



Gradient and direct proportion

Year 9
Mathematics

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Learning Objectives

By the end of the lesson I hope that you understand and can apply the following to a range of questions from the Year 9 Mathematics course.

- Understand what it means to be proportional
- To know the form of the equation that links two variables that are proportional
- Know what rate of change means
- Know what constant rate of change means



RECAP

The following table in the textbook for Question 8 was really thought provoking. It tested your **understanding** and not your ability to regurgitate. Given two pieces of information, can we find the third missing piece of the puzzle?

Complete this table showing the gradient, x -intercept and y -intercept for straight lines.

	A	B	C	D	E	F
Gradient	3	-1	$\frac{1}{2}$	$-\frac{2}{3}$	0.4	-1.25
x -intercept	-3			6	1	
y -intercept		-4	$\frac{1}{2}$			3



RECAP

In previous lessons we have looked at straight lines and more recently, what the gradient means.

Gradient is a measure of slope and, for straight lines, will be constant for the whole line regardless which two points I choose to measure it.

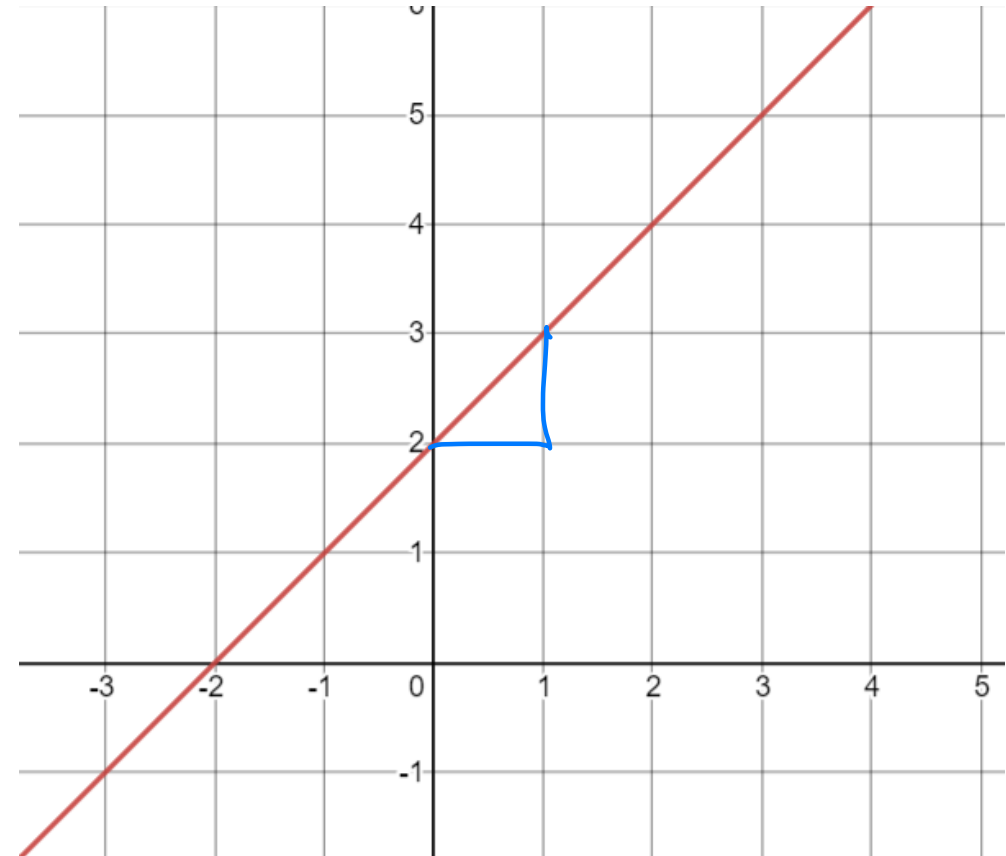
Straight line graphs show **direct proportionality**.

The **rate of change** of the y-value is proportional to the rate of change of the x-value.

So, for things to be proportional they must increase at the same rate.

This is what we're going to look at today.

$$m = \frac{\text{rise}}{\text{run}}$$



Rate of Change

It is important to note the following:

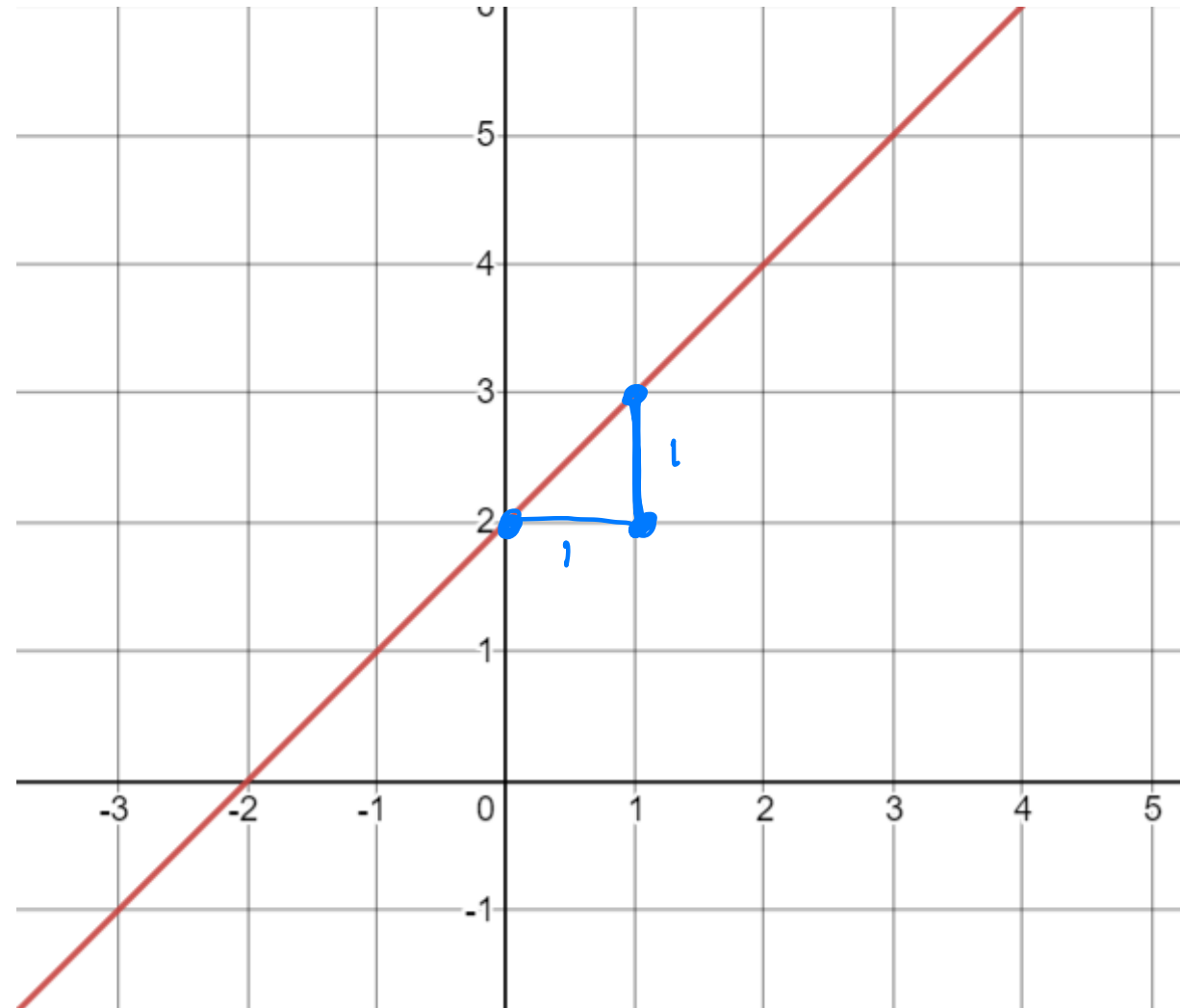
$$\text{Rate of change} = \frac{\text{change in } y \text{ - values}}{\text{change in } x \text{ - values}}$$

Hold on ... this seems to be the same as:

$$\text{Rate of change} = \frac{y_2 - y_1}{x_2 - x_1}$$

Which is the same as the gradient.

And ... Barry strikes again! **Gradient** and **rate of change** are the **same thing**. Sigh.



Average Speed: Direct Proportion

Average speed is a great one as this is a measure of direct proportion.

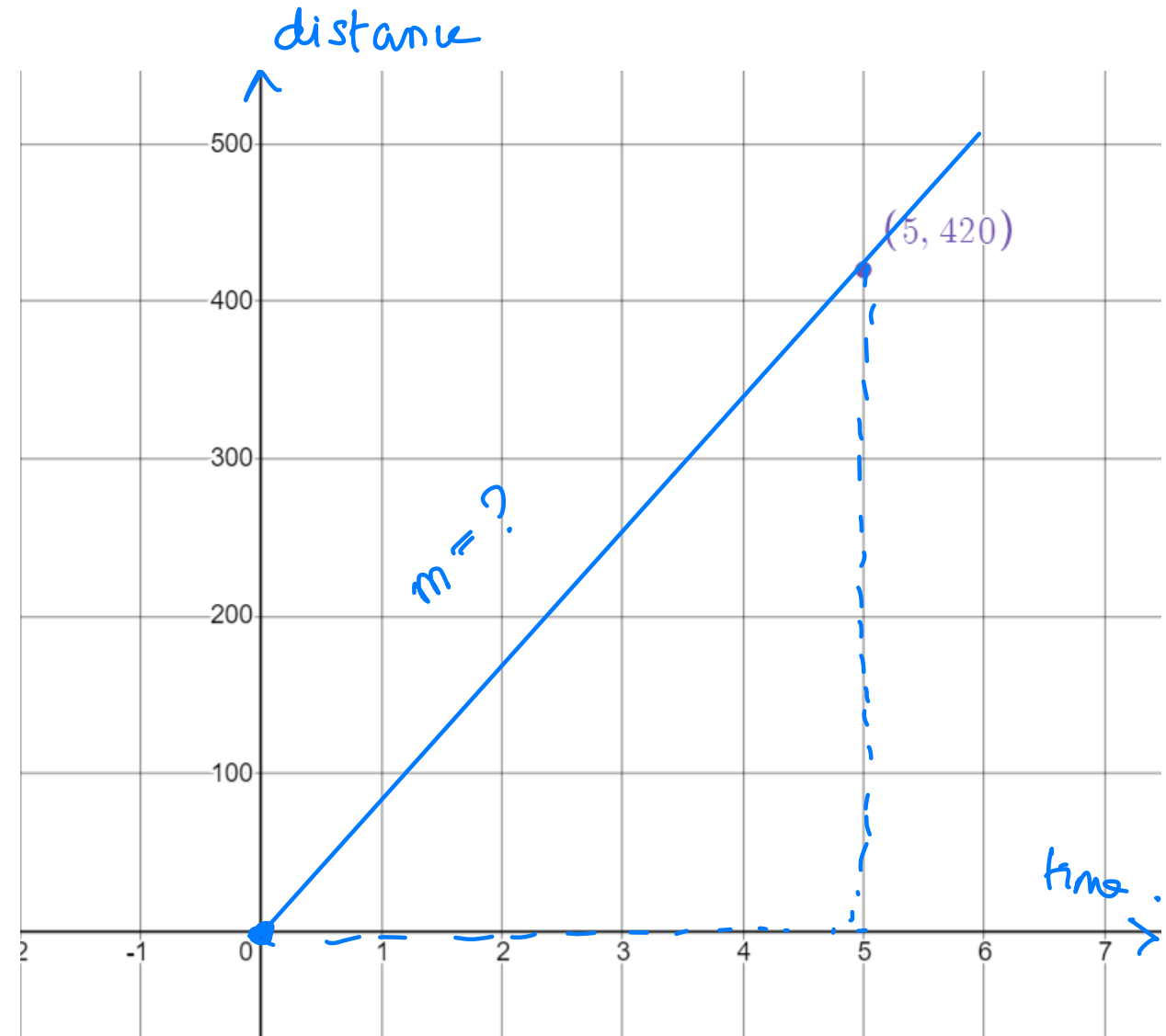
If I travel for 5 hours and cover 420 km I can make an assumption about my trip.

The speed at travel is constant.

I also notice that the information given is a **point on a graph** which allows me to draw straight lines.

It makes sense that, in 2.5 hours I will have travelled 210km. In 1 hour I will have travelled 84 km.

$$m = \frac{420}{5} = \underline{\underline{84}}$$
$$1 \text{ hr} = \underline{\underline{84 \text{ km}}}$$
$$\frac{1}{2} \text{ hr} = \underline{\underline{42 \text{ km}}}$$



Using information from a question to help plot points

The questions you will be looking at will all be direct proportion. The rate of change will be the same. Hence, the question **must** give you one (or two) points to enable you to answer questions (or to draw a graph).

Example:

Water is poured into an empty tank at a constant rate. It takes **3 hours** to fill the tank with **600 litres**.

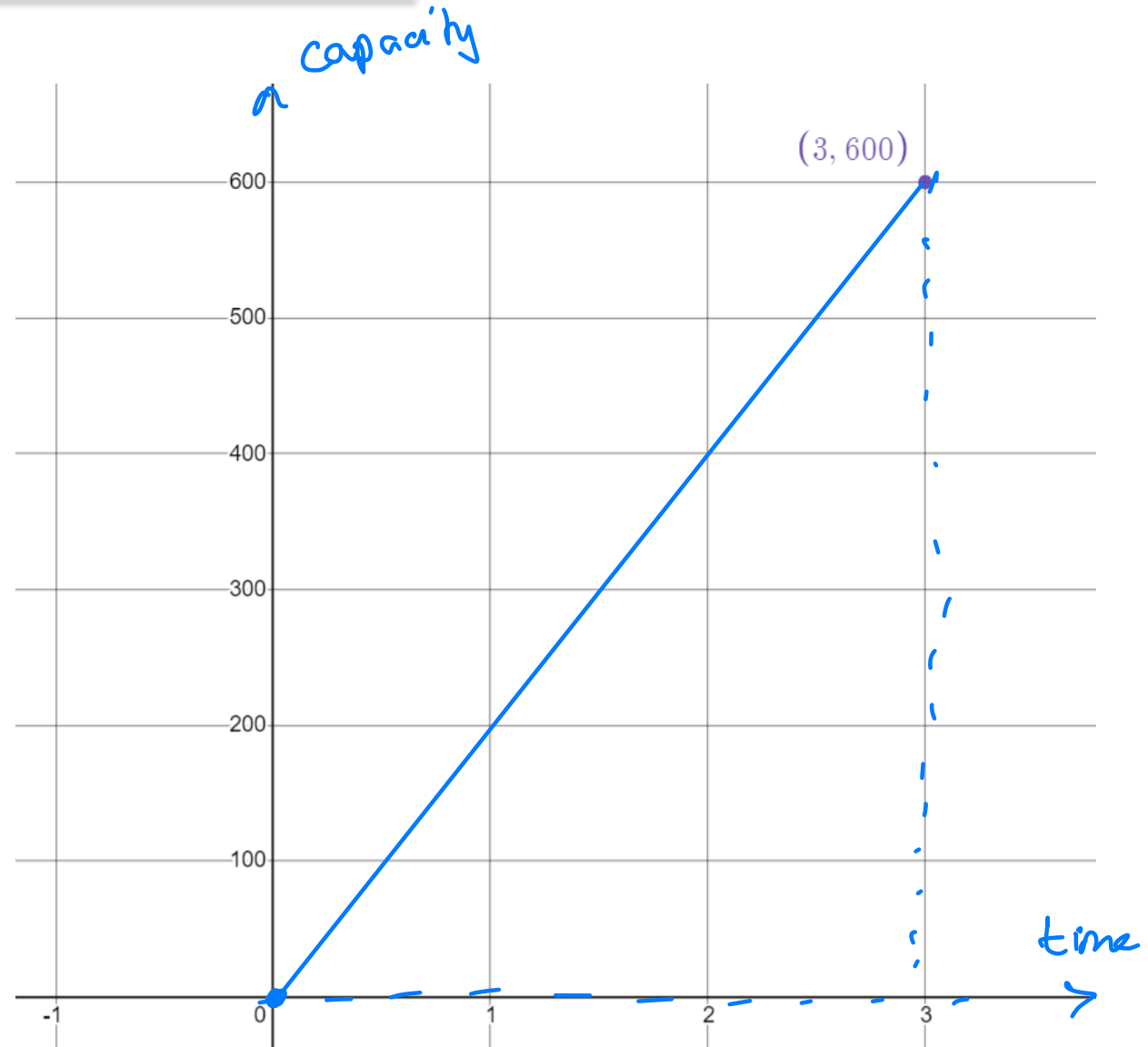
$(3, 600)$

The highlighted parts are a coordinate so I can draw a straight-line graph.

This will allow me to answer other questions.

$$m = \frac{600}{3} = \underline{\underline{200}}$$

$$1 \text{ hr} = \underline{\underline{200 \text{ litres}}}$$

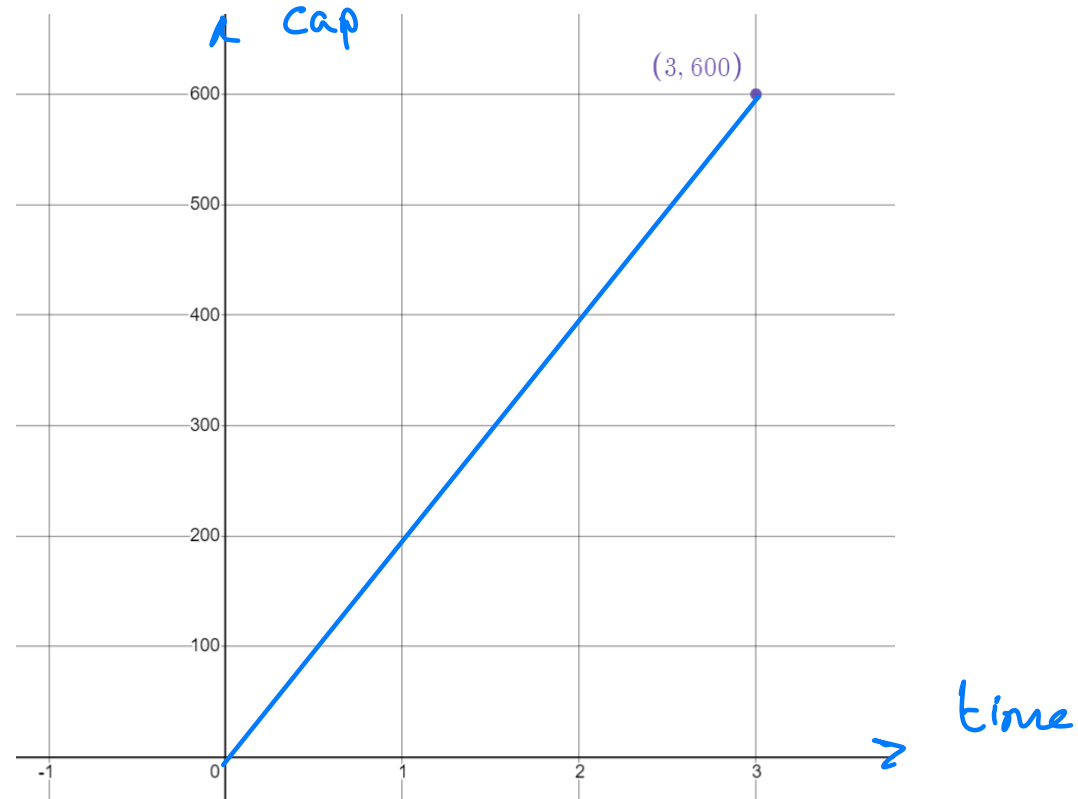


Finding rules from lines

Hopefully it is become clear that the rule for an equation can be gained from the following scaffold:

$$y \text{ variable} = \text{gradient} \times x \text{ - variable} \pm \text{constant}$$

$$\text{Capacity} = 200 \times \text{time}$$



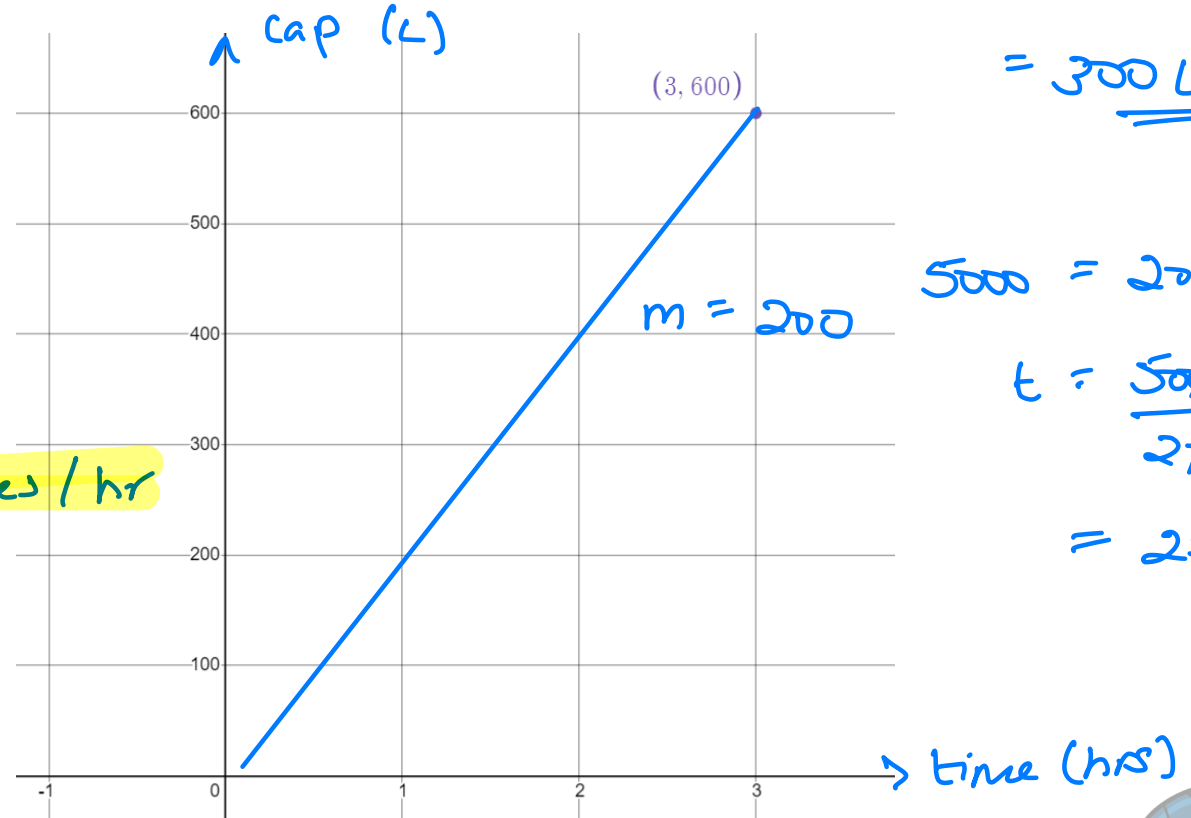
Using information from a question to help plot points

- a What is the rate at which water is poured into the tank?
b Draw a graph of volume (V litres) vs time (t hours) Using $0 \leq t \leq 3$.
c Find:
i the gradient of your graph
ii the rule for V.
d Use your rule to find:
i the volume after 1.5 hours
ii the time to fill 5000 litres.

$$\text{rate} = \frac{600}{3} = 200 \text{ litres/hr}$$

$$m = 200$$

$$0 \leq t \leq 3$$



$$\begin{aligned} \text{Cap} &= 200 \times 1.5 \\ &= \underline{\underline{300 \text{ Litres}}} \end{aligned}$$

$$5000 = 200 \times t$$

$$t = \frac{5000}{200}$$

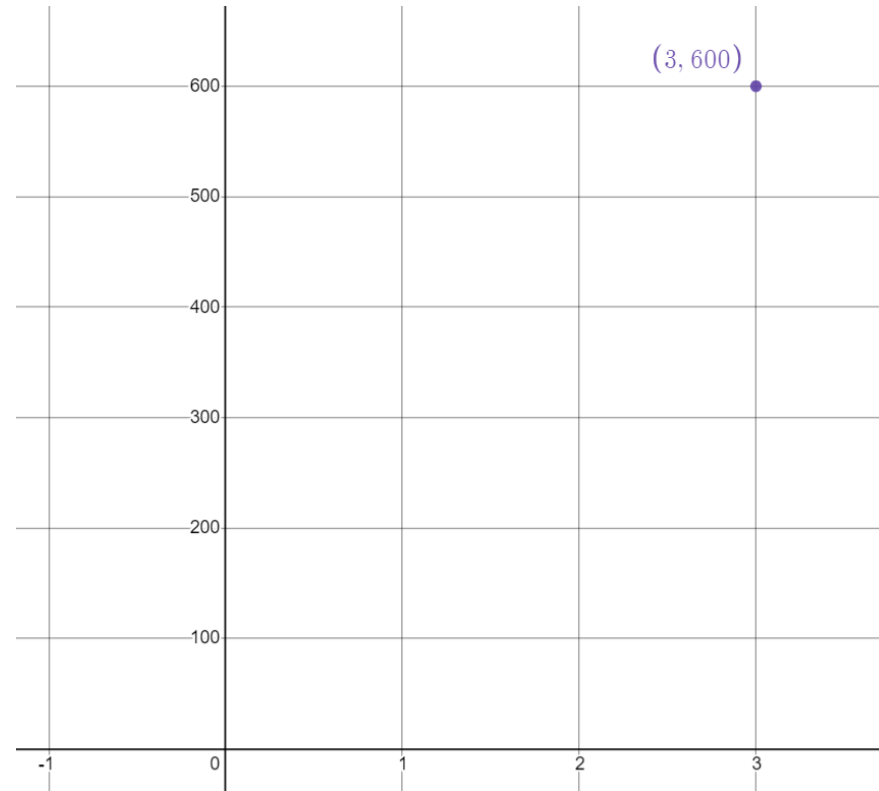
$$= \underline{\underline{25 \text{ hrs}}}$$

$$\text{Cap} = \underline{\underline{200 \times \text{time}}}$$



Using information from a question to help plot points

- a What is the rate at which water is poured into the tank?
- b Draw a graph of volume (V litres) vs time (t hours) Using $0 \leq t \leq 3$.
- c Find:
- i the gradient of your graph
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