Proportion: comparing quantities

A proportion describes the **multiplicative** relationship of one thing to another in terms of **quantity, size, or number**.

You can compare:

- a part to the whole
  "4 out of 12 eggs are white"
  "the proportion of greenhouse gases in the atmosphere is rising"
- part to part (of the whole)
  "for every 4 eggs, there are 8 white eggs"
  "the proportion of sugar to water in soft drink"
- different types of quantities
  "you walk 5 km (distance) for each one hour (time)"
  "there are 70 people for each square km"

Proportions are everywhere

Proportions are everywhere in maths, science, commerce and so on. For example, you need to reason with proportions to operate successfully in:

- fractions, decimals and percentages
- scale drawing
- probability
- drawing timelines
- interpreting and comparing rates such as speed, density and unit price
- interpreting ratios such as timelines and map scales

Types of proportion scenarios

There are usually two types of proportion scenarios:

- find a missing value
- compare two proportions (not covered here)

Note

The following pages show only **non-algebraic** methods for finding a missing value in scenario involving proportions.

Examples: Find a missing value

Example 1 (you can use your intuition)

A recipe for 10 muffins requires 200 mg of butter.

If we want to make more (or less) than 10 muffins we would need to adjust the recipe–*carefully keeping the proportion of butter to muffins stay the same*.

The proportion given is "200 g of butter for every 10 muffins"

Think: What is 10 muffins multiplied (and/or divided by) to get 20 muffins?

It's probably obvious that we need to double the amount of butter because we doubled the number of muffins.

Did you know?

You can write a proportion in an infinite number of ways. For example, "200 g for each 10 muffins" and "400g for each 20 muffins" describe the **same** proportion**.** For this example, the simplest most useful might be "1 muffin for each 20g of butter"

You can calculate as many different expressions of the same proportion as you like.

number of muffins	10	20	1
butter (g)	200	400	20

Remember
To keep the proportion the same always multiply or divide the quantities by the same number.

Example 2 (not so intuitive)

In the last example it was obvious that we wanted to make double the number of muffins (multiply by 2) given in the recipe.

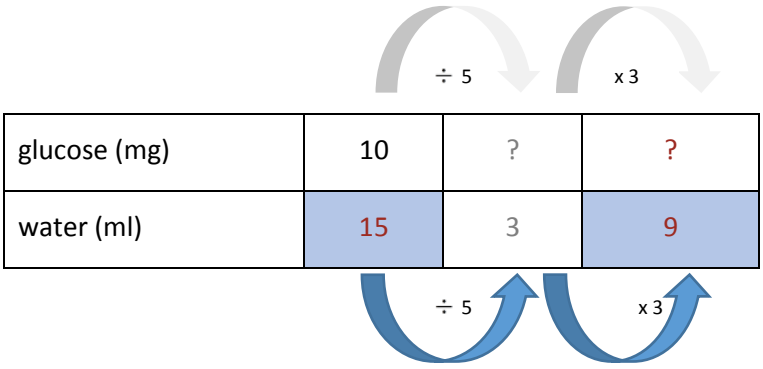
It isn't always obvious what to multiply or divide the original amount by do to get the new amount.

Here is the example:

If 10 mg of glucose is mixed with 15 mL of water, how many milligrams of glucose are needed to mix with 9 mL of water?

Think: What has 15 ml of water been multiplied (and/or divided by) to get 9 ml? You might need to use the table to play around.

Method 1: use a table



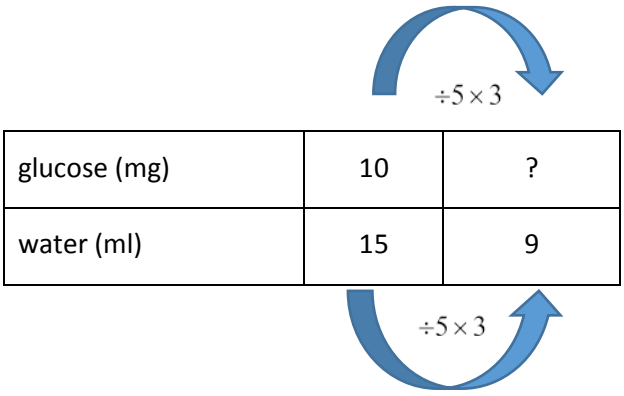
Think: What has 15 ml been multiplied (and/or divided by) to get 9 ml?

Use the table to build up or down from 15 to 9 using only $\div$ *and* $\times$ (shown with blue arrows)

$15\ ml \div 5 \times 3 = 9\ ml$

Then: Repeat the same operations ($\div 5 \times 3$) for glucose (shown with grey arrows).

Alternatively,



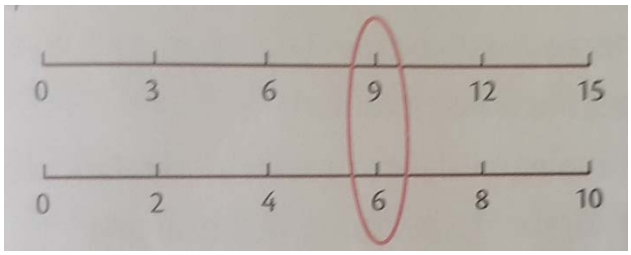
Tip

If you are comfortable using fractions, you could think of $\div 5 \times 3$ as just $\times \frac{3}{5}$

Method 2: Scale comparison

glucose (mg)

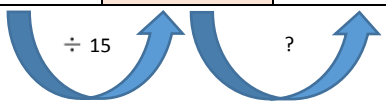
water (ml)



Method 3: Unitary method ('unit' means just 1)

Find how much glucose is needed for each 1 ml of water. You can use the table below or follow the steps shown below the table.

glucose (mg)	10	10/15 (or 2/3)	?
water (ml)	15	1	9



How much glucose is required for each 1 ml of water?

Steps:

1. convert the proportion to amount of glucose needed for 1 ml of water.

Think: How much glucose is required for each 1 ml of water?

The proportion is 10 mg of glucose for each 15 ml of water

$10\ mg \div 15$ and $15\ ml \div 15$

So $\frac{10}{15}$ mg of glucose is needed for each 1 ml of water

2. We now know that $\frac{10}{15}$ mg of glucose is needed for each 1 ml of water

Think: We have 9 ml of water: how much glucose is needed?

$\frac{10}{15} mg \times 9$ and $1\ ml \times 9$

So we need $(10 \div 15 \times 9)$ mg or 6 mg of glucose for 9 ml of water.

For more about proportions see:
vUWS >Improve Your Maths> Numeracy> MESH Module> Week 4 Ratio and rates.