Step graphs

Year 12 Further Mathematics
Units 3 and 4

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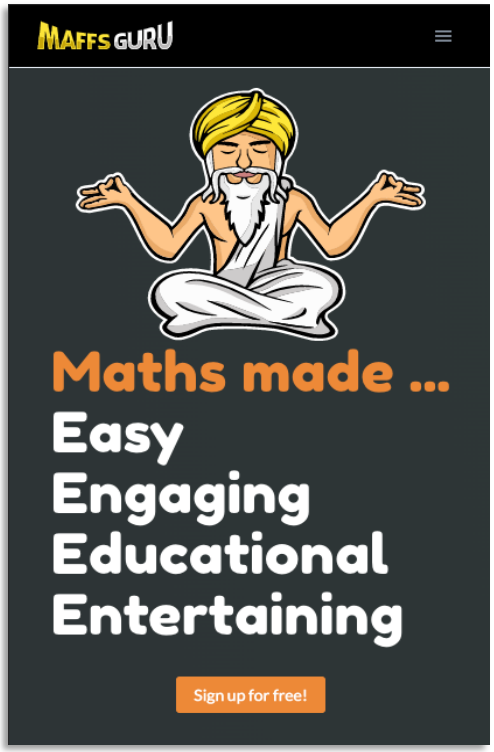

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Learning Objectives

By the end of the lesson I would hope that you have an understanding and be able to apply to questions the following concepts:

- Understand what a step graph is
- Know how to construct a step graph
- Know how to read a step graph

Recap

In the previous lesson we looked at what a line segment graph was.

The basic definition was that the graph was made up of a number of line segments which were joined together.

We can see a great example of shown on the right.

But do all line segment graphs have to look like this?

Well, no. This is where we meet the step graph.

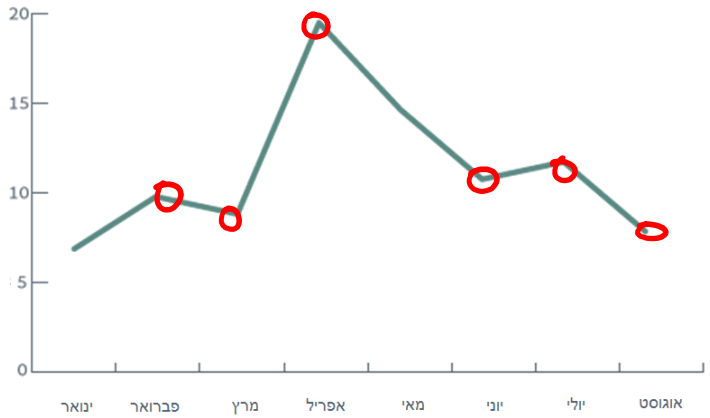
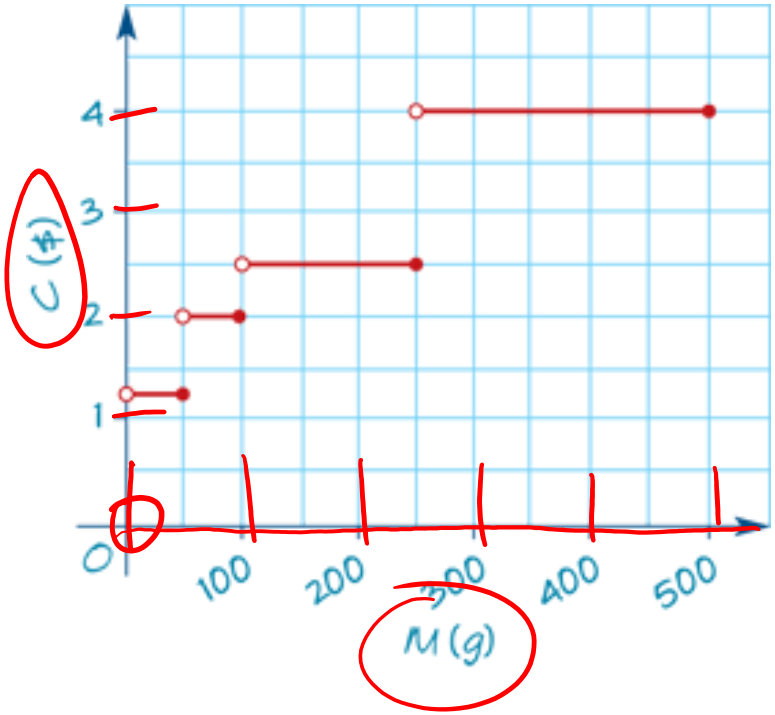


Image source: Wikipedia

What is a step graph?

We know what steps are.
They are horizontal sections of wood or concrete which allow us to go up, or down.
Well, this pretty much defines what a step graph is.
An example is shown below.
Can you think of a real world example of what it's trying to show?



Cost ($)

Mass (grams)

Image source: Year 12 Further Mathematics Textbook (Units 3 and 4)

Hold on! What's with the circles at the end of the lines?

Normally, with all the graphs we have drawn, we make sure they join.

But, not all graphs join.

This is an example of a cost function relating to the cost of sending articles through the post.

If we look at 100(g) we see that one line starts and another line ends at 100 g.

It's not possible for something which weighs 100 g to cost two amounts to post.

So, we use an open and closed circle to tell us which is the actual cost

An **open circle** means the start or the end of the line isn't included.

A **closed circle** means the start or end of the line is included.

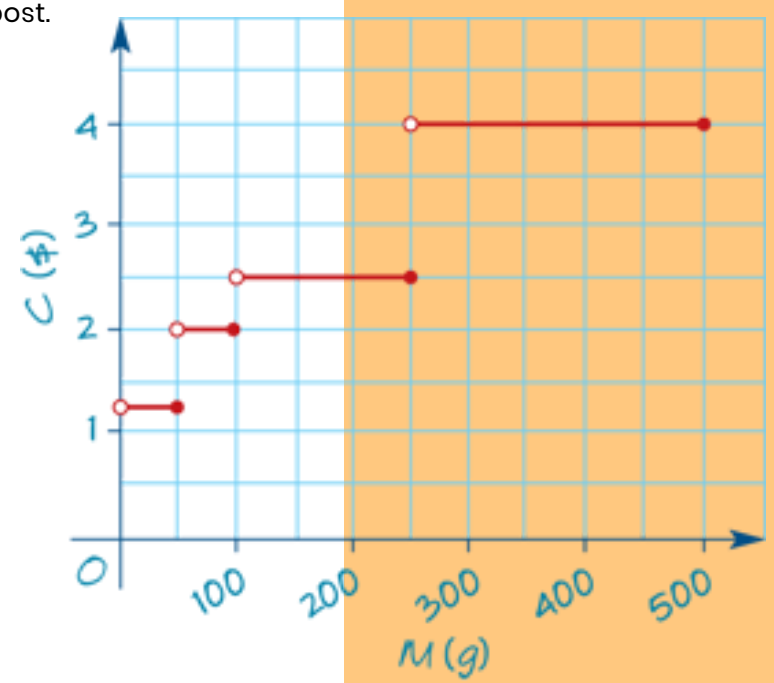


Image source: Year 12 Further Mathematics Textbook (Units 3 and 4)

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Another example

Here is another example of a step graph

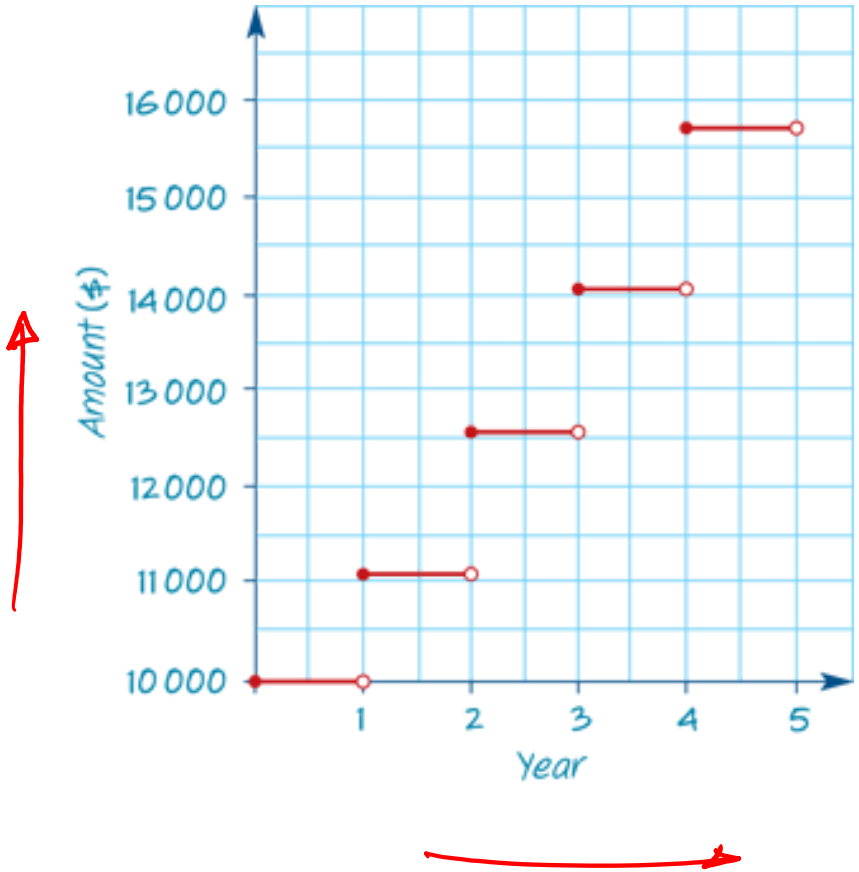


Image source: Year 12 Further Mathematics Textbook (Units 3 and 4)

How to draw step graphs

Drawing graphs is quite simple.

The lines are going to be horizontal. They are going to have a start and end point. One end is going to have an open circle, the other end a closed circle.

But how do we tell if it's open or closed?

Notice the words "**up to**".

Mass M(g)	*Cost C* ($)
Up to 50 g	$1.20
Over 50 g up to 100 g	$2.00
Over 100 g up to 250 g	$2.50
Over 250 g up to 500 g	$4.00

up to = includes

over = x include.

Image source: Year 12 Further Mathematics Textbook (Units 3 and 4)

What's a cost function?

We haven't even drawn a line yet and the question opens with, "What is the cost function?"

A cost function is a fancy way of writing the table.

It has a certain form which, once you understand it, is the same for every question. The only thing which changes is the numbers.

Mass M(g)	*Cost C ($)*
Up to 50 g	$1.20
Over 50 g up to 100 g	$2.00
Over 100 g up to 250 g	$2.50
Over 250 g up to 500 g	$4.00

$$C = \begin{cases} 1.20, & M \leq 50 \\ 2.00, & 50 < M \leq 100 \\ 2.50, & 100 < M \leq 250 \\ 4.00, & 250 < M \leq 500 \end{cases}$$

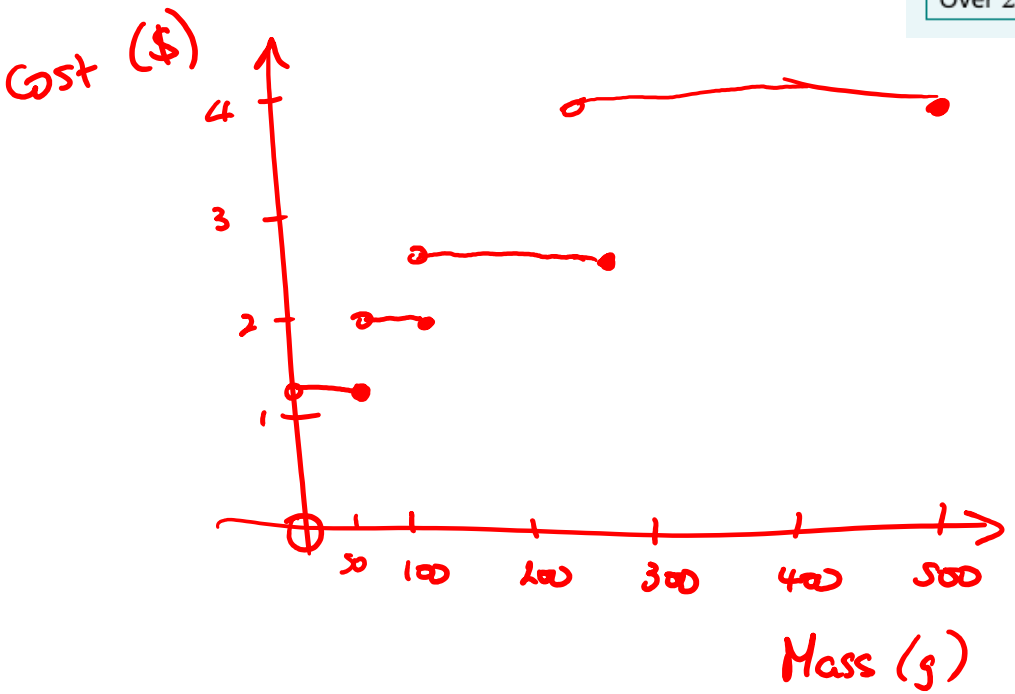
Image source: Year 12 Further Mathematics Textbook (Units 3 and 4)

The full question

This table shows the airmail rates for articles in a particular country.

- Write a cost function, i.e. CC ($$) in terms of MM(g).
- Sketch a graph of the cost function.

Mass M(g)	*Cost C ($)*
Up to 50 g	$1.20
Over 50 g up to 100 g	$2.00
Over 100 g up to 250 g	$2.50
Over 250 g up to 500 g	$4.00



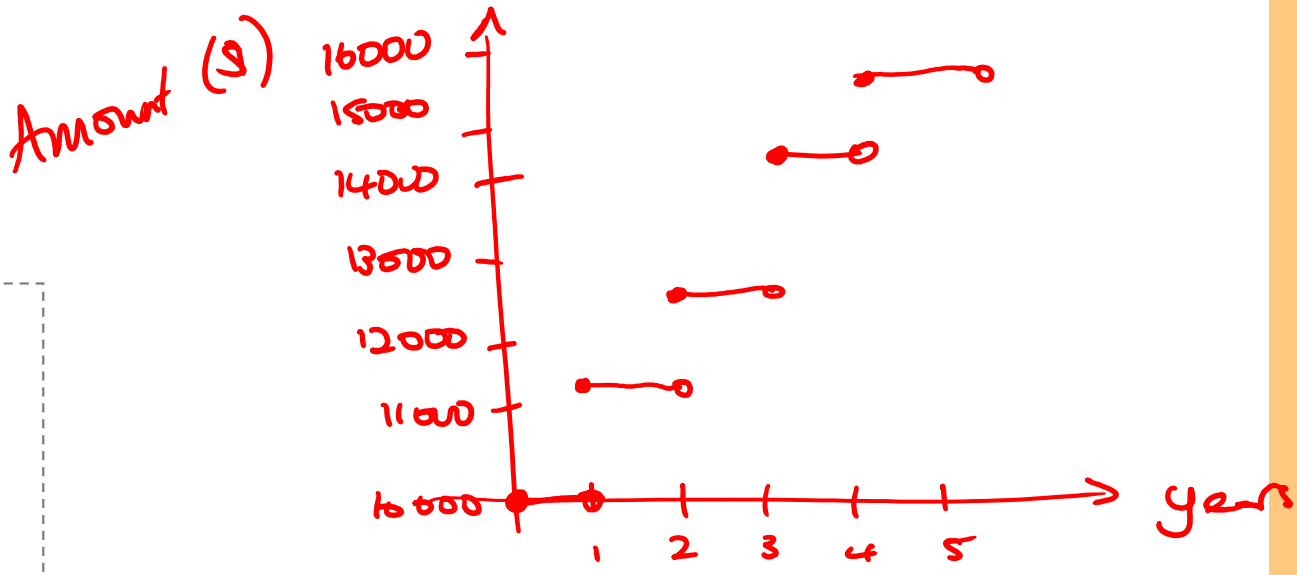
Examples have been extracted, with permission, from the Cambridge Further Mathematics Units 3 and 4 Textbook

Another question

Sophie invests $10 000, for which interest will be 12% per annum. The interest is calculated at the end of each year and added to the amount invested; i.e. $10 000 is invested at 12% per annum compound interest.

The amount of money she has in the account for the first 5 years is shown in the table. Sketch the graph of the amount in the account against the year.

Year (interest paid at the end of each year)	*Amount ($) (amount given to the nearest dollar)*
0–1	10 000
1–2	11 200
2–3	12 544
3–4	14 049
4–5	15 735



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