Converting units

R1, N13 · Ratio, proportion and rates of change · revision notes

You must convert between metric units of length, mass and capacity, between units of time, area and volume, and between currencies or imperial units using a given rate. Conversions are often one step inside a bigger problem, so a slip here can cost you the final accuracy mark.

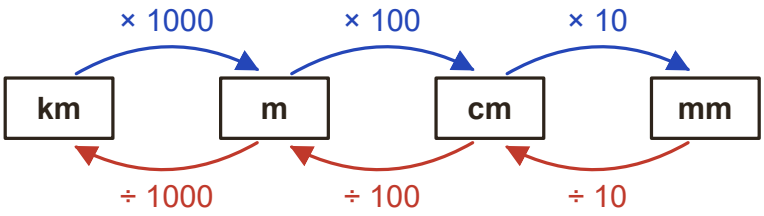
Key facts

- 10 mm = 1 cm, 100 cm = 1 m, 1000 m = 1 km
- 1000 ml = 1 litre; 1 cm^3 = 1 ml; 1000 cm^3 = 1 litre
- 1 m^3 = 1 000 000 cm^3 = 1000 litres
- 1 hour = 60 minutes = 3600 seconds
- 1000 g = 1 kg, 1000 kg = 1 tonne
- 1 cm^2 = 100 mm^2; 1 m^2 = 10 000 cm^2
- To a smaller unit: multiply. To a bigger unit: divide
- Grade 5+ only 1 g/cm^3 = 1000 kg/m^3

Notes

Metric units

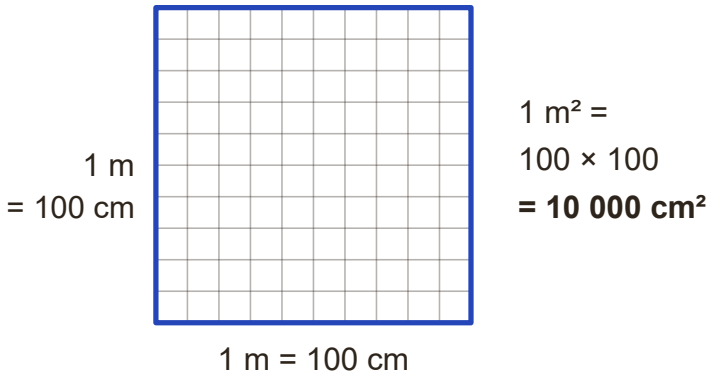
- Length: 10 mm = 1 cm, 100 cm = 1 m, 1000 m = 1 km.
- Mass: 1000 g = 1 kg, 1000 kg = 1 tonne.
- Capacity: 1000 ml = 1 litre (and 100 cl = 1 litre).
- Going to a smaller unit, multiply (you need more of them); going to a bigger unit, divide. 3.4 km = 3400 m and 250 g = 0.25 kg.



Multiply to go to a smaller unit (right); divide to go to a bigger unit (left).

Area, volume and capacity

- Area units are squared, so square the length factor: 1 m = 100 cm, so 1 m^2 = 100 × 100 = 10 000 cm^2. Also 1 cm^2 = 100 mm^2.

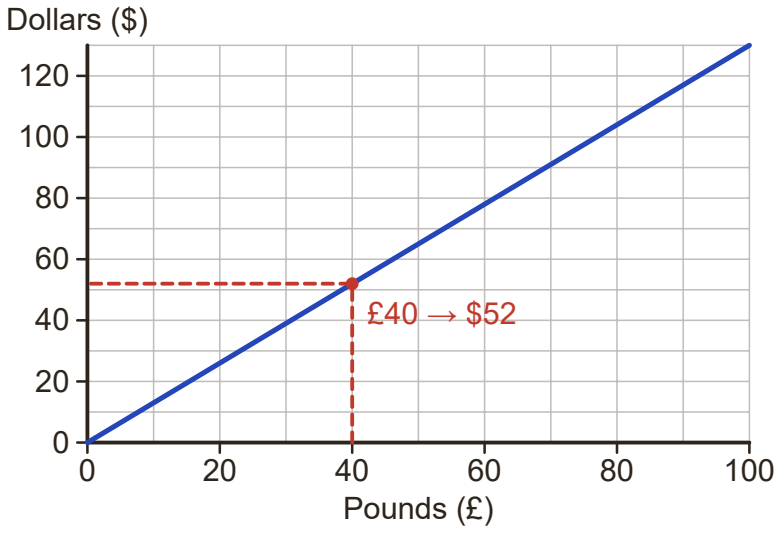


Each small square is 10 cm by 10 cm = 100 cm². There are 100 of them, so 1 m² = 100 × 100 = 10 000 cm².

- Volume units are cubed: 1 m^3 = 100 × 100 × 100 = 1 000 000 cm^3, and 1 cm^3 = 1000 mm^3.
- Volume and capacity: 1 cm^3 = 1 ml, 1000 cm^3 = 1 litre and 1 m^3 = 1000 litres.
- Example: a box measuring 50 cm by 40 cm by 30 cm holds 60 000 cm^3 = 60 litres.

Time, money and other units

- 60 seconds = 1 minute, 60 minutes = 1 hour, 24 hours = 1 day, 365 days = 1 year (366 in a leap year).
- Time is not decimal: 0.1 hour = 6 minutes, so 2.7 hours = 2 hours 42 minutes.
- Exchange rates: if £1 = $1.30, multiply by 1.3 to change pounds to dollars and divide by 1.3 to change back, so $91 = £70.
- Imperial units (miles, pounds (lb), pints): the conversion is given, e.g. 5 miles ≈ 8 km. Use it like a ratio: 40 miles ≈ 64 km.
- Conversion graphs: work out what one small square is worth. For a value off the graph, read a smaller value and multiply (only if the line goes through (0, 0)).



£1 = $1.30: read up from £40 to the line, then across to $52.

Compound and algebraic units Grade 5+ only

- Convert one unit at a time: 3 litres per second = 3 × 3600 = 10 800 litres per hour = 10.8 m^3 per hour.
- Density: 1 g/cm^3 = 1000 kg/m^3.
- The same rules work with letters: x m^2 = 10 000x cm^2, and v km/h = $\frac{5v}{18}$ m/s.

How to answer each type of question

M = method mark, A = answer mark, B = a mark on its own, C = a communication mark.

Convert metric units and times

1 to 2 marks | Grade 2

1. Decide if you are going to a smaller unit (multiply) or a bigger unit (divide).
2. Use the right factor: 10, 100 or 1000 for metric units; 60 for time.
3. For decimal hours, multiply the decimal part by 60 to get the minutes.

Example. (a) Change 4.6 kg into grams.
(b) Change 3.25 hours into hours and minutes.

Model answer.

(a) 4.6 × 1000 = 4600 g (B1)

(b) 0.25 × 60 = 15, so 3 hours 15 minutes (B1)

Compare prices using an exchange rate

3 marks | Grade 4

1. Convert one price into the other currency: multiply to go from pounds to the other currency, divide to come back.
2. Compare the two prices in the same currency.
3. Write a conclusion that names the cheaper place and quotes both prices.

Example. A pair of trainers costs £72 in London.
The same trainers cost €85 in Paris.
The exchange rate is £1 = €1.16
In which city are the trainers cheaper?
You must show how you get your answer.

Model answer.

72 × 1.16 (M1)

= €83.52 (A1)

London is cheaper, because €83.52 is less than €85 (C1)

(Or 85 ÷ 1.16 = £73.28, which is more than £72.)

Convert area units

2 marks | Grade 5

1. Square the length conversion: 1 m = 100 cm, so 1 m^2 = 100 × 100 = 10 000 cm^2.
2. Multiply to go to the smaller unit; divide to go to the bigger unit.
3. Sense check: an area in cm^2 is a much bigger number than the same area in m^2.

Example. The top of a table has an area of 1.8 m^2.
Write this area in cm^2.

Model answer.

1.8 × 10 000, or 1.8 × 100 × 100 (M1)

= 18 000 cm^2 (A1)

Find a capacity from a volume

3 marks | Grade 5

1. Change all the lengths into the same unit (usually cm).
2. Work out the volume.
3. Use 1000 cm^3 = 1 litre (or 1 m^3 = 1000 litres).

Example. A tank is a cuboid measuring 1.2 m by 80 cm by 50 cm.
How many litres of water does the tank hold when it is full?

Model answer.

120 × 80 × 50 (M1)

= 480 000 cm^3, and 480 000 ÷ 1000 (M1)

= 480 litres (A1)

Convert a rate into different units

3 marks | Grade 5

1. Change one unit at a time and write the new units after each step.
2. Per second to per hour: × 3600. Litres to m^3: ÷ 1000.
3. Check the size: a rate per hour should be a much bigger number than the same rate per second.

Example. A pump removes water from a flooded cellar at a rate of 2.5 litres per second.
Work out this rate in m^3 per hour.

Model answer.

2.5 × 3600 = 9000 litres per hour (M1)

9000 ÷ 1000 (M1)

= 9 m^3 per hour (A1)

Don’t lose marks

- Using 1 m^2 = 100 cm^2 (it is 10 000 cm^2), or 1 m^3 = 1000 cm^3 (it is 1 000 000 cm^3).
- Treating time as decimal: 1.5 hours is 1 hour 30 minutes, not 1 hour 50 minutes.
- Multiplying by an exchange rate when you should divide: check which currency you are changing into.
- Working out a volume with the lengths in different units.
- Mixing up 1 litre = 1000 cm^3 with 1 m^3 = 1000 litres.

More tips

Memory tricks

- The prefix tells you the factor: kilo = 1000, centi = $\frac{1}{100}$, milli = $\frac{1}{1000}$
- Smaller unit, bigger number: if you change to a smaller unit and get a smaller number, you divided when you should have multiplied.
- Picture a 1 m square: it is 100 cm by 100 cm, so its area is 10 000 cm^2, not 100 cm^2.
- For rates, change one unit at a time and write the new units after every step.

Exam technique

- Write the unit with every answer, especially when the question has changed units.
- In 'which is cheaper' questions, convert to one currency, show both amounts and write a clear conclusion.
- Use any conversion given in the question (e.g. 1 hectare = 10 000 m^2) exactly as given.
- On a conversion graph, work out the value of one small square before you read off a value.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 2 — **Convert metric units of length, mass and capacity**
Multiply or divide by 10, 100 or 1000, e.g. 3.4 km = 3400 m.

Grade 2 — **Convert between units of time**
Use 60 seconds in a minute and 60 minutes in an hour, e.g. 2.5 hours = 2 hours 30 minutes.

Grade 3 — **Convert money using an exchange rate**
Multiply by the rate to change pounds into the other currency, and divide to change back.

Grade 3 — **Read and use a conversion graph**
Read across and down carefully, working out the value of one small square first.

Grade 4 — **Use a given metric–imperial conversion**
Treat it as a ratio, e.g. with 5 miles ≈ 8 km, 40 miles ≈ 64 km.

Grade 5 — **Convert area and volume units**
Square or cube the length factor, e.g. 1 m^2 = 100 × 100 = 10 000 cm^2.

Grade 5 — **Convert between volume and capacity**
Use 1 cm^3 = 1 ml and 1000 cm^3 = 1 litre.

Grade 5 — **Convert rates and algebraic quantities between units**
Change one unit at a time, e.g. 2.5 litres per second = 9000 litres per hour = 9 m^3 per hour.

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