



- 1** A graph shows the total cost of hiring a ladder plotted against the number of days of hire.

The graph is a straight line with gradient 6.

Interpret what the gradient tells you about the cost of hiring the ladder.

Cost is measured in pounds and hire time in days.

(1 mark)

The gradient of a cost graph is the rate of change of cost

A gradient of 6 means the cost goes up by £6 for each extra day

- 2** Water is poured into a tank at a steady rate.

The graph of depth of water, in cm, against time is a straight line that crosses the vertical axis at 20.

Interpret the value 20.

(1 mark)

The vertical intercept is the value when time = 0

So the depth of water at the start was 20 cm

3

A taxi company charges a fixed amount plus a charge for each mile. The table shows the fare for some journeys. A graph of fare against distance is a straight line.

Distance (miles)	0	2	4	6	8
Fare (£)	3	7	11	15	19

- Use the table to write down the fare for a journey of 6 miles.
- Write down the fixed charge.
- Work out the charge for each mile.
- Work out the fare for a journey of 15 miles.

(4 marks)

a)

£15

b) fare at 0 miles

£3

c) gradient

$$(19 - 3) \div 8 = 2$$

£2 per mile

d)

$$= 3 + 15 \times 2$$

$$= 3 + 30$$

£33

4

Amy cycles from her house to the library.

She leaves home at 09:00 and arrives at the library at 09:45.

The library is 12 km from her house and she cycles at a steady speed.

Work out Amy's average speed in km/h.

(3 marks)

$$\text{Time taken} = 45 \text{ minutes} = 0.75 \text{ hours}$$

$$\text{Speed} = \text{distance divided by time} = \frac{12}{0.75}$$

$$\text{Speed} = 16 \text{ km/h}$$

16 km/h

5

This table gives the conversion between miles and kilometres. The conversion graph is a straight line through the origin.

Miles	0	10	20	30	40
Kilometres	0	16	32	48	64

- Convert 25 miles to kilometres.
- Convert 56 kilometres to miles.
- Convert 120 miles to kilometres.

(3 marks)

$$16 \text{ km} \div 10 \text{ miles} = 1.6 \text{ km per mile}$$

a)

$$25 \times 1.6 = 40$$

40 km

b)

$$56 \div 1.6 = 35$$

35 miles

c) carry on at the same rate

$$120 \times 1.6 = 192$$

192 km

6

Water is poured into a tank at a constant rate. The table shows the depth of water.

Time (minutes)	0	2	4	6	8
Depth (cm)	4	10	16	22	28

- What was the depth of water at the start?
- Work out the rate at which the depth increases, in cm per minute.
- How long does it take for the depth to reach 40 cm?

(3 marks)

a) depth when time = 0

4 cm

b)

$$(28 - 4) \div 8 = 3$$

3 cm per minute

c) extra depth needed

$$40 - 4 = 36$$

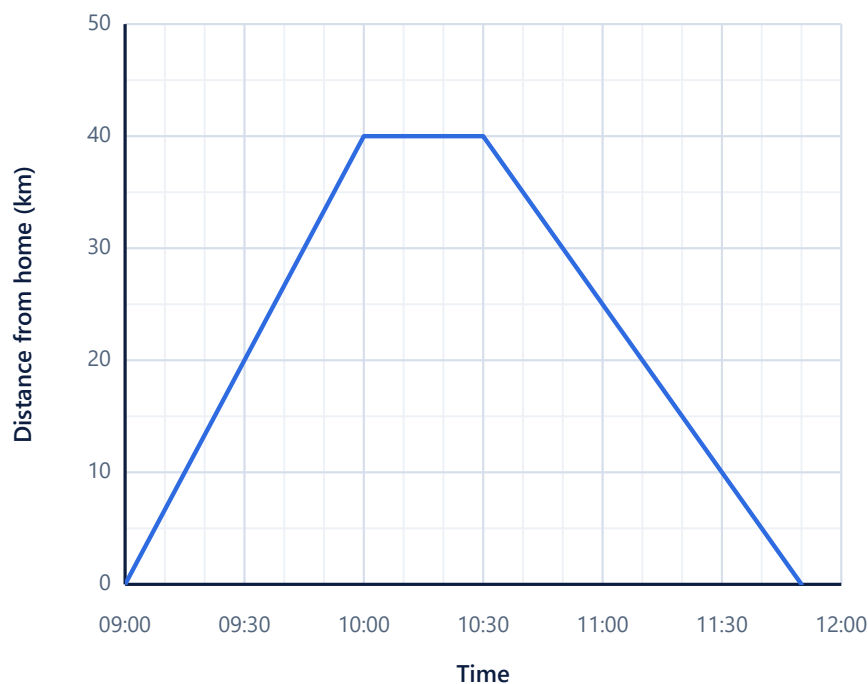
$$36 \div 3 = 12$$

12 minutes

7

The distance-time graph shows Marek's car journey from home to a garden centre and back.

- For how many minutes does Marek stay at the garden centre?
- Work out his speed, in km/h, on the way to the garden centre.
- Work out his speed, in km/h, on the way home.



(3 marks)

a) The horizontal section runs from 10:00 to 10:30, so 30 minutes

b) He travels 40 km between 09

00 and 10:00, so speed = $\frac{40}{1} = 40$ km/h

c) He travels 40 km between 10

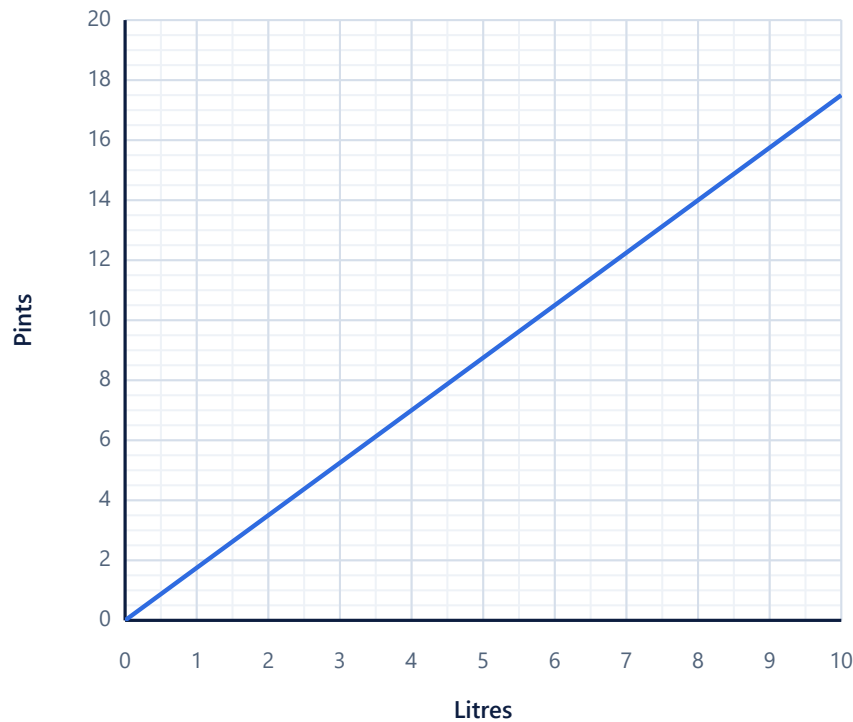
30 and 11:50, which is 80 minutes = $\frac{4}{3}$ hours

Speed = 40 divided by $\frac{4}{3} = 30$
km/h

8

The conversion graph can be used to change between litres and pints.

- Use the graph to change 6 litres to pints.
- Use the graph to change 14 pints to litres.



(3 marks)

The line passes through (10 litres, 17.5 pints), so 1 litre = 1.75 pints

a) 6 litres = $6 \times 1.75 = 10.5$ pints

b) 14 pints = $14 \div 1.75 = 8$ litres

9

A mobile phone plan costs a fixed monthly charge plus an amount for each minute of calls. The table shows the monthly cost, £ C , for m minutes of calls. The graph of C against m is a straight line.

Minutes (m)	0	100	200	300	400
Cost (£ C)	8	12	16	20	24

- Write down the fixed monthly charge.
- Work out the gradient of the line and say what it represents.
- Work out the cost in a month with 650 minutes of calls.
- Rhys's bill was £30. How many minutes of calls did he make?

(4 marks)

a) cost when $m = 0$

£8

b)

$$(24 - 8) \div 400 = 0.04$$

£0.04 (4p) per minute

c)

$$= 8 + 0.04 \times 650$$

$$= 8 + 26$$

£34

d)

$$30 - 8 = 22$$

$$22 \div 0.04 = 550$$

550 minutes

10

Water is poured into a container at a constant rate. The table shows the depth of the water.

Time (minutes)	0	1	2	3	4	5	6	7	8
Depth (cm)	0	2	4	6	8	12	16	20	24

- Work out how fast the depth rises during the first 4 minutes, and after 4 minutes.
- The container has a wide part and a narrow part. Which part is at the bottom? Give a reason.

(3 marks)

a)

$$0 \text{ to } 4 \text{ min: } 8 \div 4 = 2 \text{ cm per min}$$

$$4 \text{ to } 8 \text{ min: } (24 - 8) \div 4 = 4 \text{ cm per min}$$

b) same water each minute

depth rises slowly at first = wide

Wide part at the bottom

11

Priya cycles from home. The table shows her distance from home. She cycles at a constant speed between the times shown.

Time	09:00	10:00	10:30	11:30
Distance from home (km)	0	24	24	36

- For how long did she stop?
- Work out her speed between 09:00 and 10:00.
- Work out her speed between 10:30 and 11:30.
- Work out her average speed for the whole journey.

(5 marks)

a) distance stays 24 km

30 minutes

b)

$$24 \div 1 = 24$$

24 km/h

c)

$$(36 - 24) \div 1 = 12$$

12 km/h

d) total time 09:00 to 11:30 = 2.5 h

$$36 \div 2.5 = 14.4$$

14.4 km/h

12

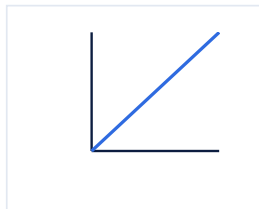
Water is poured at a steady rate into four containers.

- **Container 1:** a cylinder with straight vertical sides
- **Container 2:** a cone standing on its point, so it is widest at the top
- **Container 3:** a vase that is widest at the bottom and gets steadily narrower towards the top
- **Container 4:** a wide cylinder at the bottom with a narrow cylinder fixed on top

Each graph shows the depth of water (vertical axis) against time (horizontal axis) as a container fills. Match each container to its graph.



A



B



C



D

(4 marks)

steep = depth rising fast = narrow part

shallow = depth rising slowly = wide part

1) same width all the way: constant rate

1 = B (straight line)

2) gets wider: rises slower and slower

2 = D

3) gets narrower: rises faster and faster

3 = A

4) wide then narrow: shallow then steep, two straight parts

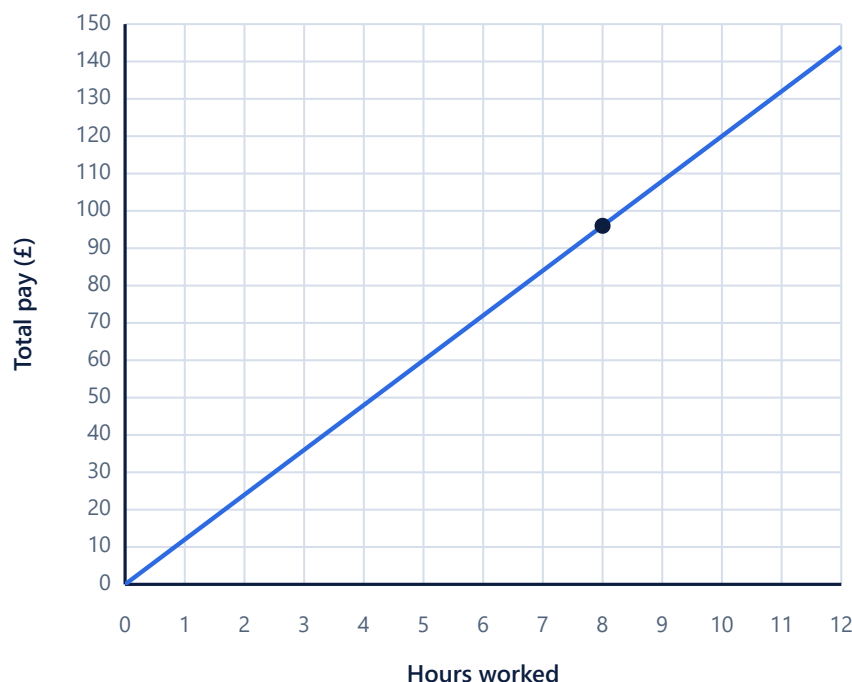
4 = C

13

A graph shows Kelly's total pay plotted against the number of hours she works.

The graph is a straight line through (0, 0) and through the point (8, 96), where pay is in pounds.

- Work out Kelly's hourly rate of pay.
- Work out Kelly's total pay for working 11 hours.



(3 marks)

a) 8 hours of work pays £96, so hourly rate = $\frac{96}{8} = £12$

b) Pay for 11 hours = 11 times 12 = £132

14

A cup of tea cools down. The table shows its temperature.

Time (minutes)	0	2	4	6	8	10
Temperature (°C)	90	64	48	38	32	28

- Work out the average rate of fall in temperature between 0 and 4 minutes.
- Work out the average rate of fall in temperature between 6 and 10 minutes.
- Explain why your answer to part (b) is smaller than your answer to part (a).

(4 marks)

a) fall = $90 - 48 = 42$

$42 \div 4 = 10.5$

$10.5^{\circ}\text{C per minute}$

b) fall = $38 - 28 = 10$

$10 \div 4 = 2.5$

$2.5^{\circ}\text{C per minute}$

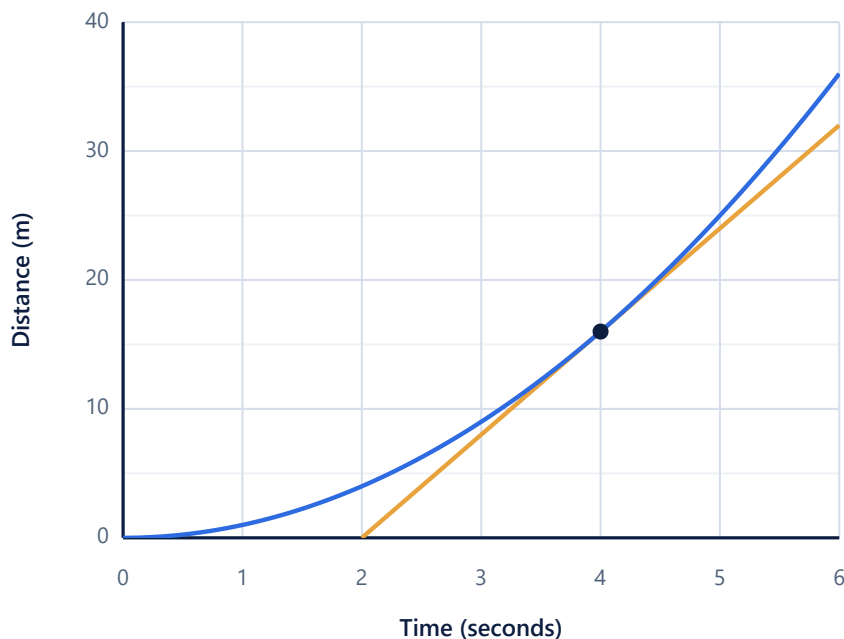
c)

cools more slowly when closer to room temperature

15

A sprinter accelerates from rest. The graph shows her distance from the start line, in metres, against time, in seconds. A tangent has been drawn to the curve at $t = 4$.

- Use the tangent to estimate her speed at 4 seconds.
- Explain why the sprinter's speed at 2 seconds is less than her speed at 4 seconds.



(3 marks)

a) speed = gradient of tangent

tangent passes through $(2, 0)$ and $(6, 32)$

$$\text{change in distance} = 32 - 0 = 32$$

$$\text{change in time} = 6 - 2 = 4$$

$$32 \div 4 = 8$$

about 8 m/s

b) speed = steepness of curve

curve is less steep at 2 s than at 4 s

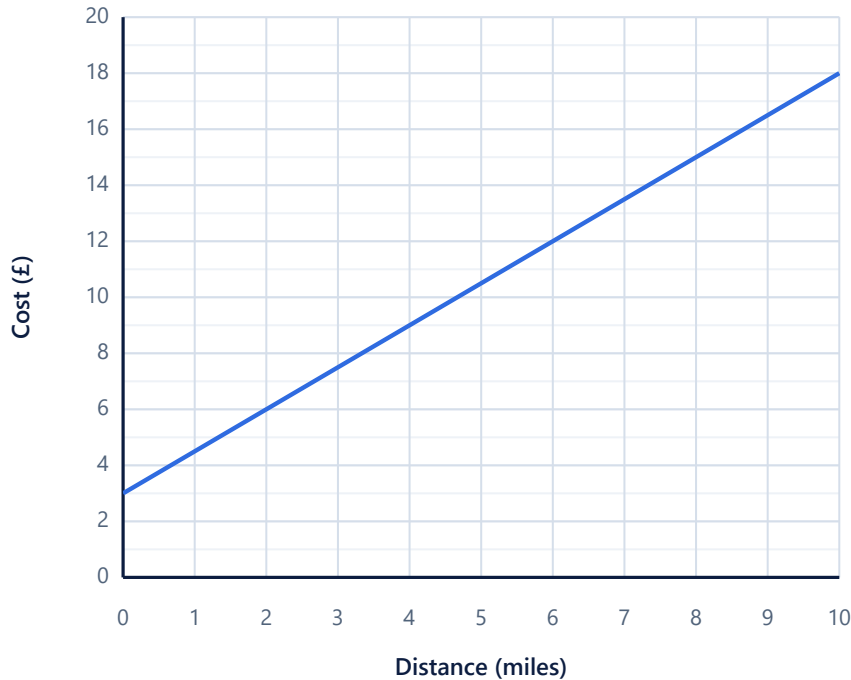
smaller gradient, so slower

16

A taxi company shows its fares on a graph of cost against distance.

The graph is a straight line through (0, 3) and (10, 18), where cost is in pounds and distance is in miles.

- Write down the fixed charge for any journey.
- Work out the cost per mile.
- Work out the fare for a journey of 6 miles.



(3 marks)

a) The vertical intercept is 3, so the fixed charge is £3

b) Gradient = $\frac{18 - 3}{10 - 0} = \frac{15}{10} = £1.50$ per mile

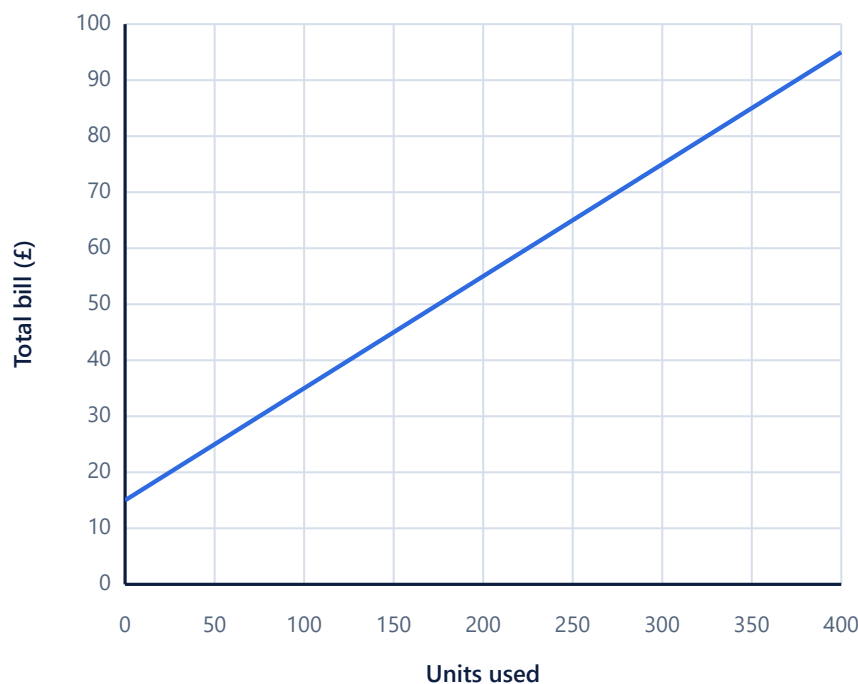
c) Fare = $3 + 6 \text{ times } 1.50 = 3 + 9 = £12$

17

An electricity company's monthly bill is shown on a graph of total bill against units used.

The graph is a straight line through (0, 15) and (400, 95), where the bill is in pounds.

- Work out the gradient of the line.
- Interpret what the gradient tells you.



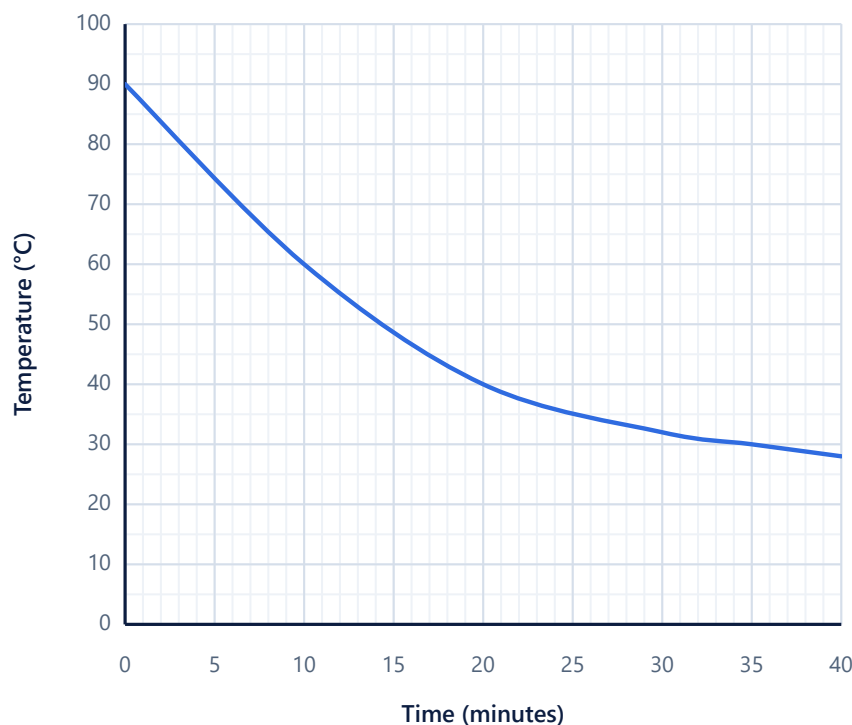
(3 marks)

a) Gradient = $\frac{95 - 15}{400 - 0} = \frac{80}{400} = 0.2$

b) The bill rises by £0.20, that is 20p, for each extra unit of electricity used

18 The graph shows the temperature of a cup of coffee as it cools.

- Write down the temperature of the coffee at the start.
- Find the temperature of the coffee after 20 minutes.
- Find how long the coffee takes to cool to 30°C .



(3 marks)

- Read the curve at time 0: the temperature is 90°C
- Read up from 20 minutes to the curve and across: 40°C
- Read across from 30°C to the curve and down: 35 minutes

19 Ben drives from Leeds to visit his aunt.

He leaves Leeds at 09:30 and drives 60 km in 1 hour.

He then stops at a service station for 30 minutes.

He then drives a further 40 km in 1 hour to arrive at his aunt's house.

- Work out the time Ben arrives at his aunt's house.
- Work out Ben's average speed, in km/h, for the whole journey from Leeds to his aunt's house.

(4 marks)

a) 09

$$30 + 1 \text{ hour} = 10:30, + 30 \text{ minutes} = 11:00, + 1 \text{ hour} = 12:00$$

$$\text{b) Total distance} = 60 + 40 = 100 \text{ km}$$

$$\text{Total time} = 2.5 \text{ hours, including the stop}$$

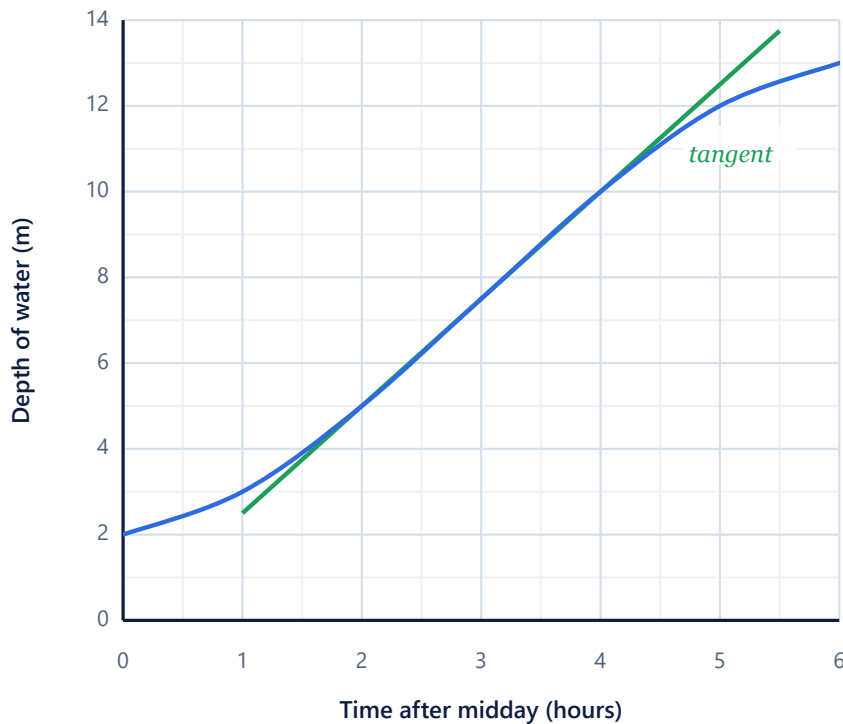
$$\text{Average speed} = \frac{100}{2.5} = 40 \text{ km/h}$$

20

The graph shows the depth of water in a harbour, in metres, during the 6 hours after midday.

By drawing a suitable tangent to the curve, estimate the rate at which the depth is increasing 3 hours after midday.

Give your answer in metres per hour.



(4 marks)

A tangent is a straight line that follows the curve's direction at the chosen point. Its gradient estimates how quickly the depth is changing at that instant, rather than an average over the whole time interval

Draw a tangent to the curve at $t = 3$

Work out the gradient of the tangent using a large triangle, for example rise 5 m over run 2 hours

Gradient of tangent is approximately $\frac{5}{2} = 2.5$ metres per hour

21

Sara walks from home to a park 3 km away.

She leaves home at 14:00 and walks at a steady speed, arriving at the park at 14:40.

She stays at the park for 30 minutes.

She then walks straight home at a steady speed of 4 km/h.

- Work out Sara's speed, in km/h, on the way to the park.
- Work out the time Sara arrives back home.
- Work out the total time, in hours and minutes, that Sara is away from home.

(5 marks)

$$\text{a) } 40 \text{ minutes} = \frac{2}{3} \text{ hour, so speed} = 3 \text{ divided by } \frac{2}{3} = 4.5 \text{ km/h}$$

b) She leaves the park at 14

$$40 + 30 \text{ minutes} = 15:10$$

$$\text{Walking home takes } \frac{3}{4} \text{ hour} = 45 \text{ minutes at } 4 \text{ km/h}$$

$$15:10 + 45 \text{ minutes} = 15:55$$

c) From 14:00 to 15:55 is 1 hour 55 minutes

22

Elin uses the rule "5 miles = 8 kilometres" to change miles to kilometres.

A more accurate conversion is 1 mile = 1.609 kilometres.

Elin's journey is 150 miles.

Work out the difference, in kilometres, between the two conversions of 150 miles.

(4 marks)

Using the rule

$$150 \div 5 \times 8 = 240 \text{ km}$$

Using the accurate conversion

$$150 \times 1.609 = 241.35 \text{ km}$$

$$\text{Difference} = 241.35 - 240 = 1.35 \text{ km}$$

$$\boxed{1.35 \text{ km}}$$

23

Jamal leaves home at 10:00 and drives at a steady speed of 60 km/h for 1 hour.

He rests for 30 minutes.

He then drives straight home at a steady speed of 40 km/h.

- Draw a distance-time graph for Jamal's journey.
- Work out the time Jamal arrives back home.



(5 marks)

a) In the first hour he travels 60 km, so draw a line from (10:00, 0) to (11:00, 60)

The rest is a horizontal line from (11:00, 60) to (11:30, 60)

b) The journey home is 60 km at 40 km/h, which takes $\frac{60}{40} = 1.5$

hours

11:30 + 1 hour 30 minutes = 13:00, so the final line goes down to (13:00, 0)