



Rates and ratios

A **ratio** is the comparison of quantities expressed in the same units.

A **rate** is the comparison of quantities that may be expressed in different units (hence you must always specify the units with a rate).

E.g. You can mix concrete with the **ratio** of cement : sand : gravel as 1:2:3

A car travels at the **rate** of 60km/hr (ie 60km : 1hr)

Warning: If we say the ratio of cordial to water is 1:10. This does **not** mean that $\frac{1}{10}$ of the mixture is cordial. Only one part out of a total of 11 parts of the mixture is cordial, hence $\frac{1}{11}$ of the mixture is cordial.

Equivalent ratios

Multiplying or dividing both sides of a given ratio will not change the value of the ratio. So the ratios 15:12 and 5:4 are equivalent. $15:12 = 5:4$

Ratios should always be expressed by using the smallest whole numbers possible.

To simplify 120:12 divide both quantities by 12 giving 10:1.

To simplify $1\frac{1}{2}:2$ multiply both quantities by 2 giving 3:4.

Example

Divide the lotto winnings of \$5000 into the ratio of 2:3

$$2 + 3 = 5$$

$$\$5000 \div 5 = \$1000$$

$$2 \times \$1000:3 \times \$1000$$

$$\$2000:\$3000$$

Add the two parts

Divide the total amount by your answer

Multiply both sides by your answer



Example

Scales on maps are an example of ratios.

On a map drawn with a scale of 1:25000 a line 3cm long would represent a line that is $3 \times 25000\text{cm} = 75000\text{cm} (= 750\text{m})$ in real life.

A fence that is 500m would be drawn on the map as a line that is

$$500 \div 25000 = 0.02\text{m} (= 2\text{cm}) \text{ long.}$$

Rates

A car travels at 50 km/hr. How long will it take to go 350km?

$$350 \div 50 = 7 \text{ hours} \quad \text{Divide the total distance by speed}$$

An ant runs at 0.015m/second how long does it take to run 3 metres?

Hint: Divide the total distance by speed

$$3 \div 0.015 = 200 \text{ seconds} (= 3\text{mins and } 20 \text{ sec})$$

Equivalent rates

Rates can be expressed in different units

Example

A car travels at 72km/h what is the speed in metres per second?

$$72\text{km} : 1\text{hr}$$

$$72 \times 1000\text{m} : 1 \times 60 \times 60 \text{ seconds} \quad \text{Change units}$$

$$72000\text{m} : 3600 \text{ seconds}$$

$$20\text{m} : 1 \text{ second}$$

$$20\text{m/s}$$

Divide both parts by the number of seconds

Exercises

1. Simplify these ratios

(a) 3:27 (b) 0.5:0.25 (c) 24:36 (d) 64:16 (e) $1\frac{3}{4}:\frac{3}{8}$

2. Divide \$700 in the ratio of 4:3

3. Divide 540kg in the ratio of 5:4

4. A map is drawn with a scale of 1:25000. A road is 5km long, how long is it on the map?

5. A model of a new passenger plane is claimed to be made using a scale of 1:100. The model has a wingspan of 23cm. Do you think the claim could be accurate? What would be the wingspan of the real plane?

6. You are mixing cement sand and gravel in the ratio 1:2:3 to make concrete.

(a) You have 3 shovels of cement, how much sand and gravel do you need?

(b) You have 8 shovels of sand, how much cement and gravel do you need?

(c) You have 15 shovels of gravel, how much sand and cement do you need?

7. Convert 120km/hr into a speed in m/s.

8. Convert 2m/second to a speed in km/hr.

Answers

1. (a) 1:9 (b) 2:1 (c) 2:3 (d) 4:1 (e) 14:3

2. \$400:\$300

3. 300kg:240kg

4. 20cm

5. The wingspan of the real plane would be 2.3m. This is not big enough for a passenger plane, so the claim is not accurate.

6. (a) 6 shovels of sand and 9 shovels of Gravel

(b) 4 shovels of cement and 12 shovels of Gravel

(c) 5 shovels of cement and 15 shovels of Gravel

7. 33.3m/s

8. 7.2km/hr