













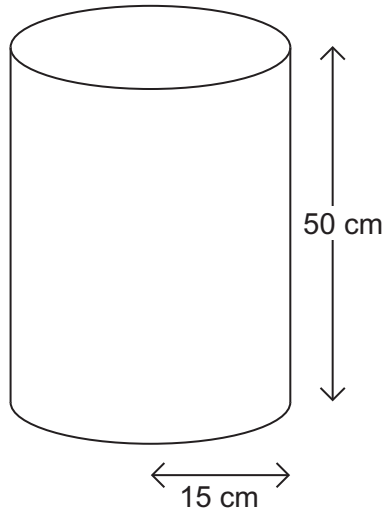








A tank is in the shape of a cylinder of radius 15 cm and height 50 cm



(a) Work out the volume of the tank.

[3 marks]

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Answer .....  $\text{cm}^3$

(b) The volume of another tank is  $33\,000\text{ cm}^3$

The tank is empty.

The tank is filled at the rate of 0.22 litres a second.

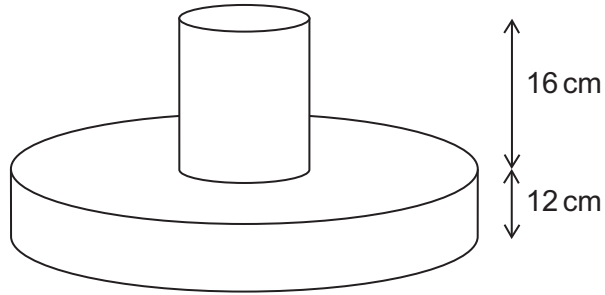
How many **minutes** will it take to fill the tank?

[4 marks]

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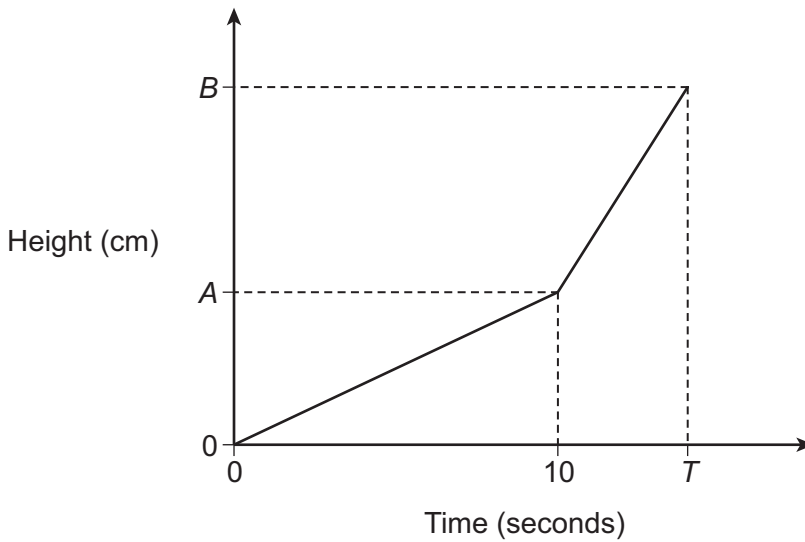
Answer ..... minutes

- 8 The diagram shows an empty container.  
Each part is a cylinder.



Water is added to the container at a steady rate.  
The container is full after  $T$  seconds.

The sketch graph shows the height, in cm, of the water as the container fills.



- 8 (a) State the values of  $A$  and  $B$ .

Answer  $A = \dots\dots\dots$ ,  $B = \dots\dots\dots$  (2 marks)

- 8 (b) The water is added at 250 millilitres per second.  
When full, the container holds 3.25 litres.

After how many seconds is the height of the water 20 cm?  
You **must** show your working.

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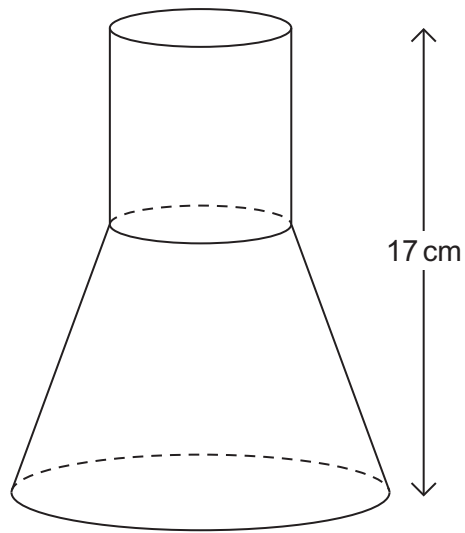
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Answer ..... seconds (3 marks)

9

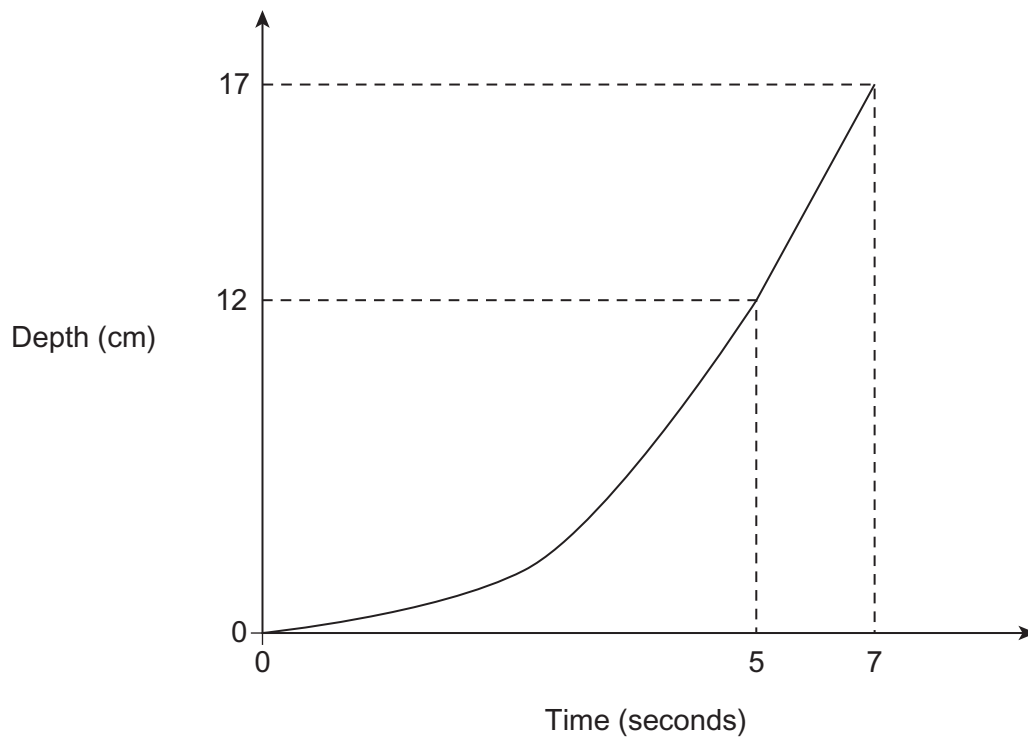
The diagram shows an empty container of height 17 cm  
The container consists of a cylinder on a frustum of a cone.



Water is added to the container at a constant rate for 7 seconds.

The sketch graph shows the depth of the water as the container fills.

The graph is a curve for the first 5 seconds and a straight line for the next 2 seconds.



**9 (a)** Circle the height of the cylinder.

**[1 mark]**

5 cm

8.5 cm

12 cm

17 cm

**9 (b)** Work out the rate of increase of the depth of water between 5 seconds and 7 seconds.  
State the units of your answer.

**[3 marks]**

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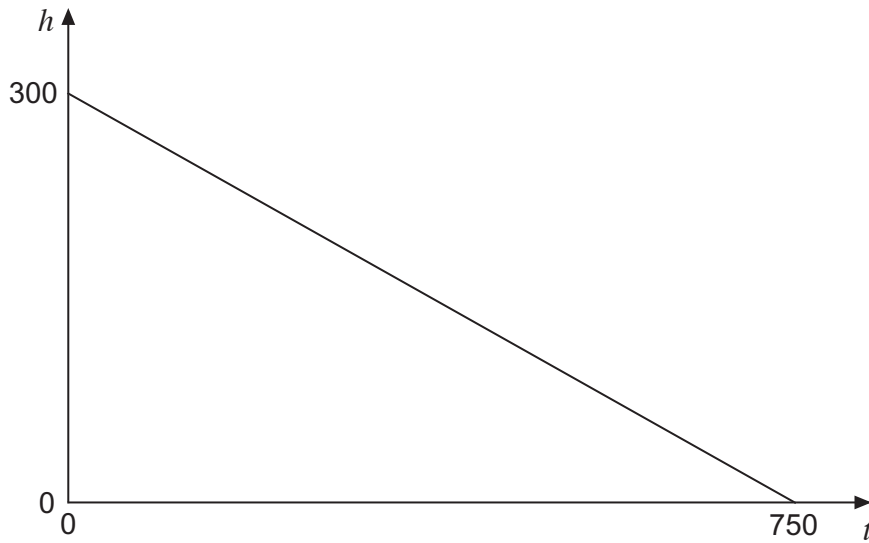
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Answer .....

**10** Here is a sketch graph showing the height of a candle as it burns.

$h$  is the height, in millimetres, of the candle.

$t$  is the time, in minutes, after the candle starts burning.



**10 (a)** Work out the rate at which the height of the candle decreases.  
Give your answer in millimetres per minute.

**[2 marks]**

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Answer \_\_\_\_\_ mm/min

**10 (b)** The relationship between  $h$  and  $t$  can be written as  $h = a - bt$

Work out the values of  $a$  and  $b$ .

**[2 marks]**

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Answer  $a =$  \_\_\_\_\_  $b =$  \_\_\_\_\_

**10 (c)** When the candle is 80 mm high, a new candle is used.

Work out the amount of time that the candle burns before a new candle is used.  
Give your answer in hours and minutes.

**[4 marks]**

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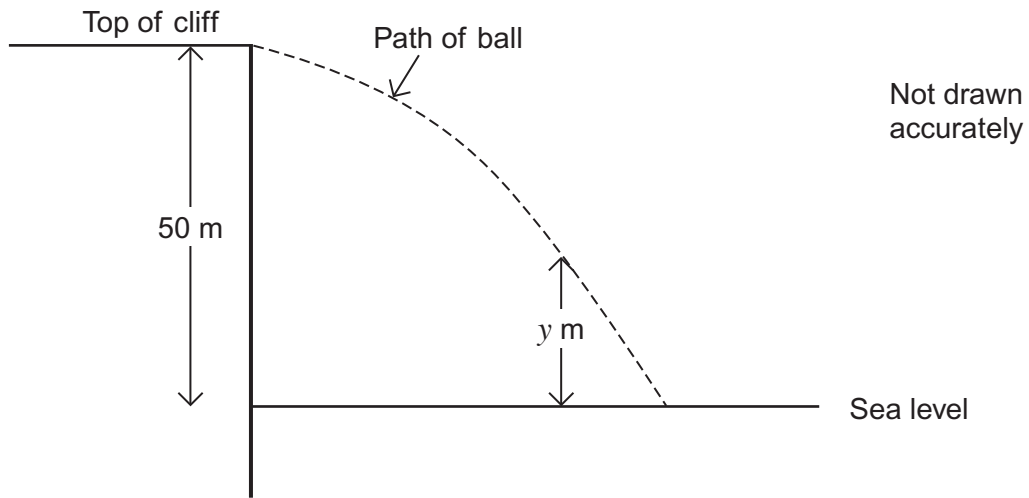
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Answer \_\_\_\_\_ hours \_\_\_\_\_ minutes

- 11 A ball is kicked horizontally from the top of a cliff. The top of the cliff is 50 metres above sea level.



The height of the ball is modelled by the equation

$$y = 50 - 4.9t^2$$

$y$  is the height of the ball, in metres, above sea level.

$t$  is the time, in seconds, after the ball is kicked.

- 11 (a) Complete this table of values for  $y = 50 - 4.9t^2$   
Values of  $y$  are given to 1 decimal place.

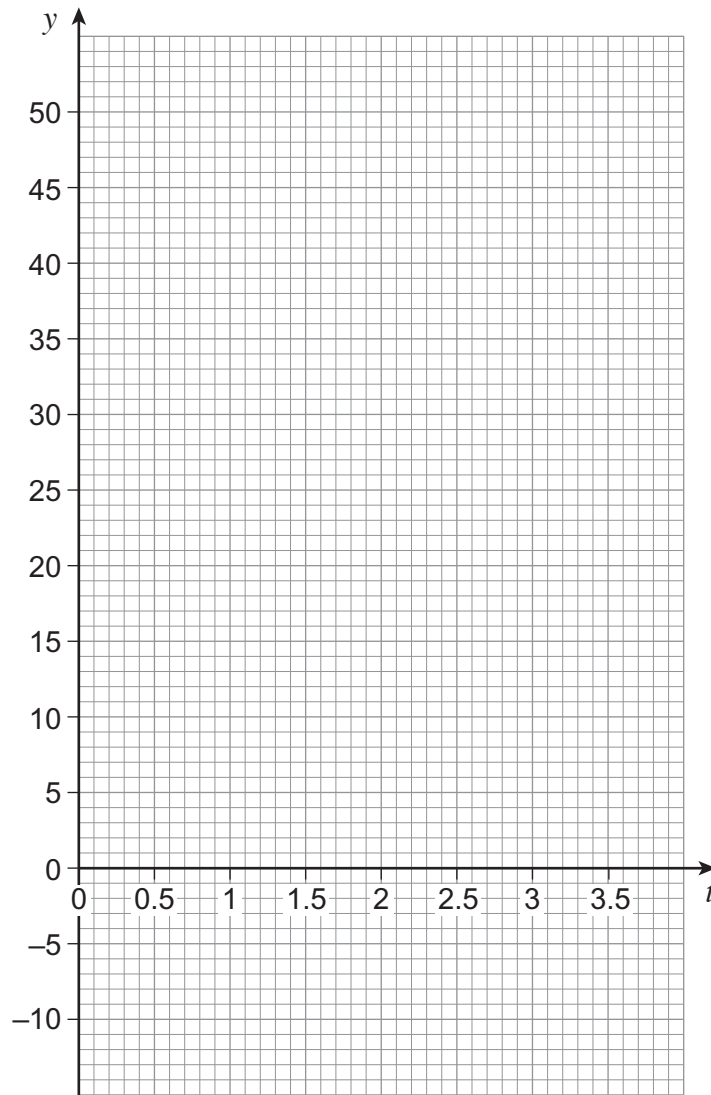
[2 marks]

$t$	0	0.5	1	1.5	2	2.5	3	3.5
$y$	50.0	48.8		39.0		19.4	5.9	-10.0



11 (b) Draw the graph of  $y = 50 - 4.9t^2$  for values of  $t$  from 0 to 3.5

[2 marks]



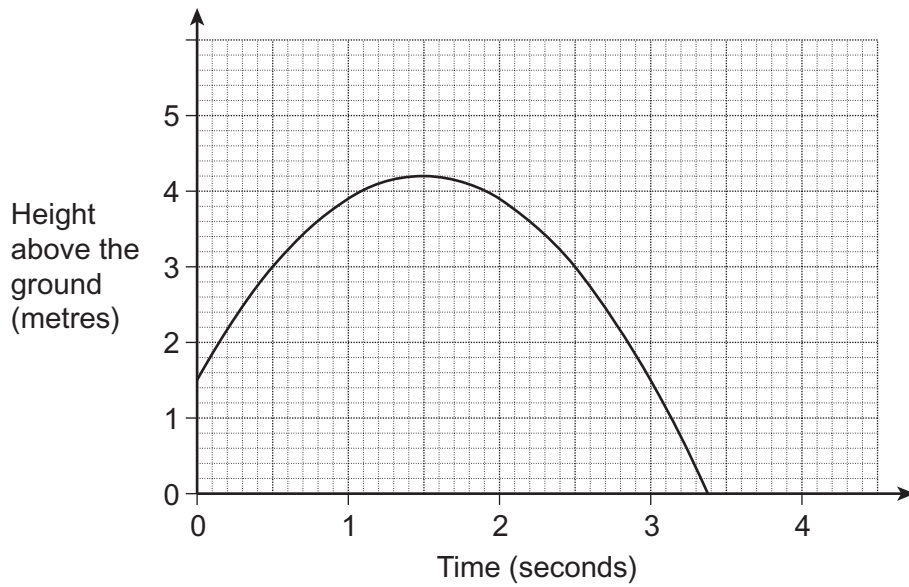
11 (c) Use your graph to estimate the time the ball takes to reach sea level.

[1 mark]

Answer ..... seconds

12 Sachin throws a ball.

The graph shows the height of the ball above the ground, in metres, after he throws it.



12 (a) How high above the ground is the ball when Sachin throws it?

Answer ..... m (1 mark)

12 (b) After how many seconds does the ball hit the ground?

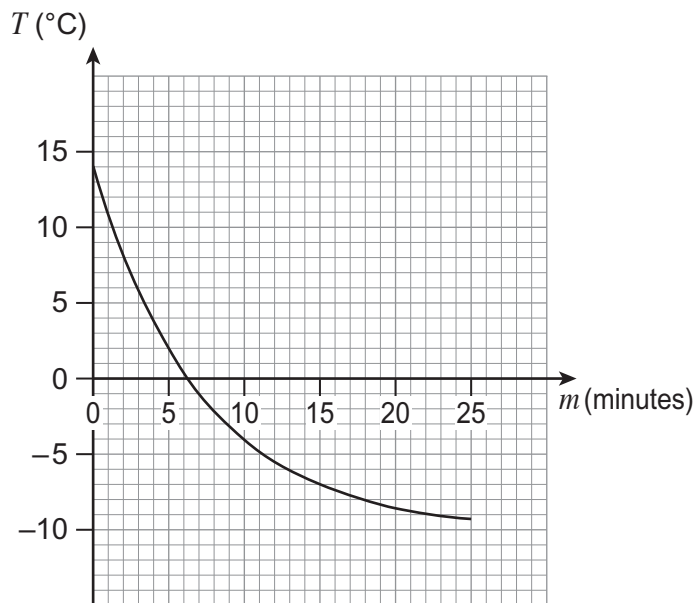
Answer ..... s (1 mark)

12 (c) For how many seconds is the ball more than 3 metres above the ground?

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Answer ..... s (2 marks)

- 13 The graph shows the temperature,  $T$  ( $^{\circ}\text{C}$ ) of bread,  $m$  (minutes) after it is placed in a freezer.



- 13 (a) How many minutes does it take for the temperature to reach  $0^{\circ}\text{C}$ ?

[1 mark]

Answer ..... min

- 13 (b) Estimate the rate at which the temperature is decreasing when  $m = 3$ .  
You **must** show your working.

[3 marks]

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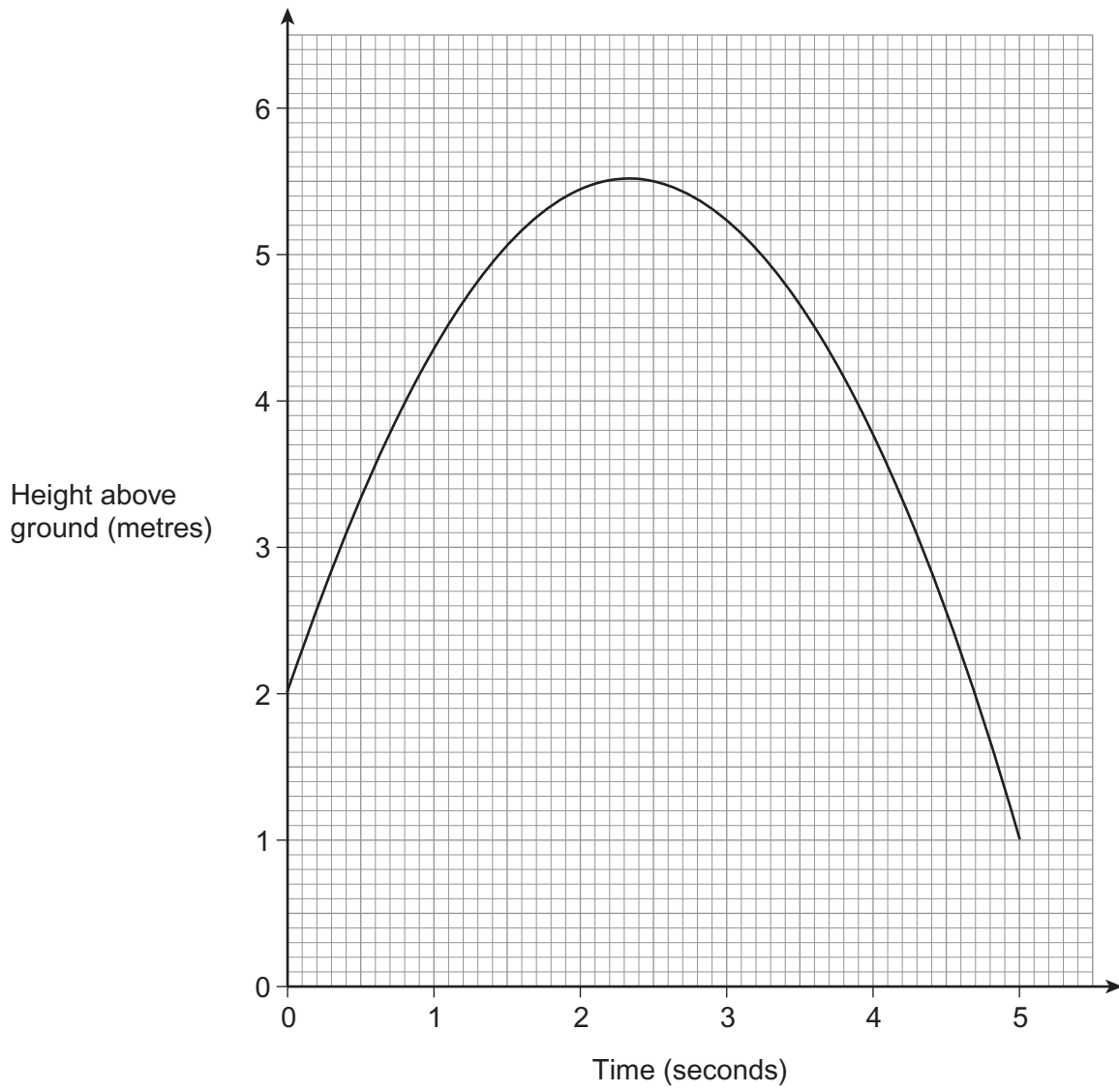
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Answer .....  $^{\circ}\text{C}$  per minute

14

Asif throws a cricket ball to Ben.  
The ball is in the air for 5 seconds.  
The graph shows the height of the ball above the ground.



**14 (a)** Give a reason why the graph shows that Ben catches the ball.

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(1 mark)

**14 (b)** After how many seconds is the ball at its greatest height?

Answer ..... seconds (1 mark)

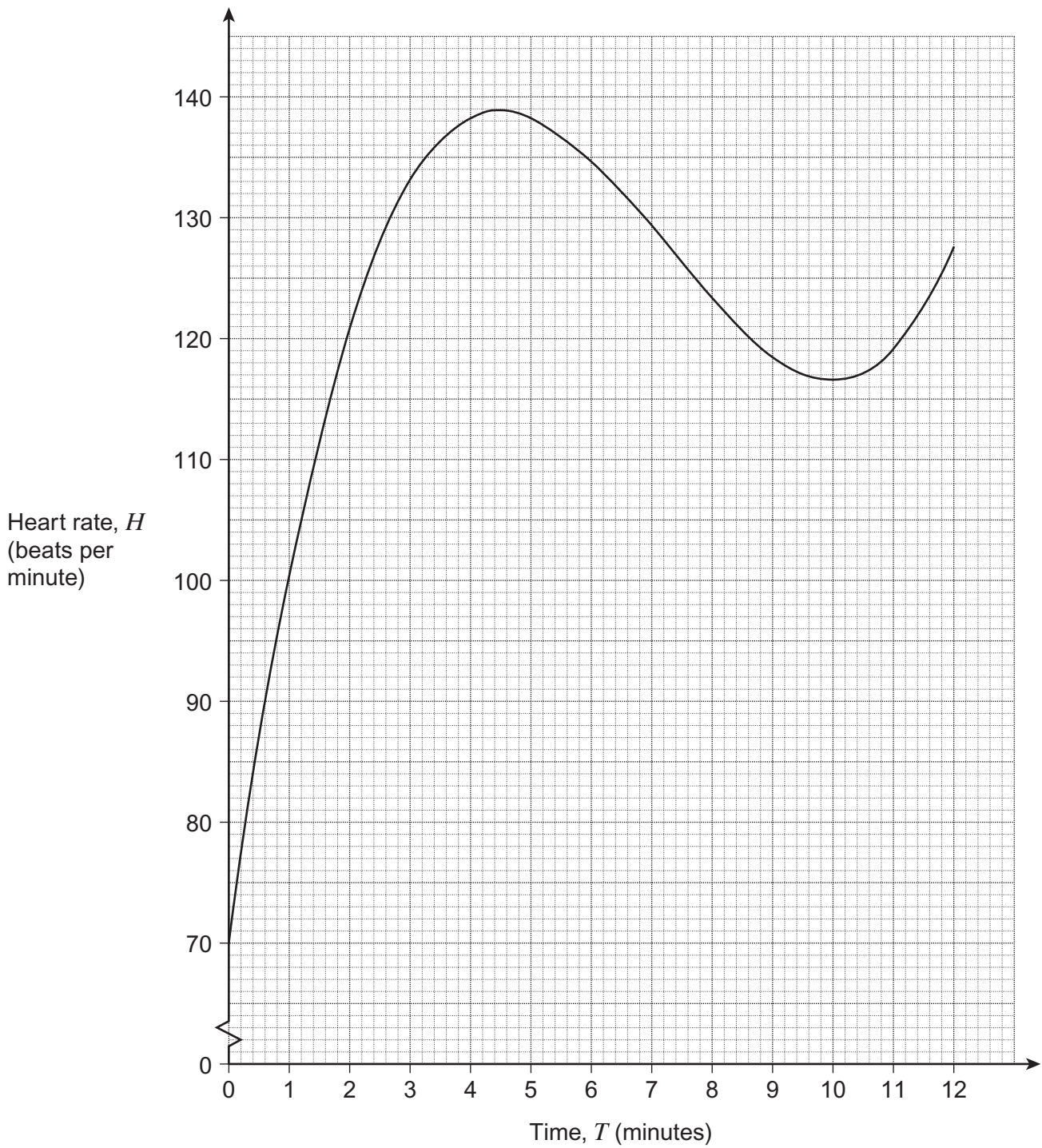
**14 (c)** What is the greatest height of the ball?

Answer ..... metres (1 mark)

15

Leroy goes to a gym to exercise.

The graph shows his heart rate,  $H$  (beats per minute) during 12 minutes of exercise.



15 (a) What was his heart rate when he started to exercise?

Answer ..... beats per min (1 mark)

15 (b) How many minutes of exercise did it take for him to reach his highest heart rate?

Answer ..... min (1 mark)

15 (c) By drawing a tangent, work out the rate of increase of  $H$  when  $T = 4$   
You **must** show your working.

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Answer..... beats per min<sup>2</sup> (3 marks)

**16** A dish contains some bacteria.

An antibiotic is added to the dish.

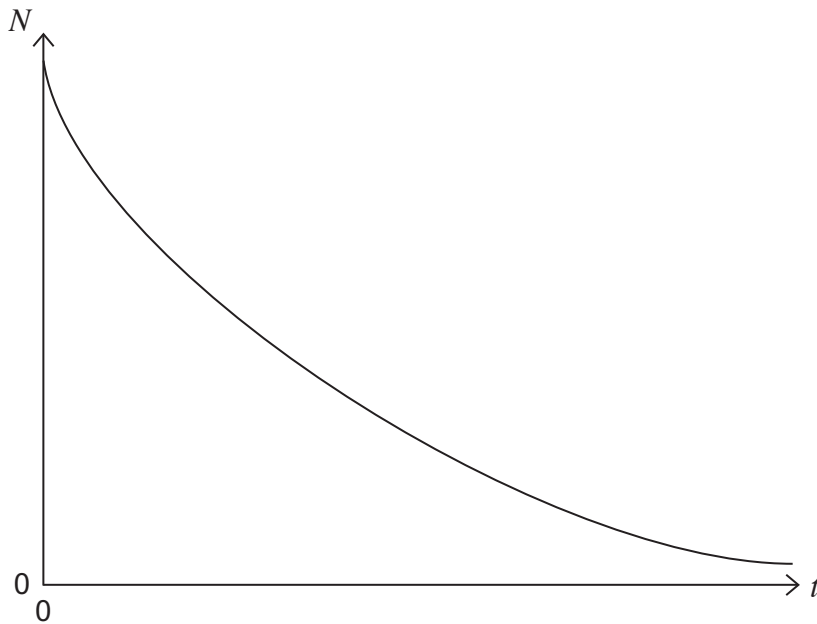
The antibiotic reduces the number of bacteria in the dish.

$N$  is the number of bacteria  $t$  hours after the antibiotic is added.

The relationship between  $N$  and  $t$  is modelled by

$$N = 12\,000a^t \quad \text{where } a \text{ is a positive constant.}$$

A sketch graph of  $N = 12\,000a^t$  is shown.



**16 (a)** Show that there are 12 000 bacteria in the dish when the antibiotic is added.

**[1 mark]**

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**16 (b)** There are 6144 bacteria in the dish after 3 hours.

Work out the value of  $a$ .

**[2 marks]**

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Answer .....

**16 (c)** Show that approximately one-sixth of the bacteria are left in the dish after 8 hours.

**[1 mark]**

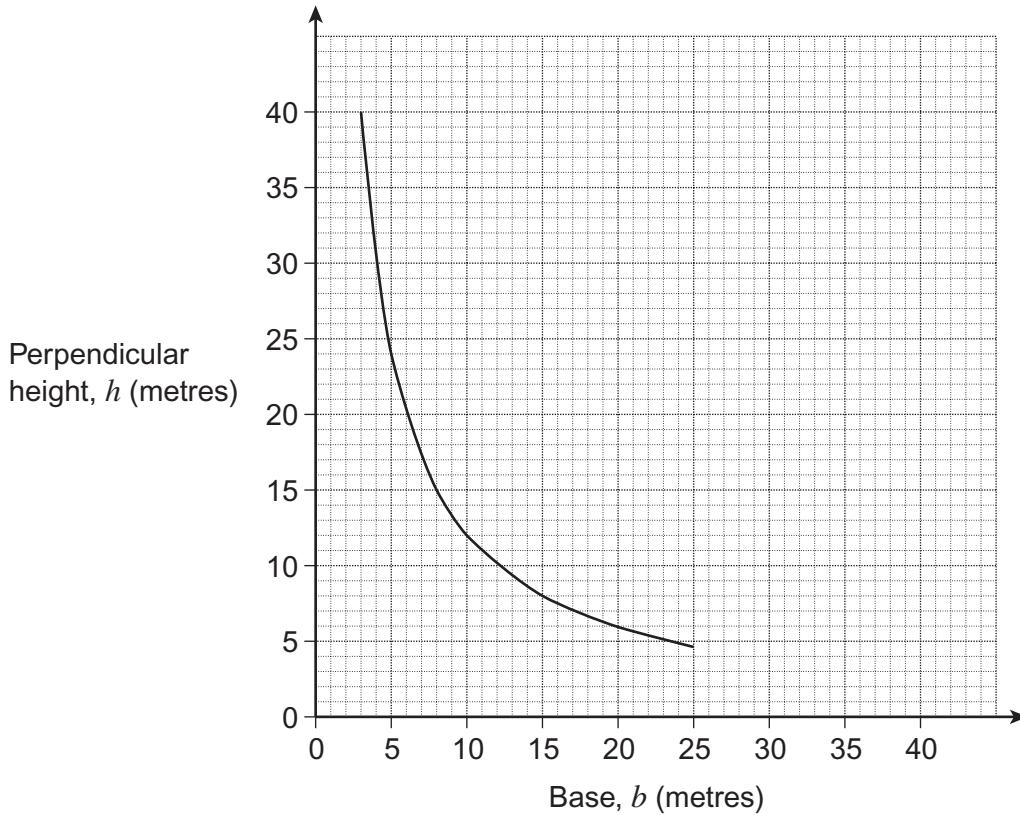
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17 A farmer wants to make a **triangular** enclosure of area  $60 \text{ m}^2$ .

This graph shows the relationship between the base,  $b$  (metres), and the perpendicular height,  $h$  (metres), of the triangle.



17 (a) Explain how the graph shows that the area of the triangle is  $60 \text{ m}^2$ .

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(2 marks)

17 (b) Complete the graph for values of  $b$  up to 40.

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(2 marks)

17 (c) The farmer decides to make the base twice as long as the perpendicular height.

17 (c) (i) Plot these points on the graph opposite and join them with a straight line.

$b$	0	20	40
$h$	0	10	20

(1 mark)

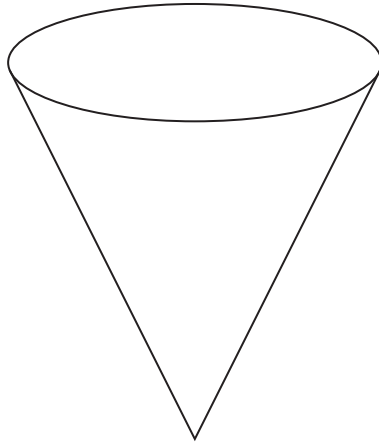
17 (c) (ii) Use your line to write down approximate values for the base and perpendicular height that the farmer will use.

Base ..... m

Perpendicular height ..... m (2 marks)

18

The diagram shows an empty cone of radius 1.5 metres and height 4 metres.



Sand is poured into the cone at a rate of  $0.2 \text{ m}^3$  per minute.

Work out the number of minutes it takes to fill the cone.

**[3 marks]**

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Answer ..... minutes