

# Y8 Maths Knowledge Organiser Topic 9: Rates of change

|   |   |       |  |         |   |         |  |
|---|---|-------|--|---------|---|---------|--|
| <p><b>What must I be able to do?</b></p> <p>You may need to revise the following:</p> <ul style="list-style-type: none"> <li>• <a href="#">Year 7 Topic 8: Working with units</a></li> </ul> <p><b>New content:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Use the relationship between distance, time and speed                     <ul style="list-style-type: none"> <li>➤ <a href="#">Mathswatch R11a</a></li> </ul> </li> <li><input type="checkbox"/> Write speed in different units such as km/h, m/min, m/s and cm/s</li> <li><input type="checkbox"/> Convert from one unit of speed to another (e.g. km/h to m/s)</li> <li><input type="checkbox"/> Solve word problems involving speed, uniform speed and average speed</li> <li><input type="checkbox"/> Use the relationship between density, mass and volume to solve problems                     <ul style="list-style-type: none"> <li>➤ <a href="#">Mathswatch R11b</a></li> </ul> </li> </ul> | <p><b>Key vocabulary</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Speed</td> <td style="padding: 2px;">A measurement of <u>how fast</u> something is travelling. It involves two other measures, distance and time.</td> </tr> <tr> <td style="padding: 2px;">Density</td> <td style="padding: 2px;">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.</td> </tr> <tr> <td style="padding: 2px;">Uniform</td> <td style="padding: 2px;">A value which <u>does not change</u>.</td> </tr> </table> | 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   | 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

|                       |                                |          |
|-----------------------|--------------------------------|----------|
| 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 hour | 1000 m/min = 16.67 m/s (2d.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  | kg/m <sup>3</sup> |
| Grams per centimetre cubed | g/cm <sup>3</sup> |

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<sup>3</sup>.

Material B has a density of 4.1g/cm<sup>3</sup>.

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<sup>3</sup>

Volume of Material B = 1640 ÷ 4.1 = 400 cm<sup>3</sup>

Total volume of Material C = 65 + 400 = 465 cm<sup>3</sup>

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

Density of Material C = 2017 ÷ 465 = 4.34 g/cm<sup>3</sup> (2d.p.)

➔ Density is in grams per cm<sup>3</sup> so all mass needs to be in grams  
1.64kg = 1640g