1. Question part 1/2 | 0607 Feb-March 2025 P6 V2 Q8

Section B

MODELLING STREET LIGHTS

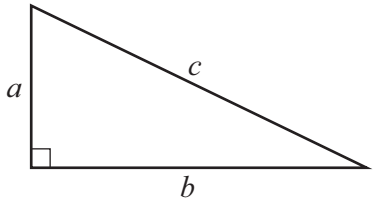
You are advised to spend no longer than 45 minutes on this section.

In this task you will be modelling how to place lights on paths.

In this task:

- paths are straight
- lights are shown as large dots
- lights shine on an area that is a circle called the *circle of light*
- lights must shine on all parts of the path
- lights are placed as far apart as possible.

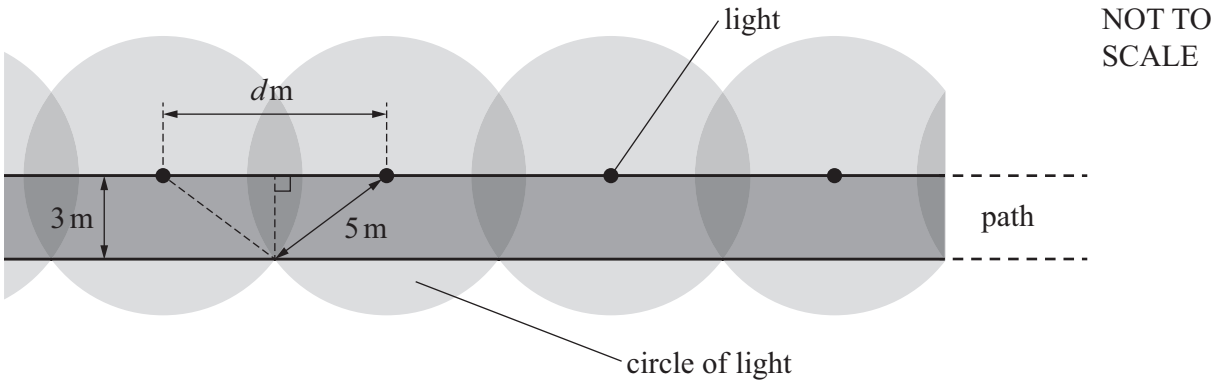
In this task you will find Pythagoras' theorem useful.



$a^2 + b^2 = c^2$

8 This path has a width of 3 m.
The radius of each circle of light is 5 m.
The distance along the path between the lights is d metres.

(a) The lights are placed on the same side of the path as shown.

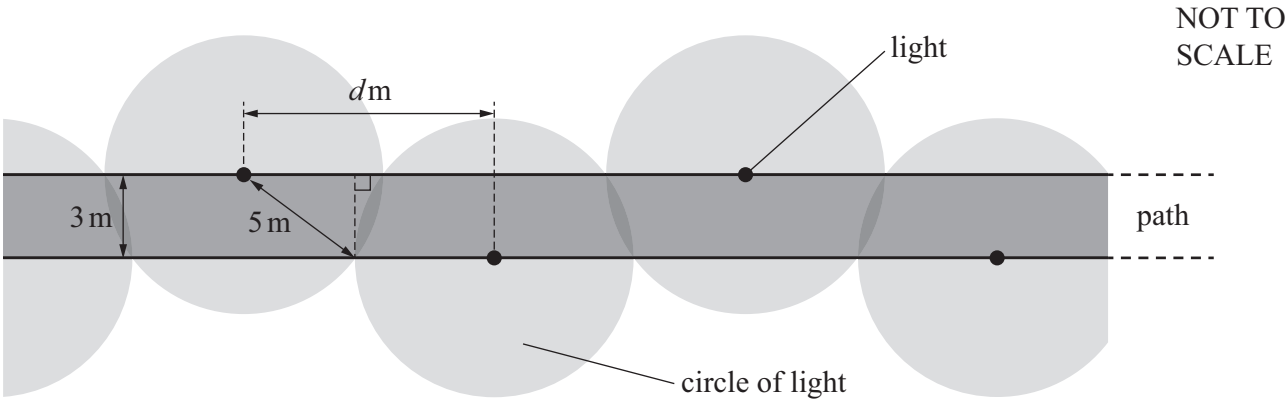


Use Pythagoras' theorem to find the value of d.

..... [3]

1. Question part 2/2 | 0607 Feb-March 2025 P6 V2 Q8

(b) The lights are placed on both sides of the path as shown.



Show that the value of d is now 9.

[1]

(c) Lights are placed on a long path.

Which arrangement, **part (a)** or **part (b)**, uses the smaller number of lights?
Give a reason for your answer.

..... [1]

2. Question | 0607 Feb-March 2025 P6 V2 Q9

9 A different path has a width of 4 m.
The radius of each circle of light is 5 m.

Calculate the distance along the path between lights

(a) when the lights are all on the **same** side of the path

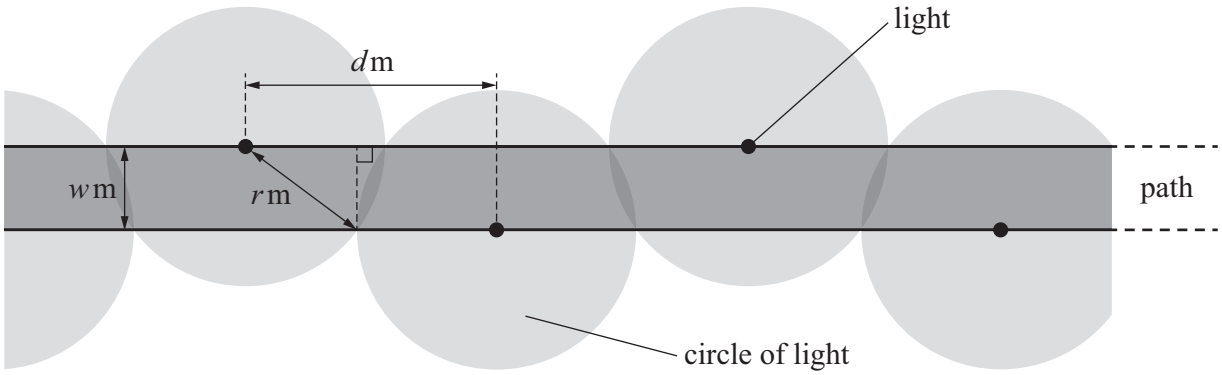
..... [2]

(b) when the lights are on **both** sides of the path.

..... [2]

3. Question | 0607 Feb-March 2025 P6 V2 Q10

10



For this path:

- the width of the path is w metres
- the radius of the circle of light is r metres
- lights are on both sides of the path.

(a) A model for d in terms of r and w is $d = r + \sqrt{r^2 - w^2}$.

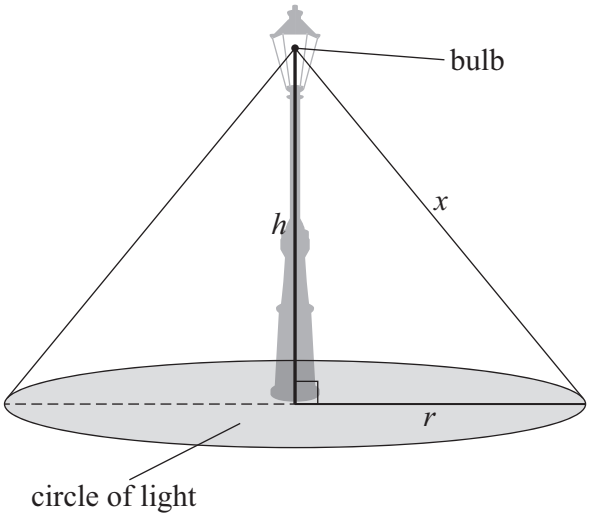
Draw and label a diagram to show this is correct.

[2]

(b) Find the value of d when $w = 6$ and $r = 6.8$.

..... [2]

11



The diagram shows a light with height h metres and its circle of light.

A model for the intensity of light, L, at distance x metres from the bulb is

$$L = \frac{B}{x^2}.$$

B is a number called the *brightness index* of the bulb.
When B is larger the light is brighter.

The intensity of light on the circumference of the circle of light must be 0.05 units.

(a) Show that $r = \sqrt{20B - h^2}$.

[3]

(b) The height of the light is 6 m.
The radius of the circle of light is 10 m.

Find the value of B.

..... [3]

(c) The height of the lights is h metres.

Change the model $d = r + \sqrt{r^2 - w^2}$ to find a model for d in terms of B, h and w.

..... [1]

5. Question | 0607 Feb-March 2025 P6 V2 Q12

12 The height of the lights is 3.0 m.
The lights are on both sides of the path.
The brightness index is 3.5 .
The intensity of light on the circumference of the circle of light is still 0.05 units.

Find the greatest possible width for the path.

..... [5]

6. Question part 1/3 | 0607 May-June 2025 P6 V1 Q3

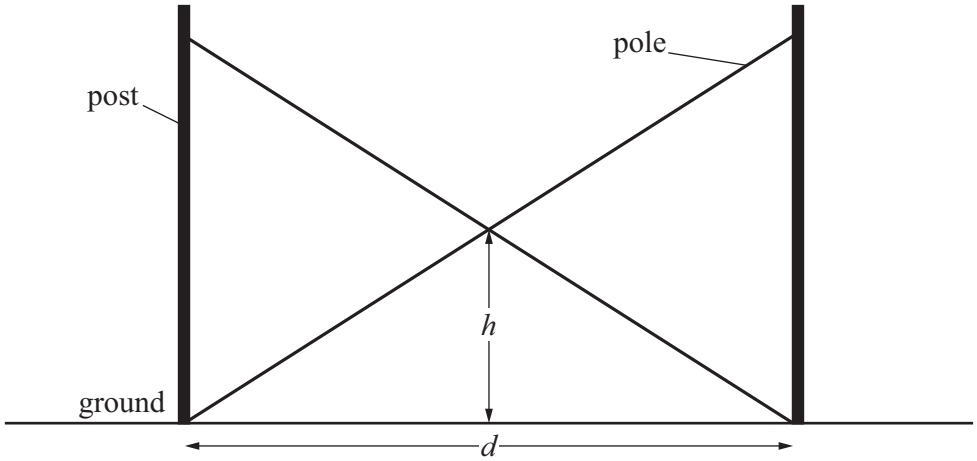
Section B

MODELLING CROSSED POLES

You are advised to spend no more than 45 minutes on this section.

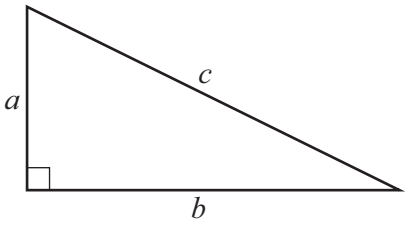
In this task you will be modelling the heights of triangles made below two poles when they cross.

Each triangle is made from 2 poles that lean between vertical posts.



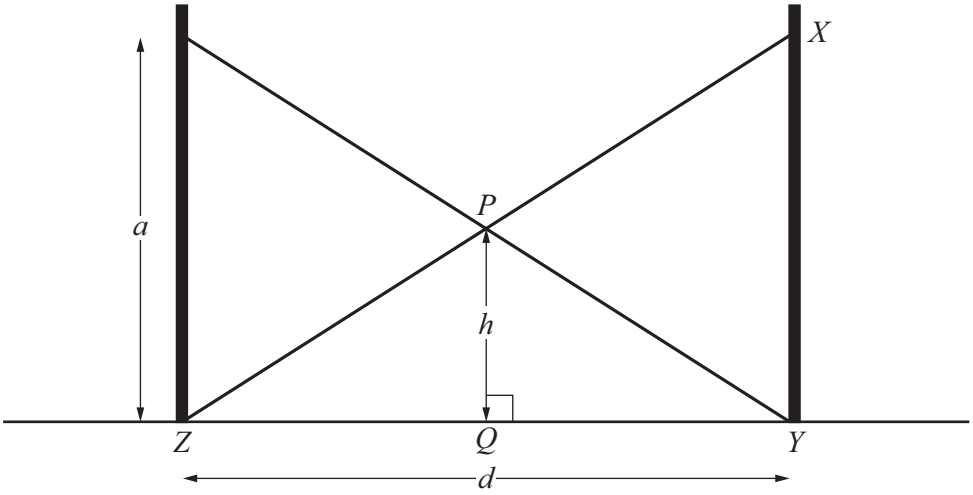
One end of each pole rests on the ground and the other end rests against a vertical post.
The posts are d metres apart on horizontal ground.
The poles cross each other h metres above the ground.

In this task you will find Pythagoras' theorem useful.



$$a^2 + b^2 = c^2$$

3 The poles are 10 m long.
Each pole touches one post on the ground and the other post a metres above the ground.



NOT TO SCALE

Q is the midpoint of ZY.

(a) (i) Complete the statement.

Triangle .....P..... is similar to triangle XYZ. [1]

(ii) Use similar triangles and a and h to complete this statement.

$$\frac{\frac{1}{2}d}{d} = \frac{\square}{\square}$$

[1]

(b) In this part $h = 4$.

(i) Write down the value of a.

..... [1]

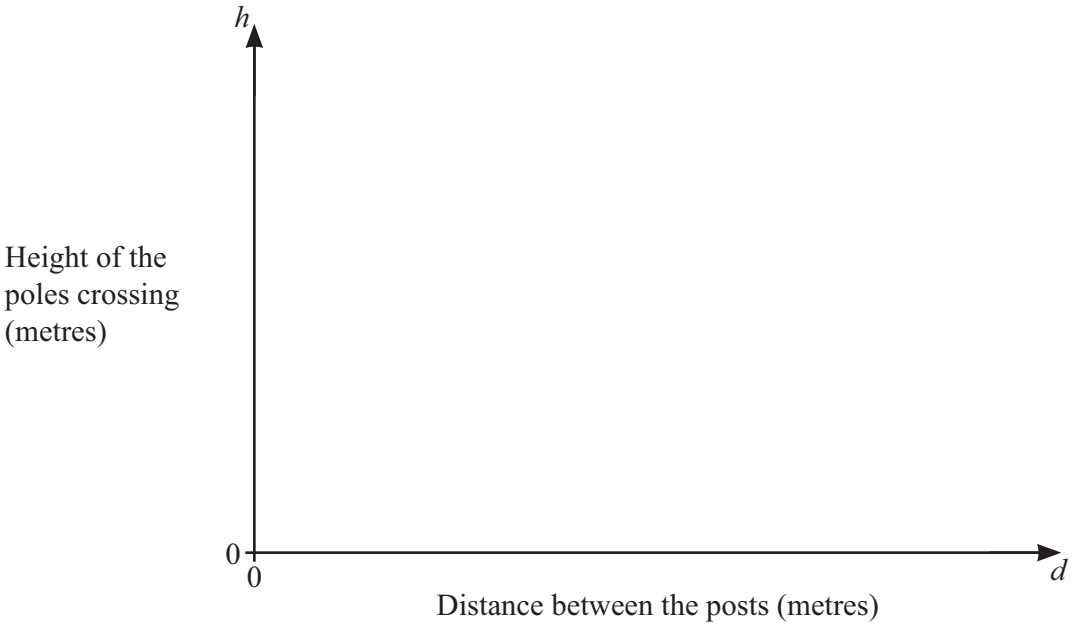
(ii) Use Pythagoras' theorem to find the value of d.

..... [2]

(c) **(i)** Show that a model for h in terms of d is $h = \frac{1}{2}\sqrt{100 - d^2}$.

[2]

(ii) Sketch the model for h.



[2]

(d) Look at the diagram on page 8.

(i) Describe the position of the poles when the curve meets the d-axis on the graph.

..... [1]

(ii) Give a reason why the model is not valid when the curve meets the h-axis on the graph.

..... [1]

7. Question | 0607 May-June 2025 P6 V1 Q4

4 Two poles are each 15 m long.

(a) Change the model in **Question 3(c)(i)** for poles of length 15 m.

..... [1]

(b) The poles cross at a height of 6 m.

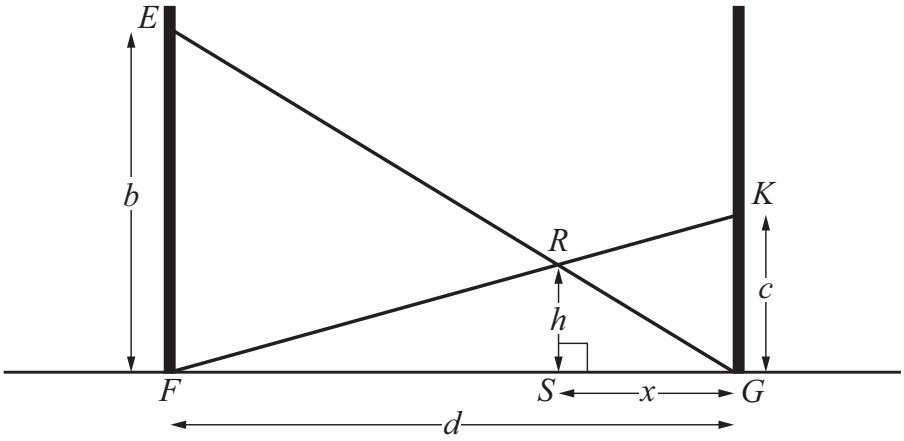
Find the distance between the posts.

..... [3]

5 In this question the lengths of the two poles are different.
One pole is 20 m long and the other pole is 15 m long.

The 20 m pole touches the left post at a height of b metres above the ground.
The 15 m pole touches the right post at a height of c metres above the ground.

The poles cross at R, which is x metres from the right post.



NOT TO SCALE

(a) (i) Use similar triangles to complete these statements.

In triangles RSG and EFG $\quad \frac{x}{d} = \frac{h}{\square}$.

In triangles RSF and KGF $\quad \frac{d-x}{d} = \frac{\square}{\square}$.

[1]

8. Question part 2/3 | 0607 May-June 2025 P6 V1 Q5

(ii) Use the equations in **part (a)(i)** to show that

$$\frac{h}{b}+\frac{h}{c}=1.$$

[1]

(iii) Use the equation in **part (a)(ii)** to show that

$$\frac{h}{\sqrt{400-d^2}}+\frac{h}{\sqrt{225-d^2}}=1.$$

[3]

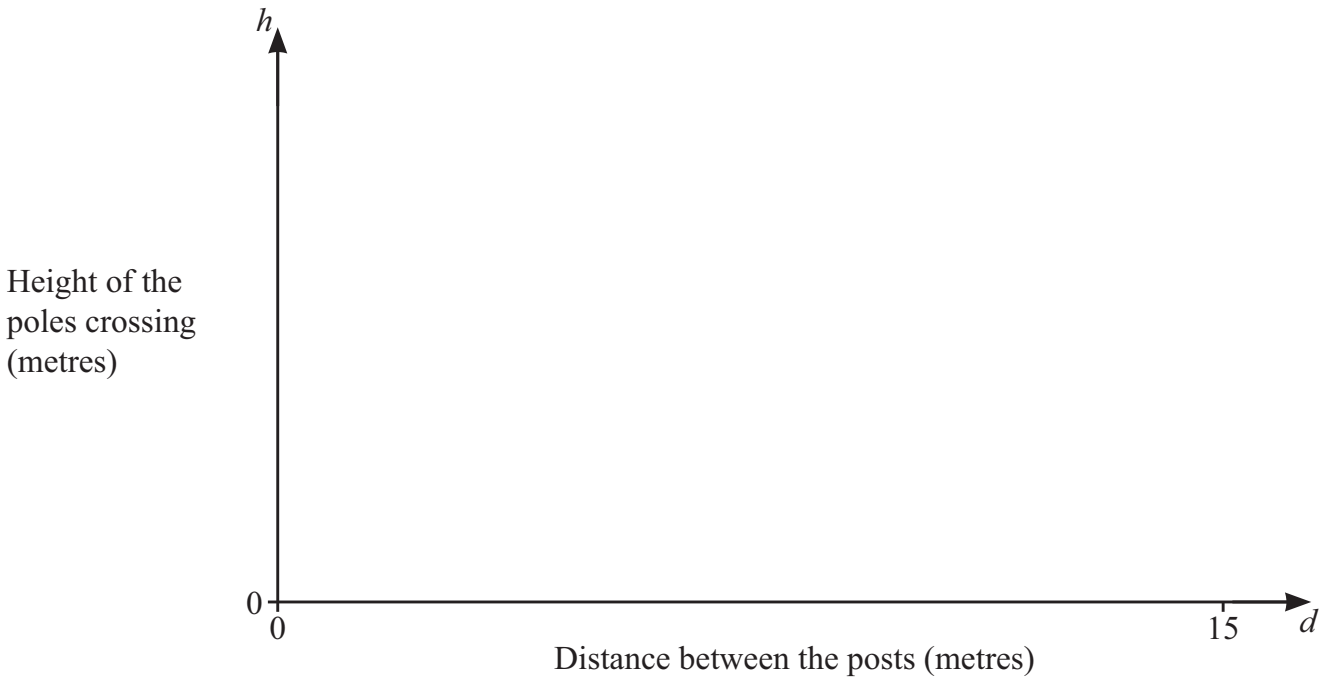
(iv) Rearrange the model in **part (a)(iii)** to show that a model for h in terms of d is

$$h=\frac{\left(\sqrt{400-d^2}\right)\left(\sqrt{225-d^2}\right)}{\left(\sqrt{225-d^2}+\sqrt{400-d^2}\right)}.$$

[1]

Questions 5(a)(v), (b)(i) and (b)(ii) are printed on the next page.

(v) Sketch the model for h in **part (a)(iv)** for values of d between 0 and 15.



[1]

(b) The distance between the posts is 8 m.

(i) Find the height where the poles cross.

..... [1]

(ii) Find the heights of the points where the poles touch the posts.

.....

.....

[2]

Section B

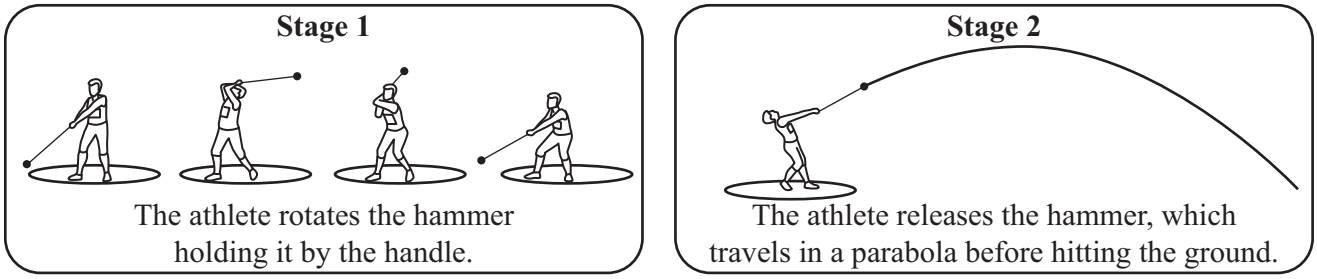
MODELLING HAMMER THROWING

You are advised to spend no more than 45 minutes on this section.

In this task you will look at the sport of hammer throwing.

The task uses models to find the horizontal distance that an athlete can throw the hammer.
The hammer is a metal ball.
The metal ball is fixed to a wire with a handle.

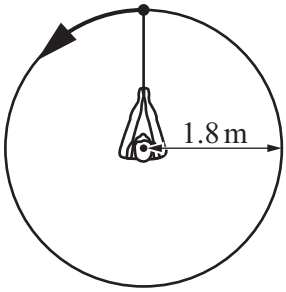
A hammer throw has two stages.



Athletes want to maximise the horizontal distance that the hammer travels after release.

6 Stage 1

The athlete rotates the hammer holding it by the handle.
The hammer travels along a circle of radius 1.8 m as shown in this diagram.



(a) The circumference, C, of a circle of radius r is $C = 2\pi r$.

Calculate how far the hammer travels in one complete turn.

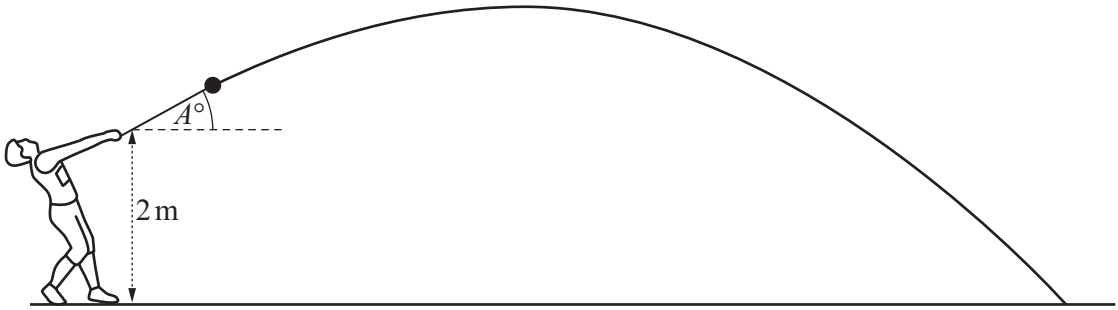
..... [2]

(b) The hammer makes N complete turns in one second.
The speed of the hammer is V m/s.

Write down a model for V in terms of N.

..... [1]

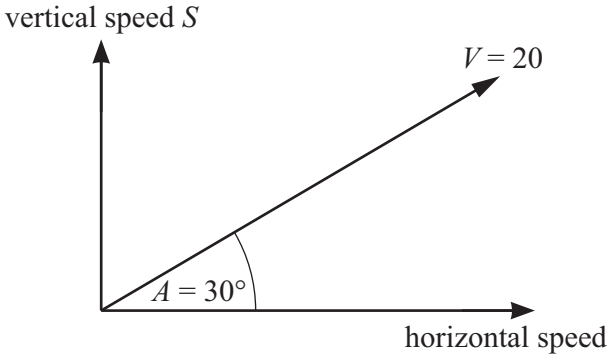
7 Stage 2



The diagram shows an athlete releasing the hammer at a speed of V m/s at an angle A to the horizontal.
A is the *release angle*.

The athlete releases the hammer at a speed of 20 m/s with release angle 30°.

As the hammer travels it moves both vertically and horizontally as shown.



This is a model for the vertical speed S m/s.

$$S = V \sin A$$

(a) Calculate the vertical speed of the hammer.

..... [2]

10. Question part 2/2 | 0607 May-June 2025 P6 V2 Q7

(b) In this part assume that gravity has no effect.

The hammer travels vertically for x seconds at the speed that you calculated in **part (a)**.

(i) Write down an expression in terms of x for the number of metres that the hammer travels vertically.

..... [1]

(ii) The athlete releases the hammer when it is 2 metres above the ground.

Change your expression in **part (b)(i)** to give the number of metres that the hammer is above the ground after x seconds.

..... [1]

(c) Gravity reduces the height in **part (b)(ii)** by $4.9x^2$ metres.

(i) Write down a model for the height in metres, H, of the hammer above the ground after x seconds.

..... [1]

(ii) When the hammer hits the ground, $H = 0$.
The hammer hits the ground after x seconds.

Find the value of x.

..... [3]

11. Question part 1/2 | 0607 May-June 2025 P6 V2 Q8

8 The best release angle A is approximately 45°.
This angle gives the greatest horizontal distance that the hammer travels after release.

An Olympic athlete uses the best release angle.
The athlete releases the hammer at a speed of V m/s when the hammer is 2 metres above the ground.
The hammer hits the ground after x seconds.

(a) $S = V\sin A$ and $\sin 45° = 0.7$.

Use **Question 7(c)(i)** to show that $4.9x^2 - (0.7V)x - 2 = 0$.

[1]

11. Question part 2/2 | 0607 May-June 2025 P6 V2 Q8

(b) The formula for the solution of $ax^2+bx+c=0$ is $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$.

(i) Use this formula to solve $4.9x^2-(0.7V)x-2=0$ and show that a model for x is

$$x=\frac{V+\sqrt{V^2+80}}{14}.$$

[3]

(ii) The solution $x=\dfrac{V-\sqrt{V^2+80}}{14}$ has been rejected because x cannot be negative.

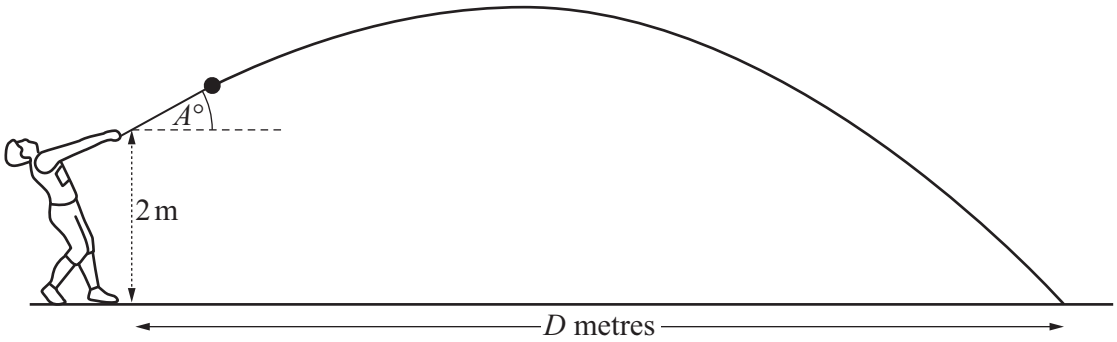
Give a reason why $\dfrac{V-\sqrt{V^2+80}}{14}$ always gives a negative result.

..... [1]

12. Question part 1/2 | 0607 May-June 2025 P6 V2 Q9

9 An athlete uses the best release angle.
The hammer has a constant horizontal speed which is equal to the hammer's vertical speed at the moment of release.

(a) An athlete uses the best release angle A to throw a hammer at a speed of 20 m/s.
The horizontal distance that the hammer travels is D metres.



(i) Use $\sin A = 0.7$ and the model $S = V \sin A$ to find the horizontal speed.

..... [1]

(ii) Use the model in **Question 8(b)(i)** to find the value of D.

..... [3]

(b) An athlete throws a hammer at V m/s using the best release angle.

Use the model in **Question 8(b)(i)** to show that a model for D is

$$D = \frac{V^2 + V\sqrt{V^2 + 80}}{20}.$$

[1]

12. Question part 2/2 | 0607 May-June 2025 P6 V2 Q9

(c) In 2016 Anita Włodarczyk from Poland set the Women's World Record for hammer throwing.

Using the best release angle, she threw the hammer 82.98 metres.

(i) Use the model in **part (b)** to find the speed V m/s at which she released the hammer. This was at the end of Stage 1 of her throw.

..... [2]

(ii) In **Question 6(b)**, at the end of Stage 1, the rate of turning is N turns per second.

Find the value of N for Anita Włodarczyk's record throw.

..... [2]

13. Question part 1/2 | 0607 May-June 2025 P6 V3 Q4

Section B

MODELLING FISH GROWTH

You are advised to spend no more than 45 minutes on this section.

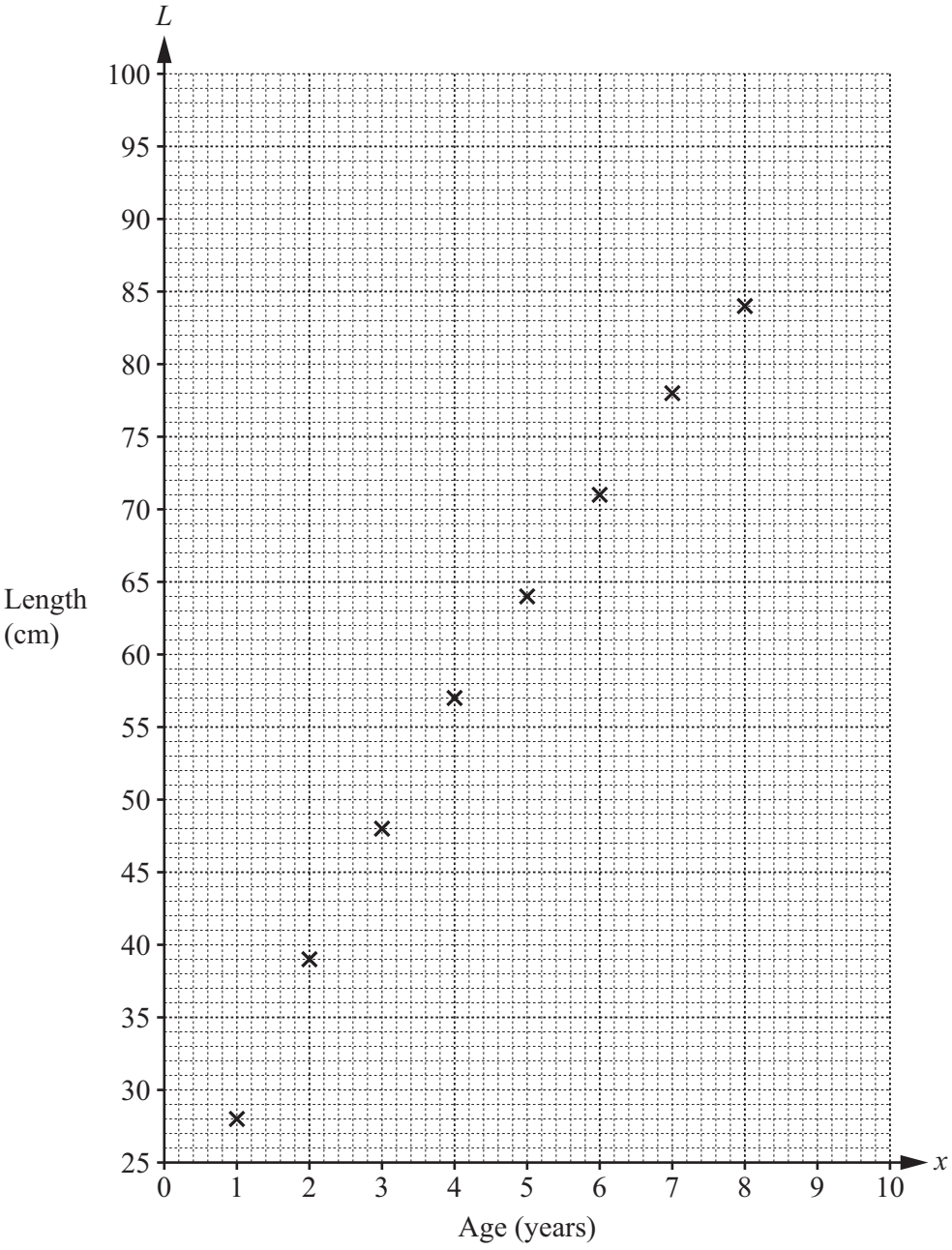
In this task you will be modelling the age and length of fish.

4 Matteo finds some data about the average length of kingfish at different ages.
The table shows this.

Age (x years)	1	2	3	4	5	6	7	8	9	10
Length (L cm)	28	39	48	57	64	71	78	84	89	94

(a) The first eight points are plotted on the grid.

Plot the last two points.



[1]

13. Question part 2/2 | 0607 May-June 2025 P6 V3 Q4

(b) Matteo decides to model the data using the regression line in the form $L = mx + c$.

(i) Find the equation of this model.

..... [2]

(ii) Explain what the value of the gradient m represents in this context.

..... [1]

(iii) Explain what the value of c represents in this context.

..... [1]

14. Question | 0607 May-June 2025 P6 V3 Q5

5 Irene finds this data about older kingfish.

Age (x years)	11	12	13	14	15	16	17	18	19	20
Length (L cm)	98	102	105	109	112	114	117	119	121	122

Is the model used in **Question 4(b)** valid for older kingfish?
Give a reason for your answer.

.....

..... [1]

15. Question | 0607 May-June 2025 P6 V3 Q6

6 Irene uses this model for the length of a kingfish.

$$L = ax^2 + bx + 2$$

(a) Use the lengths at age 10 years and at age 20 years to write two equations in terms of a and b.

.....

.....
[2]

(b) Solve your simultaneous equations from **part (a)** and write down Irene's model.

..... [3]

(c) Use Irene's model in **part (b)** to estimate the length of a kingfish at age 14.5 years.

..... [2]

16. Question | 0607 May-June 2025 P6 V3 Q7

7 Mayuko uses a different model for the length of a kingfish.

$$L = \frac{123}{1 + 3.2 \times 10^{-kx}} \text{ where } k \text{ is a positive constant}$$

(a) Use this model to find the length of the kingfish when $x = 0$.

..... [2]

(b) **(i)** Write down what happens to the value of 10^{-kx} as the age of the kingfish increases.

..... [1]

(ii) Use **part (i)** to explain why the value of L gets closer to 123 as the age of the kingfish increases.

.....

..... [1]

(c) The length of a kingfish is 89 cm at age 9 years.

Find the value of k.

..... [3]

Question 8 is printed on the next page.

17. Question | 0607 May-June 2025 P6 V3 Q8

8



(a) Sketch Irene's model from **Question 6(b)** for values of x between 0 and 30. [2]

(b) Sketch Mayuko's model from **Question 7** for values of x between 0 and 30. [2]

(c) Identify the better model giving a reason for your choice.

.....

..... [1]

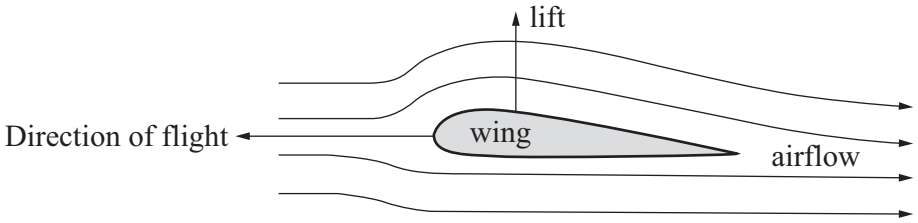
Section B

MODELLING LIFT

You are advised to spend no more than 45 minutes on this section.

In this task, you will model the upward force, *lift*, that an aircraft wing makes when it flies through the air.

Different wing shapes make different amounts of lift.
This task is about one wing shape and the lift that it makes.

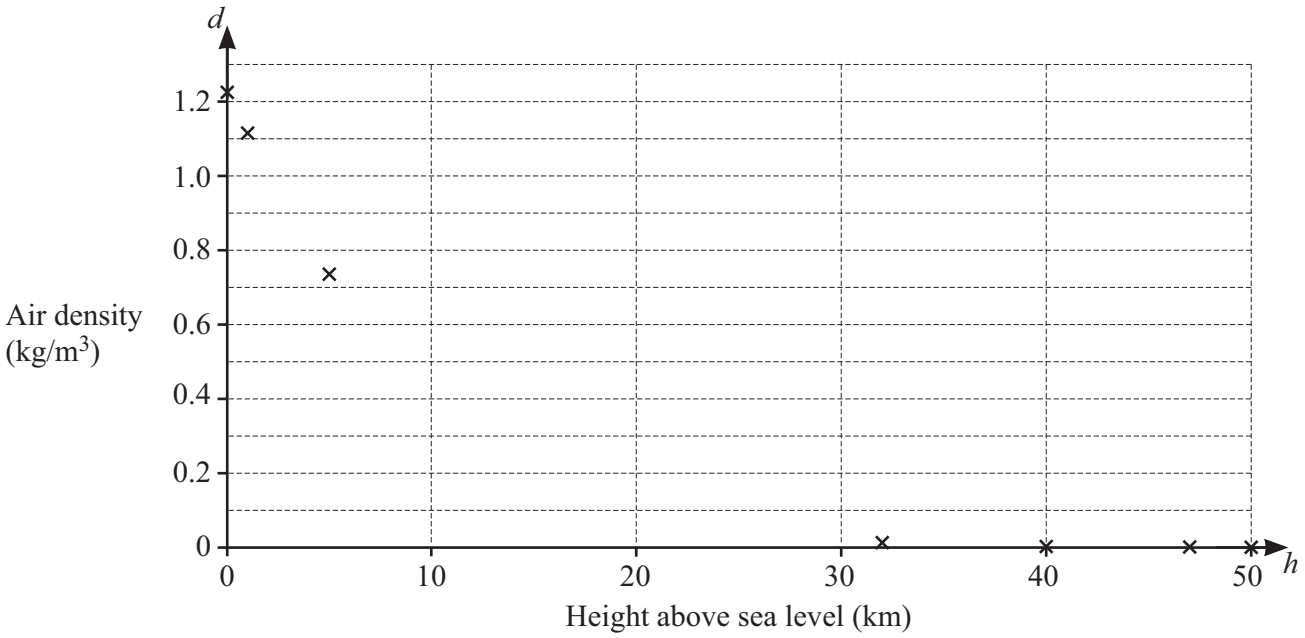


5 We need to know the *air density* (the mass of 1 cubic metre of air) to calculate the lift.

This table shows the air density at different heights above sea level.

Height above sea level (h km)	0	1	5	10	20	32	40	47	50
Air density (d kg/m^3)	1.2250	1.1160	0.7361	0.4127	0.0880	0.0132	0.0039	0.0014	0.0010

The values in the shaded cells are plotted on the grid.



18. Question part 2/2 | 0607 Oct-Nov 2025 P6 V1 Q5

(a) Plot the remaining two points on the grid. [1]

(b) **Model A**

A possible model for air density is $d = \frac{195}{39h + 160}$ for $0 \leqslant h \leqslant 50$.

(i) Sketch this model on the grid.
Label the sketch A. [2]

(ii) Estimate the range of values for h when the model will give

(a) a value below the actual air density

..... [1]

(b) a value above the actual air density.

..... [1]

(c) **Model B**

Another possible model is $d = \frac{1}{\log(2h + 3)} - 0.5$ for $0 \leqslant h \leqslant 50$.

(i) Sketch this model on the grid.
Label the sketch B. [2]

(ii) **(a)** Estimate the range of values for h when the model is valid.

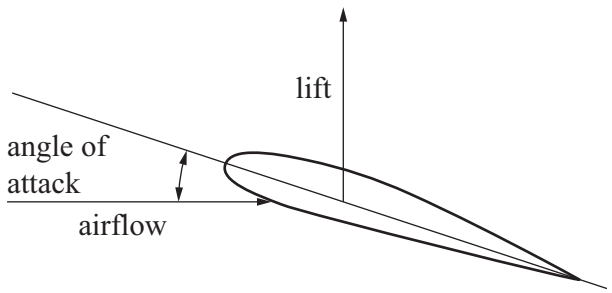
..... [1]

(b) Comment on the model when $h = 50$.

..... [1]

19. Question part 1/2 | 0607 Oct-Nov 2025 P6 V1 Q6

6 To make lift, an aircraft wing is angled to the airflow.
This is called the *angle of attack*.



As the speed of the aircraft decreases, the angle of attack, $a°$, increases to get more lift.
The amount of lift depends on a quantity known as the *lift coefficient*, C.

This table shows how C changes for different values of the angle of attack.

Angle of attack ($a°$)	-5	0	5	10	15	20	25
Lift coefficient (C)	0.00	0.55	1.05	1.46	1.70	1.66	1.44

A possible model for C is $C = m + n(a-17)^2$ where m and n are constants.

(a) Use $a = 0$ and $a = 20$ to find two equations each in terms of m and n.
Give each equation in its simplest form.

.....

.....

[3]

(b) Find the value of m and the value of n, and write the model for C.
Give each value correct to 2 significant figures.

$m =$ .....

$n =$ .....

$C =$ .....

[4]

(c) Use your model to find the maximum lift coefficient for this wing.

..... [2]

Question 7 is printed on the next page.

20. Question | 0607 Oct-Nov 2025 P6 V1 Q7

7 A model for the lift, L newtons, that an aircraft makes is $L = \frac{dv^2AC}{2}$.

d = air density (kg/m^3)
v = speed (m/s)
A = wing area (m^2)
C = lift coefficient

An aircraft has a wing area of 125 m^2.
It flies

- at a height of 12 km above sea level
- at a speed of 210 m/s
- with angle of attack 3°.

Use **Question 6(b)** and Model A in **Question 5(b)** to calculate the lift for this aircraft.
Give your answer correct to 2 significant figures.

..... [7]

21. Question part 1/2 | 0607 Oct-Nov 2025 P6 V2 Q3

Section B

MODELLING WASTE PLASTIC

You are advised to spend no more than 45 minutes on this section.

In this task you will look at how waste plastic is recycled or burned or discarded.

3 **(a)** Recycled waste plastic

The table shows some information about the percentage of waste plastic that was recycled.

Number of years after 1988 (x)	0	1	2	3	4	5
Percentage recycled (y)			2.0	2.7		

(i) Each year after 1988 the percentage of waste plastic that was recycled increased by 0.7 .

Complete the table. [2]

(ii) A straight line models the data in the table.

Find the equation of the model for y in terms of x.

..... [2]

(b) Burned waste plastic

The percentage of waste plastic that was burned also increased by 0.7 each year after 1988.
In 1988 the percentage of waste plastic that was burned was 6.6 .
y is now the percentage of waste plastic that was burned.
x is still the number of years after 1988.

Find the equation of the model for the percentage of waste plastic that was burned.

..... [1]

(c) Describe fully the transformation that maps the graph of the model for recycled waste plastic onto the graph of the model for burned waste plastic.

..... [2]

(d) Discarded waste plastic

Waste plastic that is not recycled and is not burned is discarded.
y is now the percentage of waste plastic that was discarded.
x is still the number of years after 1988.

(i) Show that the model for discarded waste plastic is $y = -1.4x + 92.8$.

[2]

(ii) Explain why the model is not valid when $x = 70$.

..... [1]

(e) Find the number of years after 1988 when the percentage of discarded waste plastic is 49.4 .
Use the model in **part (d)(i)**.

..... [2]

(f) Find the year in which the percentage of recycled waste plastic becomes more than the percentage of discarded waste plastic.
Use the models in **part (a)(ii)** and **part (d)(i)**.

..... [5]

22. Question part 1/2 | 0607 Oct-Nov 2025 P6 V2 Q4

4 You will now look at the mass of *macroplastics* in the ocean.
Macroplastics are large pieces of waste plastic.

A model for the mass of macroplastics in the ocean is

$$m = 0.001\,595t^2 - 6.399t + 6419.$$

m is the mass of macroplastics in megatonnes (1 megatonne = 10^9 kg)
t is the year

(a) In 2020, $t = 2020$.

Find the value of m in 2020.
Write down all the figures in your answer.

..... [2]

(b) On the axes, sketch the graph of the model for $2020 \leqslant t \leqslant 2050$.



[3]

22. Question part 2/2 | 0607 Oct-Nov 2025 P6 V2 Q4

(c) Use the model to find the number of years after 2020 that it takes for the mass of macroplastics to double.

..... [3]

23. Question | 0607 Oct-Nov 2025 P6 V3 Q3

Section B

MODELLING CLUB FEES

You are advised to spend no more than 45 minutes on this section.

In this task, you will look at the relationship between the number of members of a club and the fee for each member.
The fee for each member is the amount of money that each member pays to the club.

3 A club has 200 members.
The fee for each member is \$100.

(a) Show that the total fees that all the members pay to the club are \$20 000.

[1]

(b) 40 members leave the club.

(i) The club wants to increase the fee for each member by \$20.

Find the change in total fees.

..... [3]

(ii) The club decides to increase the fee for each member so that the total fees are still \$20 000.

Calculate the new fee for each member.

..... [2]

24. Question part 1/2 | 0607 Oct-Nov 2025 P6 V3 Q4

4 A club has 200 members.
The fee for each member is \$100.

x members leave the club.
The club wants the total fees to be \$20 000.

(a) Write down an expression for the new fee that each member pays.

..... [1]

(b) The increase in the fee for each member is \$$y$.

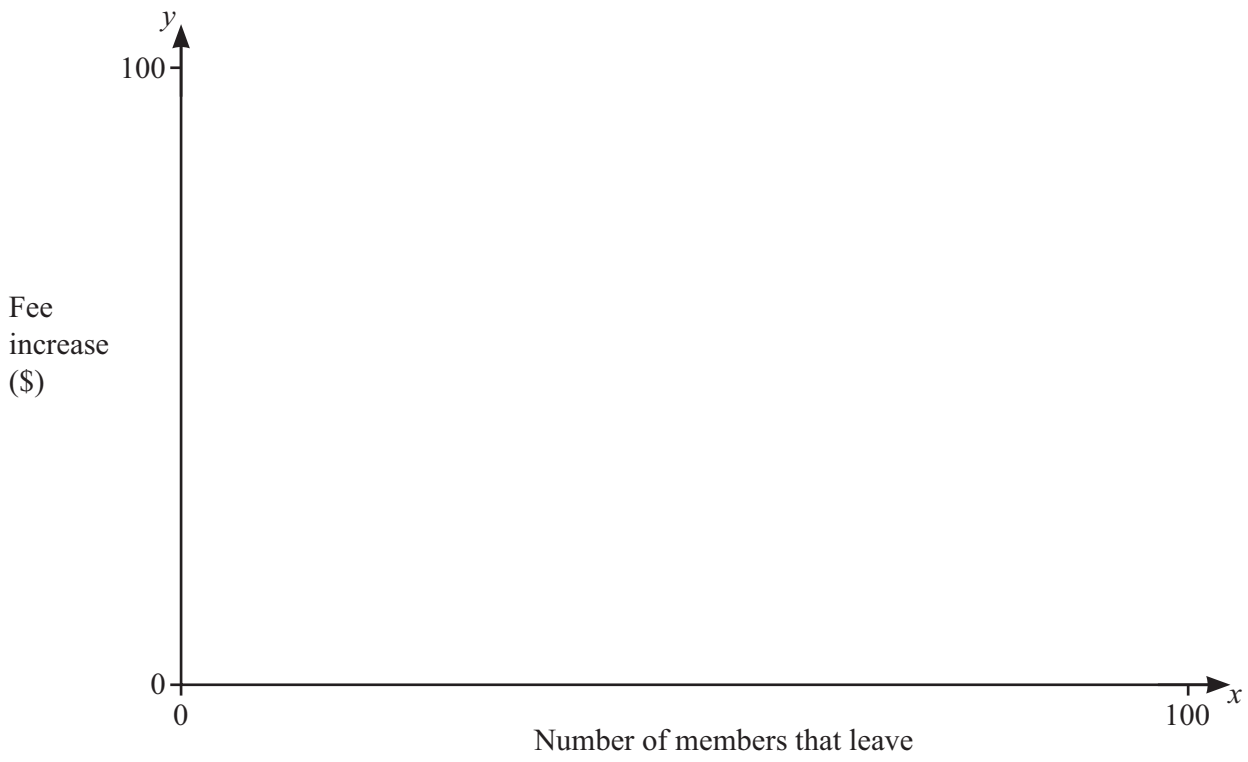
Show that a model for the increase in the fee is $y = \frac{100x}{200-x}$.

[3]

(c) Write down the values of x for which the model is valid.

..... [1]

(d) Sketch the graph of the model $y = \frac{100x}{200 - x}$ for values of x between 0 and 100.



[2]

(e) Some members leave the club.
The club uses the model $y = \frac{100x}{200 - x}$ and finds that the fee increase is \$13.

Find the number of members that left the club.

..... [2]

25. Question | 0607 Oct-Nov 2025 P6 V3 Q5

5 Another club has N members.
The fee for each member is \$$F$.

x members leave the club.
The club increases the fee for each member by \$$y$.

(a) (i) Write down an expression for the total fees before the increase in the fee.

..... [1]

(ii) Complete the expression for the total fees after the increase in the fee.

(..... − .....)(..... + ...) [2]

(b) The total fees in **part (a)(i)** and **part (a)(ii)** are the same.

Find a model for x in terms of N, F and y.
Write your answer as a single fraction.

..... [4]

(c) 20 members leave the club.
The club increases the fee for each member by \$10 so that the total fees in **part (a)(i)** stay the same.

Find a model for N in terms of F.

..... [3]

26. Question | 0607 Specimen 2025 P6 Q8

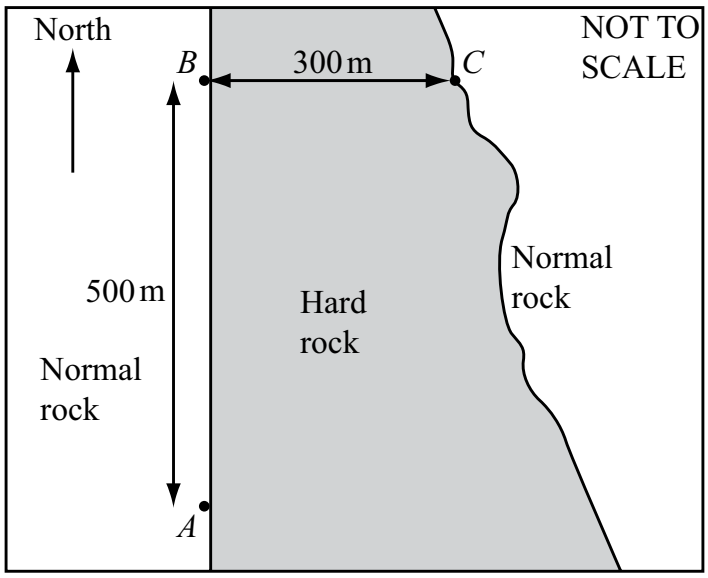
Section B MODELLING DRILLING A TUNNEL

You are advised to spend no more than 45 minutes on this section.

This task models the time and the cost of drilling a tunnel through different types of rock.

On the diagram, A is south of B and C is east of B.

$AB = 500$ metres and $BC = 300$ metres.



Engineers want to drill a tunnel from A to C.
The tunnel will have one or two straight sections and no curved sections.

8 Calculate the length of the shortest possible tunnel from A to C.
Give your answer correct to the nearest metre.

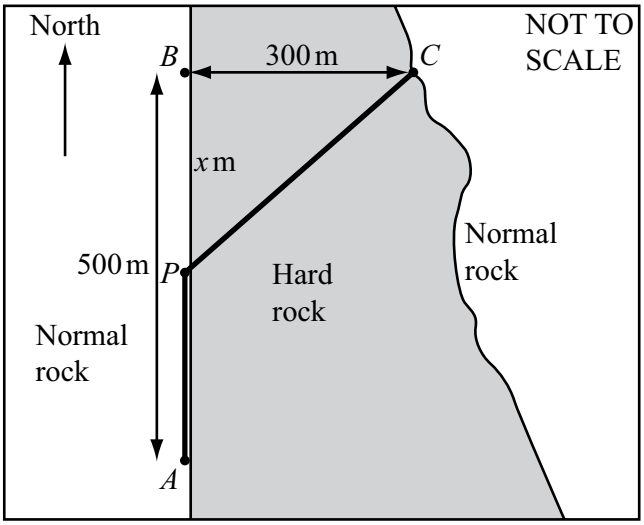
..... m [3]

27. Question | 0607 Specimen 2025 P6 Q9

9 Write down the length of the tunnel if the engineers drill through as little hard rock as possible.

..... [2]

10 On the diagram, P is a point which is x metres south of B.



The engineers decide to drill from A to P to C.

Through the normal rock, from A to P, the drill moves forward at 2 metres per hour.
Through the hard rock, from P to C, the drill moves forward at 1 metre per hour.

(a) Show that the model for the time in hours, T, that it takes to drill the tunnel, is

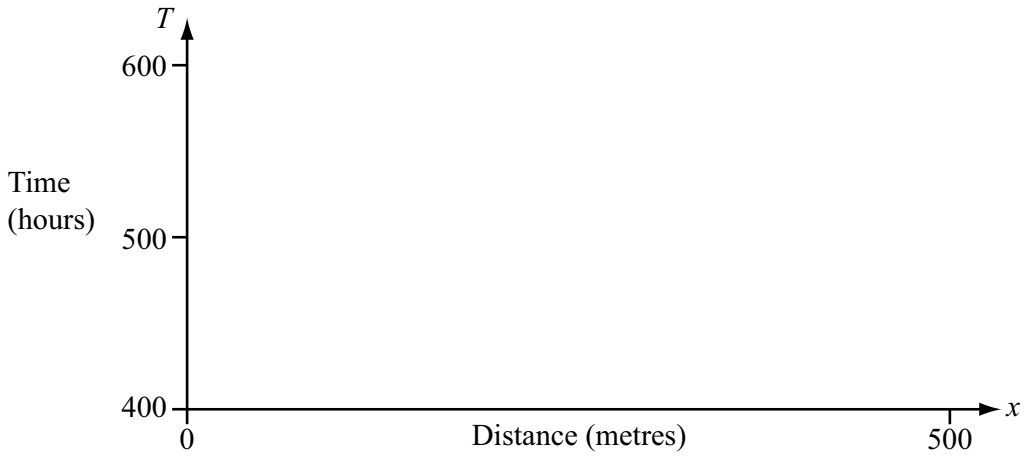
$$T = \frac{500 - x}{2} + \sqrt{90\,000 + x^2}.$$

[3]

(b) All the measurements are accurate.
Write down a practical reason why the time given by the model may be different from the actual time.

..... [1]

(c) On the diagram, sketch the graph of T against x.



[4]

(d) **(i)** Find, correct to the nearest metre, the position of P which gives the minimum time to drill the tunnel.

..... m from B [1]

(ii) Find this minimum time correct to the nearest 10 hours.

..... [1]

11 To drill through the normal rock costs 2 thousand dollars per hour.
To drill through the hard rock costs 3 thousand dollars per hour.

(a) The total cost of drilling the tunnel is n thousand dollars.
Write down a model for n in terms of x.

..... [2]

(b) Find the total cost when P is 412.5 metres north of A.

..... [4]

12 The model for the time taken to drill the tunnel is $T = \frac{500 - x}{2} + \sqrt{90\,000 + x^2}$.
B and C are fixed points.

(a) A is more than 500 m south of B.

When T is a minimum, find how changing the position of A affects the value of x.

..... [2]

(b) $AB = d$ metres

Change the model $T = \frac{500 - x}{2} + \sqrt{90\,000 + x^2}$ to find a model for the minimum time, t hours, in terms of d.
Write your answer in its simplest form.

..... [2]

Section B

Modelling Economic order quantity

You are advised to spend no more than 45 minutes on this section.

In this task you will find the minimum cost when ordering items and model the best quantity for an order.

5 A shop sells only one type of office chair.
The shop buys these chairs from a maker.
In one year the shop buys 600 of these chairs.

(a) Buying cost
It costs the shop \$240 to buy one of these chairs from the maker.
This is the buying cost for one chair.

Find the total buying cost for the 600 chairs.

..... [2]

(b) Because of lack of space and money the shop cannot buy all the 600 chairs at once.
Instead, it buys x chairs at a time.
This is called an order for x chairs.

Write down an expression for the number of orders the shop makes in one year.

..... [1]

(c) Ordering cost
For each order there is a cost, called the ordering cost.
This is for filling in forms and checking the delivery.
The shop has an ordering cost of \$32 for each order.

Use your answer to **5(b)** to find an expression for the total ordering cost in one year.
Write your answer as a single fraction.

..... [2]

(d) The shop stores the chairs that it orders.

(i) Before the delivery of an order the shop has 0 chairs.
After the delivery of an order the shop has x chairs.

The shop estimates that the number of chairs that it stores at any time is the mean of 0 and x.

Write down an expression in terms of x for the mean of 0 and x.

..... [1]

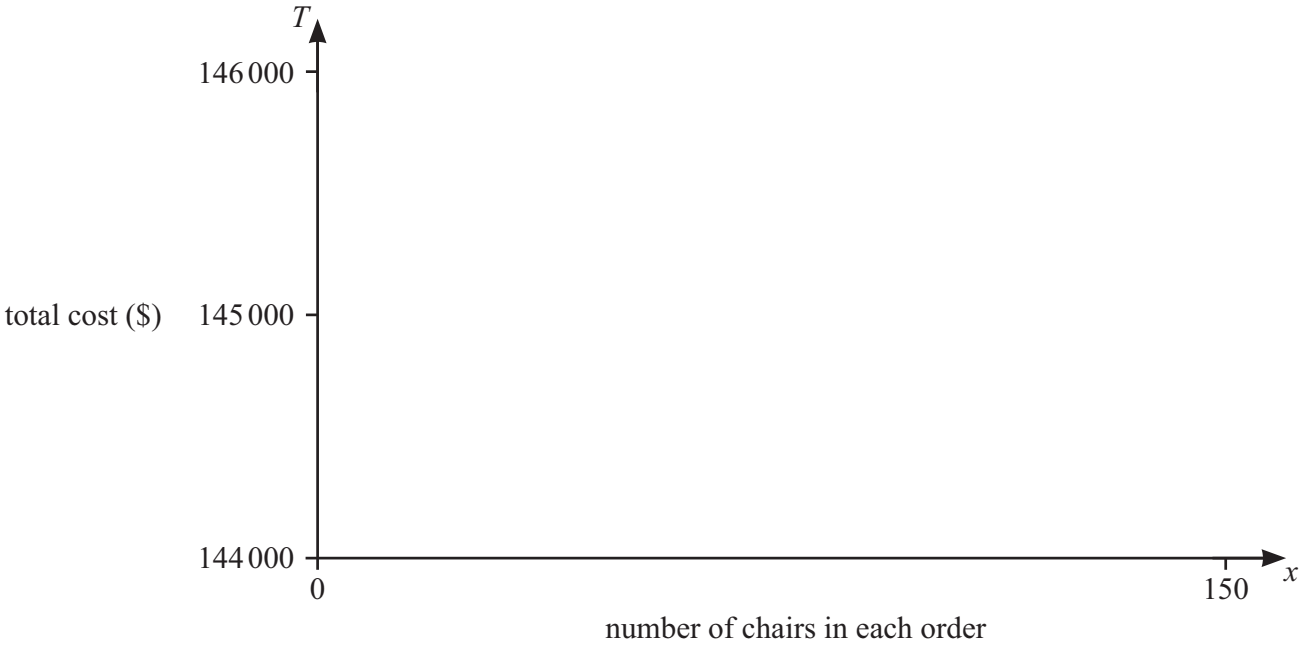
(ii) **Storage cost**
It costs \$24 to store one chair for the whole year.
This is the storage cost for one chair.

Show that a model for the total cost in dollars, T, in one year for buying, ordering and storage is

$$T = 144\,000 + \frac{19\,200}{x} + 12x.$$

[2]

6 **(a)** Sketch the graph of $T = 144\,000 + \frac{19\,200}{x} + 12x$ for values of x between 0 and 150.



[2]

(b) The number of chairs in each order that gives the minimum total cost is called the economic order quantity.

(i) Find the economic order quantity.

..... [1]

(ii) The shop buys 600 chairs in one year.

Calculate the number of orders in a year that gives the minimum total cost.

..... [2]

32. Question part 2/2 | 0607 Feb-March 2026 P6 V2 Q6

(c) To buy the 600 chairs the shop makes 50 orders.
This costs the shop more than the minimum total cost.

Calculate how much more it costs.

..... [4]

33. Question part 1/2 | 0607 Feb-March 2026 P6 V2 Q7

7 For a quicker method to calculate the economic order quantity, x, the American engineer R H Wilson used this model.

$$x = \sqrt{\frac{kNC}{S}}$$

k is an integer.
N is the number of items (chairs) bought in a year.
C is the ordering cost in \$ for each order.
S is the storage cost in \$ for each item for one year.

(a) For the shop, $N = 600$, $C = 32$ and $S = 24$.

Use your answer to **6(b)(i)** to find the value of k.

..... [2]

33. Question part 2/2 | 0607 Feb-March 2026 P6 V2 Q7

(b) The shop reduces the 600 chairs that it buys in one year by 10%.

Using Wilson's model, find the percentage change in the economic order quantity.

..... [6]

34. Question part 1/4 | 0607 May-June 2026 P6 V1 Q5

Section B

Modelling Cones and cylinders

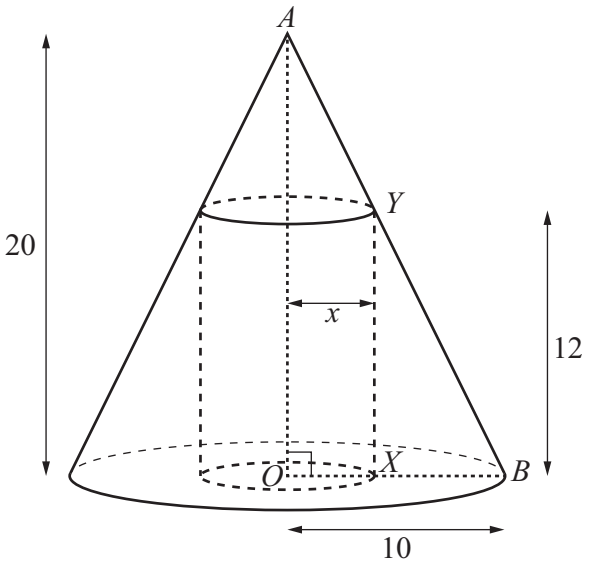
You are advised to spend no longer than 45 minutes on this section.

In this task you will look at cylinders that fit inside cones.
All lengths are in centimetres.

You may find these formulas useful.	
Volume, V, of cylinder of radius r, height h	$V = \pi r^2 h$
Volume, V, of cone of radius r, height h	$V = \frac{1}{3}\pi r^2 h$

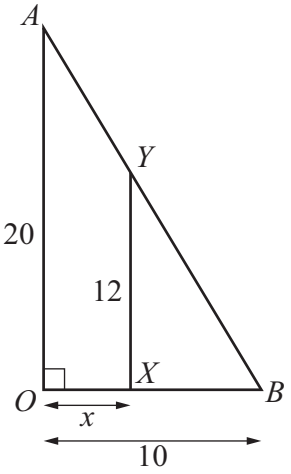
5 The diagram shows a cylinder that fits inside a cone.
OA is the axis of symmetry.

The cone has height 20 and radius 10.
The cylinder has height 12 and radius x.



NOT TO SCALE

(a) The diagram shows triangles *YXB* and *AOB*.



NOT TO SCALE

Triangle *YXB* is similar to triangle *AOB*.
$XB = 10 - x$

34. Question part 3/4 | 0607 May-June 2026 P6 V1 Q5

(i) Write the name of the correct line segment in the box.

$$\frac{XB}{OB} = \frac{\square}{OA}$$

[1]

(ii) Write the correct number in the box.

$$\frac{10-x}{10} = \frac{12}{\square}$$

[1]

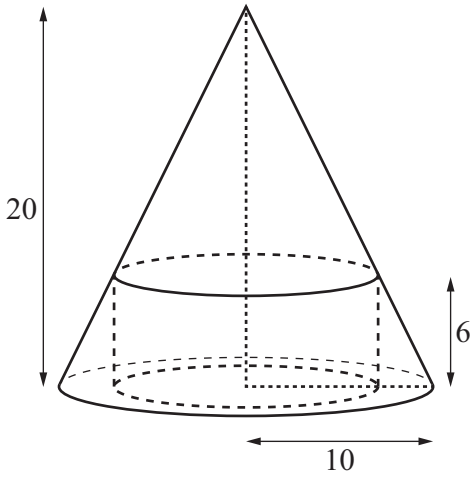
(iii) Find the value of x.

..... [2]

(iv) Use your answer to **5(a)(iii)** to find the volume of the cylinder in terms of π .

..... [2]

(b) A different cylinder fits inside the same cone.
The cylinder has height 6.



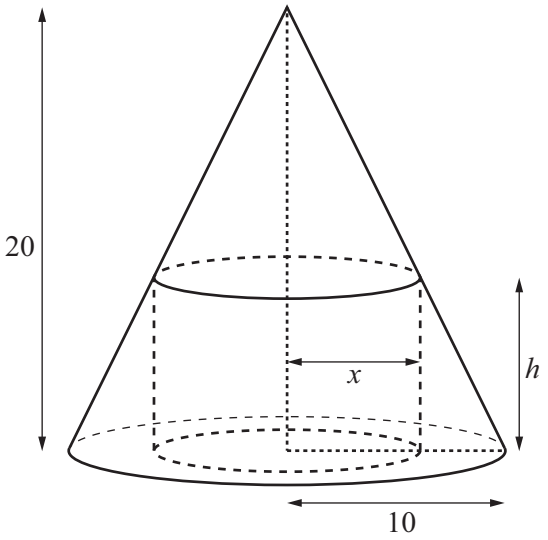
NOT TO SCALE

Find the volume of the cylinder.
Give your answer in terms of π .

..... [3]

35. Question part 1/2 | 0607 May-June 2026 P6 V1 Q6

6 A cylinder of height h fits inside the cone.



NOT TO SCALE

The cylinder has radius x and volume V.

(a) Show that a model for V is

$$V = \frac{\pi h(20-h)^2}{4}.$$

[4]

35. Question part 2/2 | 0607 May-June 2026 P6 V1 Q6

(b) Sketch the graph of $V = \frac{\pi h(20-h)^2}{4}$ for values of h between 0 and 20.



[3]

(c) Find the maximum volume of the cylinder.

..... [1]

(d) Find the height and the radius of the cylinder with the maximum volume.

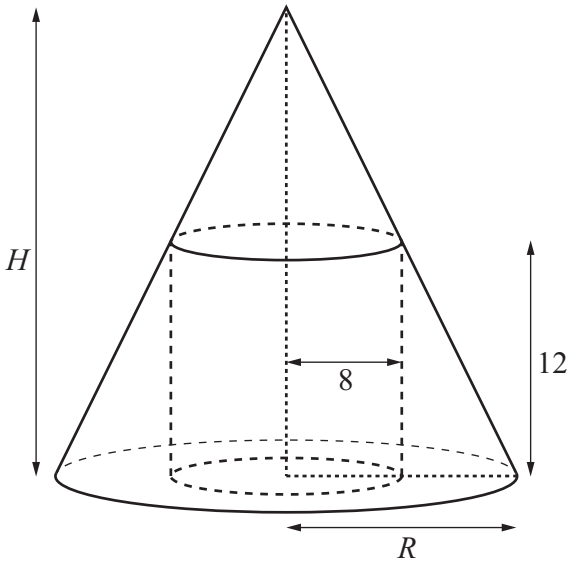
height = ...

radius = ...

[3]

36. Question part 1/2 | 0607 May-June 2026 P6 V1 Q7

7 In this question, different sized cones enclose a cylinder of fixed dimensions.



NOT TO SCALE

The cylinder has radius 8 and height 12.
The cone has radius R and height H.

(a) Find an expression for H in terms of R.

..... [2]

36. Question part 2/2 | 0607 May-June 2026 P6 V1 Q7

(b) **(i)** Show that a model for the volume of the cone, V, is

$$V = \frac{4\pi R^3}{R-8} .$$

[1]

(ii) The volume of the cone is a minimum when the radius is between 8 and 20.

Find the minimum volume of the cone.

..... [2]

37. Question | 0607 May-June 2026 P6 V2 Q6

Section B

Modelling Regular investment

You are advised to spend no more than 45 minutes on this section.

In this task you will look at investing money in an account that pays compound interest.

$\$P$ is invested at a rate of $R\%$ per unit of time.
There is a total of $\$A$ in the account at the end of n units of time.
A unit of time may be a year or a month.

$$A = Pr^n \qquad \text{where } r = 1 + \frac{R}{100}.$$

Example

\$200 is invested at a rate of 3% per year for 8 years.

So $A = 200 \times \left(1 + \frac{3}{100}\right)^8$

$A = 200 \times 1.03^8$

$A = 253.35$

6 Rosie invests \$500 in a savings account that pays compound interest at a rate of 4% per year.

(a) Work out how much money is in the account at the end of 5 years.

..... [2]

(b) Rosie wants the value of her investment to grow to \$1000.

Calculate the number of complete years it takes for the value of Rosie's \$500 to first reach \$1000.

..... [3]

38. Question | 0607 May-June 2026 P6 V2 Q7

7 At the start of each year, Abdul invests $300 in a savings account that pays compound interest at a rate of 4% per year.

At the end of 2 years:

- there is $300 which has been in the account for 2 years
- there is $300 which has been in the account for 1 year
- interest is paid on each of these amounts.

Work out the total amount of money Abdul has in the account at the end of 2 years.

..... [3]

39. Question part 1/2 | 0607 May-June 2026 P6 V2 Q8

8 Joe invests in a savings account that pays compound interest at a rate of 4% per year.

At the start of each year he invests \$$P$ into the account.
At the end of 5 years, there is a total of \$$T$ in the account.

(a) Complete the missing expressions in these calculations.

$$T = \text{.....} + P\times 1.04^4 + P\times 1.04^3 + P\times 1.04^2 + P\times 1.04$$

$$1.04T = \text{.....} + \text{.....} + P\times 1.04^4 + P\times 1.04^3 + P\times 1.04^2$$

[2]

(b) Use **8(a)** to show that

$$T = \frac{1.04P(1.04^5 - 1)}{1.04 - 1}.$$

The first line of working has been started for you.

$1.04T - T =$

[3]

39. Question part 2/2 | 0607 May-June 2026 P6 V2 Q8

(c) Joe wants to have a total of $700 in the account at the end of 5 years.

Work out how many dollars Joe should invest each year.

..... [3]

40. Question | 0607 May-June 2026 P6 V2 Q9

9 Each year, Maya invests \$$P$ in a savings account that pays compound interest at a rate of R% per year.

At the end of n years there is a total of \$$T$ in the account.

A model for the total value of Maya's investment is

$$T = \frac{P \times r(r^n - 1)}{r - 1}, \qquad \text{where } r = 1 + \frac{R}{100}.$$

Maya invests \$250 each year for 9 years.
The account pays a rate of 5% compound interest per year.

Find the value of T.

..... [2]

41. Question part 1/2 | 0607 May-June 2026 P6 V2 Q10

10 Each month, Esa invests in a savings account that pays compound interest at a rate of R% per month.
Esa invests \$50 each month for 15 months.
\$$T$ is the total amount in the account at the end of 15 months.

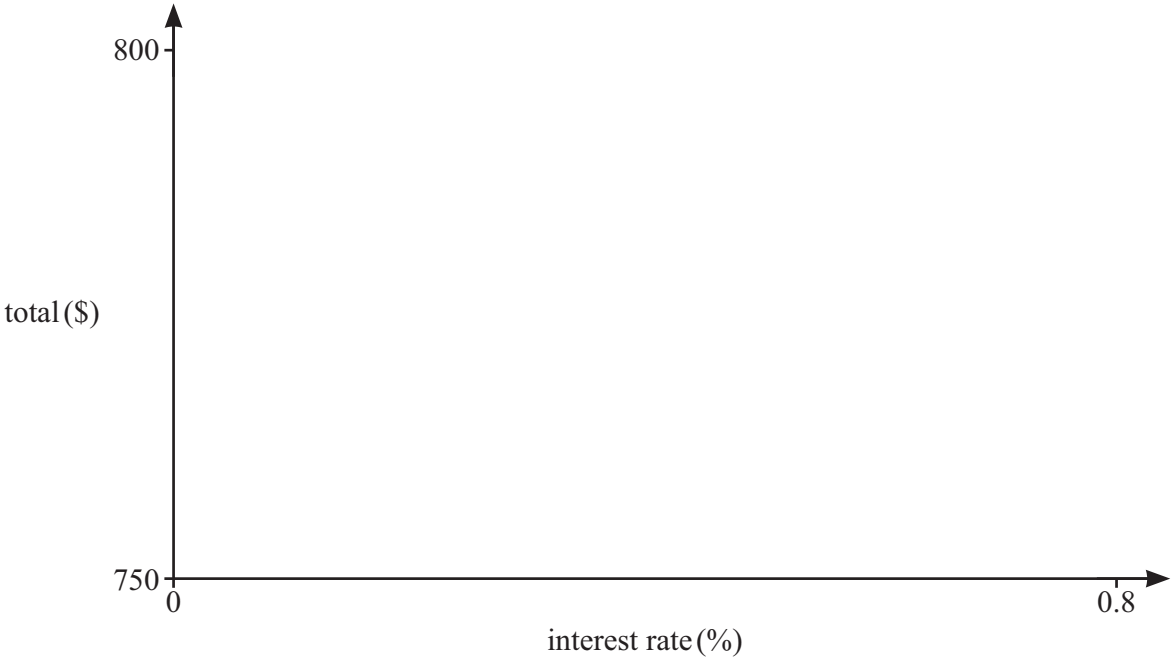
(a) Use the model in **Question 9** to show that a model for T is

$$T = \left(\frac{5000}{R} + 50\right)\left(\left(1 + \frac{R}{100}\right)^{15} - 1\right).$$

[3]

41. Question part 2/2 | 0607 May-June 2026 P6 V2 Q10

(b) (i) On the diagram, sketch the graph of T for values of R between 0 and 0.8.



[2]

(ii) Find a linear model for T in terms of R.

..... [2]

42. Question part 1/2 | 0607 May-June 2026 P6 V3 Q5

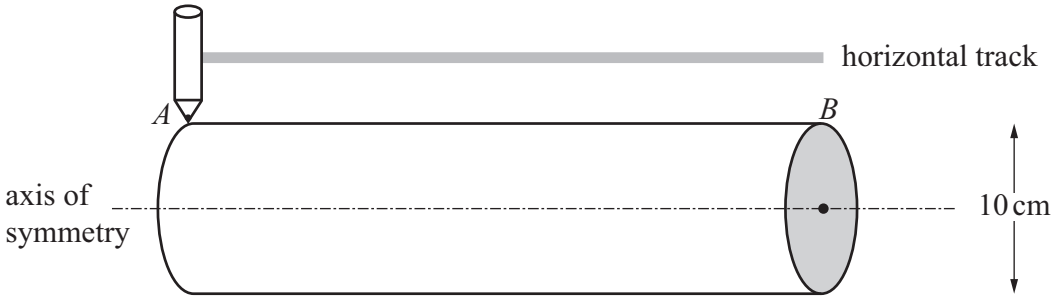
Modelling **Helix**

You are advised to spend no more than 45 minutes on this section.

In this task you will look at the length of a line drawn on the curved surface of a cylinder.
This line is called a helix.

In this task, diagrams are not drawn to scale.

A rectangle of paper is wrapped around a cylinder with diameter 10 cm.
The long edges of the paper meet along the line AB.

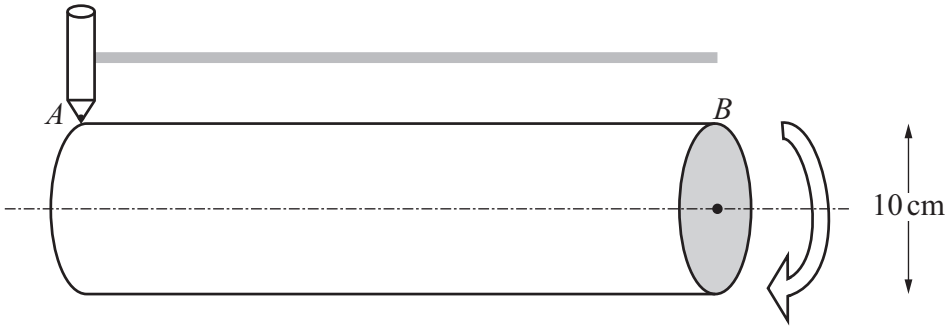


A pencil is fixed to a horizontal track above the cylinder.
The pencil rests on the paper at A.

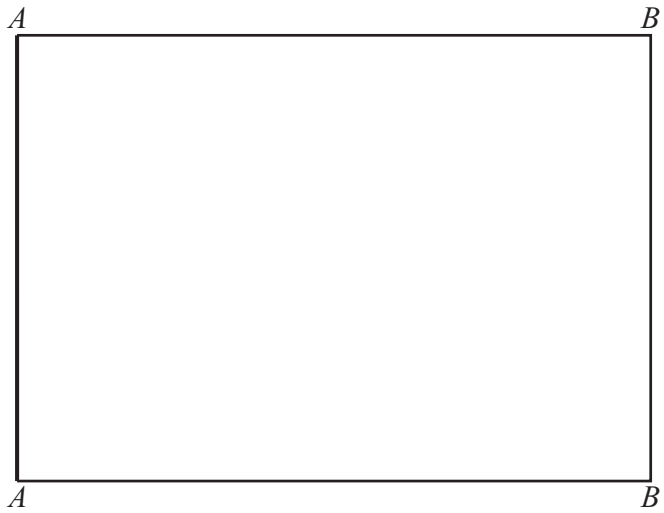
You may find this formula useful.

Circumference, C, of circle of diameter d. $C = \pi d$

5 The cylinder turns clockwise about its axis of symmetry.
The pencil does not move but draws a line on the paper.
The cylinder stops turning at the end of one full turn.



This diagram shows the paper when it is unwrapped from the cylinder.
AB is shown at the top and bottom of the rectangle because *AB* is where the two long edges meet on the cylinder.
The length of the line drawn by the pencil is shown by the line *AA* in the rectangle.

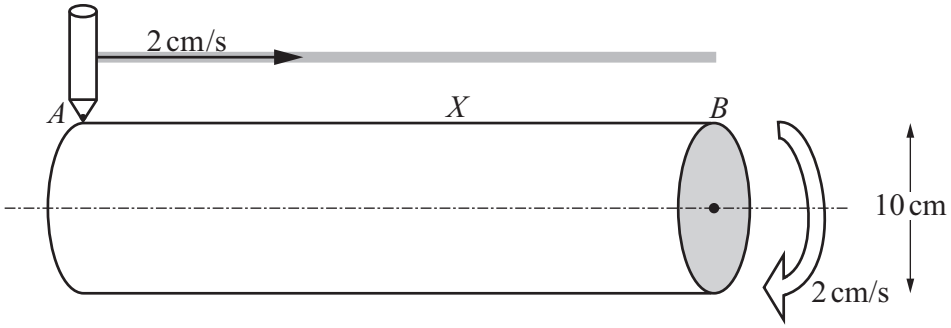


Explain why the length of the line drawn by the pencil is 31.4 cm, correct to 3 significant figures.

.....

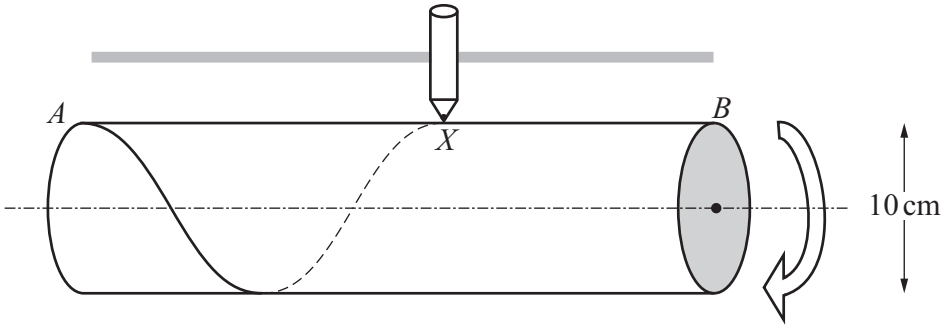
..... [2]

6 A new piece of paper is wrapped around the cylinder in the same way.

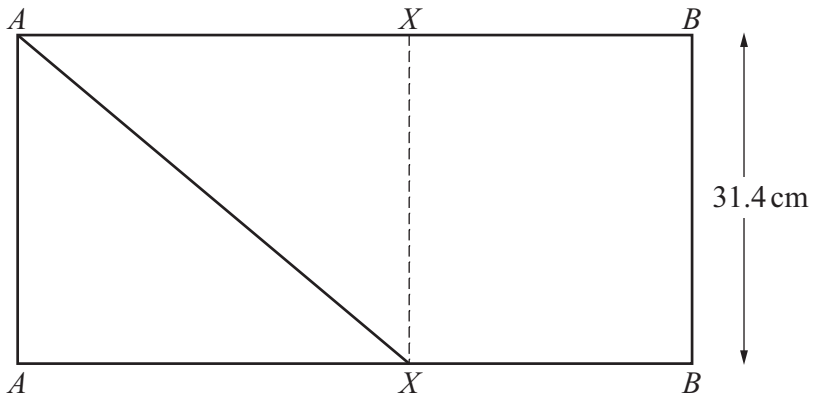


The cylinder turns clockwise about its axis of symmetry.
AB rotates at a speed of 2 cm/s as shown by the curved arrow.
The pencil moves along the horizontal track at a speed of 2 cm/s.

After one complete turn of the cylinder the pencil is at *X*, a point on *AB*.



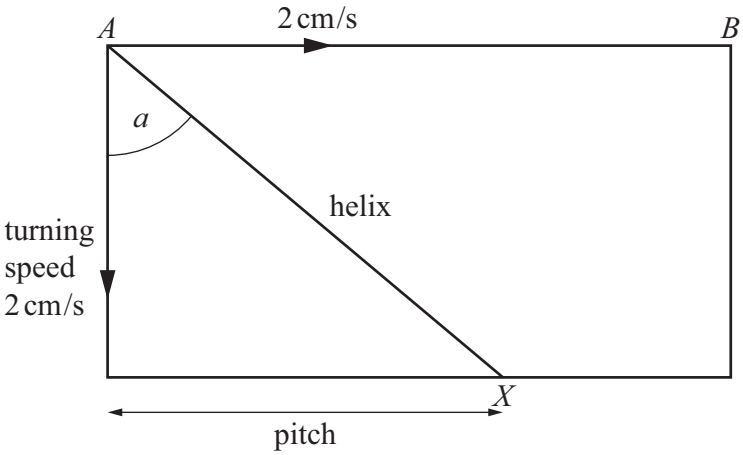
The paper is unwrapped from the cylinder.
On the unwrapped paper the curved line appears as a straight line.



The curved line on the cylinder is called a helix.

43. Question part 2/2 | 0607 May-June 2026 P6 V3 Q6

The distance along AB to where the pencil meets AB again is called the pitch of the helix.



(a) Write down the size of a, the angle AX makes with the short side of the paper.

..... [1]

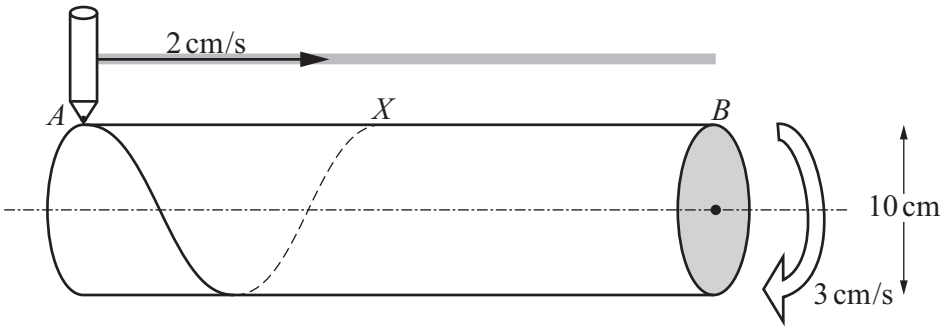
(b) Use **5** and **6(a)** to calculate the pitch and the length, AX, of the helix.

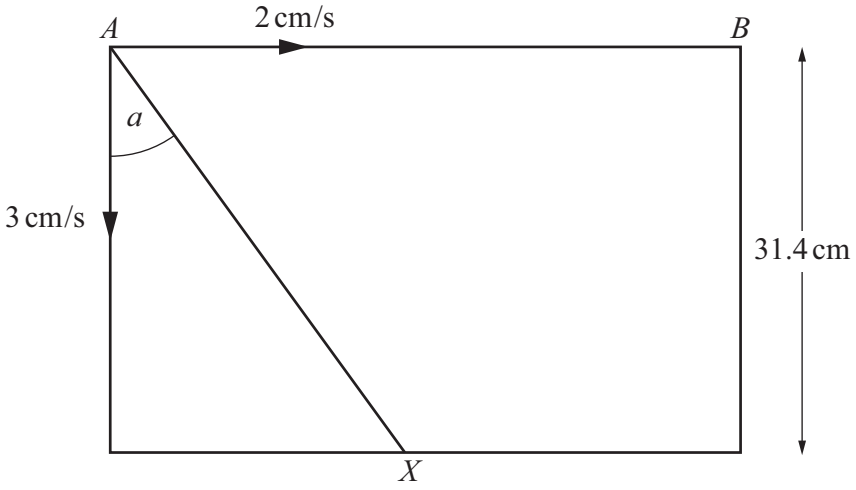
pitch = ...

length = ...
[4]

7 A new piece of paper is wrapped around the cylinder.
AB rotates at a speed of 3 cm/s.

The pencil moves along the horizontal track at a speed of 2 cm/s.
The helix is from A to X.





(a) Show that $a = 33.7°$, correct to 3 significant figures.

[2]

44. Question part 2/2 | 0607 May-June 2026 P6 V3 Q7

(b) Work out the pitch and the length of the helix.

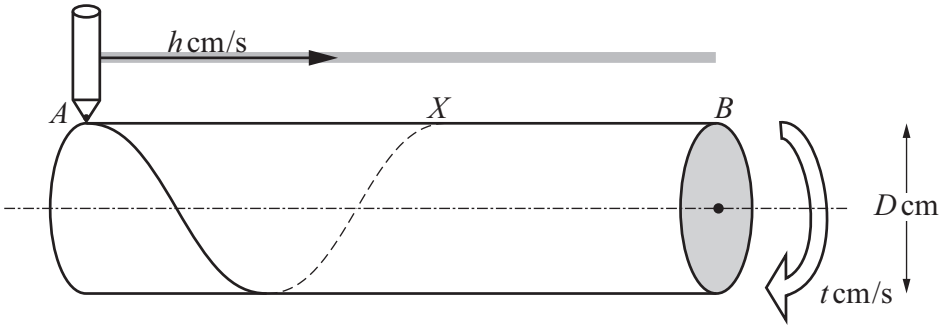
pitch = ...

length = ...

[4]

45. Question part 1/4 | 0607 May-June 2026 P6 V3 Q8

8 A new piece of paper is wrapped around the cylinder.



The cylinder has diameter D cm.
AB rotates at a speed of t cm/s.
The pencil moves along the horizontal track at a speed of h cm/s.
The helix is from A to X.

(a) Find a model for the pitch, P cm, in terms of h, t and D.

..... [2]

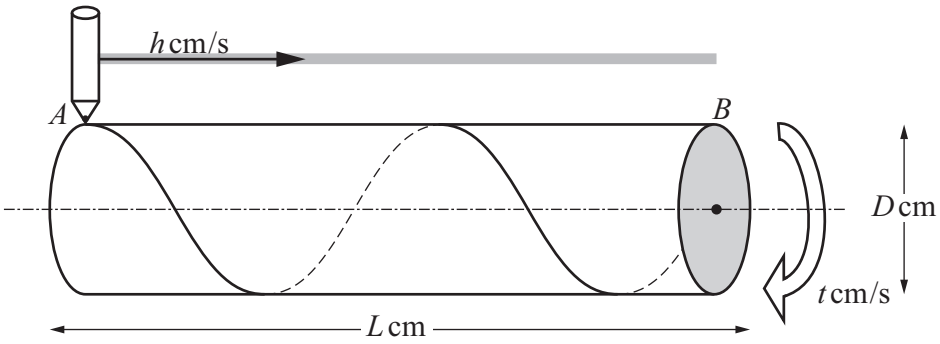
45. Question part 2/4 | 0607 May-June 2026 P6 V3 Q8

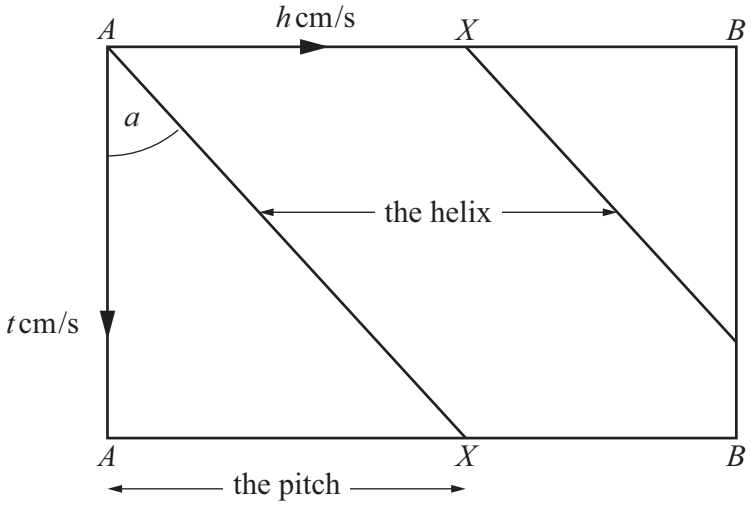
(b) Use Pythagoras' theorem and **8(a)** to show that a model for the length, H_1 cm, of the helix from A to X is

$$H_1 = \pi D\sqrt{1+\left(\frac{h}{t}\right)^2} \ .$$

[3]

(c) The cylinder rotates and the pencil moves until it reaches the end of the cylinder.
The cylinder has length L cm.





The length, H_2 cm, of the helix is now the total length of the two straight lines on the paper.

Use **8(a)** to find a model for the number of turns the cylinder makes before the pencil reaches the end of the cylinder.
Give your answer in terms of D, h, L and t.

..... [1]

45. Question part 4/4 | 0607 May-June 2026 P6 V3 Q8

(d) Use **8(b)** and **8(c)** to show that a model for the total length, H_2 cm, of the helix is

$$H_2 = L\sqrt{\frac{t^2}{h^2}+1}\ .$$

[3]

46. Question | 0607 May-June 2026 P6 V3 Q9

9 A cylinder has length 50 cm.
A pencil moves along the horizontal track at a speed of 3 cm/s.
The helix drawn has a total length of 100 cm.

Find the speed at which AB rotates.

..... [3]