



1 Making measurements

This unit covers:

- quantities and measurement
- quantities and units
- density.

Exercise 1.1 Quantities and how they are measured

This exercise checks that you understand some of the important words we use when we take measurements in physics.

- 1 John wanted to measure the length of a block of wood. He used a ruler. In his notebook, he wrote:

length of block = 22.4 cm

- a Complete the third column in the table using information from the text above.

Term	Definition	Example from text above
quantity	something that can be measured	
measuring instrument	a device used to measure a quantity	
value	the result of measuring a quantity	

- b The value of a quantity has both a number and a unit. What is the unit of length in the text above?
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- 2 We use different measuring instruments to measure different quantities.

- a Complete the first two columns of the following table using the words from the list.

temperature	ruler	measuring cylinder	clock	volume
length	time	thermometer		



Measuring instrument	Quantity measured	Unit

b In the third column of the table, write the unit name for each quantity.

c Turn each row of the table into a sentence. Here is an example:

A ruler is used to measure length in centimetres.

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3 In her notebook, Siti described how she measured the volume of a pebble. She didn't use appropriate scientific words. She wrote:

We filled a water cylinder half-way up. We wrote down the amount it said. To find out how big the pebble was, we put it under the water and wrote down the new amount. We worked out the difference between the two amounts.

Rewrite Siti's description. Use words from this list to replace some of Siti's words.

immersed calculated volume measuring cylinder
half-filled recorded determine

Use words from this list to help give structure to your description.

First, Next, After that, Then, Finally,

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Exercise 1.2 Quantities and units

In this exercise, you will practise using ideas about quantities and units.

In physics, it is important to record measurements correctly. Remember that each value has two parts:

- a number
- a unit.

1 Read the text below. Draw a circle around each value mentioned.

It was a hot day – over 30°C . We had to walk 5 km to get home. It took 2 h because we kept stopping for water. I drank more than 1.5 dm^3 . I had to carry a box with 10 kg of tins of food inside it.

2 Complete the table to show the quantities that are mentioned in the text and their values. In the third column, write the full name of each unit. The first row has been done for you.

Quantity	Value	Unit
temperature	30	degree Celsius ($^{\circ}\text{C}$)

3 Scientists usually use standard units called SI units. Metres, kilograms and seconds are examples of SI units.

Each unit has a symbol, for example 'g' stands for grams – by this we mean 'g' represents or means 'grams'.

The size of a unit can be changed by adding a prefix in front of the symbol. For example, 'k' stands for 'kilo-', which means one thousand. A kilogram (kg) is one thousand grams.

Take care! The letter 'm' can stand for a unit. It can also stand for a prefix.

a In the unit cm, what does the prefix 'c' stand for?

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b What unit is represented by 'm'?

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- c** What does 'm' stand for when it is a prefix, for example in 'ms'?
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- d** What does the symbol 'mm' stand for?
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- e** Give the names and symbols for two units of mass.
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- f** Give the names and symbols for two units of length which are smaller than a metre.
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- g** What does the symbol 'ms' stand for?
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- h** Which is bigger, 1 ms or 1 μ s?
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- i** What quantity can be measured in m^3 and cm^3 ?
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Exercise 1.3 Measuring density

The idea of density allows us to compare different materials. In everyday life, we might say, 'Steel is heavier than plastic'. In science, we say, 'Steel is denser than plastic'. If we take one centimetre cubed of steel and the same volume of plastic, the steel will have a greater mass. Take care! We have to think about mass (g or kg), not weight.

- 1** The density of water is 1 g/cm^3 . We say, 'one gram per centimetre cubed'. The word 'per' means 'for each'. This is shown by the solidus (/) in the unit.
- a** We can write: density of water = 1000 kg/m^3 . Write this in words.
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- b** We can write: the density of water is one kilogram per decimetre cubed. Write this unit in symbols.
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- If we think about the unit of density, this will help us to see how to calculate density.
- c** What quantity is measured in grams?
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d What quantity is measured in centimetres cubed?

e Think about the unit of density, g/cm^3 . This will help you to decide which of the following is the correct equation for calculating density. Draw a circle around it.

density = mass \times volume density = $\frac{\text{volume}}{\text{mass}}$ density = $\frac{\text{mass}}{\text{volume}}$

If we know the densities of two or more materials, we can compare them using *adjectives*.

Adjectives are used to describe nouns, or 'things'. To compare two nouns, you need to use the **comparative** form of the adjective. For example, *longer* is the comparative form of *long*. It is followed by *than*.

This is a *long* book. It is *longer* than the Chemistry book.

We can also use the **superlative** form of the adjective when we mean something is the 'most'. *Longest* is the superlative form of *long*. In general, to make a superlative we use *-est* for small words like 'long', or *most* for longer words like 'expensive'.

If an adjective ends with 'y', we use *-ier* and *-iest* to make the comparative and superlative.

This book is the *longest* in the bookshop. Also, it is the *most expensive*.

2 In each example below, there are three sentences. Underline the adjective in the first sentence. Then fill the gaps in the second and third sentences using the comparative and superlative forms of the adjective. The first has been done for you.

Hydrogen is a light gas. It is *lighter* than helium. It is the *lightest* gas in the Periodic Table.

- a** John is lifting heavy weights. The red weight is than the blue one. The green one is the weight of all.
- b** Today we have experienced high winds. The wind today has been than yesterday. Tomorrow we will experience the winds this month.
- c** The pressure is low today. Tomorrow it is forecast to be The pressures are usually during the winter.
- d** Gold is a dense metal. It is than silver. Osmium is the metal in the Periodic Table.



3 This table shows the densities of some different metals. Use the information in the table to answer the questions that follow.

Material	Density (kg/m^3)
aluminium	2700
copper	8900
lead	11 300
steel	7700
tin	7300

- a** Which is the densest metal?
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- b** Is copper denser or less dense than steel?
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- c** Density can be 'high' or 'low'. Which metal has the lowest density?
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- d** Is the density of tin higher or lower than the density of steel?
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- e** Which metal has a lower density than tin?
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- f** Density of gold = $19\,300\text{ kg/m}^3$; density of silver = $10\,500\text{ kg/m}^3$; density of platinum = $21\,400\text{ kg/m}^3$. Write different sentences comparing these metals.
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4 Here are the instructions for measuring the density of a piece of steel.

- Fill a measuring cylinder halfway with water.
- Record the volume of the water.
- Find the mass of the cylinder.
- Immerse the steel in the water.



- Record the volume of the water again.
- Weigh the cylinder again.

Imagine that you have done this experiment. Rewrite the instructions as a paragraph describing what you did. The first sentence has been done for you.

First, we filled a measuring cylinder halfway with water. Next,

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This is a good way to describe an experiment. However, an even better way is with the **passive voice** in the **simple past**. This is how a scientist would describe an experiment.

How do we make a sentence passive?

There are three simple steps. Here is an active sentence:

We recorded the volume of water again.

To make this active sentence passive:

- 1 Find the object of the sentence. The object is the 'thing' that the verb is acting on: *the volume of water*. This becomes the subject of the new sentence.
- 2 Choose between *was* or *were*. You use *was* if the object is singular and *were* if it is plural. So in this case: *was*.
- 3 Next, use the **past participle** of the verb. When you see three forms of a verb given – such as *take/took/taken* – the past participle is the third form. The past participle of *to record* is: *recorded*.

This gives you the passive sentence:

The volume of water was recorded again.

We use the passive voice in science because *what is happening* is more important than who is doing the action.



- 5 Now, rewrite the paragraph you wrote for question 4. This time, use the passive voice in the simple past. The first sentence has been done for you.

First, a measuring cylinder was filled halfway with water. Next,

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