**4.** Consider the following data:

| Age | Weight (pounds) |
|---|---|
| 21 | 100 |
| 22 | 112 |
| 24 | 110 |
| 25 | 130 |
| 28 | 145 |
| 35 | 146 |
| 37 | 148 |

If we want to create a scatterplot with this data, can the numbers in the table simply be used as labels on evenly-spaced tick marks? Why or why not?



# 1.9 Multiply or Divide?

Explore

**1.** Jena's Internet data plan allows for 5 gigabytes a month. She checked her usage and found that she had already used 5,800 megabytes for the month. Her plan has a fee of 5 cents/MB over the plan allotment. Will she incur a fee if she stops using the Internet now? If so, what would it be?

**a.** What are the units involved? What quantities do they measure in this context?

**b.** Which unit is larger?

**c.** What is the relationship between the units?

**d.** Answer the question in the problem statement.



Discover

The exploration problem involves a conversion between units. There is more than one way to convert units, but the most common method used in daily life involves multiplying or dividing using a conversion fact. This method can be challenging if there are several conversions to be made or if the context makes it difficult to know which operation to use. We will learn another method later in the book. The problems we will solve in this cycle have a manageable amount of conversions and difficulty level. So for now, we will work to understand when we should multiply or divide to convert. Let's take a closer look at this process.

# A CLOSER LOOK

## LEARN

We will begin by finding a relevant conversion fact and trying to understand the relationship it states, using a picture if necessary. We will then determine the operation needed for the conversion and calculate the answer. Finally, we will check to make sure the answer is reasonable.

**EXAMPLE 1** John has decided to run a 10K. He'd like to know how many miles he will be running.

What do we want to know?

| | |
|---|---|
| 1. Find a relationship between the units. | Start by making sense of the units. 10K = 10 kilometers. Miles are abbreviated mi. Both are measures of length. One relationship is 1 km ≈ 0.62 mi. |
| 2. Understand the relationship. | Draw a picture and label it with this fact: 1 km ≈ 0.62 mi<br>0 mi<br>0 km<br>Notice from the picture that miles are larger than kilometers.<br>Our units in the problem are in kilometers. Let's look at the conversion fact from that perspective. |
| 3. Determine the operation to be used: multiplication or division. | Since each km is 0.62 mile, we need to _____ 10 by 0.62. |
| 4. Calculate the answer. | |
| 5. Check if the answer is reasonable. | |

There are often multiple conversion facts available to use. Solve this problem again but use this fact instead: 1 mi ≈ 1.61 km

**EXAMPLE 2** John has decided to run a 10K. He'd like to know how many miles he will be running.

| What do we want to know? | |
|---|---|
| 1. Find a relationship between the units. | 1 mi ≈ 1.61 km |
| 2. Understand the relationship. | We can draw a new picture or use the one we had before. The conversion fact can be added to it.<br>0 mi<br>0 km<br>The fact says that for every 1 mile, we get 1.61 kilometers. But our problem starts with a quantity in kilometers, not miles. So let's look at the fact from the perspective of kilometers. |
| 3. Determine the operation to be used: multiplication or division. | Since we need to know how many times 1.61 goes into 10, we need to _____ 10 by 1.61. |
| 4. Calculate the answer. | |
| 5. Check if the answer is reasonable. | |

**STICKY note**

Units are useful and helpful. Include them whenever possible. They can guide you through many math problems even when you don't expect it.

**How it works**

**To convert units:**

1. Find a relationship between the units. This may involve one or more conversion facts.
2. Understand the relationship. Use a picture if needed.
3. Determine the operation to be used: multiplication or division.
4. Calculate the answer.
5. Check to ensure the answer is reasonable.

For example, to convert 120 pounds to kilograms, we begin by finding a conversion fact. 1 kg ≈ 2.2 lb. So, for every kilogram, we get 2.2 pounds. We don't have kilograms, so let's look at the fact from another angle. For every 2.2 pounds, we get a kilogram.

So we need to see how many 2.2's are in 120. That indicates division.

$$\frac{120}{2.2} \approx 54.5 \text{ kg}$$

Kilograms are a larger unit of weight than pounds, so it makes sense that we have fewer of them.

**Commonly used unit conversions:**

| | | | |
|---|---|---|---|
| 1 ft = 12 in. | 1 in. = 2.54 cm | 1 L = 1,000 mL | 1 min = 60 sec |
| 1 mi = 5,280 ft | 1 km = 1,000 m | 1 lb = 16 oz | 1 hr = 60 min |
| 1 yd = 3 ft | 1 m = 100 cm | 1 kg = 1,000 g | 1 yr = 52 weeks |
| 1 km ≈ 0.62 mi | 1 cm = 10 mm | 1 g = 1,000 mg | 1 week = 7 days |
| 1 mi ≈ 1.61 km | | 1 ton = 2,000 lb | |
| | | 1 gal = 4 qt | |
| | | 1 kg ≈ 2.2 lb | |



## PRACTICE

**PRACTICE 1** If you are 5'6", are you 5.6 feet tall? How tall are you in inches?

**PRACTICE 2** You are going to a movie that is 189 minutes long. Your friend is seeing a movie that starts at the same time, but is 2 hours, 10 minutes long. Who will be finished first? By how many minutes?

**PRACTICE 3** **a.** Convert 300 mm to cm and then to m.

**b.** Convert 5 kg to g and then to mg.

**c.** Convert 500 mg/hour to g/day. HINT: First convert to milligrams per day and then convert mg to g.


A doctor orders 200 mg of an antibiotic for an infant who weighs 15.4 lb. It should be taken every 8 hours. The medication label shows that 75–150 mg/kg per day is the appropriate dosage range.

2. Determine if the dosage ordered is within the desired range. Write your solution in the format you would use if this was a test question. That is, show all steps in an organized way and circle your final answer.



The point of this exercise is to teach you how to solve problems with unit conversions. But more than that, you get to see how others approach problem solving. Even with strong math skills, you often still need to work to solve problems; what makes a good problem solver is not always reflected only in his/her abilities, but also in his/her attitude. More specifically, a good problem solver is willing to persevere even when challenged.


## lesson WRAP-UP

### What's the point?

Understanding the process behind unit conversions can make the calculations easier.

### What did you learn?

How to convert units by multiplying or dividing

### Cycle 1 Question: What can be learned?

The ability to persist when problems challenge you is important in mathematics. When you get frustrated, what can you do to fight wanting to give up?

# 1.9 Homework

## Skills MyMathLab

- Convert units by multiplying or dividing.

**1.** A pill contains 500 mg of an active ingredient. How many grams is that?

**2.** Convert 10 miles to inches.

## Concepts and Applications

**3.** If you are converting from a large unit to a smaller unit, will you always divide? Explain and include an example.

**4. a.** Convert 30 days to seconds by first converting days to hours, then hours to minutes, then minutes to seconds.

**b.** Convert 30 days directly to seconds using the fact that each day contains 86,400 seconds.

**c.** What do you notice about your answers to a and b?

**5. a.** If you are converting from a smaller unit to a larger unit, the number will get _____.

**b.** If you are converting from a larger unit to a smaller unit, the number will get _____.

**6. a.** If there are exactly 2.54 centimeters in one inch, how many inches are in one centimeter? Round to two decimal places.

**b.** If one mile is 5,280 feet, how many miles are in one foot? Round to six decimal places.

# Part 1 Recap

## Skills MyMathLab

**1.** Complete the MyMathLab quiz that accompanies this recap. Then complete the problem below.

Convert a salary of $50,000/year to dollars per hour, assuming that the worker works fifty 40-hour weeks.

## Concepts and Applications

**2. a.** Suppose the following data shows the percent of students in a college class who use various forms of social media. Decide if a bar or pie graph is appropriate for this data and explain why.

| Social Media | Percent |
|---|---|
| Twitter | 45 |
| Instagram | 20 |
| Pinterest | 8 |
| LinkedIn | 4 |
| Google+ | 23 |

**b.** Make the appropriate graph from part a.

**3.** Jack is driving on a highway through Wyoming, from Casper to Cheyenne, with the cruise control set at 75 mph.

**a.** 75 mph is a rate. What two quantities are being compared?

**b.** Jack uses an online map service to determine how long the 179-mile trip will take. It says the trip should take 2 hours, 37 minutes. What average speed is being assumed by the online map program?