

Bridging Units: Resource Pocket 3

Graphs in real-life contexts

Kinematics

Graphs representing financial situations

Most students will have some knowledge of how to calculate bills such as mobile phone contracts containing fixed charges, however this is often assumed knowledge and many students struggle to understand the breakdown of the bill. When meter readings are introduced, many students do not know what to do with the various numbers and are not aware what they stand for. Spending time discussing these personal finance topics will be beneficial for the students prior to beginning a GCSE course.

Students are likely to have met distance – time graphs in science but further detailed study of this area will help students grasp the mathematical concepts involved. Velocity – time graphs and the calculation of acceleration (gradient) should also be familiar from science lessons, but it will be beneficial to revise this to ensure that students are familiar with the terms prior to starting the GCSE.

This resource pocket progresses through three sections: developing understanding, skills builders and problem solving activities. As with all 9 resource pockets a number of different learning styles and approaches are used to cater for a variety of learners.

1. Developing Understanding

These are class based, teacher led questions with suggested commentary to get the most from a class or small group discussion. The boxed text can either be copied onto the whiteboard for class discussion, or printed onto cards and handed out to students to be used for paired or small group work.

2. Skills Builders

These are standard progressive worksheets that can be used to drill core skills in a particular area.

3. Problem Solving Activities

Extension activities for paired work or small group work to develop problem solving skills whilst focussing on a particular area of mathematics that students can learn to apply.

Developing Understanding 1



Helen is calculating her gas bill.

Her gas supplier charges a **daily charge** and a **cost per unit** of gas that she uses.

Daily Charge =	6.3 pence
Cost per Unit =	19.4 pence

Helen has taken three meter readings throughout the year:

1st January	15236
30th June	17248
30th September	17831

Many students will be unfamiliar with gas units, meter readings and how utility bills are calculated. Ask students if they know where the gas and electricity meters are at home and explain that official meter readings are taken regularly and readings can be taken and submitted to the suppliers over the phone. Generate a discussion about what the meter readings show:

- Is it good to have a high meter reading or a low meter reading?
- How can we calculate Helen's bill for Jan – June?
- What is Helen's bill for June – Sept?
- Is this what you would expect?
- Can we predict the bill for Oct – Dec?
- Might bills vary at different times of year? Why?

Ask each group/pair to make a sensible prediction for the bill for the final quarter, justifying their prediction using numbers.

Helen's gas supplier came out to read her meter on 31st December.

Her bill for the whole year has arrived.

It states that electricity charges from 1st January to 31st December amount to:



£788.71 + VAT

- What is the total bill including VAT at 20%?
- Can you work out Helen's meter reading on 31st Dec?

Explain that normally, we pay a fixed monthly amount that is calculated by estimating our gas use.

Discuss what would happen if Helen had been paying £100 per month... What if she had been paying £70 per month?

Answers:

Total bill including VAT = £946.45 Meter reading on 31st December = 19183
(allow 19182 due to rounding)

Developing Understanding 2 (1 of 2)

Rav wants a new mobile phone.

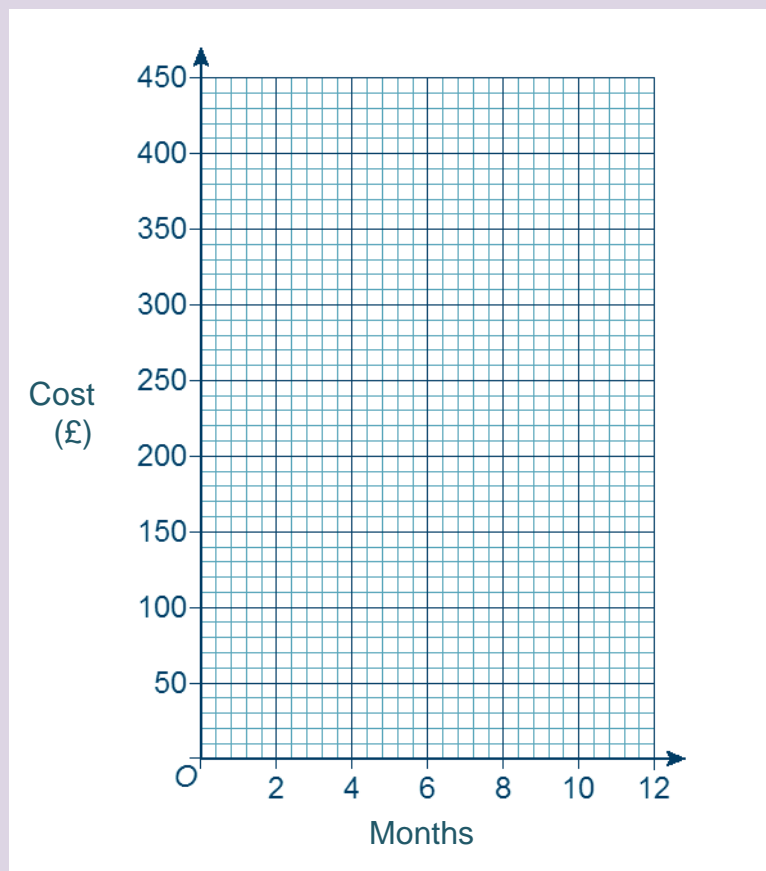
He has decided on the model that he wants and is comparing the costs with some different network providers.

He is going to take a 12 month contract with unlimited calls, texts and data.

Modafone have the following deal:

£80 for the phone.

Then £18 per month on a 12 month contract.



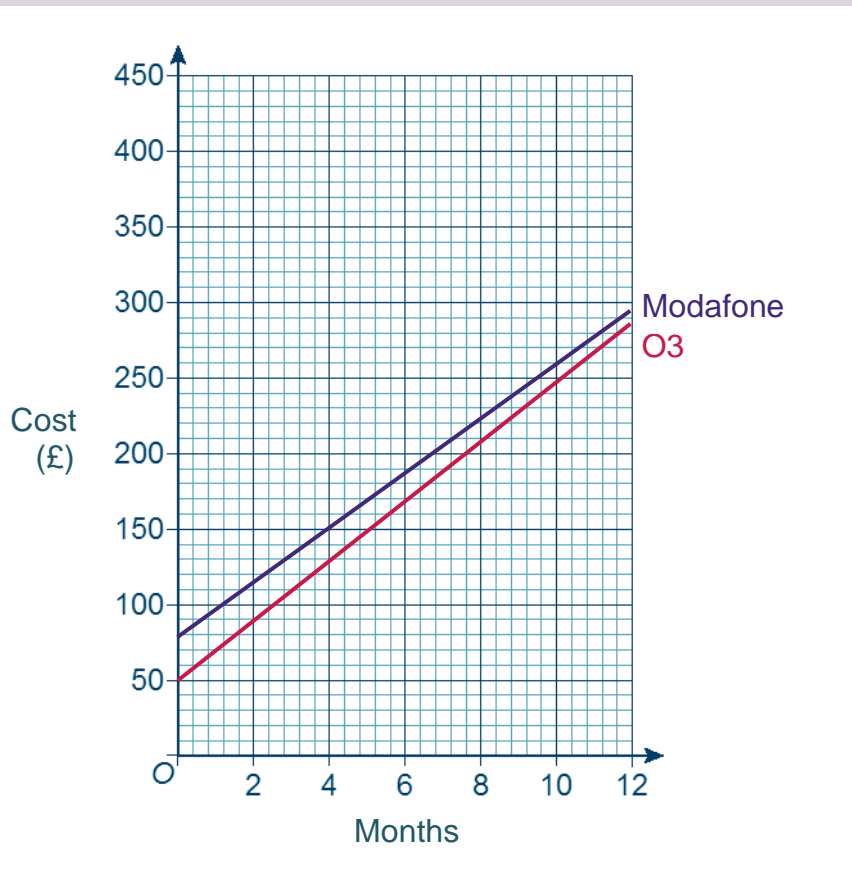
Discuss with the students how a mobile phone contract works. Explain that at the end of the contract you are able to upgrade to get a new phone; some phones are free with a contract but some phones have to be bought.

- What would this deal look like if it was represented by a graph?
 - Would it be a straight line or a curve?
 - How would the graph show the £80 phone cost?
 - How would the graph show that the monthly charge is £18?
- Using the grid, draw a graph to represent Modafone's deal.

Developing Understanding 2 (2 of 2)

The grid below shows the graph of **Modafone**'s deal.

It also shows a graph that represents a similar deal by **O3**.



Rav has found a third deal by **Green**.

£25 per month on a 12 month contract.

There is no charge for the phone.



Focusing on the deals by Modafone and O3, begin a class discussion about the differences between the two graphs.

- What do we know about the graph representing the Modafone deal?
- What can we interpret from the O3 graph? Can we explain the deal in words?

Using the information that has been interpreted from the O3 graph, ask students to work out which of the two deals is better value.

- How can we use the graph to decide which of the two deals is the better value?

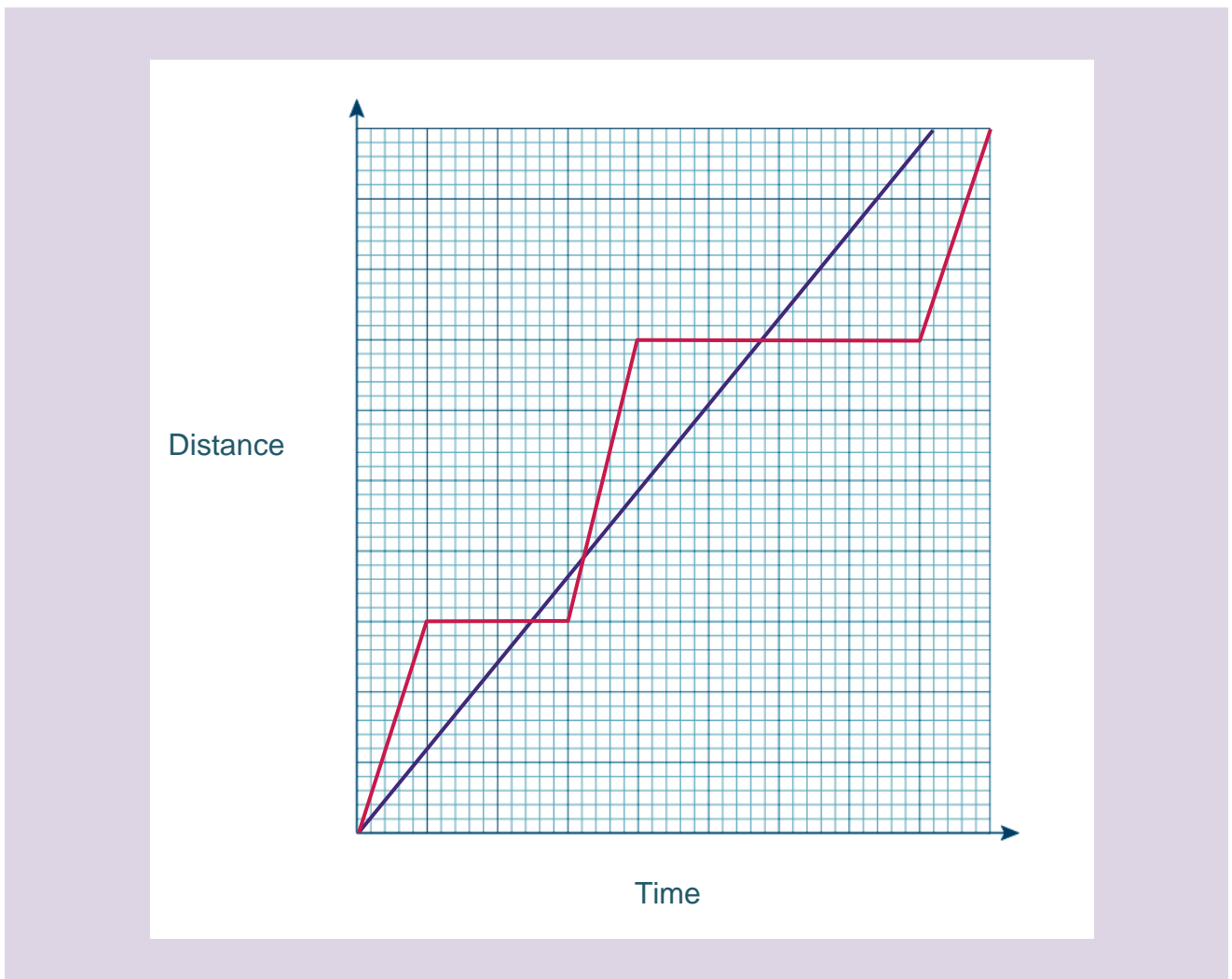
Ask students to draw the graph to represent the deal from Green.

Discuss with the class what the key points on the graph show.

Re-emphasise by pointing to various points on each graph and asking students to explain what it shows.

- By only considering the graphs, which deal is the better value and why?

Developing Understanding 3 (1 of 3)



- There is no title on the graph, nor are there any scales on the axes. What could the graphs be showing?

Allow students time to come up with some possible explanations. They could work in pairs or small groups, then share their best ideas with the rest of the class.

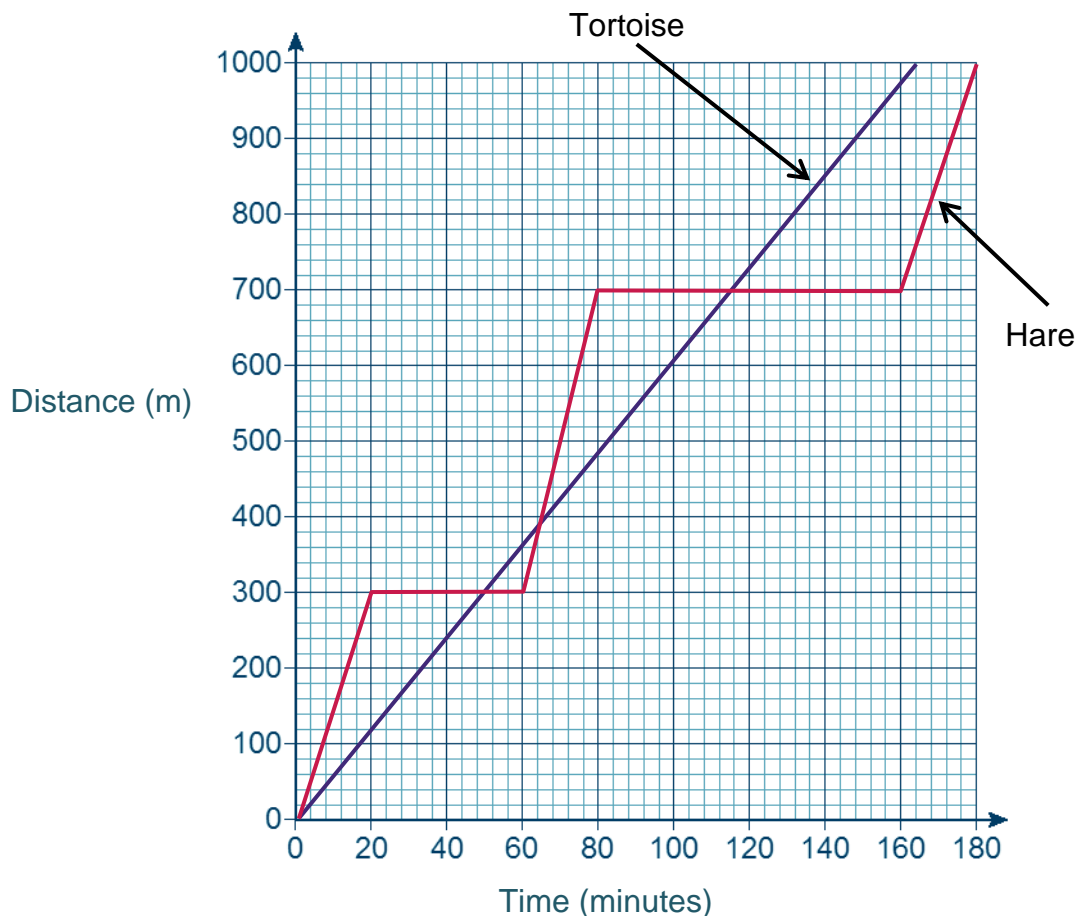
- Would your explanation change if a scale was added to each axes?
- What if the x axes was showing years... Does your explanation still make sense?
- What if the y axis was showing centimetres... Does your explanation still make sense?

Tell students that the graphs are actually showing a race between a tortoise and a hare.

- In pairs, write a story to explain what happened during the race.

Developing Understanding 3 (2 of 3)

Graph to show the race between the Tortoise and the Hare



- Now the scales have been included on each axes, what more can we interpret?
- Who won the race?
- By how much?
- Over what distance was the race?

Introduce calculating speed.

- Can we work out the speed at which the tortoise travelled?
- Can we work out the speed at which the hare travelled? How would this differ from the tortoise?

Answers:

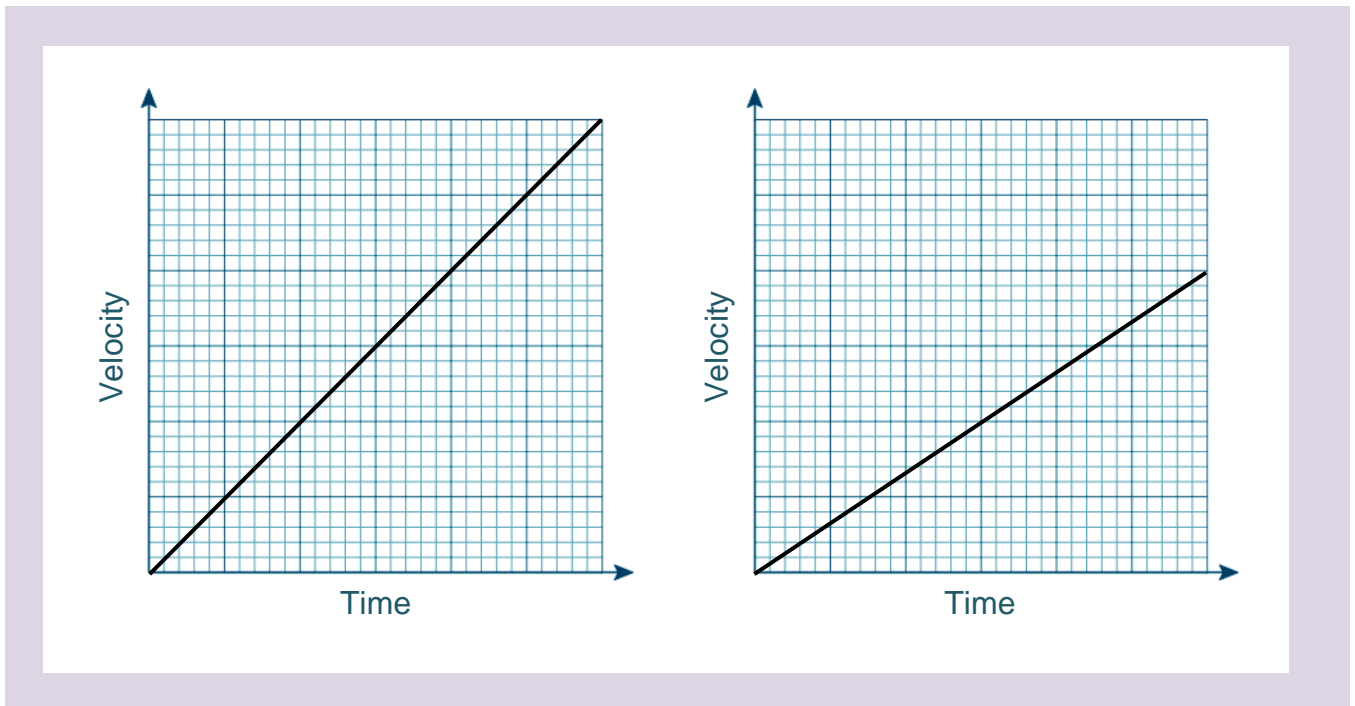
The tortoise won by 16 minutes. The race was 1000 m.

The tortoise's average speed was 6.1 m/min

The hare's average speed was 5.6 m/min. This is different because it includes some periods of 'rest' while the hare isn't moving. The tortoise was always moving.

Developing Understanding 3 (3 of 3)

If the students are ready, now is a good time to introduce velocity-time graphs



- What is velocity? Where have you met this before? Is it the same as speed?
- The graphs show information about the start of the race. One of the graphs shows information about the tortoise, the other about the hare. Which is which? How do you know?
- What can we calculate from a velocity – time graph?

Answers:

Velocity is the rate at which an object changes position, students will study this in KS3 science. Velocity is not the same as speed as velocity takes account displacement.

The first graph describes the hare as the hare has a higher velocity than the tortoise at the start of the race.

Acceleration can be calculated from a velocity- time graph.

Skills Builder 1: Calculating Bills

- 1 Josie's mobile phone contract has a monthly line rental of £16.00.
She gets 500 free minutes of calls and 300 free text messages each month.
After her allowance calls are charged at 35 pence per minute
text messages are 14 pence each.
- Calculate Josie's bill if in one month she uses:
- (a) 850 minutes of calls and 280 text messages
 - (b) 475 minutes of calls and 518 text messages
 - (c) 508 minutes of calls and 411 text messages
 - (d) 623 minutes of calls and 394 text messages
- 2 Each month Jamie makes a maximum of 450 minutes of calls and sends a maximum of 150 text messages.
- Which mobile phone contract would be the cheapest for him?

Option 1

£15 monthly line rental
200 free minutes
200 free texts

Call Charges:

28 pence per minute
10 pence per text

Option 2

£20 monthly line rental
400 free minutes
unlimited

Call Charges:

30 pence per minute

- 3 Leckie Ltd provide Paige's electricity.
Their charges are:
- 2.4 pence daily charge
 - 23.6 pence per peak unit
 - 15.5 pence per off peak unit
- Calculate Paige's bill for the months detailed below:

Month	Peak units used	Off peak units used
March	124	67
May	109	82
August	82	30
December	142	114

Skills Builder 2: Speed, Distance & Time

1 Calculate Johnny's speed in km per hour, if he travels:

- | | |
|------------------------|-------------------------|
| (a) 100 km in 2 hours | (b) 120 km in 4 hours |
| (c) 200 km in 5 hours | (d) 18 km in 3 hours |
| (e) 4 km in 30 minutes | (f) 10 km in 15 minutes |
| (g) 8 km in 20 minutes | (h) 2 km in 5 minutes |

2 Calculate the distance in km that Johnny has travelled if he travels for:

- | | |
|---------------------------------------|---------------------------------------|
| (a) 2 hours at a speed of 50 km/hr | (b) 3 hours at a speed of 90 km/hr |
| (c) 1.5 hours at a speed of 45 km/hr | (d) 0.5 hours at a speed of 20 km/hr |
| (e) 2 hours at a speed of 50 km/hr | (f) 2 hours at a speed of 50 km/hr |
| (g) 15 minutes at a speed of 10 km/hr | (h) 20 minutes at a speed of 30 km/hr |

3 Calculate the time (in minutes) that Johnny's journey takes if he travels:

- | | |
|-----------------------------------|----------------------------------|
| (a) 10 km at a speed of 10 km/hr | (b) 20 km at a speed of 10 km/hr |
| (c) 50 km at a speed of 100 km/hr | (d) 6 km at a speed of 4 km/hr |
| (e) 15 km at a speed of 20 km/hr | (f) 10 km at a speed of 30 km/hr |

4 Calculate my speed in km/hr if I travel 25 km in 30 minutes.

5 How long would it take to travel 8 km at a speed of 24 km/hr

6 If I travel for 10 minutes at a speed of 60 km/hr, how far will I get?

7 Karen needs to attend a meeting that begins at 10:30 am.
The meeting is 24 km from her home; she will travel at a speed of 60 km/hr.

What is the latest time that she can leave home to arrive at 10:30 am?

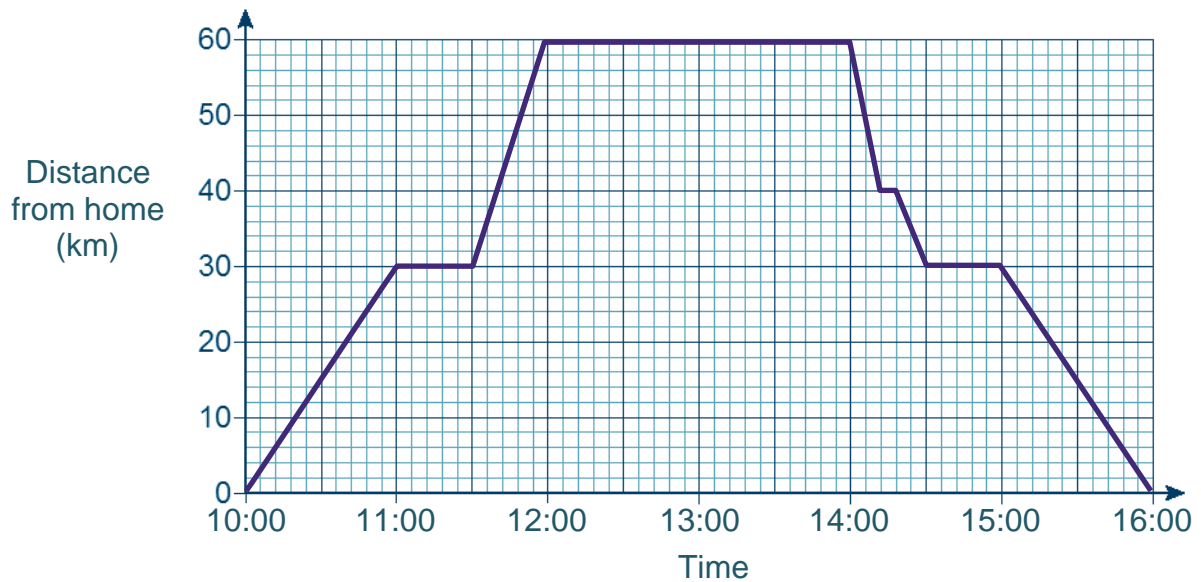
8 Jed leaves work at 5pm. He needs to arrive home by 6:30 pm.
His journey home is 30 km.

What is the slowest speed that Jed can travel home to make it for 6:30 pm?

Skills Builder 3: Distance-Time Graphs

- 1 Zack is going to meet his friends for lunch at a café.

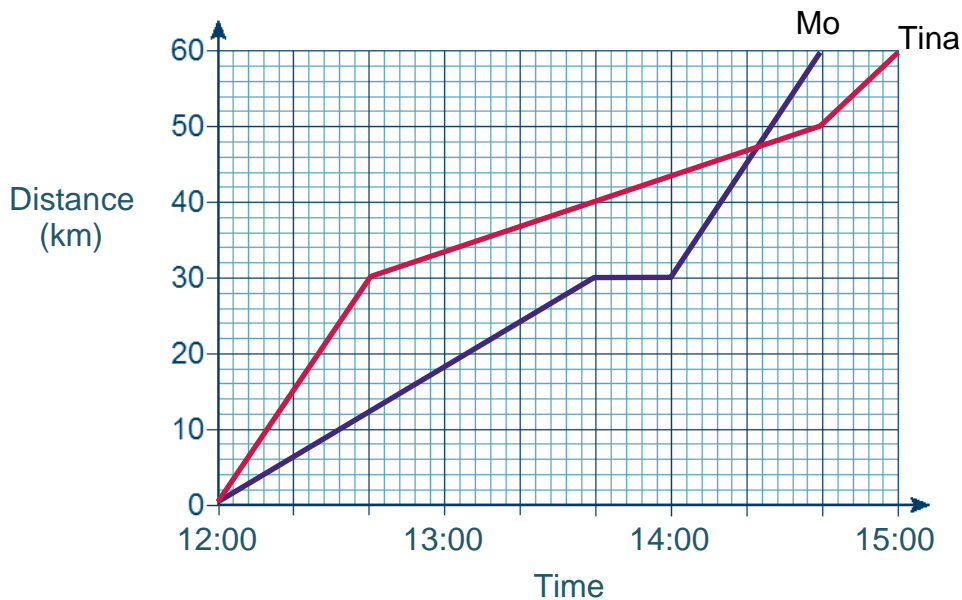
The distance-time graph below shows his journey



- (a) Zack called to pick up a friend on the way to the café.
What time did Zack arrive at his friend's house?
- (b) At what speed did Zack travel to his friend's house?
- (c) At what time did Zack arrive at the café?
- (d) How long did Zack stay at the café?
- (e) On Zack's way home he stopped for petrol then dropped off his friend.
How far from his friend's house was the petrol station?
- (f) At which point of the journey was Zack's speed the greatest?

2 Tina and Mo had a bicycle race.

The distance-time graph below represents the race.



- (a) One of the riders had a puncture and had to stop to change their tyre. Who was it?
- (b) Who was ahead in the race when the puncture happened?
- (c) Who won the race?
- (d) Describe Tina's race.
- (e) On Zack's way home he stopped for petrol then dropped off his friend. How far from his friend's house was the petrol station?
- (f) What was the fastest speed Mo travelled?

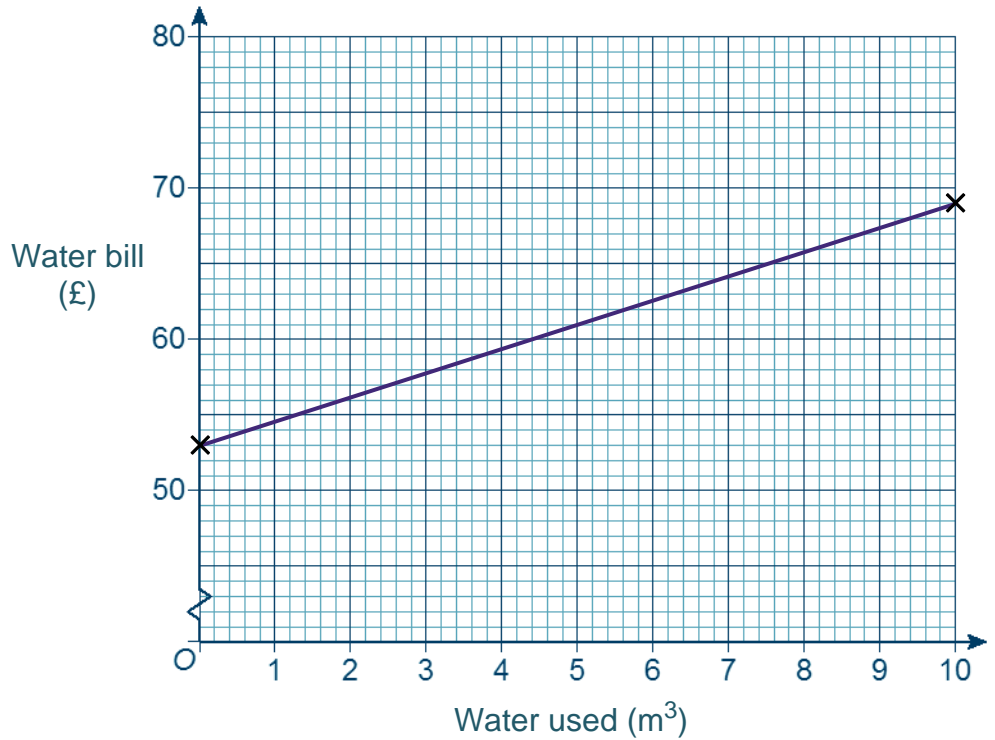
Problem solving 1: Water Bills

Print and cut out the cards

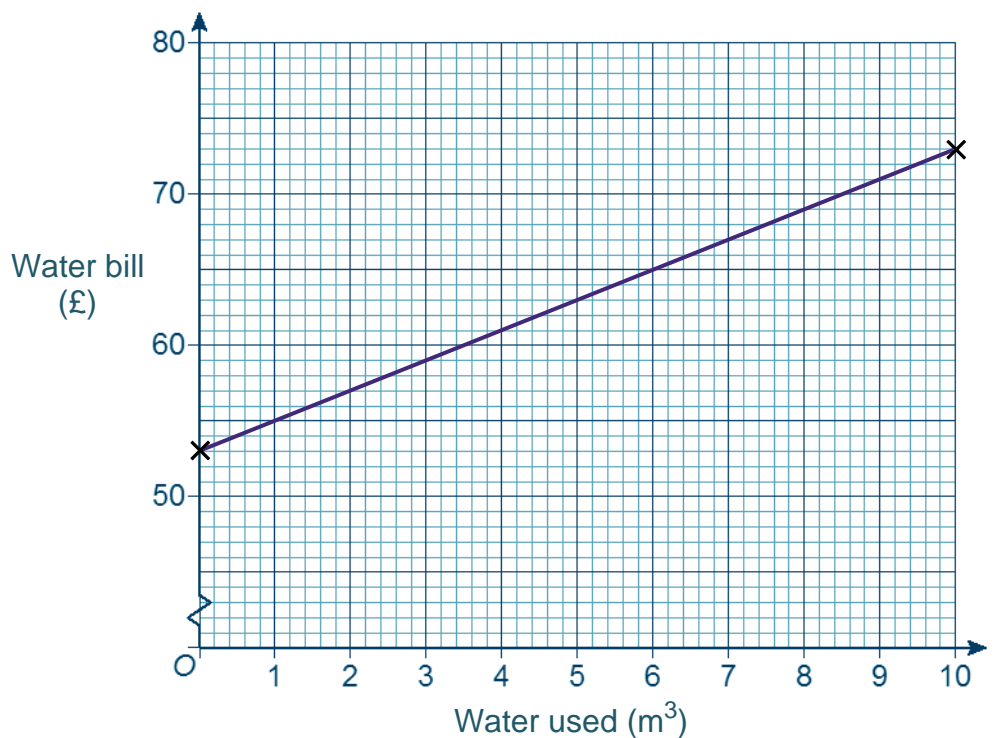


Look carefully at each of the water charges detailed on the cards, then match these with the correct graph.

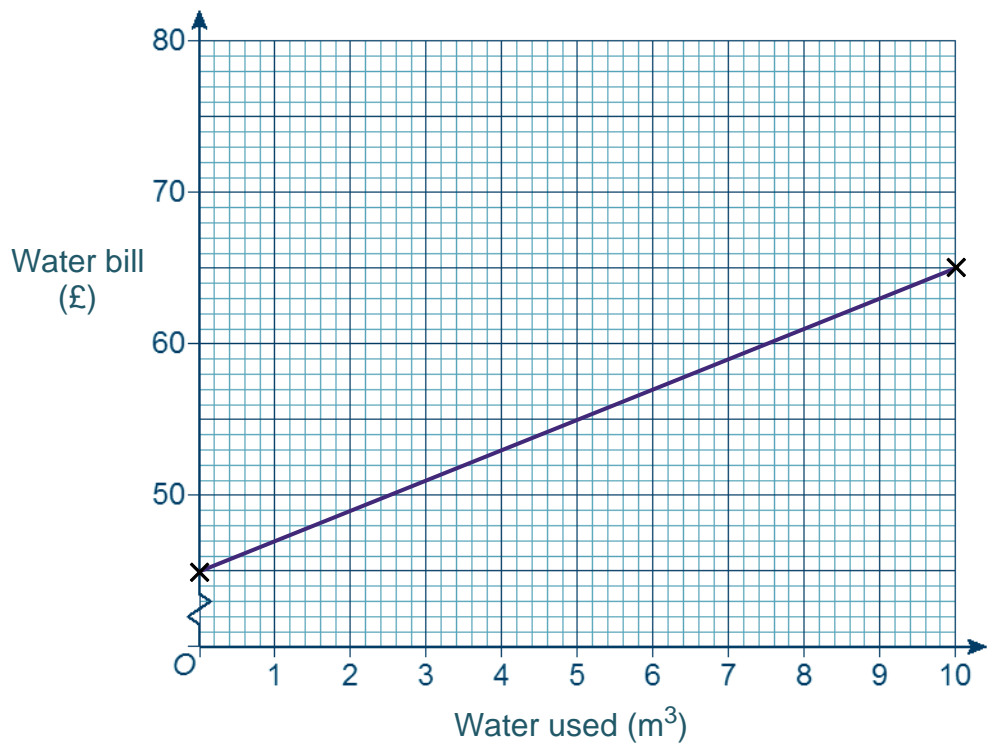
Standing charge £53 p/a
£1.60 per m^3



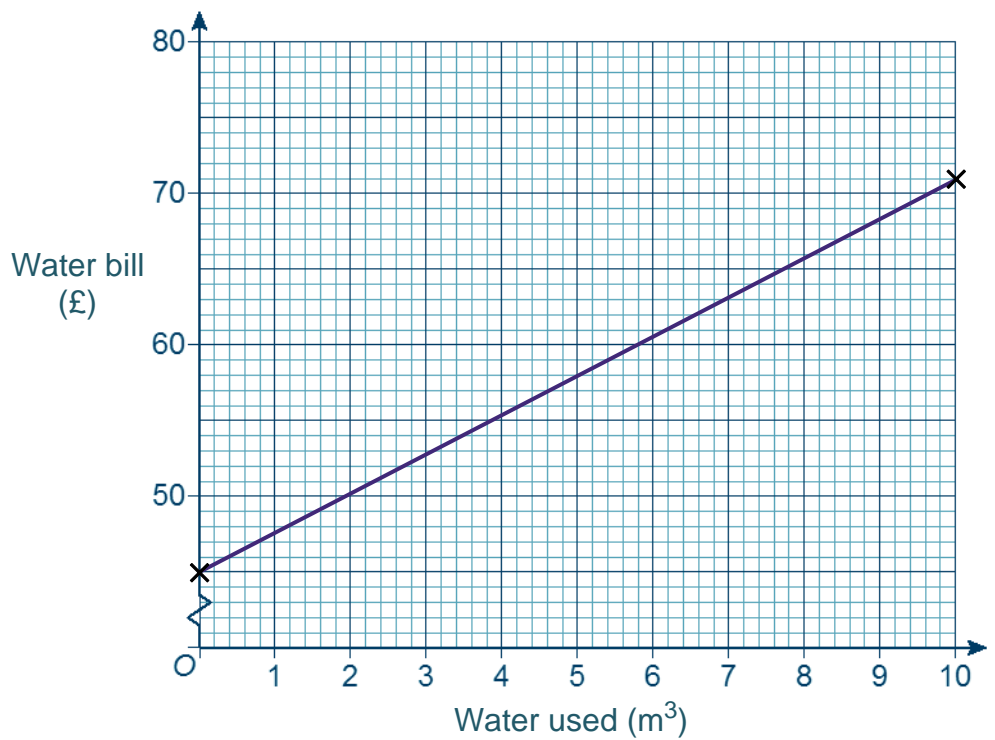
Standing charge £53 p/a
£2 per m^3



Standing charge £45 p/a
£2 per m³

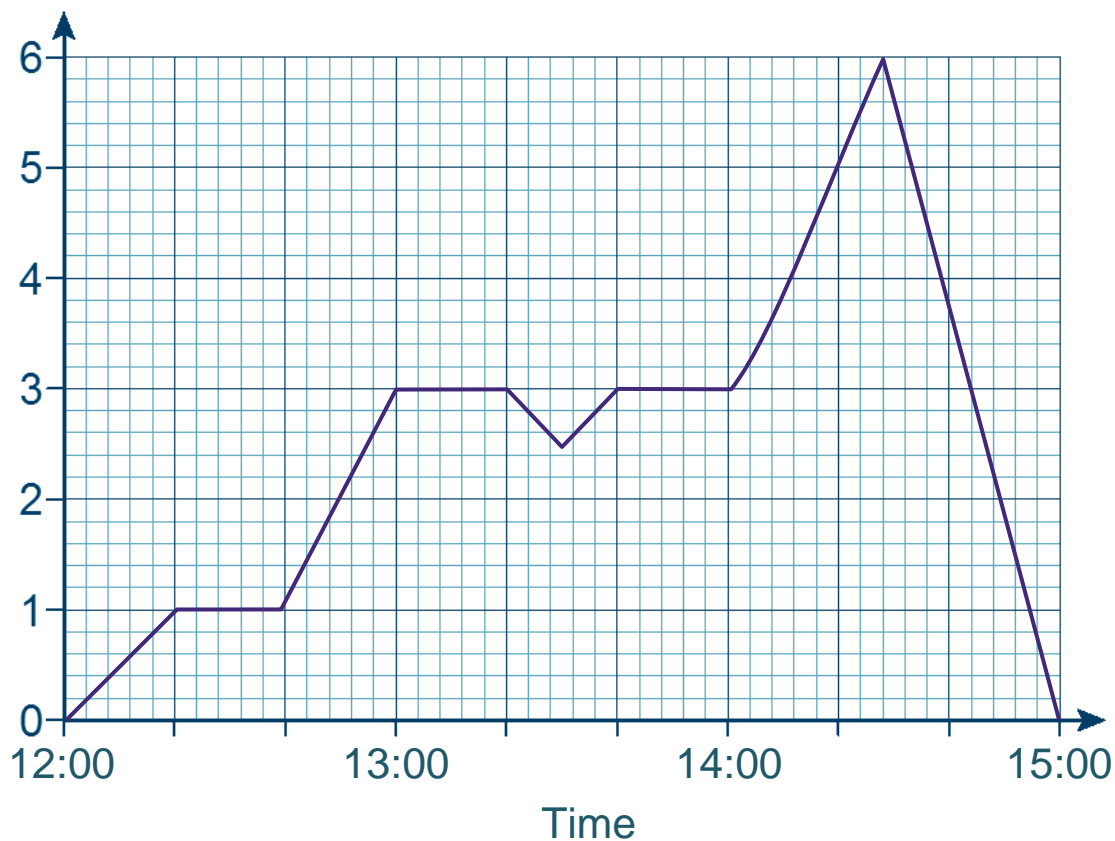


Standing charge £45 p/a
£2.60 per m³



Problem solving 2: Distance-Time Graphs

Write a story that can be represented by this distance-time graph.



You **must** include the following words or phrases:

'...at a speed of...'

'...the time was...'

broken

top hat

library

tired

Answers

Skills builder 1

- 1 (a) £138.50 (b) £46.52
(c) £34.34 (d) £72.21
- 2 Option 1 = £85 Option 2 = £35 Option 2 is better value
- 3 March = 40.29
May = £39.18
August = £24.75
December = £51.93

Skills builder 2

- 1 (a) 50 km/hr (b) 30 km/hr (c) 40 km/hr (d) 6 km/hr
(e) 8 km/hr (f) 40 km/hr (g) 24 km/hr (h) 24 km/hr
- 2 (a) 100 km (b) 270 km (c) 67.5 km (d) 10 km
(e) 2.5 km (f) 10 km
- 3 (a) 60 mins (b) 120 mins (c) 30 mins (d) 90 mins
(e) 45 mins (f) 20 mins
- 4 50 km/hr
- 5 20 minutes
- 6 10 km
- 7 10:06 am
- 8 20 km/hr

Skills builder 3

- 1 (a) 11 am (b) 30 km/hr (c) 12:00 (d) 2 hours
(e) 10 km (f) From the café to the petrol station

- 2 (a) Mo
(b) Mo
(c) Mo
(d) Tina started at a steady pace, then slowed to a slower constant pace, then finally increased to a fast constant speed
(e) 45 km/hr 10 km/hr 30 km/hr
(f) 45 km/hr