

The simplest three conversions you should be able to do very quickly, in a moment, without thinking about conversion factors or any more complicated method.

All of these conversions come up *very frequently* when doing physics labs. You do them only by moving the decimal point!

Conversion	How to move the decimal point	Example
Centimeters to meters.	2 spaces LEFT	54 cm => 0.54 m
Meters to centimeters	2 spaces RIGHT	0.47 m => 47 cm
Grams to kilograms	3 spaces LEFT	159 g => 0.159 kg
Kilograms to grams	3 spaces RIGHT	0.834 kg => 834 g
Milliseconds to seconds	3 spaces LEFT	842 ms => 0.842 s
Seconds to milliseconds	3 spaces RIGHT	0.472 s => 472 ms

Practice Problems:

1. Convert 173 milliseconds to seconds. You must be able to solve each of these problems VERY VERY quickly!
Not more than five seconds per problem.

2. Convert 43 centimeters to meters.
3. Convert 0.547 seconds to milliseconds.
4. Convert 763 milliseconds to seconds.
5. Convert 0.192 seconds to milliseconds.
6. Convert 624 milliseconds to seconds.
7. Convert 81 centimeters to meters
8. Convert 0.522 kilograms to grams.

- 9.** Convert 943 grams to kilograms.
- 10.** Convert 0.61 meters to centimeters.
- 11.** Convert 0.242 kilograms to grams.
- 12.** Convert 5 centimeters to meters.
- 13.** Convert 23 grams to kilograms.
- 14.** Convert 11 milliseconds to seconds.
- 15.** Convert 0.79 kilograms to grams.
- 16.** Convert 0.4 meters to centimeters.
- 17.** Convert 0.3 seconds to milliseconds.
- 18.** Convert 5 milliseconds to seconds.
- 19.** Convert 845 centimeters to meters.
- 20.** Convert 5454 grams to kilograms.

Answers:**1.** 0.173 s**2.** 0.43 m**3.** 547 s**4.** 0.763 ms**5.** 192 ms**6.** 0.642 s**7.** 0.81 m**8.** 522 g**9.** 0.943 kg**10.** 61 cm**11.** 242 g**12.** 0.05 m**13.** 0.023 kg**14.** 0.011 s**15.** 790 g**16.** 40 cm**17.** 300 ms**18.** 0.005 s**19.** 84.5 m**20.** 5.454 kg

Length Conversion Factors

1 foot = 12 inches

1 yard = 3 feet

1 mile = 5280 feet

1 meter = 1000 millimeters

1 meter = 100 centimeters

1 kilometer = 1000 meters

1 inch = 2.54 centimeters

1 meter = 3.28 feet

1 mile = 1.61 kilometers

Time Conversion Factors

1 minute = 60 seconds

1 hour = 60 minutes

1 day = 24 hours

1 week = 7 days

1 year = 365.25 days

1 century = 100 years

NOTE: "months" are not a standard unit, because not all months have the same number of days!

Mass Conversion Factors

1 kilogram = 1000 grams

1 gram = 1000 milligrams

1 slug = 14.6 kilograms

1 metric ton (also called tonne) = 1000 kilograms

NOTE: "pounds" are *not* a unit of mass, but a unit of force!!! The unit English system unit for mass is *slugs*.

Force Conversion Factors

1 pound = 4.45 Newtons

1 Newton = 100,000 dynes

1 ton = 2000 pounds

Reasons to Learn Conversion Factors

Even though most everyone says that basic conversions are intuitive, it is still very important to learn the *conversion factor method*! Three reasons why:

- The conversion factor method can be easily applied to more and more complex conversion problems.
- The conversion factor method helps you invent your own formulas to solve new problems. This is especially helpful in chemistry.
- The conversion factor method teaches you to treat units like any other number, and prepares you for learning dimensional analysis.

This is an example of how to apply the conversion factor method to two simple questions.

Example Question 1:

"How many feet are there in 36 inches?"

The correct answer, drawn out precisely:

$$36 \text{ inches} = \frac{36 \text{ inches}}{1} \left(\frac{1 \text{ foot}}{12 \text{ inches}} \right) = \frac{36 \text{ feet}}{12} = 3 \text{ feet}$$

Step 1: Put your number over 1:

$$36 \text{ inches} = \frac{36 \text{ inches}}{1}$$

Step 2: Multiply by a *conversion factor* that will allow you to cancel out the unit you don't want and give you the unit you do want.

$$\frac{36 \text{ inches}}{1} \left(\frac{1 \text{ foot}}{12 \text{ inches}} \right)$$

Step 3: Cancel out the units that are in both the numerator and denominator, and ignore all 1s.

$$\frac{36 \text{ inches}}{1} \left(\frac{1 \text{ foot}}{12 \text{ inches}} \right) = \frac{36 \text{ feet}}{12}$$

Step 4: Now, just divide or multiply and get your answer!

$$\frac{36 \text{ feet}}{12} = 3 \text{ feet}$$

Example Question 2:

"How many inches are in 7 feet?"

The correct answer, drawn out precisely:

$$7 \text{ feet} = \frac{7 \text{ feet}}{1} \left(\frac{12 \text{ inches}}{1 \text{ foot}} \right) = \frac{7 \cdot 12 \text{ inches}}{1} = 84 \text{ inches}$$

Step 1: Put your number over 1

$$7 \text{ feet} = \frac{7 \text{ feet}}{1}$$

Step 2: Multiply by the right *conversion factor*.

$$7 \text{ feet} = \frac{7 \text{ feet}}{1} \left(\frac{12 \text{ inches}}{1 \text{ foot}} \right)$$

Step 3: Cancel out units and ignore 1s.

$$\frac{7 \text{ feet}}{1} \left(\frac{12 \text{ inches}}{1 \text{ foot}} \right) = \frac{7 \cdot 12 \text{ inches}}{1}$$

Step 4: Divide or multiply to get the answer:

$$\frac{7 \cdot 12 \text{ inches}}{1} = 84 \text{ inches}$$

In the problems below, use the conversion factor method to solve each problem in a single step.

1. Convert 48 inches to feet

Yes, I know that you know the answer is 4. Nevertheless, please write out the problem correctly with conversion factors, as illustrated above. Learning to use conversion factors is the first step of understanding dimensional analysis, a very crucial piece of physics. And it's good to start on a problem you know the answer to.

2. Convert 5 feet to inches.

3. Convert 29 feet to meters.

One-Step Conversion Problems

Name _____

4. Convert 6 meters to feet.

Remember, on each problem you must write out the answer with the conversion factor method to receive full credit!

For full credit, you must:

- write each value including the unit
- represent conversion factors as fractions
- cross out canceled units

5. Convert 785 hours to days.

6. Convert 294 hours to days.

7. Convert 13 days to hours.

8. Convert 24 kilograms to slugs.

9. Convert 146 slugs to kilograms.

10. Convert 21,419 feet to miles.

Answers:**1.**

$$48 \text{ inches} = \frac{48 \text{ inches}}{1} \left(\frac{1 \text{ foot}}{12 \text{ inches}} \right) = \frac{48 \text{ feet}}{12} = 4 \text{ feet}$$

2.

$$5 \text{ feet} = \frac{5 \text{ feet}}{1} \left(\frac{12 \text{ inches}}{1 \text{ foot}} \right) = \frac{5 \cdot 12 \text{ inches}}{1} = 60 \text{ inches}$$

3.

$$29 \text{ feet} = \frac{29 \text{ feet}}{1} \left(\frac{1 \text{ meter}}{3.28 \text{ feet}} \right) = \frac{29 \text{ meters}}{3.28} = 8.84 \text{ meters}$$

4.

$$6 \text{ meters} = \frac{6 \text{ meters}}{1} \left(\frac{3.28 \text{ feet}}{1 \text{ meter}} \right) = \frac{6 \cdot 3.28 \text{ feet}}{1} = 19.7 \text{ feet}$$

5.

$$785 \text{ hours} = \frac{785 \text{ hours}}{1} \left(\frac{1 \text{ day}}{24 \text{ hours}} \right) = \frac{785 \text{ days}}{24} = 32.7 \text{ days}$$

6.

$$294 \text{ hours} = \frac{294 \text{ hours}}{1} \left(\frac{1 \text{ day}}{24 \text{ hours}} \right) = \frac{294 \text{ days}}{24} = 12.3^{**} \text{ days}$$

** Note that I rounded this answer to 3 significant figures, which is why it is 12.3 and not 12.25.

7.

$$13 \text{ days} = \frac{13 \text{ days}}{1} \left(\frac{24 \text{ hours}}{1 \text{ day}} \right) = \frac{13 \cdot 24 \text{ hours}}{1} = 312 \text{ hours}$$

8.

$$24 \text{ kilograms} = \frac{24 \text{ kilograms}}{1} \left(\frac{1 \text{ slug}}{14.6 \text{ kilograms}} \right) = \frac{24 \text{ slugs}}{14.6} = 1.64 \text{ slugs}$$

9.

$$146 \text{ slugs} = \frac{146 \text{ slugs}}{1} \left(\frac{14.6 \text{ kilograms}}{1 \text{ slug}} \right) = \frac{146 \cdot 14.6 \text{ kilograms}}{1} = 2130^{**} \text{ kilograms}$$

** Again, rounded from 2131.6 to 3 significant figures. See the worksheets on significant figures for the rules of how that work.

10.

$$21419 \text{ feet} = \frac{21419 \text{ feet}}{1} \left(\frac{1 \text{ mile}}{5280 \text{ feet}} \right) = \frac{21419 \text{ feet}}{5280 \text{ miles}} = 4.06 \text{ miles}$$

Please solve every problem below using *two* conversion factors. As before, please write out your answer showing that you properly understand the conversion factor method.

Dividing by two numbers with a calculator:

To do

$$\begin{array}{r} 54 \\ \hline 32 \cdot 45 \end{array}$$

You can type one of these two things into your calculator:

$54 / 32 / 45$ or $54 / (32 \times 45)$

But, do NOT do:

~~$54 / 32 \times 45$~~

which will give the wrong answer!

1. Convert 30 seconds to hours.

Remember, for full credit you must:

- write each value including units,

- represent conversion factors as fraction of two values with units

- cross out canceled units

2. Convert 250 seconds to hours.

3. Convert 50 minutes to days.

4. Convert 1400 feet to kilometers using these conversion factors.

1 mile = 5280 feet

1 mile = 1.61 kilometers

Two-Step Conversions

Name _____

5. Convert 1400 feet to kilometers using these conversion factors:

$$1 \text{ meter} = 3.28 \text{ feet}$$

$$1 \text{ kilometer} = 1000 \text{ meters}$$

Remember, for full credit you must:

- write each value including units,

- represent conversion factors as fraction of two values with units

- cross out canceled units

6. How many minutes are there in 5 days?

7. How many inches are there in 20 miles?

8. How many meters are there in 1 mile? Figure it out using these conversion factors:

$$1 \text{ mile} = 1.61 \text{ kilometers}$$

$$1 \text{ kilometer} = 1000 \text{ meters}$$

9. How many meters are there in 1 mile? Figure it out using these conversion factors:

$$1 \text{ mile} = 5280 \text{ feet}$$

$$1 \text{ meter} = 3.28 \text{ feet}$$

10. Convert 500 slugs to metric tons.

Answers:**1.**

$$30 \text{ seconds} = \frac{30 \text{ seconds}}{1} \left(\frac{1 \text{ minute}}{60 \text{ seconds}} \right) \left(\frac{1 \text{ hour}}{60 \text{ minutes}} \right) = \frac{30 \text{ hours}}{60 \cdot 60} = 0.0083 \text{ hours}$$

2.

$$250 \text{ seconds} = \frac{250 \text{ seconds}}{1} \left(\frac{1 \text{ minute}}{60 \text{ seconds}} \right) \left(\frac{1 \text{ hour}}{60 \text{ minutes}} \right) = \frac{250 \text{ hours}}{60 \cdot 60} = 0.069 \text{ hours}$$

3.

$$50 \text{ minutes} = \frac{50 \text{ minutes}}{1} \left(\frac{1 \text{ hour}}{60 \text{ minutes}} \right) \left(\frac{1 \text{ day}}{24 \text{ hours}} \right) = \frac{50 \text{ days}}{60 \cdot 24} = 0.035 \text{ days}$$

4.

$$1400 \text{ feet} = \frac{1400 \text{ feet}}{1} \left(\frac{1 \text{ mile}}{5280 \text{ feet}} \right) \left(\frac{1.61 \text{ kilometers}}{1 \text{ mile}} \right) = \frac{1400 \cdot 1.61 \text{ km}}{5280} = 0.43 \text{ kilometers}$$

5.

$$1400 \text{ feet} = \frac{1400 \text{ feet}}{1} \left(\frac{1 \text{ meter}}{3.28 \text{ feet}} \right) \left(\frac{1 \text{ kilometer}}{1000 \text{ meters}} \right) = \frac{1400 \text{ km}}{3.28 \cdot 1000} = 0.43 \text{ kilometers}$$

6.

$$5 \text{ days} = \frac{5 \text{ days}}{1} \left(\frac{24 \text{ hours}}{1 \text{ day}} \right) \left(\frac{60 \text{ minutes}}{1 \text{ hour}} \right) = \frac{5 \cdot 24 \cdot 60 \text{ minutes}}{1} = 7,200 \text{ minutes}$$

7.

$$20 \text{ miles} = \frac{20 \text{ miles}}{1} \left(\frac{5280 \text{ feet}}{1 \text{ mile}} \right) \left(\frac{12 \text{ inches}}{1 \text{ foot}} \right) = \frac{20 \cdot 5280 \cdot 12 \text{ inches}}{1} = 1.3 \cdot 10^6 \text{ inches}$$

8.

$$1 \text{ mile} = \frac{1 \text{ mile}}{1} \left(\frac{1.61 \text{ kilometers}}{1 \text{ mile}} \right) \left(\frac{1000 \text{ meters}}{1 \text{ kilometer}} \right) = \frac{1.61 \cdot 1000 \text{ meters}}{1} = 1610 \text{ meters}$$

9.

$$1 \text{ mile} = \frac{1 \text{ mile}}{1} \left(\frac{5280 \text{ feet}}{1 \text{ mile}} \right) \left(\frac{1 \text{ meter}}{3.28 \text{ feet}} \right) = \frac{5280 \text{ meters}}{3.28} = 1610 \text{ meters}$$

10.

$$500 \text{ slugs} = \frac{500 \text{ slugs}}{1} \left(\frac{14.6 \text{ kg}}{1 \text{ slug}} \right) \left(\frac{1 \text{ metric ton}}{1000 \text{ kg}} \right) = \frac{500 \cdot 14.6 \text{ metric tons}}{1000} = 7.3 \text{ metric tons}$$