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The Power Learners Method for Math

The purpose of this lesson is for you to get better at learning math. To practice the Power Learners Method, you will use it to learn to convert units.

An example of converting units would be to write your height in inches rather than the usual feet and inches. If you are 5 feet 5 inches tall, you can convert that measurement to 65 inches. You can probably do that conversion in your head. But, here, you will learn how to use math for conversions that are confusing or complex. For example, you will learn to convert the **price of oranges from dollars-per-pound to Euros-per-kilogram.** Even using Google to find out that 1 Euro is worth $1.20 and that 1 kilogram is equal to 2.2 pounds, this conversion is confusing. Few of us could do the calculation in our heads.

At the end of this lesson, in about 2 hours or less, you will be able to convert units quickly, easily and accurately. Perhaps, just as important, you will be able to check that you have done the conversion correctly. Converting units is extremely useful in math and science courses. It is also helpful for following a cooking recipe, figuring out how many yards of carpeting you need for a room that is 12 by 15 feet, and many other everyday calculations in life. But the real purpose of this lesson is for you to apply the Power Learners Method to learning math. As you use this approach to learn to convert units, we hope you will find that:

- You have the mental capacity to become competent at math.
- The Power Learners Method works for you in learning math.
- Some math skills and knowledge from earlier courses are essential for your current learning. The good news is you can quickly fill in things you never learned or have forgotten using the Power Learners Method,
- Any extra time and effort you need to catch up and keep up will save time and effort in the long run. But trying to move forward without mastering each lesson will soon slow you down and discourage you.

Success in learning feels good. The better you become in some field, the more you like it. That's part of human nature. On the other hand, it is also natural to dislike and avoid activities that you find difficult and will never learn.

What has been your experience with math?

Have you been a math star? Done OK but not great? Or have you had difficulty and pain? Before beginning this lesson, take a few minutes to think about your experiences and how they may help or hinder your learning math.

Practice

Describe your past experiences with math. What happened? How did you feel? You can just think about this question, or maybe write your answer on the computer or on paper.

What do you think about your ability to learn math?

How do you feel about working on this lesson? Are you willing to begin?

Feedback

We hope this lesson will improve your attitudes toward math and your ability to learn it.

What is math

Mathematics is a collection of techniques for solving problems you can't do in your head. It uses numbers and symbols on paper or a whiteboard to apply logic to complex problems. Thousands of years ago, people used math to record loans and measure the size of their farms. Using computers, rocket scientists can now guide a rocket from Earth to Mars, which takes over 200 days.

Why Learn Math

Before digging into the specifics of this lesson, a few overview comments about math may be helpful.

First, to operate in life, there are some things we need to know by remembering. These are things like our address and phone number. Then there are the things we need to figure out by applying logic to a set of facts. For some problems, we use facts and logic but no math. An example would be figuring out what to buy your mom for her birthday.

For other problems, we do the figuring out using numbers. For example, if you buy shoes for $87.59 and give the clerk a $100 bill, how much change should you get? Maybe you can do this in your head. Perhaps you would use a calculator. Either way, the point is that you don't remember the amount of change. You figure it out.

Math consists of ways to use numbers and symbols to solve problems you can't do in your head. Over the centuries, mathematicians have developed thousands of problem-solving methods. There are so many methods in math that no one knows them all.

In some fields, scientists, engineers, and others use various math often. In other areas, people rarely or never use math. Since only some people will need math in their careers, you might wonder why educators require math courses for everyone? Here are some possible reasons.

- Basic math and problem-solving are essential for managing your money, banking and investments, and even following a recipe when you cook.

- Math courses provide practice in logical thinking and problem-solving. You may forget the math, but the thinking processes are helpful in general.

- It takes years to learn the math needed to begin studying some technical subjects. So, schools and colleges have math courses to get students ready for those fields.

Practice

1. Consider this question:

> In what year did Columbus sail to the Americas?

Do you answer this question by remembering or by problem-solving?

Remembering   Problem-solving

2. Suppose that you work in a bicycle shop. A customer comes in and buys one mountain bike and one road bike. The manager says to you, “Give the customer a discount of 8.5%.” How does the manager expect you to solve the problem?

a. By remembering how much a mountain bike and road bike cost after a discount of 8.5%.
b. By figuring out the amount in your head.
c. By figuring out the amount with a calculator or computer.

3. Math includes:

a. Mental techniques for solving problems in your head.
b. Using written symbols and numbers to solve problems that are too difficult to do in your head.
c. A large number of methods for solving various types of problems.
d. All of the above.

4. After completing the math and science requirements for a bachelor’s degree, is it likely you will have to learn additional math in your career?

Feedback

1. Consider this question:

In what year did Columbus make his most famous expedition?

Do you answer this question by remembering or by problem-solving?

Remembering Problem-solving

A historian might figure out the year by consulting old records. But most of us know this fact simply by remembering it.

2. Suppose that you work in a bicycle shop. A customer comes in and buys one mountain bike and one road bike. The manager says to you, "Give the customer a discount of 8.5%." How does the manager expect you to solve the problem?

a. By remembering how much a mountain bike and road bike cost after a discount of 8.5%.

b. By figuring out the amount in your head.

c. By figuring out the amount with a calculator or computer.

Some stores have cash registers connected to a computer system that reads the UPC on the price tag and computes any discounts automatically. In other stores, the salespeople use handheld calculators.

3. Math includes:

a. Mental techniques for solving problems in your head.

b. Using symbols and methods to solve problems that are too difficult to do in your head.

c. A large number of methods for solving various types of problems.

d. All of the above.

4. After completing the math and science requirements for a bachelor's degree, is it likely you will have to learn additional math in your career?

Yes. With the increased importance of technology in all fields, we think you are likely to have to learn additional math methods throughout your career.

Why are there weird problems in math courses?

In math courses like algebra, you get problems such as this:

> *Mary is three times as old as Jane.*
> *The sum of their ages is 48.*
> *How old are they?*

(Don't solve this problem. It's an example).

Problems like this may seem weird. Other than possibly at a job interview for a high-tech company, when would you ever bump into someone who presented information this way? So, why do math books have problems like this?

Here's one answer: In math, you learn techniques to solve problems in fields like electronics or economics in the future. Since you don't yet understand those fields, using realistic problems would make learning the math more difficult. To avoid that, math teachers use problems you can understand, even if they are unrealistic.

Practice

Here's a typical word problem from algebra.

> The sum of three consecutive, odd integers is 255. What are those integers?

(Don't solve this problem. It's just an example.)

Which of these do you consider an important reason for learning to solve this type of problem?

a. Integer problems are useful in many professions.

b. Every well-educated person needs to know how to solve integer problems.

c. The logic and methods for solving integer problems are helpful in various technical and non-technical fields.

Feedback

Here's a typical word problem from algebra.

> The sum of three consecutive odd integers is 255. What are those integers?

(Don't solve this problem. It's just an example.)

Which of these do you consider an important reason for learning to solve this type of problem?

a. Integer problems are useful in many professions.

b. Every well-educated person needs to know how to solve integer problems.

c. The logic and methods for solving integer problems are helpful in various technical and non-technical fields.

Prerequisites

Most subjects in school and life take a while to learn. So, you learn the easy stuff first and then move on to more complex things. For example, in learning to read, you probably learned the letters first, moved on to reading simple words, and then to reading sentences. Knowing the earlier lessons is essential for later lessons. So, usually, there are prerequisites: things you need to know before you start a new lesson or course.

Hopefully, you have already found that the Power Learners Method of practicing to mastery saves you time and feels great. You learn faster because you have the prerequisites for each new lesson.

The same is true from course to course or grade to grade in school. For example, schools require that you know Spanish 1 before taking Spanish 2. Sometimes, schools will give you a written or oral test to determine if you have the necessary competence to start a course. But mostly, if you passed a course, schools assume you know it. But maybe you passed some courses without knowing the subject very well, and perhaps you have forgotten some things. So, if you have any gaps in your competence, it is critical to fill them in on an emergency basis. Unless you catch up, you will need more time and effort for your new courses. And even then, you are unlikely to get top grades. If this has happened to you in the past, you know how bad it can feel.

Then, there's the good news. You can probably fill in any gaps in your prerequisites surprisingly quickly and easily. You are likely to have that experience in this lesson.

In this lesson, you will learn to convert units using a method that involves multiplying fractions. To check whether you can quickly and accurately multiply fractions, do the following problems. If you can do them correctly and confidently, skip ahead to the next section on *Converting Units*. Otherwise, continue this section on fractions, practicing to master this prerequisite.

Either way, you will soon see that the prerequisite of multiplying fractions is essential.

Check Yourself on Multiplying Fractions

If you are already sure you need to learn to multiply fractions, skip these problems. If you are uncertain, try to do these calculations paper. Leave the answers as fractions but simplified as much as possible.

1. $$\frac{3}{4} \times \frac{5}{13} =$$

2. $$\frac{3}{17} \times \frac{51}{54} =$$

3. Is this formula for multiplying fractions accurate?

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

Here a, b, c and d can be any numbers other than zero.

4. Is this formula accurate:

$$\frac{a}{b} \times \frac{b}{a} = 1$$

5. Is this formula accurate:

$$\frac{(a + c)}{c} = a + 1$$

6. Label the parts of this fraction.

$$\frac{7}{27}$$

7. Do you feel confident that you can multiply fractions?

Feedback

1. $$\frac{3}{4} \times \frac{5}{13} = \frac{15}{52}$$

2. $$\frac{3}{17} \times \frac{51}{54} = \frac{1}{6}$$

3. Is this formula for multiplying fractions accurate?

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$ **Yes**

4. Is this formula accurate:

$$\frac{a}{b} \times \frac{b}{a} = 1$$ **Yes**

5. Is this formula accurate:

$$\frac{(a+c)}{c} = a + 1$$ **No**

6. Label the parts of this fraction.

$$\frac{7}{27}$$

<Numerator

<Denominator

7. Do you feel confident that you can multiply fractions?

If you were fast, accurate and confident, skip ahead to the section *What are Units?*. If not, continue with the following sections to learn the prerequisites about fractions you will need for converting units.

Talking About Math

To learn math, you will need to know the specific meanings of some words used by your teachers, books and videos. This vocabulary also helps you talk to yourself as you do the various steps of a problem. For example, when you add, you might say to yourself, “Five plus seven equals twelve, and carry the one.” Mathematicians use such self-talk as they solve problems. It can help you too. So, we begin with some vocabulary.

A fraction is one number divided by another. For example:

$$\frac{3}{5}$$

This fraction means 3 divided by 5. Doing the math in your head, with a calculator or by long division with a pencil and paper, you can calculate the value of 3 divided by 5:

$$\frac{3}{5} = 0.6$$

Mathematicians call the top quantity the "numerator" and the bottom quantity the "denominator."

$$\frac{3}{5} \quad \frac{\text{NUMERATOR}}{\text{DENOMINATOR}}$$

The number 3 is the numerator. The number 5 is the denominator. To help you remember these names, think: the nUmerator is UP, and the Denominator is DOWN.

$$\frac{\text{N}\overset{\text{P}}{\text{U}}\text{MERATOR}}{\underset{\substack{\text{O}\\ \text{W}\\ \text{N}}}{\text{D}}\text{ENOMINATOR}}$$

One more thing. The line in a fraction is called the **vinculum**. It means "divided by." So, in words, a fraction is the "numerator divided by the denominator."

Practice

Say the fraction $\frac{3}{7}$ in words.

Say the fraction $\frac{a}{b}$ in words.

What is the name of the line in a fraction?

Feedback

Say the fraction $\frac{3}{7}$ in words. **"Three divided by seven."**

If you do a lot of math sometime in the future, you can safely call divided-by by its nickname "over" without getting confused. For now, we suggest you say, "Three divided by seven," rather than "Three over seven."

Say the fraction $\frac{a}{b}$ in words. **"a divided by b."**

What is the name of the line in a fraction? **Vinculum**

Multiply Fractions

Here is the general rule for multiplying fractions:

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

In this formula, a, b, c, and d stand for any numbers. They can be whole numbers, decimals or fractions. Each number can also be positive or negative.

Note: Mathematical notation doesn't define the value of a number divided by 0. So, in the multiplication formula, neither b nor d can be zero.

Example:

$$\frac{1}{2} \times \frac{3}{5} = \frac{1 \times 3}{2 \times 5} = \frac{3}{10}$$

Practice

Using a pen or pencil, write your answers to these two problems:

$$\frac{3}{7} \times \frac{4}{5} =$$

$$\frac{a}{e} \times \frac{p}{t} =$$

Feedback

$$\frac{3}{7} \times \frac{4}{5} = \frac{12}{35}$$

$$\frac{a}{e} \times \frac{p}{t} = \frac{ap}{et}$$

Simplifying Fractions

You can calculate the value of a fraction using a calculator or long division. For example, $\frac{1}{2} = 0.5$. Also, you can calculate $\frac{2}{4} = 0.5$. From this, you can see that ½ and 2/4 are equal in value. Mathematicians provide us with this general rule:

> Multiplying the numerator and denominator of a fraction by the same number does not change the value of the fraction.

$$\frac{\mathrm{a}}{\mathrm{e}} = \frac{\mathrm{ab}}{\mathrm{eb}}$$

Here's an example.

$$\frac{3}{7} = 0.4285$$

Multiplying numerator and denominator by 2:

$$\frac{3}{7} = \frac{3 \times 2}{7 \times 2} = \frac{6}{14} = 0.4285$$

It is also true that dividing the numerator and denominator of a fraction by the same number does not change the value of the fraction. For example:

$$\frac{6}{14} = \frac{\frac{6}{2}}{\frac{14}{2}} = \frac{3}{7} = 0.4285$$

The general rule is: $\frac{\mathrm{ab}}{\mathrm{eb}} = \frac{\mathrm{a}}{\mathrm{e}}$

Practice

Simplify these fractions. As you do each problem, talk yourself through each step.

$\frac{8}{24}$ $\frac{\mathrm{ab}}{\mathrm{ac}}$

Feedback

"Divide the numerator and the denominator by 8."

$$\frac{8}{24} = \frac{1}{3}$$

"Divide the numerator and the denominator by a."

$$\frac{ab}{ac} = \frac{b}{c}$$

Check Yourself on Multiplying Fractions

Do these calculations paper. Leave the answers as fractions but simplified as much as possible.

1. $\frac{3}{4} \times \frac{5}{13} =$

2. $\frac{3}{17} \times \frac{51}{54} =$

3. Is this formula for multiplying fractions accurate?

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

4. Is this formula accurate:

$$\frac{a}{b} \times \frac{b}{a} = 1$$

5. Is this formula accurate:

$$\frac{(a + c)}{c} = a + 1$$

6. Label the parts of this fraction.

$$\frac{7}{27}$$

7. Do you feel confident that you can multiply fractions?

8. Did it take you more or less time to master multiplying fractions than you expected?

Feedback

1. $$\frac{3}{4} \times \frac{5}{13} = \frac{15}{52}$$

2. $$\frac{3}{17} \times \frac{51}{54} = \frac{1}{6}$$

3. Is this formula for multiplying fractions accurate?

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$ **Yes**

4. Is this formula accurate:

$$\frac{a}{b} \times \frac{b}{a} = 1$$ **Yes**

5. Is this formula accurate:

$$\frac{(a+c)}{c} = a + 1$$ **No**

6. Label the parts of this fraction.

$$\frac{7}{27}$$

<Numerator

<Denominator

7. Do you feel confident that you can multiply fractions?

If not, please get any help you need and do enough practice to feel masterful. That experience will help you overcome procrastination and persevere in the future.

8. Did it take you more or less time to master multiplying fractions than you expected?

We hope this was a quick and pleasant experience for you. Even if it took you some time, take pride in having succeeded.

What are Units?

Math and science deal with physical quantities you can count or measure, such as your height and weight.

I am 70 inches tall and weigh 160 pounds.

Here are some other examples of physical quantities that can be counted or measured:

2 pounds (of grapes, potatoes, or)

$4.38 (4.38 dollars)

15 miles per hour

Each of these quantities has two elements: a numerical value and units. The value is a number, and the units are words, abbreviations, or symbols. The value tells us how many things there are. The units tell us what kind of things they are.

Practice

1. In the quantity 55 miles per hour, the value is ________________ and the units are ___________________. .

2. True or false? All times, speeds, distances, areas, temperatures, ages, and prices have units.

True False

3. For each of these categories of physical quantities, write two or more units used to measure it.

CATEGORY	UNITS
Time	hours, minutes, seconds, months, years, centuries
Temperature	
Speed	
Distance	
Age	
Prices	
Area	

Feedback

1. In the quantity 55 miles per hour, the value is ____**55**______ and the units are miles per hour_____. .

2. True or false? All times, speeds, distances, areas, temperatures, ages, and prices have units.

True False

4. For each of these categories of physical quantities, write two or more units used to measure it.

CATEGORY	**UNITS**
Time	hours, minutes, seconds, weeks, months, years, centuries
Temperature	degrees Fahrenheit, degrees Celsius
Speed	miles per hour, feet per second, kilometers per hour
Distance	miles, feet, inches, centimeters, yards, kilometers
Age	years, months, days
Prices	dollars per pound, cents per apple, pesos per liter, Euros per day
Area	square feet, square meters, acres, square inches, square miles

Practice

Here is a definition:

> A unit of measurement is a standard amount of a physical quantity used to measure other amounts of that quantity. For example, an inch is a specific amount of length. We can measure other lengths as so many inches. Centuries ago, people defined units by common usage. For example, the unit of one foot was the length of a person's foot. Since people have different size feet, people later found it helpful to be more precise. They defined units with objects held by the government or phenomena existing in nature.

Do you understand this definition?

Feedback

If not, talk to someone who can help you become clear about what units are.

Fractional Units and Abbreviations

Sometimes the units of physical quantities are fractions. For example, the speed of a car might be 55 miles per hour. Here are some different ways of writing that speed:

55 miles per hour

55 mph [abbreviation]

55 miles/hour [division symbol]

$55\ \frac{\text{miles}}{\text{hour}}$ [fraction]

The units of speed are miles divided by hours. All the different ways of writing miles per hour are correct. In other words, miles per hour means the same as miles divided by hours, and this can be written as a fraction:

$$\frac{\text{miles}}{\text{hour}}$$

For problem-solving, it is usually easiest to write the units as a fraction.

In working with units, you don't have to pay attention to spelling or grammar. We usually say one foot or two feet. We also say, "Give me a two-foot length of rope." So, in all calculations with units, you can assume that the singular (foot) and plural (feet) forms are equivalent and both are OK.

You can also use abbreviations. For example, the price of oranges can be written as:

$$\$3.50 \text{ per dozen} = 3.50\ \frac{\text{dollars}}{\text{dozen}} = 3.50\ \frac{\$}{\text{doz}}$$

Practice

Using a measuring cup and a stop watch, you find that your kitchen faucet delivers cold water at the rate of 3 gallons per minute. Using singular and plural units, abbreviation, and fractional units, write this quantity in several different ways.

Feedback

3 gallons per minute = 3 gal/min = 3 gpm = $3\,\frac{\text{gallon}}{\text{minute}} = 3\,\frac{\text{gallons}}{\text{minutes}}$

Converting Units

You are now going to learn a systematic way to convert the units of quantities. Again, the reasons to learn this are:

- This lesson will also guide you in using the Power Learners Method in math, which will help you learn other things in math and science in the future.
- Converting units is needed for everyday problems, such as computing interest on a loan or following a cooking recipe.

To get started, unit conversions depend on the size of the different units:

- 12 inches = 1 foot
- 4 quarts = 1 gallon
- 60 seconds = 1 minute

Using relationships like these, you can convert between units of the same type. You can convert a distance from inches to feet. But you can't convert units of one kind into units of another kind. It makes no sense to convert inches to gallons or quarts to minutes.

Using the fact that 12 inches equals 1 foot, consider this fraction:

$$\frac{12\ \text{inches}}{1\ \text{foot}} = 1$$

Because the numerator of this fraction, 12 inches, is a length equal to 1 foot, this fraction has a value of 1.

In the same way, these fractions also have a value of 1.

$$\frac{4\text{ quarts}}{1\text{ gallon}} = 1 \qquad \frac{60\text{ seconds}}{1\text{ minute}} = 1$$

These fractions have numerators and denominators that are the same actual size. The values are different, and the units are different. Still, in each case, the length or volume or time in the numerator equals the quantity in the denominator. That's why these fractions have a value of 1. So, we can use such fractions as conversion factors.

Multiplying a quantity by 1 leaves it unchanged. Therefore, we can multiply any quantity by a conversion factor without changing its actual value.

Example: Convert 96 inches to feet.

$$96\text{ inches x}\frac{1\text{ foot}}{12\text{ inches}} = \frac{96\text{ inches feet}}{12\text{ inches}}$$

You get the result by dividing the numerator and denominator by inches:

$$96\text{ inches x}\frac{1\text{ foot}}{12\text{ inches}} = \frac{96\text{ inches feet}}{12\text{ inches}} = \frac{96}{12}\text{feet} = 8\text{ feet}$$

When you use conversion factors, write the problem exactly as shown here. This way of writing the problem is part of the method.

For any given pair of units, there are two conversion factors. They are the same, except one is flipped over:

Example: $\frac{1\text{ yard}}{3\text{ feet}} = 1$ and $\frac{3\text{ feet}}{1\text{ yard}} = 1$

Since the numerator and denominator are the same in each fraction, each of these conversion factors has a value of 1.

Now here's where you can start thinking like a mathematician. Since conversion factors always come in pairs, you must decide which one to use. One way to do that is to try both and see which one works. But, if you think about it for a moment, you can usually decide which one will work. If it does, you're all set. If it doesn't, try the other one.

Again, let's use converting feet to yards as an example. Though you can probably do this example in your head, please hold on. Consider the two possible conversion factors you might use: 1 yard/3 feet and 3 feet/1 yard.

Example: Convert 36 feet to yards.

The conversion factors between feet and yards are:

$$\frac{1\text{ yard}}{3\text{ feet}} \text{ and } \frac{3\text{ feet}}{1\text{ yard}}$$

Try: 36 feet x $\frac{1\text{ yard}}{3\text{ feet}}$ = 12 yards

And try: 36 feet x $\frac{3\text{ feet}}{1\text{ yard}} = \frac{108\text{ square−feet}}{\text{yard}}$

Notice that the first conversion factor worked. The units of feet cancel out, and the answer has the desired units of yards. In the second case, the units do not simplify. The calculation is accurate but not helpful. This is not a mistake. It is simply an attempt that didn't work. That's kind of like a detective investigating a suspect in a crime. Proving that a suspect is innocent is not a mistake. It is part of the job.

Practice

In this problem, first write a pair of conversion factors, such as:

$$\frac{1\text{ yard}}{3\text{ feet}} \text{ and } \frac{3\text{ feet}}{1\text{ yard}}$$

Then try both conversion factors to see which one works to get the answer requested.

Convert 15.6 yards to feet. (There are 3 feet in one yard.)

Feedback

Convert 15.6 yards to feet

The conversion factors are:

$$\frac{1 \text{ yard}}{3 \text{ feet}} \text{ and } \frac{3 \text{ feet}}{1 \text{ yard}}$$

$$15.6 \text{ yards x} \frac{1 \text{ yard}}{3 \text{ feet}} = 5.2 \ \frac{\text{square yards}}{\text{feet}}$$

$$15.6 \text{ yards x} \frac{3 \text{ feet}}{1 \text{ yard}} = 46.8 \text{ feet}$$

Practice

Convert 10,000 grams to pounds.

The conversion factors are:

$$\frac{454 \text{ grams}}{1 \text{ pound}} \text{ and } \frac{1 \text{ pound}}{454 \text{ grams}}$$

Try both.

Feedback

$$10{,}000 \text{ grams x} \frac{454 \text{ grams}}{1 \text{ pound}} = 4{,}540{,}000 \frac{\text{grams squared}}{\text{pounds}}$$

$$10{,}000 \text{ grams x } \frac{1 \text{ pound}}{454 \text{ grams}} = 22.02 \text{ pounds}$$

Practice

Suppose you are taking a science course, and you need to compare the watts of power from a motor to the Horsepower of a gasoline engine. If the electric car has a 35,000-Watt motor, how does that compare to a 200 horsepower gas engine? Convert watts to Horsepower. The conversion factors are

$$\frac{745 \text{ Watts}}{1 \text{ HP}} \text{ and } \frac{1 \text{ HP}}{745 \text{ Watts}}$$

To convert the power of the 35,000-Watt motor to Horsepower, which conversion factor would you try first?

Feedback

To convert the power of the 35,000-Watt motor to Horsepower, which conversion factor would you try first?

Answer: 35,000 Watts x $\frac{\text{1 HP}}{\text{745 Watts}}$

The alternative doesn't work:

35,000 Watts x $\frac{\text{745 Watts}}{\text{1 HP}}$

The second calculation is mathematically valid but not useful.

Practice

Here's more practice. In each case, make an educated guess and write the conversion factor you would try first.

Convert 265 inches to yards. (There are 36 inches per yard.)

Convert 40 liters to gallons. (There are 3.8 liters per gallon.)

Convert 50 months to years.

Feedback

Convert 265 inches to yards. $\frac{1 \text{ yard}}{36 \text{ inches}}$

$$256 \text{ inches x } \frac{1 \text{ yard}}{36 \text{ inches}} = 7.11 \text{ yards}$$

Convert 40 liters to gallons. $\frac{1 \text{ gallon}}{3.8 \text{ liters}}$

$$40 \text{ liters X } \frac{1 \text{ gallon}}{3.8 \text{ liters}} = 10.5 \text{ gallons}$$

Convert 50 months to years. $\frac{1 \text{ year}}{12 \text{ months}}$

$$50 \text{ months X } \frac{1 \text{ year}}{12 \text{ months}} = 4.2 \text{ years}$$

Using Several Conversion Factors

Sometimes solving a problem calls for converting units several times.

For example, suppose you want to convert 8000 miles to inches. You probably know the conversion factors for feet to inches:

$$\frac{\text{1 foot}}{\text{12 inches}} \text{ and } \frac{\text{12 inches}}{\text{1 foot}}$$

You may remember the conversion factors from feet to miles:

$$\frac{\text{1 mile}}{\text{5280 feet}} \text{ and } \frac{\text{5280 feet}}{\text{1 mile}}$$

Using one conversion factor to go from miles to feet and a second to go from feet to inches, you could calculate:

$$\text{8000 miles X } \frac{\text{5280 feet}}{\text{1 mile}} \text{ X } \frac{\text{12 inches}}{\text{1 foot}} = \text{506,880,000 inches}$$

Practice

This practice is more challenging. Before looking at the feedback on the next page, work on this problem until you are confident you have the correct answer. Use pencil and paper and multiple conversion factors.

> Suppose that at top-speed, a snail crawls 4 inches per minute. How fast is that in miles per hour?

Feedback

$$4\ \frac{\text{inches}}{\text{minute}}\ \text{x}\ \frac{1\ \text{foot}}{12\ \text{inches}}\ \text{x}\ \frac{1\ \text{mile}}{5280\ \text{feet}}\ \text{x}\ \frac{60\ \text{minutes}}{\text{hour}} = 0.0038\ \text{mph}$$

This practice required three conversion factors. Were you able to avoid trial and error and make educated guesses about which conversion factors to try first? If you feel confident about converting units, test yourself on the mastery problems below. If not, get any help you need and continue practicing until you do.

Mastery Criteria for Converting Units

To prove to yourself that you have mastered converting units, do these four conversions. Work carefully, trying to get them all right. Time yourself, but do not rush.

1. Suppose that hamburger costs 4.50 dollars per pound in the U.S. For comparison to prices in Mexico, convert this price to pesos per kilogram. (1 dollars = 18.5 pesos, and 2.2 pounds = 1 kilogram)

2. You can estimate how far away a storm is by counting the seconds from when you see a flash of lightning to when you hear the thunder. Since light travels so fast, you can ignore the time it takes for the flash of lightning to reach you. But the sound travels at about 720 miles per hour. How far does the sound travel in one second?

3. A thoroughbred horse can run 6 furlongs in 73 seconds. How fast is that in miles per hour? (1 mile = 8 furlongs)

4. Suppose you are in a supermarket in France. You see the price of oranges is:

4.5 Euros/Kg

Use these conversion rates:

- 1 U.S. dollar is worth 0.85 Euros.
- 1 kilogram is equal to 2.2 pounds.

Convert the price of these oranges to U.S. dollars per pound.

Feedback

1. Suppose that hamburger costs 4.50 Dollars per Pound in the U.S. For comparison to prices in Mexico, convert this price to Pesos per Kilogram. (1 Dollar = 18.5 Pesos, and 2.2 Pounds = 1 Kilogram)

$$\frac{4.5 \text{ Dollars}}{\text{Pound}} \text{ x } \frac{18.5 \text{ Pesos}}{1 \text{ Dollar}} \text{ x } \frac{2.2 \text{ Pounds}}{1 \text{ Kilogram}} = \frac{183\text{Pesos}}{\text{Kilogram}}$$

2. You can estimate how far away a storm is by counting the seconds from when you see a flash of lightning to when you hear the thunder. Since light travels so fast, you can ignore the time it takes for the flash of lightning to reach you. But the sound travels at about 720 miles per hour. How far does sound travel in one second?

$$\frac{720 \text{ Miles}}{\text{Hour}} \text{ x } \frac{1 \text{ Hour}}{60 \text{ Minutes}} \text{ x } \frac{1 \text{ minute}}{60 \text{ Seconds}} = \frac{0.2 \text{ Miles}}{\text{Second}}$$

3. A thoroughbred horse can run 6 furlongs in 73 seconds. How fast is that in miles per hour? (1 Mile = 8 Furlongs)

$$\frac{6 \text{ Furlongs}}{73 \text{ Seconds}} \text{ x } \frac{1 \text{ Mile}}{8 \text{ Furlongs}} \text{ x } \frac{60 \text{ Seconds}}{1 \text{ Minute}} \text{ x } \frac{60 \text{ Minutes}}{1 \text{ Hour}} = 37 \frac{\text{Miles}}{\text{Hour}}$$

If you got all four of these correct in under 40 minutes, you have successfully mastered converting units. Hopefully, you feel proud of yourself. If you are not yet at mastery, please get some more problems and continue practicing until you impress yourself with your speed and accuracy. If you need help, ask someone who knows the math.

4. Suppose you are in a supermarket in France. You see the price of oranges is:

4.5 Euros/Kg

Use these conversion rates:

- 1 U.S. dollar is worth 0.85 Euros.
- 1 kilogram is equal to 2.2 pounds.

Convert the price of these oranges to U.S. dollars per pound.

$$\frac{4.5 \text{ Euros}}{\text{Kilogram}} \text{ x } \frac{1 \text{ Kilogram}}{2.2 \text{ pounds}} \text{ x } \frac{1 \text{ Dollar}}{0.85 \text{ Euros}} = \$2.41/\text{pound}$$

Mastery Criteria for using Power Learning in Math

The two main goals of this lesson were for you to become:

- Competent in using the Power Learners Method to master math
- Confident that you can master math with reasonable effort

To check that you have reached these goals, write your answers to these questions using your computer or on paper.

1. How does it feel to have learned how to convert units?

2. With the Power Learner Method, you used has these steps:

- Define what you will learn to do.
- Have a person, video or book show and tell you how to do it.
- If you have gaps in prerequisites, invest the time to fill them.
- Practice until you master it, a step at a time.
- If you get stuck, get help. Then, continue practicing.
- Review for long-term remembering.

What steps did you find most useful? In what ways is it better than what you did before?

3. Are you now more confident that you can master future math courses?