# Y9 Maths Knowledge Organiser Topic 10: Rates of change

| What must I be able to do? | Key vocabulary | |
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| **You may need to revise the following:** <br> • Year 7 Topic 9: Working with units <br> **New content:** <br> ☐ Use the relationship between distance, time and speed <br> ➢ Sparx U151 <br> ☐ Write speed in different units such as km/h, m/min, m/s and cm/s <br> ☐ Convert from one unit of speed to another (e.g. km/h to m/s) <br> ☐ Solve word problems involving speed, uniform speed and average speed <br> ☐ Use the relationship between density, mass and volume to solve problems <br> ➢ Sparx U910 | Speed | A measurement of <u>how fast</u> something is travelling. It involves two other measures, distance and time. |
| | Density | A measurement of <u>how heavy</u> an object is for a <u>given amount</u>. If an object is heavy and small it will have a higher density. |
| | Uniform | A value which <u>does not change</u>. |

## Speed

Speed = distance ÷ time

Speed is usually measured in:

Kilometres per hour      km/h

Miles per hour      mph

Metres per second      m/s

The formula can also be rearranged to give:

Time = distance ÷ speed

Distance = speed x time

Questions involving speed will often talk about 'average speed'. Objects rarely travel at a constant speed and instead speed up and slow down during the journey. To get around this we often use the average speed of the journey instead.

Average speed = total distance ÷ total time

## Converting units of speed

This is usually best done in stages.

e.g. Convert 60 km/h into m/s

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|---|---|---|
| 1000m in a km | 60 km/h = 60,000 m/h | (x 1000) |
| 60 minutes in an hour | 60,000 m/h = 1000 m/min | (÷ 60) |
| 60 seconds in an minute | 1000 m/min = 16.67 m/s (2.d.p.) | (÷ 60) |

## Problem solving with speed

On the first part of the journey a car travels 160 km in 3 hours. On the second part of the journey the car travels at 70km/h for 2 hours. What is the average speed of the journey?

During the second part of the journey the car travels:

Distance = speed x time = 70 x 2 = 140km.

So total distance = 140 + 160 = 300km.

And total time = 3 + 2 = 5 hours.

Average speed = total distance ÷ total time = 300 ÷ 5 = 60 km/h.

## Density

Density is mass ÷ volume

Density is usually measured in:

Kilograms per metre cubed      km/m$^3$

Grams per centimetre cubed      g/cm$^3$

The formula can also be rearranged to give:

Volume = mass ÷ density

Mass = density x volume

## Problem solving with density

Material A has a density of 5.8g/cm$^3$.

Material B has a density of 4.1g/cm$^3$.

377g of Material A and 1.64kg of Material B form Material C.

Work out the density of Material C.

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Volume of Material A = 377 ÷ 5.8 = 65 cm$^3$

Volume of Material B = 1640 ÷ 4.1 = 400 cm$^3$

Total volume of Material C = 65 + 400 = 465 cm$^3$

Total mass of Material C = 377 + 1640 = 2017 g

Density of Material C = 2017 ÷ 465 = 4.34 g/cm$^3$ (2.d.p.)

Density is in grams per cm$^3$ so all mass needs to be in grams
1.64kg = 1640g