Lesson 5
Ratios, Proportions, and Rates

Outline

Part A
Ratios and Proportions

- Equivalent Ratios
- Solving Proportions

Part B
Unit Conversions

- Single Unit Conversions
- Multiple Unit Conversions
- Compound Unit Conversions

Targeted Review

Vocabulary

- ratio
- proportion
- cross product
- unit conversion (dimensional analysis)
- unit multiplier

Check out **More to Explore** in the Digital Pack to see if there are additional activities for this part of the lesson.

Warm Up

Your student should spend no more than 5 minutes on the Warm Up. This should be a quick review to activate prior knowledge.

Inverse operations are the foundation of solving equations and inequalities.

2) Remind your student to only multiply the value outside of the expression in parentheses by the LCD.

5A EXPLORE

Part A: Ratios and Proportions

Objectives

In this part of the lesson, you will learn about ratios and proportions.

By the end of this lesson, you will be able to do the following:

- Determine equivalent ratios.
- Solve a proportion using cross products.

Why?

Which brand and quantity of sports drink is the best buy at your local grocery store? You can figure out the answer to that and many other everyday situations using ratios and proportions.

Warm Up

Rewrite all equations with integer coefficients, then solve.

1) $\frac{2}{5}n - \frac{1}{3} = \frac{3}{2}$

$\text{LCD} = 30$

$30\left(\frac{2}{5}n - \frac{1}{3} = \frac{3}{2}\right)$

$12n - 10 = 45$

$12n = 55$

$n = \frac{55}{12}$

2) $\frac{3}{8}(x - 4) = \frac{3}{4}$

$\text{LCD} = 8$

$8\left(\frac{3}{8}(x - 4) = \frac{3}{4}\right)$

$3(x - 4) = 6$

$3x - 12 = 6$

$3x = 18$

$x = 6$

Equivalent Ratios

- Three ways that ratios can be written using the variables a and b are:

  $\frac{a}{b}$ $a:b$ a to b

- The **order** in which a ratio is written is very important.
- Ratios compare:
  - **part to part**
  - **part to whole**
  - **whole to part**
- **Equivalent** ratios are equal to one another and can be written as a proportion.

EXPLORE 5A

- To show ratios are equivalent, simplify to **lowest terms**, or find a **common factor**.

Example 1

Determine which, if any, of the ratios are equivalent to $\frac{3}{4}$.

9:12 8 to 6

Plan Write the ratios as fractions.
Compare them to $\frac{3}{4}$

Implement

Compare $\frac{3}{4}$ and $\frac{9}{12}$

Multiply by 1 $\left(\text{or } \frac{3}{3}\right)$:

$$\frac{3}{4} \cdot \frac{3}{3} = \frac{9}{12}$$

$$\frac{3}{4} = \frac{3}{4}$$

These are equivalent ratios.

Compare $\frac{3}{4}$ and $\frac{8}{6}$

Divide by 1:

$$\frac{8 \div 2}{6 \div 2} = \frac{4}{3}$$

$$\frac{3}{4} \neq \frac{4}{3}$$

These are not equivalent ratios.

Explain

9:12 is equivalent to $\frac{3}{4}$.

8 to 6 is not equivalent to $\frac{3}{4}$.

☑ Checkpoint

Select all ratios that are equivalent to 5:8.

- [x] **15 to 24**
- [ ] 10:13
- [x] $\frac{10}{16}$
- [ ] 2:5

☑ Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

It may be helpful for your student to write all ratios in the same format to make this comparison and then simplify to lowest terms.

Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

Q: What is the LCD of 5 and 10?

A: *10*

Q: If you multiply both sides of this proportion by 10 instead of using the cross product, what will happen? Will the fractions be eliminated?

A: *The result would be* $8 = x + 6$. *Multiplying by the LCD is another way to clear the fractions.*

5A EXPLORE

Solving Proportions

- A **proportion** is an equation that sets two ratios equal to one another.
- Proportions can be solved by finding the **cross product** of ratios.
- For a proportion to be true, the cross products must be **equal** to one another.
- The cross product is found by multiplying: $\frac{a}{b} = \frac{x}{y}$

  $ay = bx$

  - the **numerator** of the first ratio by the **denominator** of the second ratio.
  - the **denominator** of the first ratio by the **numerator** of the second ratio.
- If more than one term is in the numerator or denominator of a ratio, use the **Distributive** Property to solve the proportion.

Example 2

Solve.

$\frac{2x+1}{4} = \frac{3x-5}{5}$

Plan Find the cross product.

Implement	Explain
$(2x+1)(5) = (4)(3x-5)$	Cross product
$10x + 5 = 12x - 20$	Distributive Property
$-10x + 20 \quad -10x + 20$	Addition Property of Equality
$25 = 2x$	Multiplication Property of Equality
$x = \frac{25}{2}$	

Checkpoint

Solve.

$\frac{4}{5} = \frac{x+6}{10}$

$(4)(10) = (5)(x+6)$

$40 = 5x + 30$

$10 = 5x$

$x = 2$

PRACTICE 1 5A

Practice 1

Complete the problems on a separate sheet of paper.

Mr. Blake's music class had 15 flute players and 10 clarinet players.

1) Write an equivalent ratio of clarinet players to flute players in simplest terms. **2:3**

2) Write an equivalent ratio of flute players to clarinet players in simplest terms. **3:2**

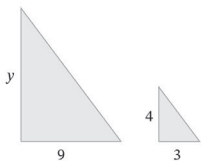
3) Are the ratios the same in problems 1 and 2? Explain. **No; the order given for the ratio matters.**

4) Create a ratio in simplest form that compares the number of flute players to the total number of people in the class.

5) Write all of the ratios below that are equivalent to 2:3. **8:12, 10:15**

8:12 9:6 30:20 10:15

6) Write and solve a proportion for the given figure.



$y = 12$

7) Solve the proportion: $\frac{5}{a} = \frac{20}{11}$

$a = \frac{55}{20}$

8) The ratio of apples to grapefruits used in the salad was six to five. If twelve apples were used, how many grapefruits were used? **$g = 10$ There were 10 grapefruits used in the fruit salad.**

9) There are 30 days in the month of September. If the ratio of cloudy to sunny days was one to two, how many days were cloudy and how many were sunny? **$c = 10$ cloudy days 20 sunny days**

Solve.

10) $\frac{2x+1}{7} = \frac{4}{9}$ **$x = \frac{19}{18}$** **11)** $\frac{8}{x-2} = \frac{9}{x+3}$ **$x = 42$** **12)** $\frac{x+15}{35} = \frac{x}{20}$ **$x = 20$** **13)** $\frac{2x}{x+1} = \frac{5}{8}$ **$x = \frac{5}{11}$**

14) Six yards of fabric cost $76.50. How many yards of the same fabric can be purchased for $134? Round to the hundredth. **$y = 10.51$ For $134, 10.51 yards of fabric can be purchased.**

15) A pizza party for a classroom of 25 students cost $63 for 7 pizzas. What would the cost be for 150 students with a $20 coupon? **$p = 358$, The pizzas will cost $358 with the coupon deducted.**

Practice 1

Worked solutions for these problems are located in the Digital Pack.

1–4)

Q: How can you determine the total number of students in the class?

A: *Add 15 flute players + 10 clarinet players.*

4) There are 15 flute players and a total of 25 students. In simplest form, 15:25 is 3:5.

5) $\frac{9}{6}$ simplifies to $\frac{3}{2}$
This does not equal $\frac{2}{3}$

$\frac{30}{20}$ simplifies to $\frac{3}{2}$
This does not equal $\frac{2}{3}$

7) This answer can be simplified to $\frac{11}{4}$ if your student prefers.

8) Your student may be able to solve this using mental math because $\frac{6 \cdot 2}{5 \cdot 2} = \frac{12}{10}$.

9) This is comparing part to whole. Therefore, cloudy and sunny days need to be added together to set up the proportion correctly.

14–15)

It is recommended that your student uses a calculator for problems 14 and 15 so that the focus is on solving the proportion rather than multiplying decimals and large numbers.

15) Remember to have your student determine what two values will be compared before starting to solve since there are three values to choose from.

Mastery Check

Show What You Know

A) Remind your student to use their Formula Sheet for the unit multipliers. You can also extend this question by having them look up other standard ratios for cooking. In part B of this lesson, your student will learn even more about unit conversions.

Say What You Know

Your student should be able to restate the objectives of the lesson in their own words. If your student is unable to restate the lesson objectives, have them go back and reread the objectives and then explain them.

- You will be able to determine equivalent ratios.
- You will be able to solve a proportion using cross products.

5A MASTERY CHECK

Mastery Check

Show What You Know

The bakers at the Pancake Palace say the perfect pancake recipe uses the following ratio:

$$2 \text{ parts flour: } 2 \text{ parts liquid: } 1 \text{ part egg: } \tfrac{1}{2} \text{ part fat}$$

When this recipe is made using cups as the measure, one batch will yield 12 large pancakes.

Oliver works at the Pancake Palace. He needs to have 54 pancakes ready to make when the doors open.

A) What is the number of times the pancake recipe ratio needs to be multiplied by? Show your work.

$\frac{54 \text{ pancakes}}{12 \text{ pancakes}}$ **in a recipe = 4.5**

Each part of the recipe should be multiplied by 4.5.

B) Determine how much of each ingredient Oliver will need to make enough pancakes.

flour: $2\,(4.5) = 9$ **parts flour**

liquid: $2\,(4.5) = 9$ **parts liquid**

egg: $1\,(4.5) = 4.5$ **parts egg**

fat: $\frac{1}{2}(4.5) = 2.25$ **parts fat**

C) If the original recipe calls for 2 teaspoons of baking powder, how many *tablespoons* will be added to the batch to make 54 pancakes?

$2 \text{ tsp } (4.5) = 9 \text{ tsp}$

$1 \text{ Tbsp} = 3 \text{ tsp}$

$9 \text{ tsp} \left(\frac{1 \text{ Tbsp}}{3 \text{ tsp}}\right) = 3 \text{ Tbsp}$

There will be 3 tablespoons added to the batch when it is 4.5 times larger than the original.

Say What You Know

In your own words, talk about what you have learned using the objectives for this part of the lesson and your work on this page.

PRACTICE 2 5A

Practice 2

Complete the problems on a separate sheet of paper.

At the 3R Farm, there are 16 cows for every 56 chickens.

1) Write a ratio of chickens to cows in simplest form. **7:2**

2) Write the ratio of cows to chickens in simplest form. **2:7**

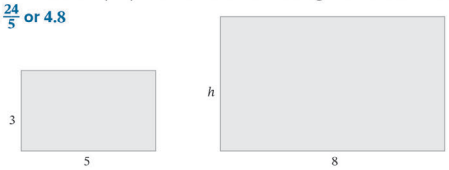
3) Write a ratio comparing the number of cows to the total number of animals in simplest form. **2:9**

The animal shelter held a pet adoption day. For every 5 dogs adopted, 2 cats were adopted.

4) How many cats would have been adopted if 10 dogs were adopted?

5) What would have been the total number of adopted pets if 6 cats were adopted?

6) Write and solve a proportion to find the missing side of the similar rectangles.
$h = \frac{24}{5}$ or 4.8



7) The ratio of time Mary spends on sports compared to school work is two to three. If she spends four hours a day practicing sports, how many hours does she spend studying? **6 hours studying = t**

8) The ratio of average snowfall in two towns is four to five. If the first town, Allentown, usually gets 22 inches a year, what is the average snowfall in the second town, Bakersfield?

9) Squirrels outnumbered rabbits by a ratio of eight to seven. If 56 rabbits were present, how many squirrels were there? **$s = 64$**

Solve.

10) $\frac{x-3}{5} = \frac{3}{10}$ **$x = 4.5$** **11)** $\frac{x}{18} = \frac{x+1}{100}$ **$x = \frac{9}{41}$** **12)** $\frac{x}{30} = \frac{x}{400}$ **$x = 0$** **13)** $\frac{6-x}{3} = \frac{x}{5}$ **$x = \frac{15}{4}$**

14) Rob used a half gallon of paint to cover 250 square feet. How much paint would he need to cover 820 square feet? Round your answer to the whole gallon.

15) Bill can complete three fifths of a project in 30 minutes. How long will it take to complete the entire project? **$x = 50$ It will take Bill 50 minutes to complete the entire project.**

Practice 2

Worked solutions for these problems are located in the Digital Pack

4) If 10 dogs were adopted, 4 cats would have been adopted.

5) There would have been 21 pets adopted.

8) $b = 27.5$ inches of snow for the second town

14) $p = 1.64$
Rob needs 2 gallons of paint to cover 820 square feet.

If needed, have your student go back to the Mastery Check and reapply what they have learned to say and show what they know.

Check out **More to Explore** in the Digital Pack to see if there are additional activities for this part of the lesson.

Warm Up

Your student should spend no more than 5 minutes on the Warm Up. This should be a quick review to activate prior knowledge.

Your student should have their Formula Sheet at all times for this lesson. They should focus on identifying the correct unit multiplier and applying it rather than memorizing all of the conversions. Using a calculator for this lesson is also recommended for larger values.

5B EXPLORE

Part B: Unit Conversions

Objectives

In this part of the lesson, you will learn about unit conversions.

By the end of this lesson, you will be able to do the following:

- Convert units for a value using a single conversion.
- Convert units for a value using multiple conversions.
- Convert compound units for a value.

Why?

Converting units is a skill that you will use often for cooking meals, building projects, and calculating distances and weights when exercising, just to name a few.

Warm Up

Use your Formula Sheet.

1) How many centimeters are in one meter? **100 cm**

2) What are two units of measurement that are equal to 36 inches? **3 feet and 1 yard**

Single Unit Conversions

- **Unit conversion**, or **dimensional analysis**, is the process of converting one measurement to another.
- In order to compare two measurements, the unit of measurement must be the **same**.
- To convert between units, you need to know the desired unit of measure and the correct **unit multiplier**.
- A unit multiplier is a **ratio** that is equal to 1, containing different units.

EXPLORE 5B

Example 1

The Holly family found that the perimeter of their garden was 24.5 yards in length. The lumber supply center sold fence pieces measured in feet. Convert the perimeter to feet to find how much fencing the Holly family needs to surround their garden.

Plan Conversion: 1 yd = 3 ft
The unit multiplier is either $\frac{1\text{ yd}}{3\text{ ft}}$ or $\frac{3\text{ ft}}{1\text{ yd}}$
Since the problem asks you to convert to feet, the correct unit multiplier is $\frac{3\text{ ft}}{1\text{ yd}}$

Implement

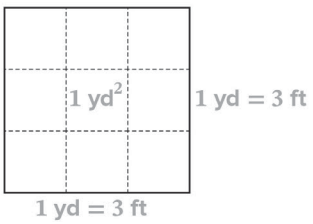
$24.5\text{ yd} \cdot \frac{3\text{ ft}}{1\text{ yd}} =$
$24.5 \cdot 3\text{ ft} = 73.5\text{ ft}$

Explain

◂ Inverse Property (The unit "yard" simplifies out of the expression.)

Extra caution should be taken when converting ___square___ or ___cubic___ units.

Square Yards to Square Feet



Example 2

Find the value of the conversion for the specified units below.
Round your answer to the nearest hundredth.

$16.65\text{ ft}^2 =$ _____ yd^2

Plan Conversion: 1 yd = 3 ft
Use the unit conversion $\frac{1\text{ yd}}{3\text{ ft}}$ twice because the units are squared.

Implement

$(16.65\text{ ft}^2)\left(\left(\frac{1\text{ yd}}{3\text{ ft}}\right)\left(\frac{1\text{ yd}}{3\text{ ft}}\right)\right) = (16.65\text{ ft}^2)\left(\frac{1\text{ yd}^2}{9\text{ ft}^2}\right) = 1.85\text{ yd}^2$

A cubic unit can also be converted by using a single conversion three times.

Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

Be sure that your student is writing out the question using the unit multipliers and dimensional analysis. They may be able to figure out the question without this format now; however, it will be very helpful for more complex questions.

Q: What unit of measure are you trying to simplify out of the problem?

A: *inches*

Q: In order for inches to simplify out of the expression, you need inches to occur once in the numerator and once in the _____?

A: *denominator*

5B EXPLORE

Checkpoint

Using your Formula Sheet, convert 100 inches into feet. Round to the nearest hundredth.

$\frac{1\text{ ft}}{12\text{ in}}$

$100\text{ in} \cdot \frac{1\text{ ft}}{12\text{ in}} = \frac{100\text{ ft}}{12} = 8.33\text{ ft}$

Multiple Unit Conversions

- Many times using ___one___ unit multiplier is not enough to convert from one unit to another.
- The process of ___dimensional analysis___ is used until the desired conversion is reached.

Example 3

Summer made 3.75 gallons of punch for her sister's birthday party. Each punch glass (pg) will hold $\frac{3}{4}$ cup of punch. How many punch glasses can be filled?

Plan 3.75 gal = _____ pg

Conversions

1 pg = $\frac{3}{4}$ c

1 pt = 2 c

1 qt = 2 pt

1 gal = 4 qt

Think about how the dimensional analysis should be set up so only "pg" for punch glass will remain.

Implement

$$(3.75\text{ gal})\left(\frac{\text{qt}}{\text{gal}}\right)\left(\frac{\text{pt}}{\text{qt}}\right)\left(\frac{\text{c}}{\text{pt}}\right)\left(\frac{\text{pg}}{\text{c}}\right) = \text{___ pg}$$

$$(3.75\text{ gal})\left(\frac{4\text{ qt}}{1\text{ gal}}\right)\left(\frac{2\text{ pt}}{1\text{ qt}}\right)\left(\frac{2\text{ c}}{1\text{ pt}}\right)\left(\frac{1\text{ pg}}{\frac{3}{4}\text{ c}}\right) = \text{___ pg}$$

$$(3.75\text{ gal})\left(\frac{4\text{ qt}}{1\text{ gal}}\right)\left(\frac{2\text{ pt}}{1\text{ qt}}\right)\left(\frac{2\text{ c}}{1\text{ pt}}\right)\left(\frac{1\text{ pg}}{\frac{3}{4}\text{ c}}\right) = \text{___ pg}$$

$$\frac{(3.75)(4)(2)(2)(\text{pg})}{(1)(1)(1)\left(\frac{3}{4}\right)} = \frac{60\text{ pg}}{\frac{3}{4}} = 80\text{ pg}$$

EXPLORE 5B

Checkpoint

Convert 114.3 centimeters to yards.
List the unit conversions needed to evaluate using your Formula Sheet.

$1\text{ cm} = 2.54\text{ in}$
$1\text{ ft} = 12\text{ in}$
$3\text{ ft} = 1\text{ yd}$

$$114.3\text{ cm}\left(\frac{1\text{ in}}{2.54\text{ cm}}\right)\left(\frac{1\text{ ft}}{12\text{ in}}\right)\left(\frac{1\text{ yd}}{3\text{ ft}}\right)$$

$$\frac{114.3(1)(1)(1\text{ yd})}{(2.54)(12)(3)} = 1.25\text{ yd}$$

Compound Unit Conversions

- Units of measure are often combined to make what is called a(n) _____compound unit_____.
- Miles per hour written as a unit multiplier is _____.

Example 4

Tristan could run at a speed of 3.4 miles per hour. How fast is this in feet per second? Round your answer to the nearest hundredth.

Plan $3.4\frac{\text{mi}}{\text{hr}} = \_\_\_\_\_\frac{\text{ft}}{\text{sec}}$

Conversions:
$5{,}280\text{ ft} = 1\text{ mi}$
$60\text{ min} = 1\text{ hr}$
$60\text{ sec} = 1\text{ min}$

Implement

$$\left(\frac{3.4\text{ mi}}{1\text{ hr}}\right)\left(\frac{5{,}280\text{ ft}}{1\text{ mi}}\right)\left(\frac{1\text{ hr}}{60\text{ min}}\right)\left(\frac{1\text{ min}}{60\text{ sec}}\right)$$

$$\frac{3.4(5{,}280\text{ ft})(1)(1)}{(1)(1)(60)(60\text{ sec})} = 4.986\overline{6}\frac{\text{ft}}{\text{sec}} \approx 4.99\frac{\text{ft}}{\text{sec}}$$

Because there are two units in the final answer there will be one remaining unit in both the numerator and denominator when simplified.

Checkpoint

A cheetah can run 90 feet per second. How fast is this in miles per hour? Round to the nearest hundredth.

Conversions:
$5{,}280\text{ ft} = 1\text{ mi}$
$60\text{ min} = 1\text{ hr}$
$60\text{ sec} = 1\text{ min}$

$$\left(\frac{90\text{ ft}}{\text{sec}}\right)\left(\frac{1\text{ mi}}{5{,}280\text{ ft}}\right)\left(\frac{60\text{ sec}}{1\text{ min}}\right)\left(\frac{60\text{ min}}{1\text{ hr}}\right)$$

$$\frac{90(1\text{ mi})(60)(60)}{5280(1)(1\text{ hr})} = 61.36\text{ mph}$$

Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

If your student is having trouble understanding where the value comes from, remind them to first find the product of all terms in the numerator and then the denominator, then divide the two numbers.

Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

Breaking this down may help your student. First, convert all of the feet into miles. Then, convert the seconds to hours. Then, write a ratio of miles over hours and simplify.

Practice 1

Worked solutions for these problems are located in the Digital Pack.

1A) Inches belongs in the numerator because the desired unit is inches.

1B) The unit centimeters belongs in the denominator because in the original problem centimeters is given in the numerator. This unit must factor out for the solution to be in inches.

3) The value 10^4 is the same as 10,000. Your student can also move the decimal point 4 spaces to the right to write the number in standard notation rather than scientific.

4) $\frac{2}{3}$ Tbsp

Showing a measuring cup with customary and metric units is a helpful visual. You could also discuss if baking with a food scale is more/less accurate than measuring cups, especially when using baking ratios.

6) Remind your student that when converting square units they need to use the unit multiplier in the expression twice.

7) Sample:
Nick could multiply the solution by $\frac{12 \text{ in}}{1 \text{ ft}}, (7.2 \text{ ft in}^2)\left(\frac{12 \text{ in}}{1 \text{ ft}}\right) = 86.4 \text{ in}^3$

Having your student circle the units may help them see that Nick should not have multiplied the units before ensuring they were in inches.

10) Q: What does the prefix "centi" mean?
A: *100*

Q: How can this help when converting meters to centimeters?
A: *Since centi means 100, this tells you that there are 100 cm in 1 meter.*

11) Q: What units do you want your final answer to be in?
A: *minutes per order*

Q: What will allow the dollar sign, $, to simplify out of the question?
A: *Having a $ in the numerator and denominator.*

5B PRACTICE 1

Practice 1

Complete the problems on a separate sheet of paper.

Use your Formula Sheet to determine the unit multiplier(s).

1) Convert the given units. 5 cm = ____ in **Conversion: 1 in = 2.54 cm**

- **A)** Which unit of measure belongs in the numerator of the unit multiplier? Why?
- **B)** Which unit of measure belongs in the denominator of the unit multiplier? Why?
- **C)** Convert to the given unit. Round to the nearest unit. **1.9... in ≈ 2 in**

Convert the given units.

2) 2 Tbsp = **6** tsp (Round to the nearest unit.)

3) 1.75×10^4 lb = **8.75** ton (1 ton = 2000 lb) (Provide the exact answer.)

4) Miranda wanted to make Turkish delight. The recipe calls for 10 milliliters of lemon juice. However, Miranda's measuring spoons were only in tablespoons. How many tablespoons of lemon juice does Miranda need for the recipe? Write the solution as a simplified fraction with no common factors between the numerator and denominator.

5) 0.8 ft^2 = ____ in^2 **115.2 in^2**

6) 750 cm^2 = ____ in^2 (Round to the nearest hundredth.) **116.250... ≈ 116.25 in^2**

7) Nick was trying to find the volume of a rectangular prism. The dimensions for the prism were given as 1.2 inches, 4.0 inches, and 1.5 feet. Nick's solution was as follows: $(1.2 \text{ in})(4.0 \text{ in})(1.5 \text{ ft}) = 7.2 \text{ ft in}^2$.
Find and correct Nick's error to provide a solution in cubic inches. Round to the nearest tenth.

Convert the given units. If necessary, round to the nearest hundredth.

8) 7.5 c = ____ qt **1.875 qt ≈ 1.88**

9) 5 day(s) = ____ sec **432,000**

10) Craig was looking to buy 25 feet of fencing for his garden. However, he found that online the measurements were in meters. How many meters of fencing does Craig need for his garden? **7.62 m ≈ 7.6 m**

11) Jamie has two job offers with two different companies. One company is offering to pay her $12.50 per hour. The other company is offering to pay her $0.52 per order for packaging orders. What is the average time, in minutes, that Jamie would need to fill each order to make the same amount of money at either job? (minutes per order) Round to the nearest tenth.

2.49... $\frac{\text{min}}{\text{order}}$ ≈ 2.5 $\frac{\text{min}}{\text{order}}$

PRACTICE 1 5B

Use the table below for problems 12–14. Round your answer to the nearest hundredth.

	Alaska	Mongolia
Land Area	3.8 million mi^2	1.56 million km^2
Est. Population in 2020	732,000 people	3.2 million people
Precipitation in Capital	92.2 in/yr (Juneau)	378 mm/yr (Ulaanbaatar)

12) What is the difference in rainfall in inches between Alaska and Mongolia's capital cities? (1 in = 25.4 mm) **77.32 in/yr**

13) If the land area of Alaska was divided evenly among its population, how many square miles would each person in Alaska have? **5.19 mi^2/person**

14) If the land area of Mongolia was divided evenly among its population, how many square miles would each person in Mongolia have? ($1\ km^2 = 0.386\ mi^2$) **0.19 mi^2**

Mastery Check

Show What You Know

A) Q: What should you check before finding the volume?

A: *That all measures have the same units.*

Be sure to read the entire problem before starting to solve.

Answers should not be rounded until the final step of the problem. Using a calculator is recommended.

B) Finding the answer in pounds and then rewriting in tons will help your student understand the immense weight of water. You can also explain that they can estimate 1 car = 1 ton, so the weight would be 187 cars on one soccer field.

C) Q: Based on the weight of water, can you see why unexpected rainfall can cause major damage?

A: *Yes, because water is very heavy, especially in large amounts.*

Your student should use a calculator to work with the large numbers in this question.

Say What You Know

Your student should be able to restate the objectives of the lesson in their own words. If your student is unable to restate the lesson objectives, have them go back and reread the objectives and then explain them.

- You will be able to convert units for a value using a single conversion.
- You will be able to convert units for a value using multiple conversions.
- You will be able to convert compound units for a value.

5B MASTERY CHECK

Mastery Check

Show What You Know

Sandy City experienced a flood. The entire city was flooded with one inch of rain that was causing damage due to the weight of all the water.

A) The high school soccer field was 115 yards by 70 yards and had one inch of standing water. What is the volume of water on the field?

$1 \text{ in} = \frac{1}{12} \text{ ft}$

$1 \text{ yd} = 3 \text{ ft}$

$V = lwh, l = 115 \text{ yd} \cdot \frac{3 \text{ ft}}{\text{yd}}, w = 70 \text{ yd} \cdot \frac{3 \text{ ft}}{\text{yd}}, h = \frac{1}{12} \text{ ft}$

$V = (345)(210)\left(\frac{1}{12}\right)$

$V = 6{,}037.5 \text{ ft}^3$

B) If water weighs 62 pounds per cubic foot, how much did the water on the soccer field weigh in tons?

$2{,}000 \text{ lb} = 1 \text{ ton}$

$6{,}037.5 \text{ ft}^3 \left(\frac{62 \text{ lb}}{\text{ft}^3}\right)\left(\frac{1 \text{ ton}}{2{,}000 \text{ lb}}\right) = 187.1625 \text{ tons}$

The water on the soccer field will weigh 187.1625 tons.

C) The entire city has an area of 21 square miles. If the town is covered in one inch of water, what is the total weight of the flood waters in the city in pounds? What is the weight in tons?

$21 \text{ mi}^2 \left(\frac{5{,}280 \text{ ft}}{\text{mi}}\right)\left(\frac{5{,}280 \text{ ft}}{\text{mi}}\right)\left(\frac{1 \text{ ft}}{12}\right)\left(\frac{62 \text{ lb}}{\text{ft}^3}\right) = 3{,}024{,}806{,}400 \text{ pounds of water}$

$3{,}024{,}806{,}400 \text{ lb} \left(\frac{1 \text{ ton}}{2{,}000 \text{ lb}}\right) = 1{,}512{,}403.2 \text{ tons}$

Say What You Know

In your own words, talk about what you have learned using the objectives for this part of the lesson and your work on this page.

Lesson Test

After achieving mastery for Parts A and B of this lesson, your student has the option to take the test. Before taking the test, ask your student these questions:

- Do you know all the new vocabulary words?
- Can you explain the objectives?
- Do you know how to check your work?
- Do you know how to use your Formula Sheet?
- Were you able to complete the practice questions without help?

YES

If your student can answer "yes" to all of these questions, decide if your student is ready to take the Lesson Test.

NOT YET

If your student cannot answer "yes" to all of these questions, consider having your student complete some of these options:

- Rework Practice 1.
- Complete Practice 2.
- Review the videos, Guided Notes, and Examples.

PRACTICE 2 5B

Practice 2

Complete the problems on a separate sheet of paper.

Convert the given units. Use your Formula Sheet to determine the unit multiplier(s).

1) 3.2 hr = _____ min. **Conversion: 1 hr = 60 min**

A) Which unit of measure belongs in the numerator of the unit multiplier? Why?

B) Which unit of measure belongs in the denominator of the unit multiplier? Why?

C) Convert to the given unit. Round to the nearest ten. **192 min ≈ 190 min**

2) $\frac{3}{4}$ yd = $\frac{9}{4}$ ft

3) 84 oz = 5.25 lb

4) Jason and Maddie need seven and a half pounds of flower petals for their project. However, flower petals are sold in ounces. How many ounces of flower petals do they need for their project? Round to the nearest unit. **120 oz**

5) 4.5 ft^2 = ____ yd^2 **1 yd = 3 ft** **0.5 yd^2**

6) 1 mi^2 = ____ ft^2 **1 mi = 5,280 ft** **27,878,400 ft^2**

7) Shayla's and Shane's swim times for 25 meters are listed below. Shayla wants to compare her time to Shane's. Convert Shayla's time to minutes in order to determine who swam 25 meters faster.

Shayla's 25 meter time: 165 sec Shane's 25 meter time: 2.8 min

165 sec = ____ min **2.75 min** **Shayla swam 25 meters faster than Shane.**

8) 115,200 min = 80 day(s)

9) 1 mi^2 = 640 acre(s) (1 acre = 43,560 ft^2)

10) Blake wants to print 2,000 buttons for his campaign on his 3-D printer. He can print 150 buttons from one spool of filament, and each spool costs $21. How much would it cost him to print the campaign buttons? **It would cost Blake $280 to print 2,000 buttons.**

11) Tanya was getting paid $15 per hour working for 30 hours each week. How much would Tanya earn working 50 weeks in the year? Round to the nearest unit. **Tanya would earn $22,500 in a year.**

12) An ice hockey rink is laying down new ice. The dimensions of the rink are 200 feet by 85 feet, and the ice will be 1 inch thick when finished. If the weight of a cubic foot of ice is 57.2 pounds, what is the weight of the ice rink? **81,033$\frac{1}{3}$ pounds**

13) The rink manager said it will take 48 hours for the new ice rink in problem 11 to be completed. Each layer of ice is $\frac{1}{32}$ of an inch and must be layered on at even time intervals. How many minutes will be needed for each layer to freeze?

90 $\frac{\text{minutes}}{\text{layer}}$

Practice 2

Worked solutions for these problems are located in the Digital Pack

1A) Minutes belongs in the numerator because the desired unit is minutes.

1B) The unit hours belongs in the denominator because in the original problem hours is given in the numerator. This unit must factor out for the solution to be in minutes.

13) Your student should convert all measurements in feet to inches to solve this problem.

Q: If the weight is measured in cubic feet, what do you need to find first?

A: *The volume of the ice.*

Q: How do you find the volume of a rectangle?

A: $V = lwh$

Hint: Look at your Formula Sheet.

If needed, have your student go back to the Mastery Check and reapply what they have learned to say and show what they know.

Lesson Test

Refer to the Part B Mastery Check instructor note to determine if your student is ready for the test.

Targeted Review

Worked solutions for these problems are located in the Digital Pack.

If your student is going to take the Lesson Test, it is recommended that they do so before beginning the Targeted Review.

1) Real numbers include irrational ($\mathcal{I}$) and rational ($\mathcal{Q}$).Subsets of rationals are integers ($\mathcal{Z}$), whole ($\mathcal{W}$), and natural ($\mathcal{N}$) numbers.

2) A rational number is a number that can be written as a ratio of two integers where the denominator does not equal zero.

3) $y = \frac{p}{5} - 3x$

4) $m = 4.5$
It will take 4.5 months for Kwame and Daliah to have the same amount of money.

5) no solution
The absolute value cannot be equal to a negative number.

6) $p = \frac{20}{3}$ or $p = -\frac{4}{3}$

7) $w \leq 14.75$ AND $w \geq 13.25$
The multigrain cracker box weights will range from 13.25 oz and 14.75 oz.

9) Sample:
The inequalities have the same graph because the same values satisfy them. If you multiply $-n \leq -3$ by negative one, it becomes $n \geq 3$. The relationship between expressions is the same.

12) Sample:
It appears that the quiz favored the Morning Class, because the majority of Morning Class students earned high scores on the quiz. However, the majority of the Afternoon Class earned low scores on the quiz.

13) Distractor Rationale:
A) This represents an AND inequality (the given is OR).
C) This is an AND inequality with closed points.
D) This is an OR inequality but the points are closed.

14) Distractor Rationale:
A) This is one of two solutions (your student would have this answer if they forget to solve for both solutions).
C) If your student misses the negative signs on both sides, they may find there is no solution.
D) This would be possible if the equals symbol was a greater than symbol.

Targeted Review

In the Targeted Review, you will practice topics you have mastered in earlier lessons. Reviewing these concepts will help you be successful as you work through this unit.

Complete the problems on a separate sheet of paper.

1) What are all of the sets of numbers under the set of real numbers? Write out the subsets and/or draw a diagram.

2) What is a rational number?

3) Write the equation in terms of y. $5(3x + y) = p$

4) Kwame earns \$200 per month at an after school job and has already saved \$750. Dahlia has \$75 saved and earns \$350 each month. How many months will it take for Kwame and Dahlia to have the same amount of money? Write an equation and solve.

5) Solve. $|5x + 7| = -9$

6) Solve. $6\left|\frac{3}{4}p - 2\right| = 18$

7) The range of weights for a box of multigrain crackers can be plus or minus 0.75 ounces from the median weight of 14 ounces. Write an absolute value inequality to find the range of weights and then solve.

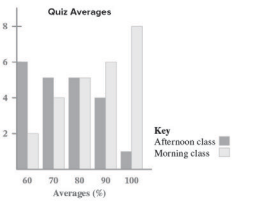
8) Write the symbol for the two inequalities that represent the graph.
n [≥] 3 $-n$ [≤] -3

9) Explain why the inequalities in problem 8 are represented by the same graph.

10) What is the average quiz score for the afternoon class (to the nearest unit)? **75**

11) What is the average quiz score for the morning class (to the nearest unit)? **86**

12) Does it appear that the quiz questions favored one of the groups? Explain.



Multiple Choice

B **13)** Which graph represents the solution for the given inequality $|3x + 4| > 7$?

A)


B)


C)


D)


B **14)** Solve.
$-\frac{1}{3}\left(\frac{1}{2}x + 5\right) = -1$

A) −4
B) **−16, −4**
C) no solution
D) all real numbers

Problem	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lesson Origin	1	1	2	2	3	3	4	4	4	PA	PA	PA	4	3