

# Converting Units

***This guide describes a simple, robust way to convert units. It also describes extensions of the method into area, volumes and more complex units.***

## Introduction

Converting units is something that you will need to do regularly if you are studying science, medicine or nursing. Different lecturers often describe different methods to convert units. **Remember that if you have a method that already works, this is the method you should use.** This guide is designed to help you if you cannot convert units successfully or often get an incorrect answer. It introduces one method which deals with all kinds of conversions. Here is the method in short (**which is explained in more detail in the following section**):

### The Method:

1. Write down something that you know related to the conversion you are trying to do in the form of an equation.
2. If the number on the left is not equal to 1 multiply both sides of the equation by the appropriate power of ten to make it equal to one.
3. If your units are squares or cubes (or other powers) square or cube both sides of your equation as need be.
4. Multiply both sides of your equation by the amount you need to convert.
5. Rewrite your answer in standard form.

It is important to have an understanding of what a unit actually is. In science there are seven basic units used for measuring the world and these are called the **SI units** (see factsheet: [SI Units](#) for more details). All other units can be made by combining these seven together in specific ways. Units can cover huge orders of magnitude, for example length may be used to describe the distance between atoms or the distance across a galaxy, and so units regularly have a **prefix** associated with them to accommodate such changes in scale. For

example nanometres are very small but megametres are very big, here “nano” and “mega” are the prefixes to the unit of distance “metres”. A full list of these prefixes is available in the factsheet: [SI Unit Prefixes](#).

In order to use this method successfully you need to be familiar with the laws of indices and specifically how the powers of 10 work. You can find more details in the study guides: [The Laws of Indices](#) and [Powers of 10 and Standard Form](#) but as a reminder remember that:

Multiplying by  $10^n$  is the same as **multiplying** by 1 followed by  $n$  zeroes

For instance  $\times 10^2$  is the same as multiplying by 100,  $\times 10^4$  is the same as multiplying by 10000 and so on.

Multiplying by  $10^{-n}$  is the same as **dividing** by 1 followed by  $n$  zeroes

For instance  $\times 10^{-2}$  is the same as dividing by 100,  $\times 10^{-4}$  is the same as dividing by 10000 and so on.

## The method

This section will outline a robust method to convert units. Let's use the example of converting 120 centimetres to metres to help illustrate the method.

1. You start by writing down something that you know related to the conversion you are trying to perform.

This should be about the prefix (or prefixes) you are dealing with. The example is dealing with centimetres to metres and you can write the **equation**:

$$1 \text{ cm} = 1 \times 10^{-2} \text{ m} \quad (\text{you can get this from the factsheet: } [SI Unit Prefixes](#))$$

Notice that:

- **what you are converting from is on the left** and **what you are converting to is on the right**. You should keep this as a rule.
  - Part of the equation is expressed as a multiple of a power of ten. This helps when you are performing any calculations as you can use the laws of indices.
2. If the number on the left is not equal to 1 multiply both sides of the equation by the appropriate power of ten to make it equal to one.

$$1 \text{ cm} = 1 \times 10^{-2} \text{ m} \quad \text{The number on the left is 1 and so no action is needed here.}$$

3. If your units are squares or cubes (or other powers) square or cube both sides of your equation as need be.

$$1 \text{ cm} = 1 \times 10^{-2} \text{ m} \quad \text{The units are not raised to any power so no action is needed.}$$

4. Multiply both sides of your equation by the amount you need to convert.

Here you have 120 cm and so multiply both sides by 120 to give:

$$120 \text{ cm} = 120 \times 10^{-2} \text{ m}$$

So 120 cm is the same as  $120 \times 10^{-2} \text{ m}$ . **At this stage you have completed the conversion but you often have to express your answer as standard form.**

5. Rewrite your answer in standard form.

The study guide: [Powers of 10 and Standard Form](#) has methods for this and you should find that  $120 \text{ cm} = 120 \times 10^{-2} \text{ m} = 1.2 \times 10^0 \text{ m}$  in standard form.

*Example:* Convert 0.25 g to mg. (Convert 0.25 grams to milligrams.)

1. Write down something that you know related to the conversion you are trying to perform.

$$1 \times 10^{-3} \text{ g} = 1 \text{ mg} \quad (\text{from the factsheet: } \a href="#">SI Unit Prefixes)$$

Grams on the left and milligrams on the right.

2. If the number on the left is not equal to 1 multiply both sides of the equation by the appropriate power of ten to make it equal to one.

Multiplying by  $1 \times 10^3$  gives 1 on the left and so:

$$1 \text{ g} = 1 \times 10^3 \text{ mg}$$

3. If your units are squares or cubes (or other powers) square or cube both sides of your equation as need be.

$$1 \text{ g} = 1 \times 10^3 \text{ mg} \quad \text{The units are not raised to any power so no action is needed.}$$

4. Multiply both sides of your equation by the amount you need to convert.

Here you have 0.25 g and so multiply both sides by 0.25 to give:

$$0.25 \text{ g} = 0.25 \times 10^3 \text{ mg}$$

So 0.25 g is the same as  $0.25 \times 10^3 \text{ mg}$ .

5. Rewrite your answer in standard form.

$$0.25 \text{ g} = 0.25 \times 10^3 \text{ mg} = 2.5 \times 10^2 \text{ mg} \text{ in standard form.}$$

*Example:* Convert 300 000 mJ to kJ. (Convert 300 000 millijoules to kilojoules.)

1. Write down something that you know.

$$1 \times 10^6 \text{ mJ} = 1 \text{ kJ} \quad (\text{from the factsheet: } \textit{SI Unit Prefixes})$$

Millijoules on the left and kilojoules on the right.

2. If the number on the left is not equal to 1 multiply both sides of the equation by the appropriate power of ten to make it equal to one.

Multiplying both sides by  $1 \times 10^{-6}$  gives 1 on the left and so:

$$1 \text{ mJ} = 1 \times 10^{-6} \text{ kJ}$$

3. If your units are squares or cubes (or other powers) square or cube both sides of your equation as need be.

$$1 \text{ mJ} = 1 \times 10^{-6} \text{ kJ} \quad \text{The units are not raised to any power so no action is needed.}$$

4. Multiply both sides of your equation by the amount you need to convert.

Here you have 300 000 mJ and so multiply both sides by 300 000 to give:

$$300\,000 \text{ mJ} = 300\,000 \times 10^{-6} \text{ kJ}$$

So 300 000 mJ is the same as  $300\,000 \times 10^{-6}$  kJ.

5. Rewrite your answer in standard form.

$$300\,000 \text{ mJ} = 300\,000 \times 10^{-6} \text{ kJ} = 3 \times 10^{-1} \text{ kJ in standard form.}$$

*Example:* Convert  $120 \text{ cm}^2$  to  $\text{m}^2$ .

1. Write down something that you know related to the conversion you are trying to perform. If you have power associated with your unit ignore them to start with:

$$1 \text{ cm} = 1 \times 10^{-2} \text{ m} \quad (\text{from the factsheet: } \textit{SI Unit Prefixes})$$

2. If the number on the left is not equal to 1 multiply both sides of the equation by the appropriate power of ten to make it equal to one.

$$1 \text{ cm} = 1 \times 10^{-2} \text{ m} \quad \text{The number on the left is 1 and so no action is needed here.}$$

3. If your units are squares or cubes (or other powers) square or cube both sides of your equation as need be.

You are converting a unit which is squared and so square both sides of the equation.

$$(1 \text{ cm})^2 = (1 \times 10^{-2} \text{ m})^2$$

Opening the brackets by applying the laws of indices you get:

$$1 \text{ cm}^2 = 1 \times 10^{-4} \text{ m}^2$$

4. Multiply both sides of your equation by the amount you need to convert.

Here you have  $120 \text{ cm}^2$  and so multiply both sides by 120 to give:

$$120 \text{ cm}^2 = 120 \times 10^{-4} \text{ m}^2$$

So  $120 \text{ cm}^2$  is the same as  $120 \times 10^{-4} \text{ m}^2$ . Notice that this conversion is not the same as the one in the first example in this guide. This is because you square the unit. Errors in this type of conversion are very common.

5. Rewrite your answer in standard form.

$$120 \text{ cm}^2 = 120 \times 10^{-4} \text{ m}^2 = 1.2 \times 10^{-2} \text{ m}^2$$

*Example:* Convert  $120 \text{ cm}^3$  to  $\text{m}^3$ .

1. Write down something that you know related to the conversion you are trying to perform. If you have power associated with your unit ignore them to start with:

$$1 \text{ cm} = 1 \times 10^{-2} \text{ m} \quad (\text{from the factsheet: } \textit{SI Unit Prefixes})$$

2. If the number on the left is not equal to 1 multiply both sides of the equation by the appropriate power of ten to make it equal to one.

$$1 \text{ cm} = 1 \times 10^{-2} \text{ m} \quad \text{The number on the left is 1 and so no action is needed here.}$$

3. If your units are squares or cubes (or other powers) square or cube both sides of your equation as need be.

You are converting a unit which is cubed and so cube both sides of the equation.

$$(1 \text{ cm})^3 = (1 \times 10^{-2} \text{ m})^3$$

Opening the brackets by applying the laws of indices you get:

$$1 \text{ cm}^3 = 1 \times 10^{-6} \text{ m}^3$$

4. Multiply both sides of your equation by the amount you need to convert.

Here you have  $120 \text{ cm}^3$  and so multiply both sides by 120 to give:

$$120 \text{ cm}^3 = 120 \times 10^{-6} \text{ m}^3$$

So  $120 \text{ cm}^3$  is the same as  $120 \times 10^{-6} \text{ m}^3$ . Again, notice that this conversion is not the same as the one in the first example in this guide or the previous example. This is because you cube the unit. Errors in this type of conversion are also very common.

5. Rewrite your answer in standard form.

$$120 \text{ cm}^3 = 120 \times 10^{-6} \text{ m}^3 = 1.2 \times 10^{-4} \text{ m}^3$$

## Want to know more?

If you have any further questions about this topic you can make an appointment to see a [Learning Enhancement Tutor](#) in the [Student Support Service](#), as well as speaking to your lecturer or adviser.

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