

Linear modelling

Year 11 General Maths
Units 1 and 2

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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 Unit 1 and 2 General Mathematics course.

- To be able to construct linear models.
- To be able to interpret and analyse linear models.



Recap

As we move to the end of this module of work we now look at how we can use the work we have been doing and apply it to “real world situations”. The whole point of Mathematics is to use it.

Whilst it’s not possible to “teach” how to solve the problems (as they are so varied) we can look at the basics which apply to each type of problems.

It’s important to note that all the modelling we are going to do is linear; hence, the graphs will always be straight and the equations will always be of the form:

$$y = a + bx$$

int

grad

$$y - 8 = 3x$$

$$y = 8 + 3x$$



Example

Plants generally grow by a fixed amount per time period.

They might grow 3cm per day for example.

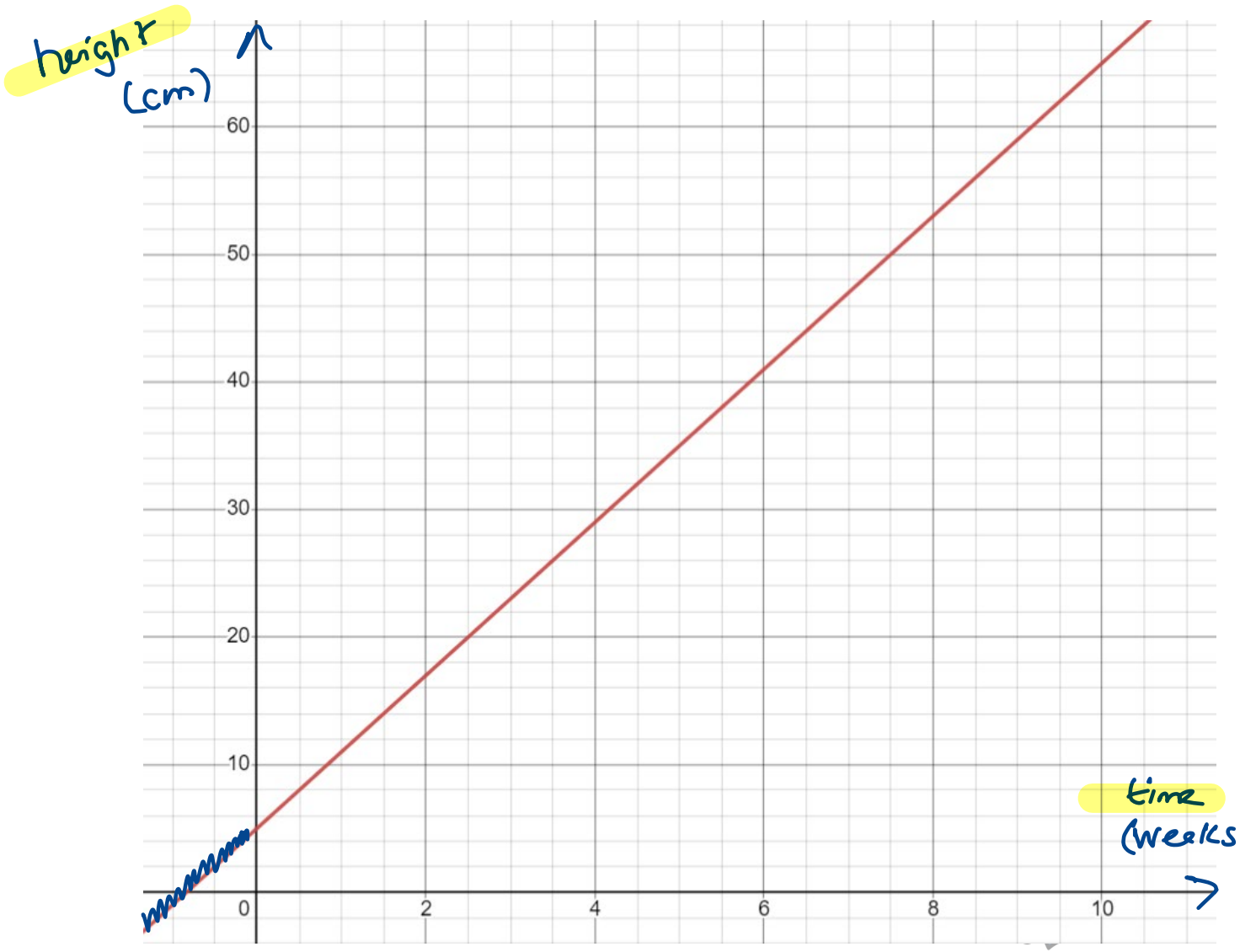
This means we can relate the height of the plant with time.

When we relate things, we can draw them on a set of axes..

Let's imagine that a plant is purchased from a garden centre and starts it's life in a plant plot at 5cm tall. If it grows at 6 cm per week for 10 weeks, we can "model" this using a graph.

$h = \ldots\ldots\ t$

grad /....



Finding the equation of the straight line.

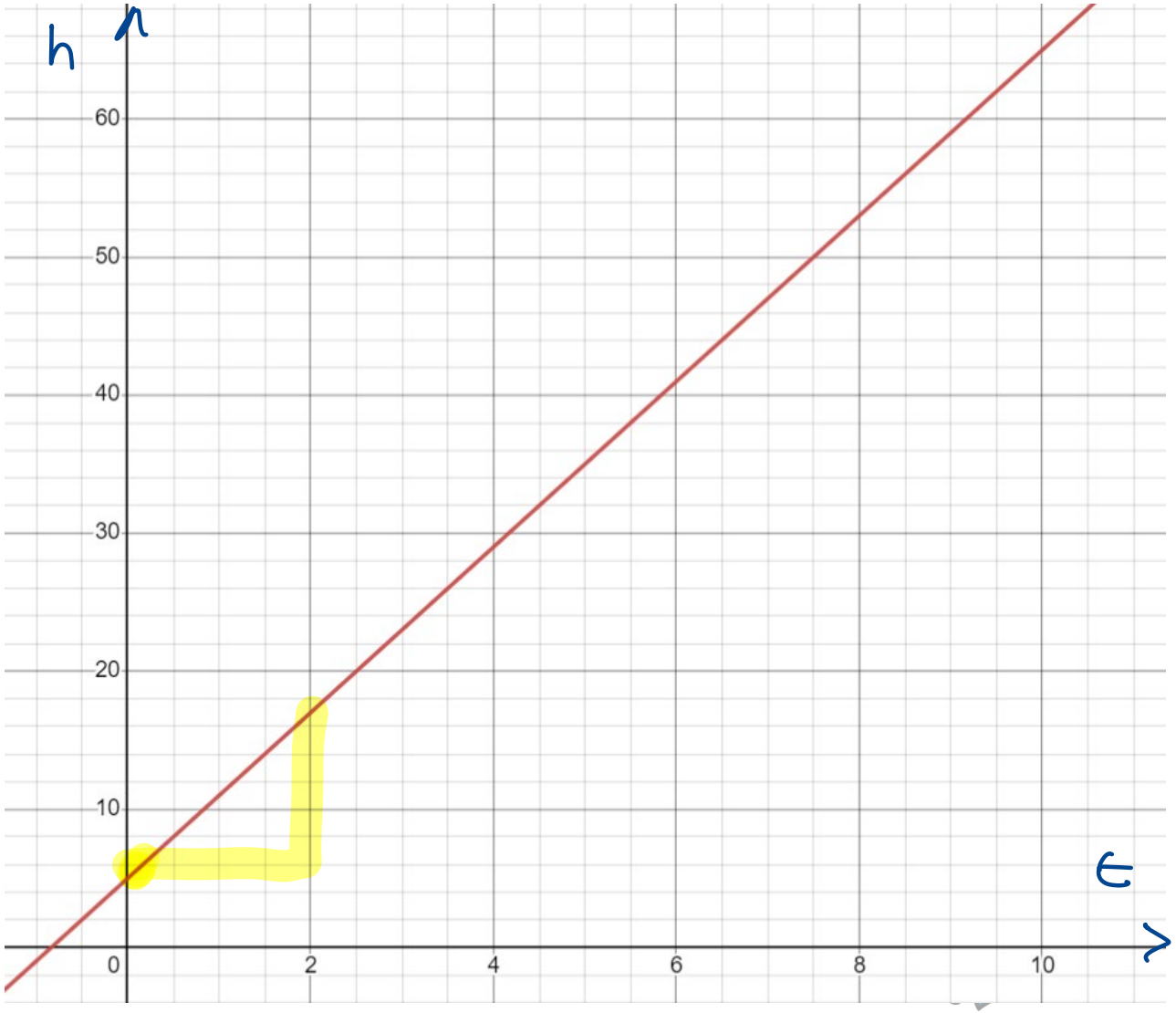
Why do we need to know the equation of the straight line?

To predict values which we might not know.

The whole point of equations is to help us predict.

Remember:

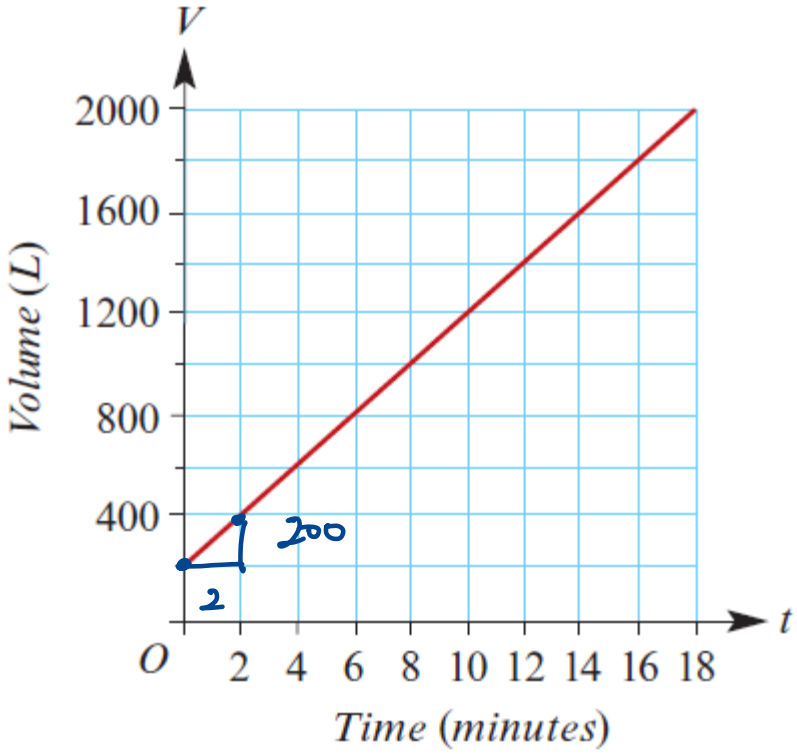
- We need to label the axes to ensure we use the correct letters
- Find the y-axis intercept
- Find the gradient (by counting squares or otherwise)
- Use the correct equation



Example

Water is pumped into a partially full tank. The graph gives the volume of water, V, (in litres) after t minutes.

a How much water is in the tank at the start (t = 0)? 200 L
b How much water is in the tank after 10 minutes (t = 10)? 1200 L
c The tank holds 2000 L. How long does it take to fill? 18 mins
d Find the equation of the line in terms of V and t.
e Use the equation to calculate the volume of water in the tank after 15 minutes.
f At what rate is the water pumped into the tank; that is, how many litres are pumped into the tank each minute?



$y = a + bx$

$V = 200 + 100.t$

$V = 200 + 100 \times 15$

$= 1700\ L$

$\therefore$ rate $= 100\ L/min$

$m = b = \frac{200}{2} = 100$



Example

Water is pumped into a partially full tank. The graph gives the volume of water, V, (in litres) after t minutes.

a How much water is in the tank at the start (t = 0)?
b How much water is in the tank after 10 minutes (t = 10)?
c The tank holds 2000 L. How long does it take to fill?
d Find the equation of the line in terms of V and t.
e Use the equation to calculate the volume of water in the tank after 15 minutes.
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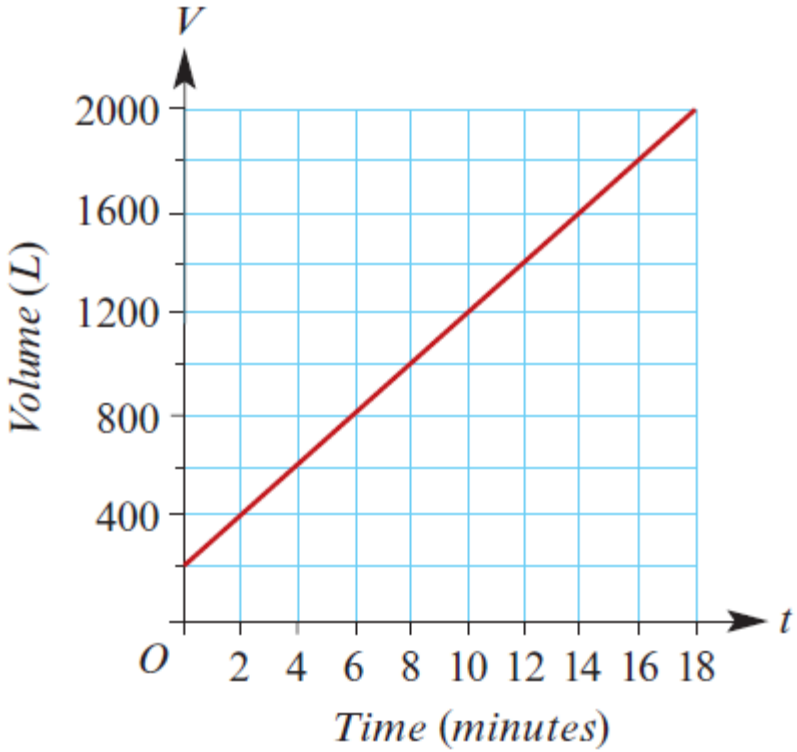
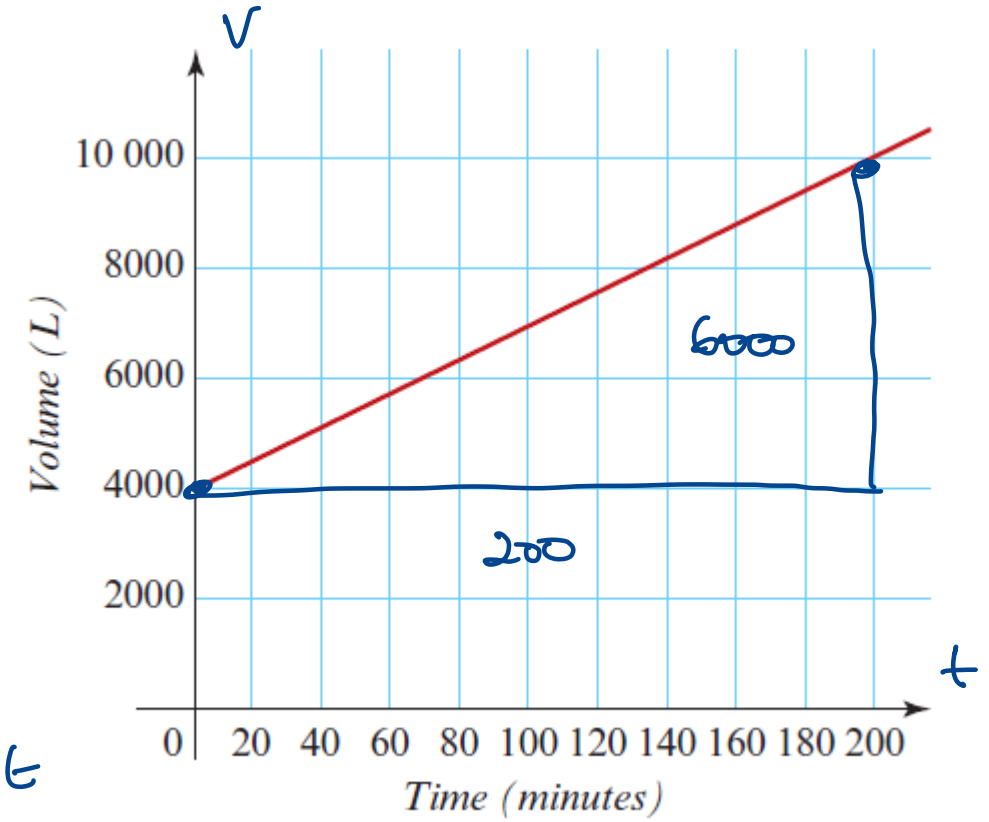




Example

Petrol is pumped into a partially full storage tank. The graph shows the volume of petrol, V, (in litres) after t minutes.

a How much petrol is in the tank at the start (t = 0)?
b How much petrol is in the tank after 100 minutes (t = 100)?
c The tank holds 10 000 L. How long does it take to fill?
d Find the equation of the line in terms of V and t.
e Use the equation to calculate the volume of water in the tank after 150 minutes.
f At what rate is the water pumped into the tank; that is, how many litres are pumped into the tank each minute?



4000 L

7000 L

200 mins

$y = a + bx$

$V = 4000 + 30t$

$V = 4000 + 30 \times 150$

$= 8500$ L

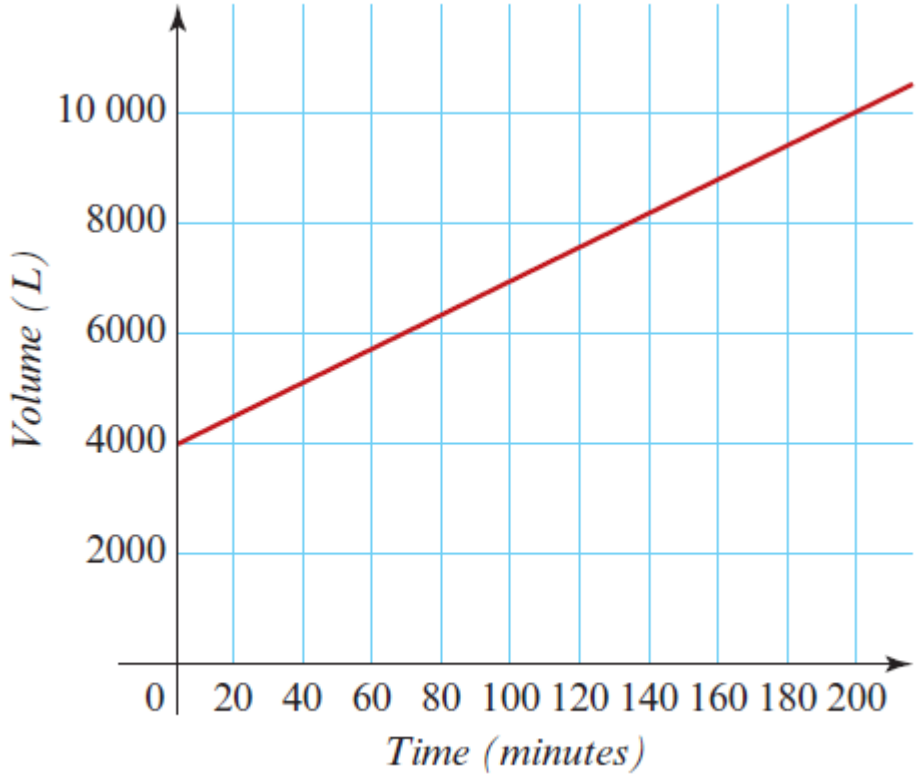
rate = 30 L/min



Example

Petrol is pumped into a partially full storage tank. The graph shows the volume of petrol, V, (in litres) after t minutes.

a How much petrol is in the tank at the start (t = 0)?
b How much petrol is in the tank after 100 minutes (t = 100)?
c The tank holds 10 000 L. How long does it take to fill?
d Find the equation of the line in terms of V and t.
e Use the equation to calculate the volume of water in the tank after 150 minutes.
f At what rate is the water pumped into the tank; that is, how many litres are pumped into the tank each minute?



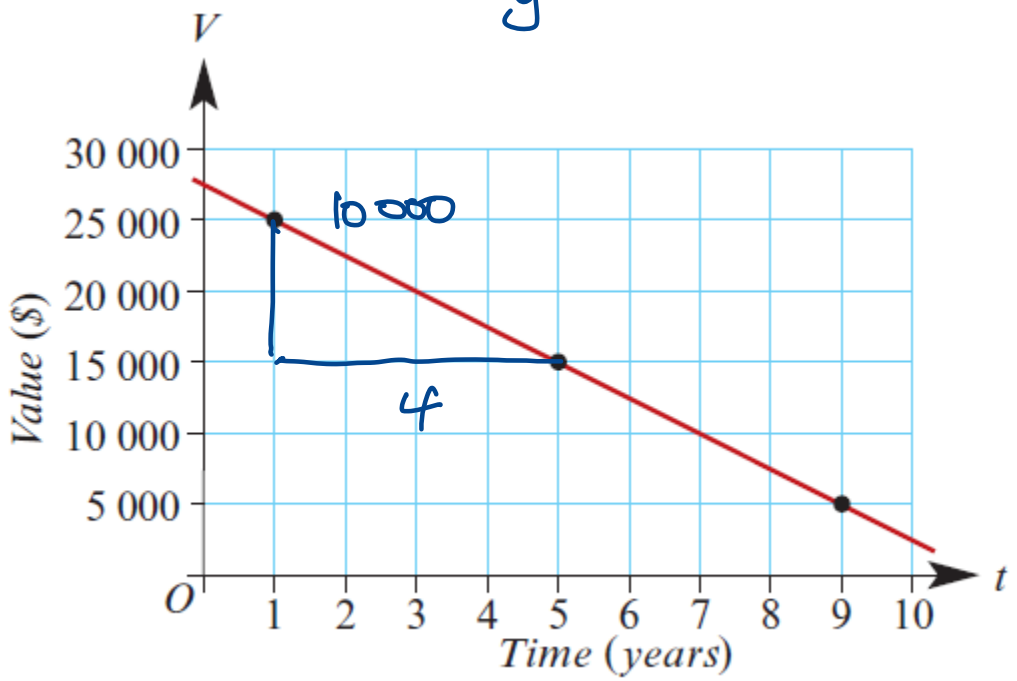


Example

The value of new cars depreciates with time. The graph shows how the value, V, (in dollars) of a new car depreciates with time, t, (in years).

a What was the value of the car when it was new?
b What was the value of the car when it was 5 years old?
c Find the equation of the line in terms of V and t.
d At what rate does the value of the car depreciate with time; that is, by how much does its value decrease each year?
e When does the equation predict the car will have no (zero) value?

$y = a - bx$



$27 500

$15 000

$y = a - bx$

$V = 27\,500 - 2500.t$

$2500/year

solve(0 = 27 500 − 2500.t, t)

∴ 11 years



Example

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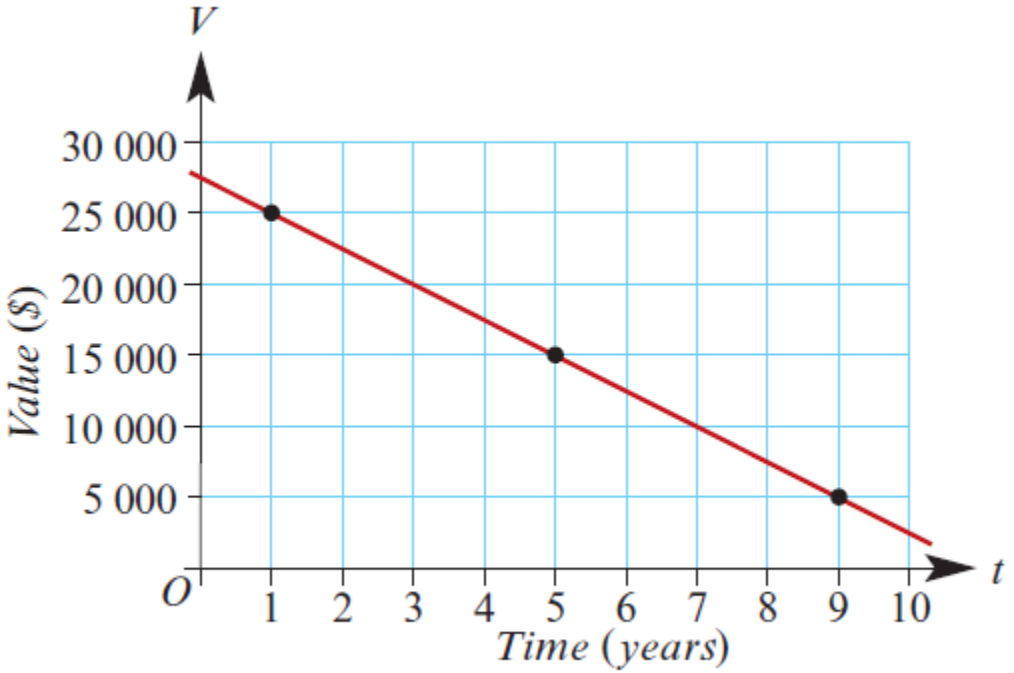



Work to complete

The work I am asking to be completed for this topic is shown below.

This is the minimum work which should be completed. The more questions which are answered the better your chance of success in exams. Questions towards the end of the exercises and in the Chapter Review are the best practice you can do.

Questions to complete:
Exercise 5G: All

