



- 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 conversion graph for gallons and litres is a straight line through the points (0, 0) and (10, 45). The horizontal axis shows gallons and the vertical axis shows litres.

a. Work out the gradient of the line.

b. What does the gradient represent?

(3 marks)

a.)

$$\text{gradient} = \frac{45 - 0}{10 - 0}$$

4.5

b) Litres ÷ gallons

4.5 litres in each gallon

4

Two companies hire out a bouncy castle. The straight-line graphs show the total cost, in pounds, against the number of days.

Company A: the line passes through (0, 20) and (5, 70).

Company B: the line passes through (0, 50) and (5, 80).

- Work out the gradient of each line.
- Which company charges more for each extra day? How can you tell from the graph?
- What does the point where each line crosses the vertical axis represent?

(4 marks)

a)

$$A: \frac{70 - 20}{5} = 10$$

$$B: \frac{80 - 50}{5} = 6$$

b) Gradient = £ per day

Company A (steeper line)

c) Days = 0

fixed charge: £20 (A), £50 (B)

5

A taxi fare, F pounds, for a journey of m miles is shown by a straight-line graph through the points (0, 3.50) and (5, 15.50).

- Work out the gradient of the line and say what it represents.
- Write down the equation of the line in the form $F = am + b$.
- Work out the fare for a 12-mile journey.

(4 marks)

a)

$$\text{gradient} = \frac{15.5 - 3.5}{5} = \frac{12}{5} = 2.4$$

£2.40 per mile

b) Intercept is 3.5 (fixed charge)

$$F = 2.4m + 3.5$$

c) $m = 12$

$$F = 2.4 \times 12 + 3.5$$

$$= 28.8 + 3.5$$

$$\text{£}32.30$$

6

A cyclist rides from home to a lake and back. On the distance-time graph the cyclist travels in a straight line from (0 hours, 0 km) to (1.5 hours, 24 km). The graph is then horizontal until 2 hours. It then goes in a straight line to (4 hours, 0 km).

- Work out the cyclist's speed on the way to the lake.
- What does the horizontal part of the graph show?
- Work out the cyclist's speed on the way home, and explain why the gradient of that part of the graph is negative.

(4 marks)

a)

$$\text{speed} = \frac{24}{1.5} = 16$$

16 km/h

b) Distance not changing

stopped for 0.5 hours

c) 24 km in 2 hours

$$\text{speed} = \frac{24}{2} = 12$$

12 km/h

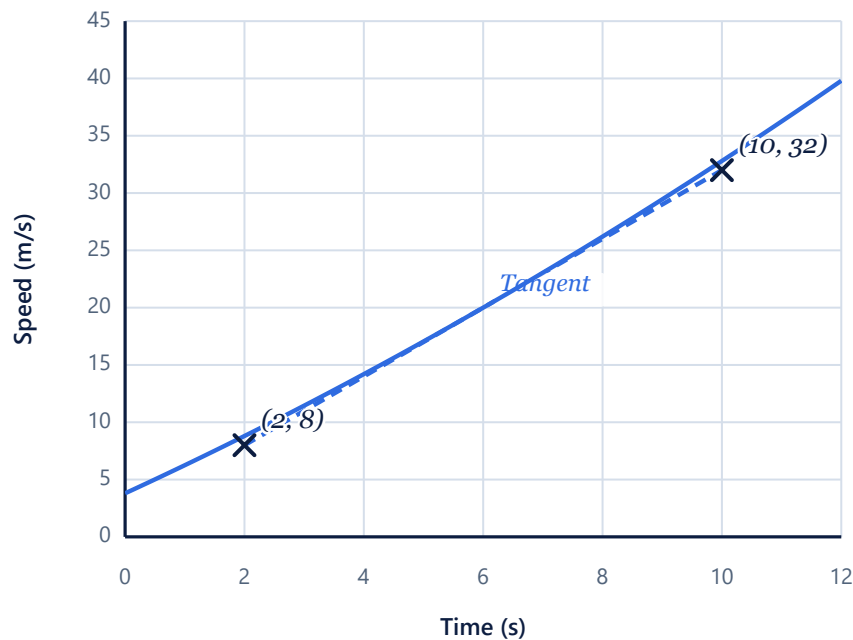
negative gradient: getting closer to home

7

The speed-time graph for a car is a smooth curve for $0 \leq t \leq 12$, where t is the time in seconds and the speed is in m/s.

A tangent drawn by eye to the curve at $t = 6$ passes through the points $(2, 8)$ and $(10, 32)$.

- Use the tangent to estimate the acceleration of the car at $t = 6$.
- Explain why your answer is only an estimate.



(4 marks)

a) Acceleration at $t = 6$ is the gradient of the tangent at $t = 6$

$$\text{Gradient} = \frac{32 - 8}{10 - 2} = \frac{24}{8} = 3$$

So the acceleration is approximately 3 m/s^2

b) The tangent is drawn by eye to a curved graph, so its gradient (and therefore the acceleration) is only an estimate

8

A cup of tea cools down. Its temperature, T °C, is measured every 2 minutes.

Time, t (minutes)	0	2	4	6	8	10
Temperature, T (°C)	90	72	60	52	46	42

- Use the values at $t = 2$ and $t = 6$ to estimate the rate at which the tea is cooling at $t = 4$. Give the units.
- Use the values at $t = 6$ and $t = 10$ to estimate the rate of cooling at $t = 8$.
- Explain why the tea cools more slowly at $t = 8$ than at $t = 4$.

(4 marks)

a) Gradient between $t = 2$ and $t = 6$

$$\frac{52 - 72}{6 - 2} = \frac{-20}{4} = -5$$

cooling at 5 °C per minute

b) Gradient between $t = 6$ and $t = 10$

$$\frac{42 - 52}{10 - 6} = \frac{-10}{4} = -2.5$$

cooling at 2.5 °C per minute

c) The graph gets less steep

tea is nearer room temperature so it cools more slowly

9

The distance-time graph for a cyclist is a smooth curve. A tangent drawn to the curve at $t = 20$ seconds passes through the points (10, 30) and (30, 110), where the distances are in metres.

- Use the tangent to estimate the speed of the cyclist at $t = 20$ in m/s.
- Convert your answer to km/h.

(4 marks)

a) Gradient of the tangent

$$\frac{110 - 30}{30 - 10} = \frac{80}{20} = 4$$

4 m/s

b) $\times 3600$ for one hour, $\div 1000$ for km

$$4 \times 3600 \div 1000 = 14.4$$

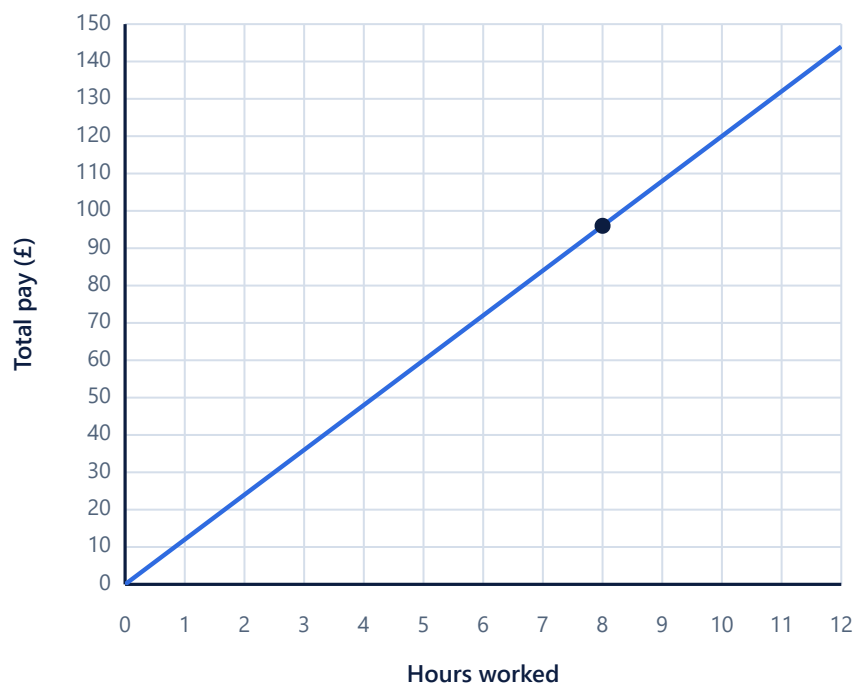
14.4 km/h

10

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 = $\frac{96}{8} = £12$

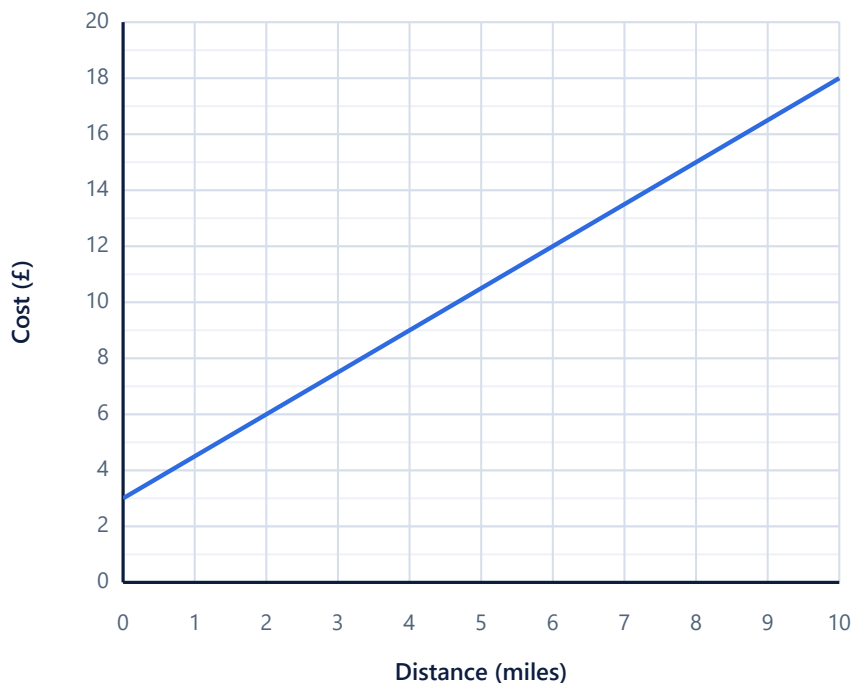
b) Pay for 11 hours = 11 times 12 = £132

11

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

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

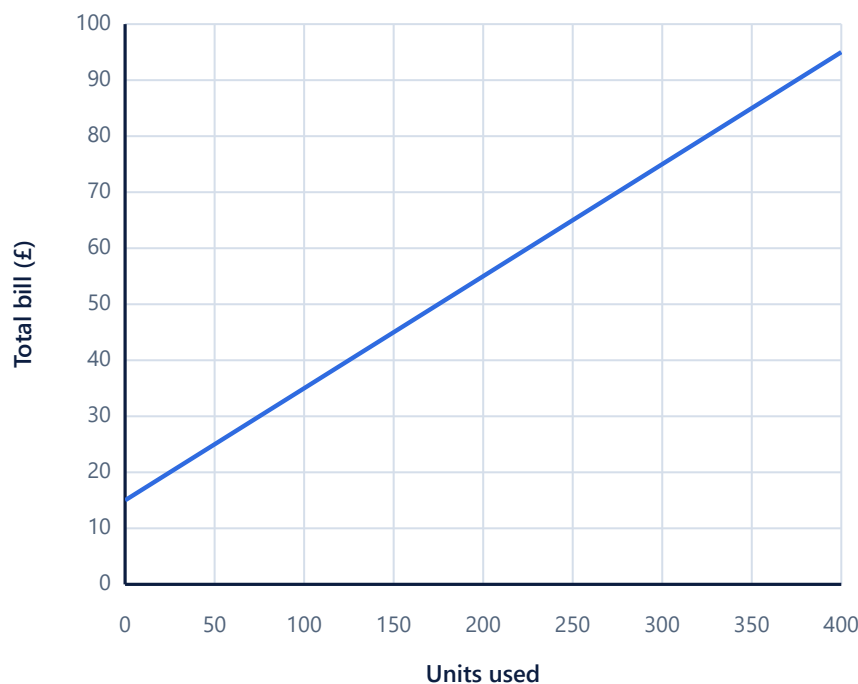
$$\text{c) Fare} = 3 + 6 \text{ times } 1.50 = 3 + 9 = \text{£}12$$

12

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

13

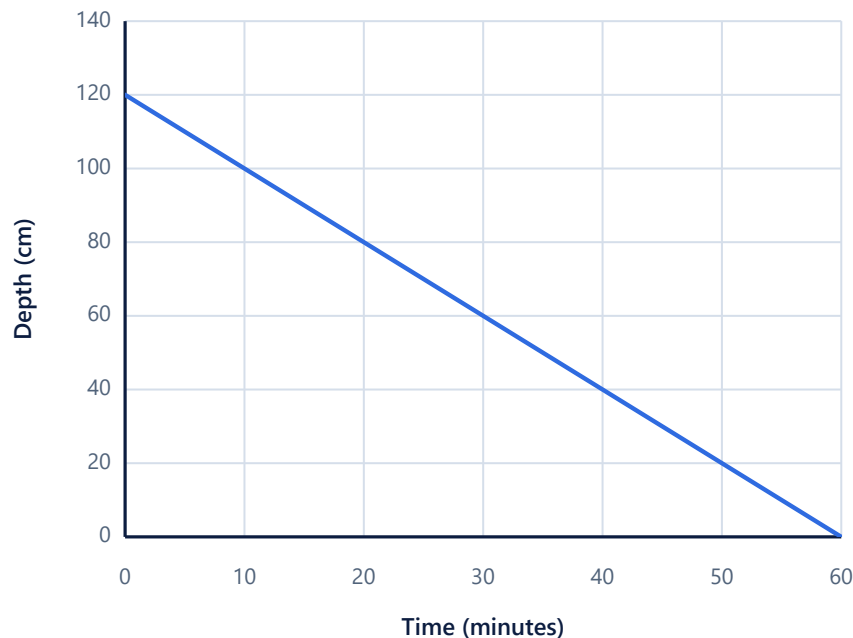
Water is draining from a tank at a constant rate.

The depth of the water is 120 cm when the tank starts to drain.

After 40 minutes the depth of the water is 40 cm.

The graph of depth against time is a straight line.

- Work out the gradient of the line.
- Interpret what your gradient means in this situation.



(3 marks)

The line passes through (0, 120) and (40, 40)

$$\text{Gradient} = \frac{40 - 120}{40 - 0} = -80 \div 40 = -2$$

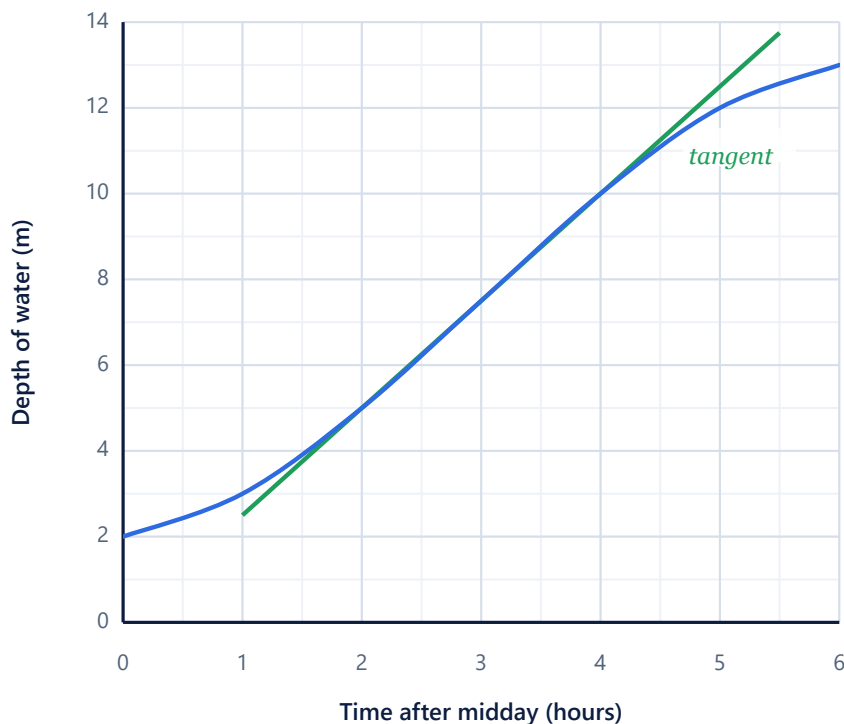
The gradient tells you the rate of change: the depth of water falls by 2 cm every minute

14

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