Year 9 - Rates

Essential knowledge

Solve speed, distance, time questions • Use distance time graphs • Solve density, mass, volume problems • Solve flow problems • Use flow graphs • Interpret rates of change and their units

Key Vocabulary

Convert: change
Mass: a measure of how much matter is in an object. Commonly measured by weight.
Origin: the coordinate (0, 0)
Volume: the amount of 3D space a shape takes up
Substitute: putting numbers where letters are – replacing numbers into a formula

Prior learning links

Year 8 – Ratio and scale

Year 8 – Multiplicative change

Density, Mass, Volume

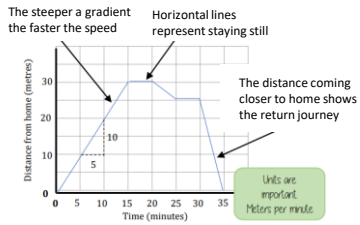
$$density = \frac{mass}{volume}$$

$$volume = \frac{mass}{density}$$

$$\text{mass} = \text{volume} \times \text{density}$$

Distance-Time Graphs

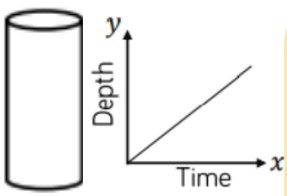
$$gradient = speed$$



Flow Problems and Graphs

This will fill at a constant rate, then as the space decreases it will speed up and the neck of the bottle fill at a faster constant speed

The cylinder will fill at a constant speed



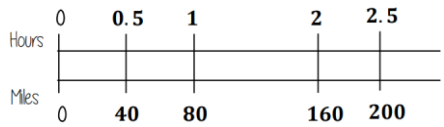
Units are important. Ensure any volume calculations are the same unit as the rate of flow

Speed, Distance, Time

"per" means for every
e.g. 80 miles per hour (mph)
Travel 80 miles every hour

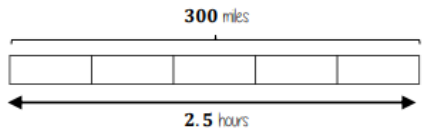
$$speed = \frac{distance}{time}$$

You can use a double number line to help you calculate distance

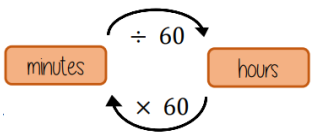


Bar models can help to calculate mph

e.g. A boat travels at a constant speed for 2.5 hours It



Each part is half an hour Each part is 60 miles



Before calculations – make sure you are working in the same units as the speed

Learn or learn how to rearrange the formula for speed, distance and time

$$time = \frac{distance}{speed}$$

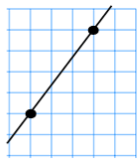
$$\text{distance} = \text{speed} \times \text{time}$$

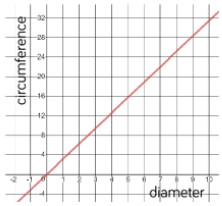
Substitute in the variables given

Year 9- Rates

Prior learning links

The gradient of this line is $\frac{4}{3}$
Use a triangle and the points on the line to explain why.
How is this different to a gradient of $\frac{3}{4}$?





The circumference of a circle is directly proportional to its diameter.

Use the graph to estimate the circumference of a circle with diameter:

- 4 m
- 10 m
- 14 m
- 140 cm
- 0.14 inches

Are these statements true or false?
The graph shows a constant rate of increase.
A circle with a negative diameter has a negative circumference.
All direct proportion graphs go though the origin.

Density, Mass, Volume

A ruby has a density of 4 g per cm^3 (4 g/cm^3)
Complete the table.

Density (g/cm^3)	Mass (g)	Volume (cm^3)
4	4	1
4		2
4		3

Tick the correct formula.

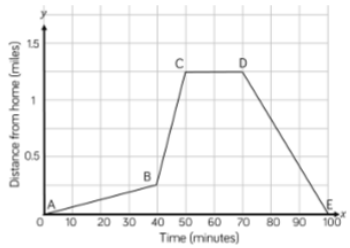
Density = Mass × Volume	Density = $\frac{\text{Mass}}{\text{Volume}}$	Density = $\frac{\text{Volume}}{\text{Mass}}$

The density of tin is 7260 kg/m^3

- Calculate the mass of a piece of tin with a volume of 0.2 m^3
- Calculate the volume of a piece of tin with a mass of 8 kg.

Distance-Time Graphs

Tom sets off from his house. Sometimes he walks, sometimes he runs and at one point he stops for a break.
Match the line segment to the activity.



AB	Running
BC	Stop for a break
CD	Walking at a quick speed
DE	Walking very slowly

Key Vocabulary

Convert:

Mass:

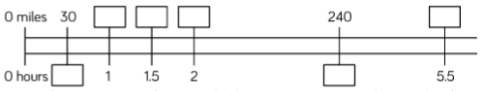
Origin:

Volume:

Substitute:

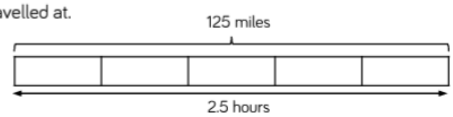
Speed, Distance, Time

A train travels at a constant speed of 60 mph.
Complete the missing information on the double number line.



What else can you work out? Add the information onto the number line.

A tram travels at a constant speed for 2.5 hours.
In this time, the tram travels 125 miles.
Use the bar model to help you work out the speed that the tram travelled at.



Dora says, "To convert minutes into hours, divide by 60".
Mo says, "To convert hours into minutes, multiply by 60".
Are both Dora and Mo correct? Convert the following into hours.

- 8 minutes
- 1 hour and 8 minutes
- 2 hours and 48 minutes

Convert the following into hours and minutes.

- 0.15 hour
- 1.45 hours
- 1.6 hours

- Work out the average speed of an aeroplane which travels 5000 miles in 8 hours and 42 minutes.
- Work out the distance a golden eagle flies, when travelling at a constant speed of 125 km/h for 8 hours and 42 minutes.
- Work out the time it takes for a wasp to travel 1 metre if it travels at a constant speed of 200 metres per minute.