you need to ship video games from the United States to Canada. You can use the fact that 1 kilogram is about 2.2 pounds. Write this relationship as a rate.

E. Suppose that you need to ship a box of video games that weighs 22 pounds. Use the rate you wrote in Part (D) to write a proportion to find the number of kilograms that there are in 22 pounds. Use your method from Part (B) to solve the proportion.

Investigate Problem 1

1. Math Path: Solving Proportions with Variables

Because the proportion that you wrote in Part (E) includes a decimal quantity, we need to find an efficient method for solving proportions such as this one. When we solve a proportion, we are finding a missing, or unknown, quantity. We can use a symbol to represent the quantity. Because an unknown quantity's value is different, or varies, from problem to problem, the symbol is called a **variable.** It is convenient to use a letter to represent a variable.

Suppose we have 66 pounds that we need to convert to kilograms. We can set up the following proportion to find the number of kilograms in 66 pounds.

$$\frac{1 \text{ kilogram}}{2.2 \text{ pounds}} = \frac{x \text{ kilograms}}{66 \text{ pounds}}$$

Because we know that the product of the means equals the product of the extremes, we can write:

66 kilogram-pounds = (x • 2.2) kilogram-pounds

In order to solve the proportion, we need to find the number that we can multiply by 2.2 to get 66 as a product. We can use mental math to find the number. We can also find this number by dividing both sides of the equation by 2.2 kilogram-pounds.

$$\frac{66 \cdot \text{kilogram-pounds}}{2.2 \cdot \text{kilogram-pounds}} = \frac{(x \cdot 2.2) \text{ kilogram-pounds}}{2.2 \cdot \text{kilogram-pounds}}$$

When you do this, numbers and units divide out to get:

$$\frac{66 \cdot \cancel{\text{kilogram-pounds}}}{2.2 \cdot \cancel{\text{kilogram-pounds}}} = \frac{(x \cdot \cancel{2.2}) \ \cancel{\text{kilogram-pounds}}}{\cancel{2.2} \cdot \cancel{\text{kilogram-pounds}}}$$

$$\frac{66}{2.2} = x$$

When we find the quotient, we have solved the proportion. So, x = 30 and 66 pounds is equivalent to 30 kilograms.

2. We can use this process to solve any proportion. Solve each proportion. Be sure to show all of your work.

$$\frac{2 \text{ gallons}}{9 \text{ miles}} = \frac{x \text{ gallons}}{36 \text{ miles}}$$

$$\frac{2 \text{ trees}}{48 \text{ oranges}} = \frac{x \text{ trees}}{24 \text{ oranges}}$$

Investigate Problem 1

$$\frac{8 \text{ games}}{3 \text{ great sellers}} = \frac{172 \text{ games}}{x \text{ great sellers}}$$

$$\frac{4 \text{ defective light bulbs}}{500 \text{ light bulbs}} = \frac{42 \text{ defective light bulbs}}{x \text{ light bulbs}}$$

There are many practical and useful problems that can be solved by setting up ratios and proportions. Form a group with another partner team to solve the following problem using proportions. Be sure to show all of your work.

Problem 2 Video Game Inventory

A store that sells video games looked back at their sales over the last year in order to decide which games to order for next year. The table shows a summary of last year's sales.

Game	X	Y	Z	W
Number Sold	120	80	50	150

A. How many total games were sold last year?

B. If the store wants to order a total of 1000 games this year, how many of each game should the store order?

C. If the store wants to order a total of 240 games this year, how many of each game should the store order?

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Looking Back at Chapter 5

Key Terms

Summary

Writing Ratios as Fractions and Using Colons (p. 145)

To write the ratio of one quantity to another quantity as a fraction, write the first quantity with its units in the numerator and write the second quantity with its units in the denominator. To write the ratio of one quantity to another quantity using colons, write the first quantity with its units, then write a colon and the second quantity with its units.

Examples

There are 8 girls and 9 boys in the school drama club. The ratio of boys to girls is 8 girls to 9 boys.

Ratio as a fraction: $\frac{8 \text{ girls}}{9 \text{ boys}}$

Ratio using a colon: 8 girls : 9 boys

You have 5 red marbles, 4 blue marbles, and 3 yellow marbles in a bag. The ratio of red and yellow marbles to the total number of marbles in the bag is 8 red and yellow marbles to 12 marbles.

Ratio as a fraction: $\frac{8 \text{ red and yellow marbles}}{12 \text{ marbles}}$

Ratio using a colon: 8 red and yellow marbles : 12 marbles

Comparing Ratios (p. 148)

To compare ratios, first write the ratios as fractions, then compare the fractions.

Example

In the parking lot, there are 20 blue cars and 40 red cars.

The ratio of the number of blue cars to the number of red cars is $\frac{20 \text{ blue cars}}{40 \text{ red cars}} = \frac{1 \text{ blue car}}{2 \text{ red cars}}$.

The ratio of the number of blue cars to the total number of cars is $\frac{20 \text{ blue cars}}{60 \text{ total cars}} = \frac{1 \text{ blue car}}{3 \text{ total cars}}$.

The ratio of the number of red cars to the total number of cars is $\frac{40 \text{ red cars}}{60 \text{ total cars}} = \frac{2 \text{ red cars}}{3 \text{ total cars}}$.

The ratio of the number of red cars to the number of blue cars is $\frac{40 \text{ red cars}}{20 \text{ blue cars}} = \frac{2 \text{ red cars}}{1 \text{ blue car}}$.

The ratios in order from least to greatest are $\frac{1 \text{ blue car}}{3 \text{ total cars}}$, $\frac{1 \text{ blue car}}{2 \text{ red cars}}$, $\frac{2 \text{ red cars}}{3 \text{ total cars}}$, and $\frac{2 \text{ red cars}}{1 \text{ blue car}}$.

Writing Proportions (p. 150)

To write a proportion, place an equals sign between two equivalent ratios or rates, or use a double colon instead of an equals sign when you are using a colon to write the ratios or rates.

Example The following statements represent the same proportion.

225 miles in 5 hours is the same as 45 miles in 1 hour.

$\frac{225 \text{ miles}}{5 \text{ hours}} = \frac{45 \text{ miles}}{1 \text{ hour}}$ 225 miles : 5 hours :: 45 miles : 1 hour

Writing Equivalent Ratios and Rates (p. 150)

To write a ratio or rate that is equivalent to a given ratio or rate, first write the ratio or rate as a fraction. Then write an equivalent fraction using the same units.

Example

$$\frac{8 \text{ gallons}}{2 \text{ minutes}} = \frac{(8 \div 2) \text{ gallons}}{(2 \div 2) \text{ minutes}} = \frac{4 \text{ gallons}}{1 \text{ minute}}$$

$$\frac{8 \text{ gallons}}{2 \text{ minutes}} = \frac{(8 \bullet 30) \text{ gallons}}{(2 \bullet 30) \text{ minutes}} = \frac{240 \text{ gallons}}{60 \text{ minutes}}$$

Using Equivalent Ratios and Rates to Solve Proportions (p. 151)

To solve a proportion, use equivalent ratios or rates to complete the proportion.

Example

$$\frac{17.5 \text{ women's teams}}{16 \text{ men's teams}} = \frac{? \text{ women's teams}}{32 \text{ men's teams}}$$

$$\frac{17.5 \text{ women's teams}}{16 \text{ men's teams}} = \frac{35 \text{ women's teams}}{32 \text{ men's teams}}$$

Using Means and Extremes to Solve Proportions (p. 151)

To solve a proportion, first identify the means and extremes. Then set the product of the means equal to the product of the extremes and solve for the missing quantity.

Example 1200 people : 5 buildings :: ? people : 14 buildings

The means are 5 buildings and ? people. The extremes are 1200 people and 14 buildings.

$5 \times ? = 1200 \times 14$

$5 \times ? = 16{,}800$

$? = 3360$

So, the proportion is 1200 people : 5 buildings :: 3360 people : 14 buildings.

Finding Unit Rates (p. 156)

To find a unit rate for a given rate, write an equivalent rate with a denominator of 1 unit.

Examples

$$\frac{\$3.45}{3 \text{ pounds}} = \frac{\$(3.45 \div 3)}{(3 \div 3) \text{ pounds}} = \frac{\$1.15}{1 \text{ pound}}$$

$$\frac{90 \text{ miles}}{120 \text{ minutes}} = \frac{(90 \div 120) \text{ miles}}{(120 \div 120) \text{ minutes}} = \frac{0.75 \text{ mile}}{1 \text{ minute}}$$

Using Unit Rates to Make a Comparison (p. 156)

You can use unit rates to compare rates. To compare two rates, write the unit rates for each rate and then compare the unit rates.

Example

A grocery deli charges $4.59 for 1.5 pounds of maple ham. The deli charges $5.25 for 1.75 pounds of bologna.

maple ham:

$$\frac{\$4.59}{1.5 \text{ pounds}} = \frac{\$3.06}{1 \text{ pound}}$$

bologna:

$$\frac{\$5.25}{1.75 \text{ pounds}} = \frac{\$3.00}{1 \text{ pound}}$$

The maple ham is $3.06 per pound and the bologna is $3.00 per pound. So, the bologna is the better buy.

Using a Proportion to Solve a Problem (p. 159)

You can often use a proportion to solve a problem that involves rates or ratios. To solve a problem using a proportion, first write any rates or ratios from the given information. Then, when appropriate, set the ratios or rates equal to each other and solve for the missing quantity.

Example

You are making fruit punch for a party. According to the fruit punch recipe, you need 12 ounces of orange juice for every 360 ounces of fruit punch. You have 16 ounces of orange juice. How many ounces of fruit punch can you make?

$$\frac{12 \text{ ounces orange juice}}{360 \text{ ounces fruit punch}} = \frac{16 \text{ ounces orange juice}}{? \text{ ounces fruit punch}}$$

Because $\frac{12}{360} = \frac{1}{30} = \frac{16}{480}$,

$$\frac{12 \text{ ounces orange juice}}{360 \text{ ounces fruit punch}} = \frac{16 \text{ ounces orange juice}}{480 \text{ ounces fruit punch}}$$

So, you can make 480 ounces of fruit punch with 16 ounces of orange juice.

Solving Proportions with Variables (p. 160)

To solve a proportion with variables, first set up the proportion. Then set the product of the means equal to the product of the extremes. Next, use mental math or divide both sides of the equation by the number that is in the product with the variable.

Examples

$$\frac{3 \text{ trees}}{52 \text{ apples}} = \frac{x \text{ trees}}{780 \text{ apples}}$$

$$3 \bullet 780 = 52 \bullet x$$

$$2340 = 52x$$

$$\frac{2340}{52} = \frac{52x}{52}$$

$$45 = x$$

$$\frac{7 \text{ defective headphones}}{480 \text{ headphones}} = \frac{x \text{ defective headphones}}{2400 \text{ headphones}}$$

$$7 \bullet 2400 = 480 \bullet x$$

$$16{,}800 = 480x$$

$$\frac{16{,}800}{480} = \frac{480x}{480}$$

$$35 = x$$