A close-up of a sign

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Task 1

1. A cyclist travels 45 km in 1 hour 30 minutes. What is their average speed in km/h?

45 ÷ 1.5 = **30 km/h**

1. A train travels 120 miles in 2 hours 30 minutes. What is its average speed in mph?

120 ÷ 2.5 = **48 mph**

1. A swimmer covers 400 m in 5 minutes. What is their average speed in m/s?

400 ÷ 300 = **1.33 m/s (3 sf)**

1. A lorry driver travels 275 km in 5 hours. What is their average speed in km/h?

275 ÷ 5 = **55 km/h**

1. A sprinter completes 200 m in 20 seconds. What is their speed in m/s?

200 ÷ 20 = **10 m/s**

1. A car travels at 65 mph for 2 hours 15 minutes. How far does the car travel?

2 hours 15 minutes = 2.25 hours

65 × 2.25 = **146.25 miles**

1. A ship sails at 25 km/h for 3.6 hours. How far does the ship travel?

25 × 3.6 = **90 km**

1. A bus travels 156 miles at a speed of 52 mph. How long does the journey take?

156 ÷ 52 = **3 hours**

1. A cheetah runs 420 m at a speed of 21 m/s. How long does it take?

420 ÷ 21 = **20 seconds**

1. Convert 90 km/h into m/s.

90 × 1000 ÷ (60 × 60) = **25m/s**

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Task 2

1. A block has a mass of 250 g and a volume of 50 cm³. Calculate its density.

250 ÷ 50 = **5 g/cm³**

1. A stone has a density of 3 g/cm³ and a volume of 400 cm³. Work out its mass in kg.

3 × 400 = 1200 g = **1.2 kg**

1. A liquid has a mass of 5.4 kg and a volume of 3 litres. Find its density in g/ml.

5.4 kg = 5400 g

3 litres = 3000 ml

5400 ÷ 3000 = **1.8** **g/ml**

1. A box has a density of 0.8 g/cm³ and a mass of 640 g. Work out the volume of the box.

640 ÷ 0.8 = **800 cm³**

1. A machine exerts a force of 1200 N on the ground with an area of 0.25 m². Calculate the pressure.

1200 ÷ 0.25 = **4800 N/m²**

1. The pressure on the ground from a suitcase is 4000 N/m². The suitcase’s weight has a force of 320 N. Work out the area of contact the suitcase has with the ground.

320 ÷ 4000 = **0.08 m²**

1. A person exerts a force of 600 N on a floor, while standing on two feet. Given, each foot has an area of 0.03 m², calculate the pressure on the floor.

Total area = 0.06 m²

600 ÷ 0.06 = **10,000 N/m²**

1. A force of 600 N acts over an area of 300 cm². Work out the pressure in N/m².

300 cm² ÷ 1002 = 0.03 m²

600 ÷ 0.03 = **20,000 N/m²**

1. A block of metal has a mass of 2.4 kg and a density of 8 g/cm³. Work out the volume in cm³.

2.4 kg = 2400 g

2400 ÷ 8 = **300 cm³**

1. A tank holds 2500 ml of liquid with a density of 1.2 g/ml. Find the mass of the liquid in kilograms.

2500 × 1.2 = 3000 g = **3 kg**

Task 3

1. A train travels 225 km in 3 hours and 45 minutes. Work out the speed of the train in m/s.  
   225 ÷ 3.75 = 60 km/h

60 × 1000 ÷ (60 × 60) = **16.7 m/s (3 sf)**

1. A cube with a side length of 5 cm has a mass of 2.7 kg. Work out its density in g/cm³.  
   Volume = 5³ = 125 cm³

Mass = 2700 g

Density = 2700 ÷ 125 = **21.6 g/cm³ (3 sf)**

1. A rectangular block measures 20 cm × 15 cm × 10 cm. Its mass is 12 kg. Find its density in g/cm³.

Volume = 20 × 15 × 10 = 3000 cm³

Mass = 12,000 g

Density = 12,000 ÷ 3000 = **4 g/cm³**

1. A car tyre has a surface area of 0.04 m² in contact with the road. If the car has a total weight of 12,000 N spread equally across 4 tyres, calculate the pressure each tyre exerts on the road.

Weight per tyre = 3000 N

Pressure = 3000 ÷ 0.04 = **75,000 N/m²**

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1. A diver weighs 800 N. He wears flippers with a total area of 0.12 m². Calculate the pressure he exerts on the seabed to the nearest unit. Compare this with the pressure if he stood barefoot with an area of 0.025 m².

With flippers: 800 ÷ 0.12 = **6667 N/m² (unit)**

Barefoot: 800 ÷ 0.025 = **32,000 N/m²**

Much less pressure with flippers.

1. Sophie cycles 72 km from Oxford to Cambridge. She cycles the first 45 km at an average speed of 18 km/h. The remainder of the journey takes her 1 hour and 10 minutes. Work out Sophie’s average speed for the whole journey. Give your answer to 3 significant figures.

First 45 km at 18 km/h

Time = 45 ÷ 18 = 2.5 h

Remaining distance = 72 − 45 = 27 km

Given time for remainder = 1 h 10 min

Total time = + h

Average speed = 72 ÷

=

= 19.6363…

**19.6 km/h (3 sf)**

1. Daniel swims 1,500 m in 22 minutes and 18 seconds.
2. Work out how long it would take Daniel to swim 3,000 m at the same speed. Give your answer in minutes and seconds.

Convert time to seconds:

(22 × 60) + 18 = 1338 s

At same speed, 3000 m takes double the time:

(2 × 1338) = 2676 s

2676 ÷ 60 = 44.6 minutes

**44 min 36 s**

1. Daniel tires quickly after 2,000 m.  
   How would this affect your answer to part a?

**If speed decreases, time increases. It would take more time.**

Challenge

1. 250 ml of cranberry juice and 350 ml of apple juice are mixed to make a fruit drink. The cranberry juice has a density of 0.9 g/ml. The apple juice has a density of 1.15 g/ml. Work out the density of the fruit drink. Give your answer to 3 decimal places.

Mass of cranberry juice

= 0.9 × 250 = 225 g

Mass of apple juice

= 1.15 × 350 = 402.5 g

Total mass = 225 + 402.5 = 627.5 g

Total volume = 250 + 350 = 600 ml

Density of the fruit drink

= 627.5 ÷ 600

= 1.04583… g/ml

**= 1.046 g/ml (3 dp)**

1. Emma drives a total of miles. She drives the first half of the journey at mph.  
   She drives the second half of the journey at mph. Write a fully simplified expression, in terms of and , for Emma’s average speed for the whole journey.

First half of journey:

time

Second half of journey:

time

Total time

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Average speed

= total distance ÷ total time

1. A mixture is made by combining:

ml of a liquid with density g/ml, and

ml of a liquid with density g/ml.

Write a fully simplified expression for the density of the mixture in terms of , , , and .

Mass from first liquid = a × p

Mass from second liquid = b × q

Total mass = ap + bq

Total volume = a + b

Density of mixture

= (total mass) ÷ (total volume)

**=**