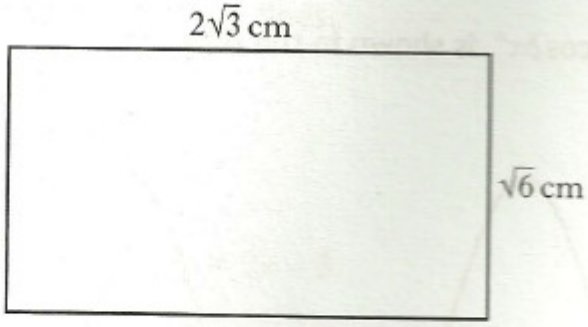
National 5 Maths: Prelim Revision Questions by Topic

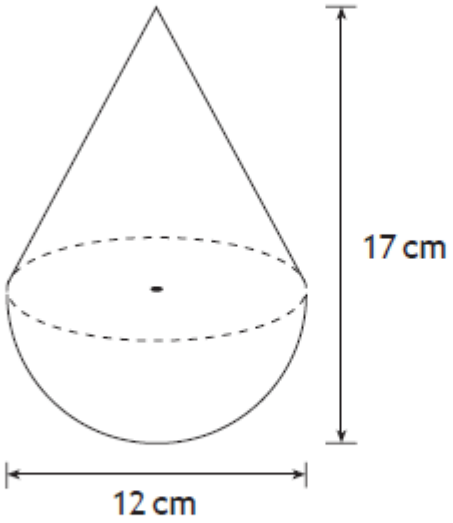
Shaded Questions are from the NON CALCULATOR paper.

	Expressions & Formulae 1.1: Surds & Indices	
1.	Express $\frac{4}{\sqrt{6}}$ with a rational denominator in its simplest form.	2
2.	(a) Multiply out the brackets and simplify: $x^{\frac{1}{2}}\left(x^{-\frac{3}{2}}+x^{-\frac{1}{2}}\right)$.	2
	(b) Find the exact value of this expression when $x=6$.	1
	Total marks	3
3.	Express $\sqrt{40}+4\sqrt{10}+\sqrt{90}$ as a surd in its simplest form.	3
4.	Express $\frac{4}{\sqrt{8}}$ with a rational denominator. Give your answer in its simplest form.	3
5.	Evaluate $8^{\frac{5}{3}}$.	2
6.	Evaluate $9^{\frac{3}{2}}$.	2
7.	 The rectangle above has length $2\sqrt{3}$ centimetres and breadth $\sqrt{6}$ centimetres. Calculate the area of the rectangle. Express your answer as a surd in its simplest form.	3
8.	There are 3×10^5 platelets per millilitre of blood. On average, a person has 5·5 litres of blood. On average, how many platelets does a person have in their blood? Give your answer in scientific notation.	2
9.	Simplify $\frac{n^5 \times 10n}{2n^2}$.	3

10.	$E = mc^2$ Find the value of E when $m = 3{\cdot}6 \times 10^{-2}$ and $c = 3 \times 10^8$. Give your answer in **scientific notation.**	3
	Expressions & Formulae 1.2: Algebraic Expressions	
1.	Multiply out the brackets and collect like terms: $(2x-5)(3x+1)$.	2
2.	Multiply out the brackets and collect like terms $(2x+3)(x^2-4x+1)$.	3
3.	Multiply out the brackets and collect like terms $(x-4)(x^2+x-2)$.	3
4.	Expand and simplify $(3x-2)(2x^2+x+5)$	3
5.	Expand fully and simplify $x(x-1)^2$.	2
	Expressions & Formulae 1.3: Algebraic Fractions	
1.	Express $\frac{4}{x+2}-\frac{3}{x-4}$, $x \neq -2,\ x \neq 4$ as a single fraction in its simplest form.	3
2.	Simplify $\frac{x^2-4x}{x^2+x-20}$.	3
3.	Express $\frac{3y^2-6y}{y^2+y-6}$ in its simplest form.	3
4.	Simplify $\frac{3}{m}+\frac{4}{m+1}$.	3
5.	Express $\frac{7}{x+5}-\frac{3}{x}$ $x \neq -5,\ x \neq 0$ as a single fraction in its simplest form.	3
6.	Express $\frac{5t}{s} \div \frac{t}{2s^2}$ in its simplest form.	3

Expressions & Formulae 1.4: Arcs & Sectors; Volumes

1. A child's toy is in the shape of a hemisphere with a cone on top, as shown in the diagram.



The toy is 12 centimetres wide and 17 centimetres high.

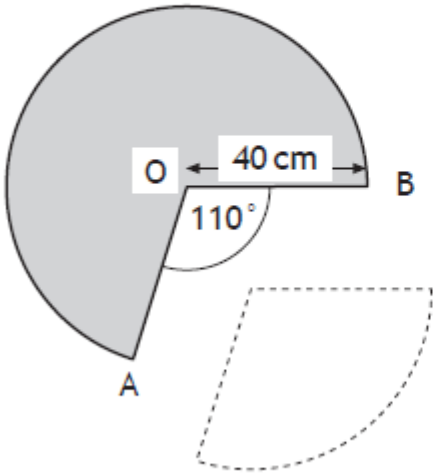
Calculate the volume of the toy.

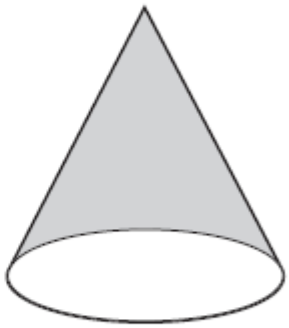
Give your answer correct to 2 significant figures. **5**

2. A cone is formed from a paper circle with a sector removed as shown.

The radius of the paper circle is 40 centimetres.

Angle AOB is 110°.



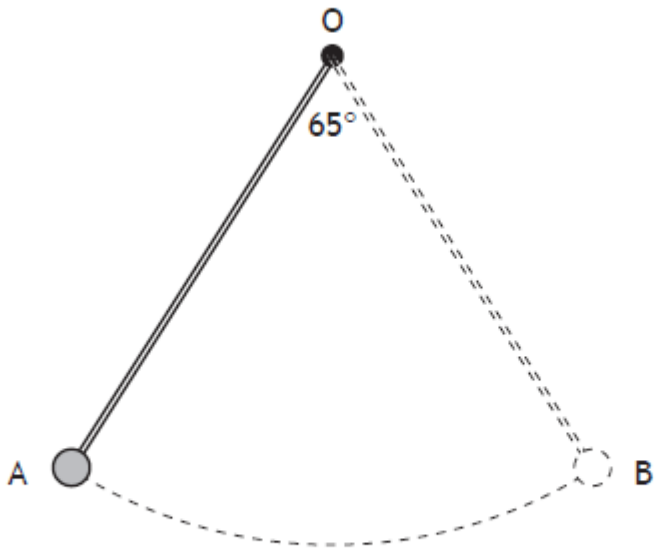


(a) Calculate the area of the sector removed from the circle. **3**

(b) Calculate the circumference of the base of the cone. **3**

Total marks 6

3. The pendulum of a clock swings along an arc of a circle, centre O.



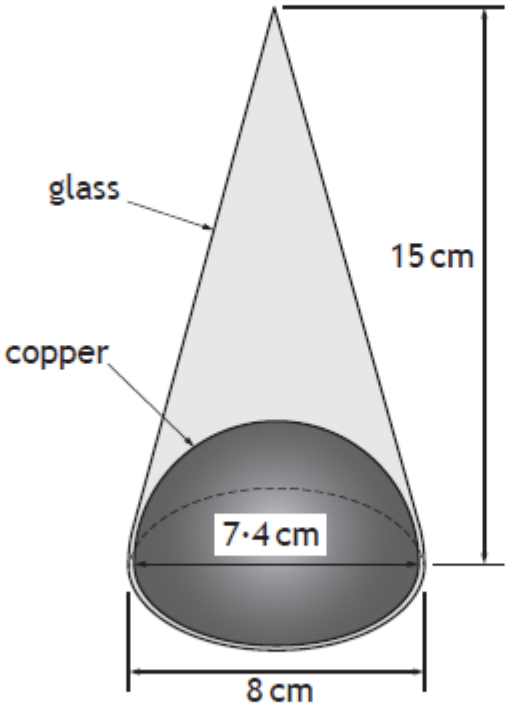
The pendulum swings through an angle of 65°, travelling from A to B.

The length of the arc AB is 28·4 centimetres.

Calculate the length of the pendulum. **4**

4 An ornament is in the shape of a cone with diameter 8 centimetres and height 15 centimetres.

The bottom contains a hemisphere made of copper with diameter 7·4 centimetres. The rest is made of glass, as shown in the diagram below.



Calculate the volume of the glass part of the ornament.

Give your answer correct to 2 significant figures. **5**

5. (a) The Earth is approximately spherical with a radius of 6400 kilometres.

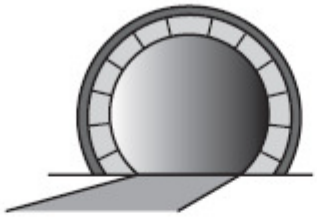
Calculate the volume of the Earth giving your answer in scientific notation, correct to 2 significant figures.

3

(b) The approximate volume of the Moon is $2{\cdot}2 \times 10^{10}$ cubic kilometres.

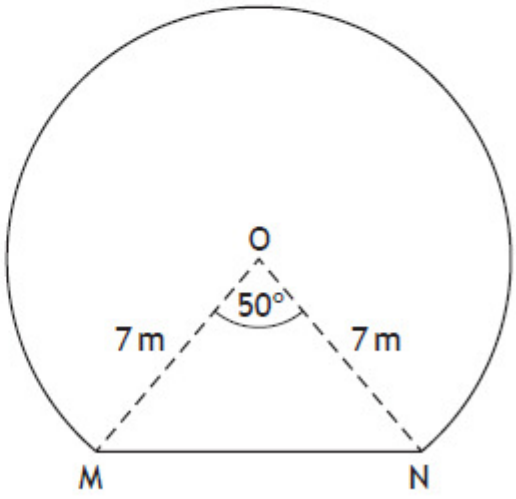
Calculate how many times the Earth's volume is greater than the Moon's. 2

6. The picture shows the entrance to a tunnel which is in the shape of part of a circle.



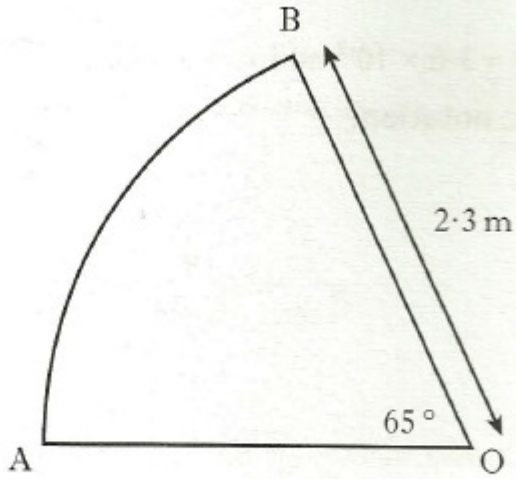
The diagram below represents the cross-section of the tunnel.

- The centre of the circle is O.
- MN is a chord of the circle.
- Angle MON is 50°.
- The radius of the circle is 7 metres.



Calculate the area of the cross-section of the tunnel. 5

7. A sector of a circle, centre O, is shown below.

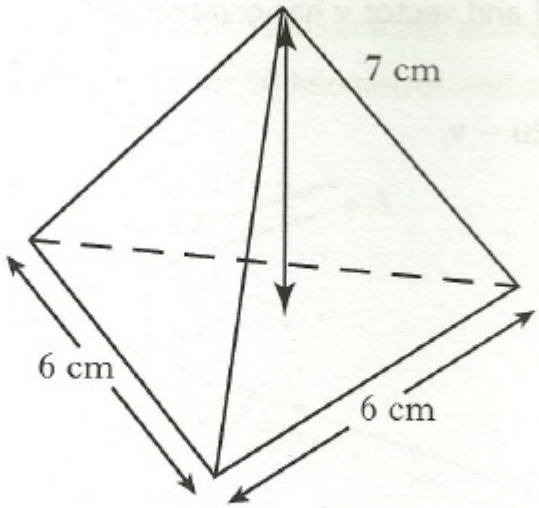


The radius of the circle is 2·3 metres.

Angle AOB is 65°.

Find the length of the arc AB. **3**

8. The diagram below shows a pyramid.



The base of the pyramid is an equilateral triangle of side 6 centimetres.

The height of the pyramid is 7 centimetres.

Calculate the volume of the pyramid. **3**

Relationships 1.1: Linear Equations

1. Change the subject of the formula $p = \frac{mv^2}{2}$ to v. **3**

2. Solve algebraically the inequality

$$11 - 2(1 + 3x) < 39$$ **3**

3. Solve algebraically the system of equations

$$3x + 2y = 17$$
$$2x + 5y = 4.$$ **3**

4. Find the equation of the line joining the points (−2, 5) and (3, 15).

Give the equation in its simplest form. 3

5. Brian and Bob visit a ski resort. Brian buys 3 full passes and 4 restricted passes. The total cost of his passes is £185.

(a) Write down an equation to illustrate this information. 1

(b) Bob buys 2 full passes and 3 restricted passes.

The total cost of his passes is £130.

Write down an equation to illustrate this information. 1

(c) Find the cost of a restricted pass and the cost of a full pass. 3

Total marks 5

6. (a) A straight line has equation $4x+3y=12$.

Find the gradient of this line. 2

(b) Find the coordinates of the point where this line crosses the x-axis. 2

Total marks 4

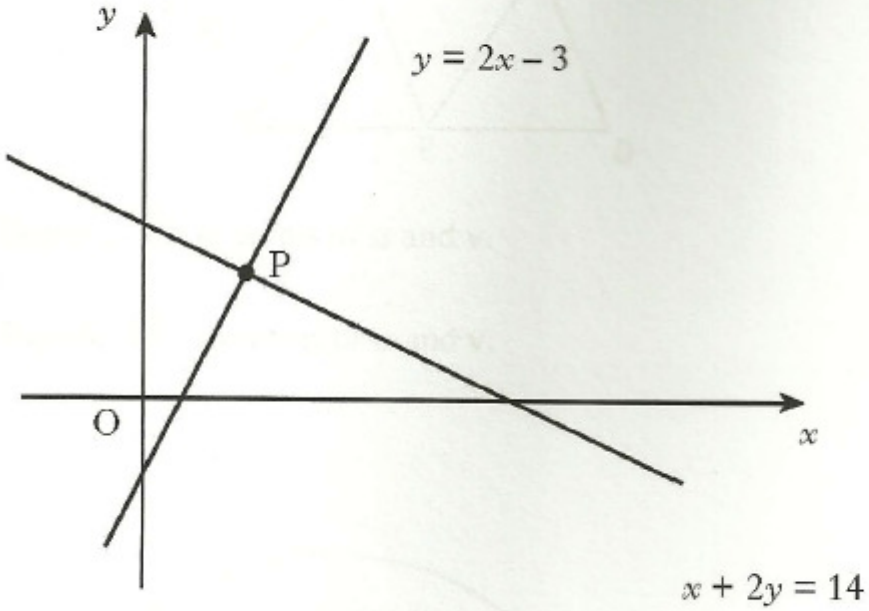
7. Change the subject of the formula to m.

$$L=\frac{\sqrt{m}}{k}$$

2

8. The graph below shows two straight lines.

- $y=2x-3$
- $x+2y=14$



The lines intersect at the point P.

Find, **algebraically**, the coordinates of P. 4

9. Two groups of people go to a theatre.

Bill buys tickets for 5 adults and 3 children.

The total cost of his tickets is £158·25.

(a) Write down an equation to illustrate this information. 1

(b) Ben buys tickets for 3 adults and 2 children.

The total cost of his tickets is £98.

Write down an equation to illustrate this information. 1

(c) Calculate the cost of a ticket for an adult and the cost of a ticket for a child. 4

Total marks 6

10. Change the subject of the formula $s = ut + \frac{1}{2}at^2$ to a. 3

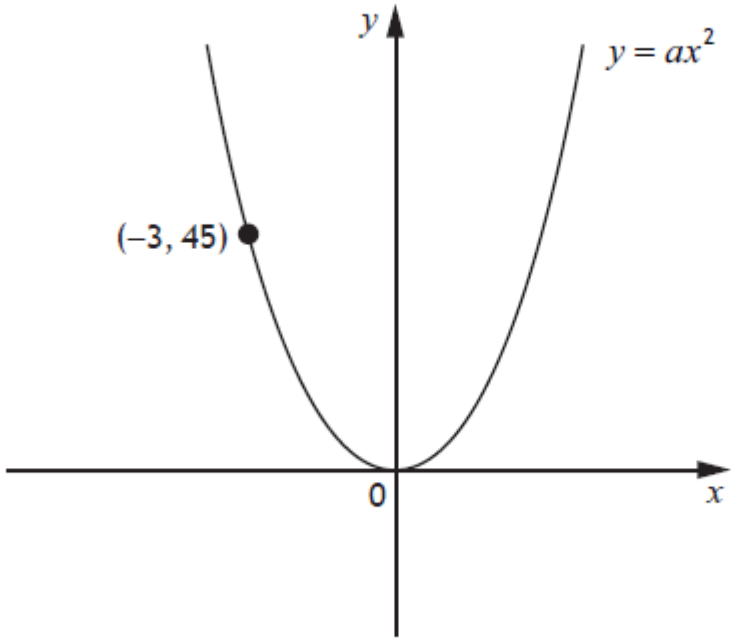
11. A function is defined as $f(x) = 3x + 2$.

Given that $f(a) = 23$, calculate a. 2

12. Change the subject of the formula $p = q + 2r^2$ to r. 3

Relationships 1.2: Quadratic Graphs

1. The diagram below shows part of the graph of $y = ax^2$



Find the value of a. 2

2. A parabola has equation $y = x^2 - 8x + 19$.

(a) Write the equation in the form $y = (x - p)^2 + q$. 2

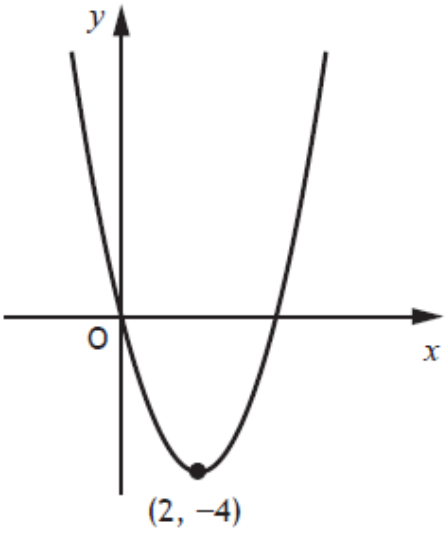
(b) Sketch the graph of $y = x^2 - 8x + 19$, showing the coordinates of the turning point and the point of intersection with the y-axis. 3

Total marks 5

3. Express $x^2 - 14x + 44$ in the form $(x-a)^2 + b$. **2**

4. The graph below shows part of the parabola with equation of the form

$$y = (x+a)^2 + b.$$



The minimum turning point (2, −4) is shown in the diagram.

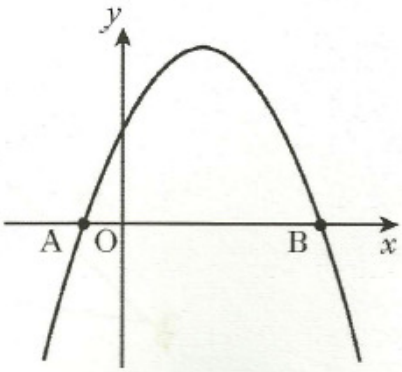
(a) State the values of

(i) a **1**

(ii) b. **1**

(b) Write down the equation of the axis of symmetry of the graph. **1**

5. The diagram shows part of the graph of $y = 5 + 4x - x^2$.



$y = 5 + 4x - x^2$

A is the point (-1, 0).

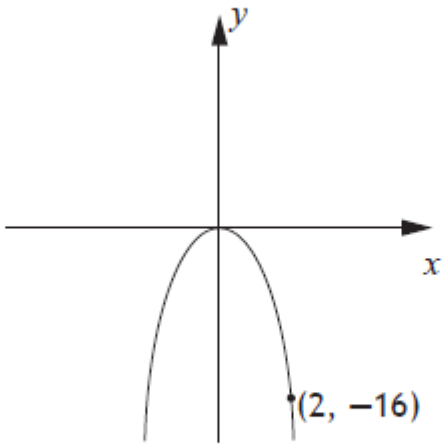
B is the point (5, 0).

(a) State the equation of the axis of symmetry of the graph. **2**

(b) Hence, find the maximum value of $y = 5 + 4x - x^2$. **2**

Total marks 4

6. The graph with equation $y = kx^2$ is shown below.



The point (2, −16) lies on the graph.

Determine the value of k. 2

Relationships 1.3: Quadratic Equations

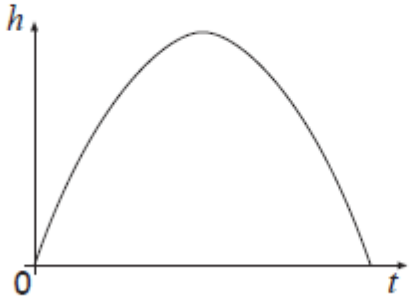
1. Solve the equation

$$2x^2 + 7x - 15 = 0.$$

3

2. The diagram below shows the path of a small rocket which is fired into the air. The height, h metres, of the rocket after t seconds is given by

$$h(t) = 16t - t^2$$



(a) After how many seconds will the rocket first be at a height of 60 metres? 4

(b) Will the rocket reach a height of 70 metres?
Justify your answer. 3

Total marks 7

3. Prove that the roots of the equation $2x^2 + 8x + 5 = 0$ are real and irrational. 4

4. Find the range of values of p such that the equation $px^2 - 2x + 3 = 0,\ p \neq 0,$ has no real roots. 4

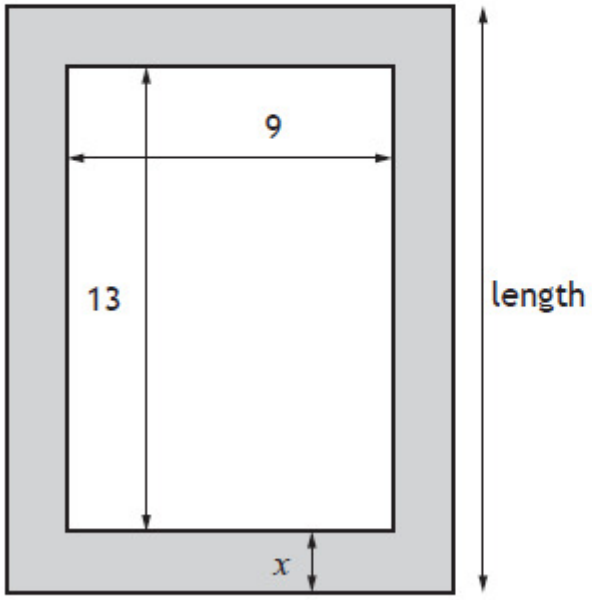
5. Solve the equation $2x^2 + 3x - 7 = 0$.

Give your answer **correct to 2 significant figures.** 4

6. A rectangular picture measuring 9 centimetres by 13 centimetres is placed on a rectangular piece of card.

The area of the card is 270 square centimetres.

There is a border x centimetres wide on all sides of the picture.



(a) (i) Write down an expression for the length of the card in terms of x. 1

(ii) Hence show that $4x^2 + 44x - 153 = 0$. 2

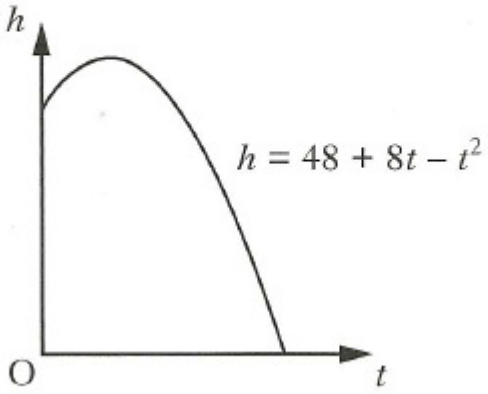
(b) Calculate x, the width of the border.

Give your answer correct to one decimal place. 4

7. The diagram shows the path of a flare after it is fired.

The height, h metres above sea level, of the flare is given by

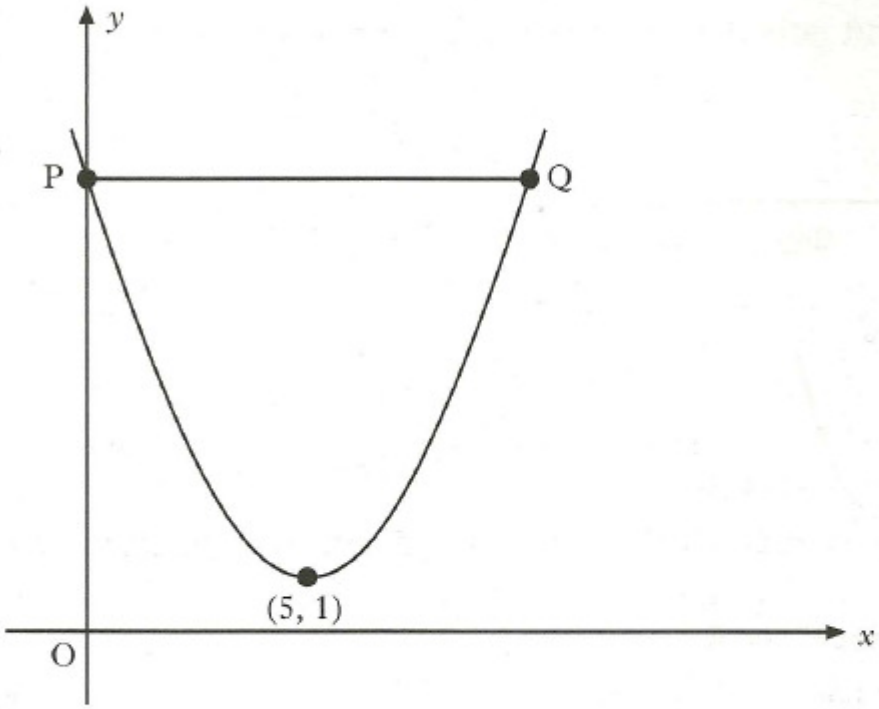
$h = 48 + 8t - t^2$ where t is the number of seconds after firing.



Calculate, **algebraically**, the time taken for the flare to enter the sea. 4

8. The graph below shows part of a parabola with equation of the form

$$y = (x+a)^2 + b\,.$$



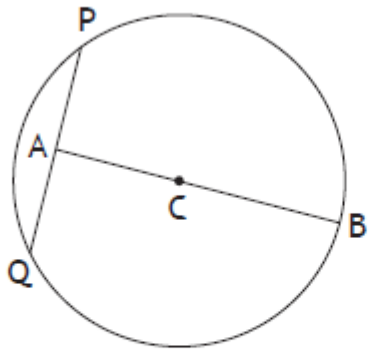
(a) State the values of a and b . 2

(b) The line PQ is parallel to the x - axis.
Find the coordinates of points P and Q. 3

Total marks 5

Relationships 1.4: Similarity; Pythagoras; Circle Geometry

1. The diagram below shows a circle, centre C.



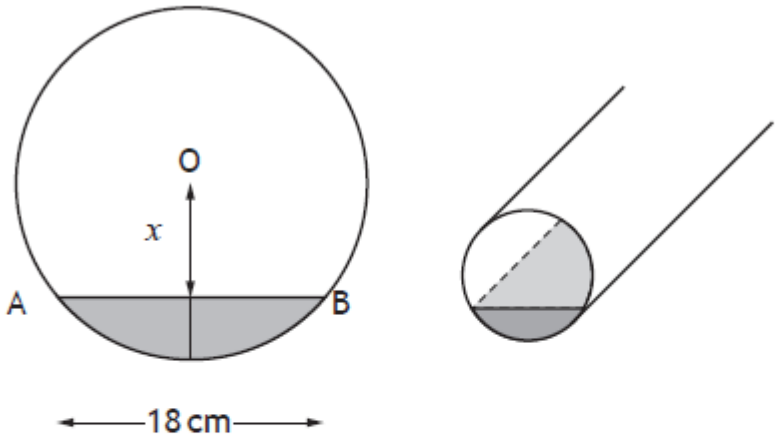
The radius of the circle is 15 centimetres.

A is the mid-point of chord PQ.

The length of AB is 27 centimetres.

Calculate the length of PQ. 4

2. A cylindrical pipe has water in it as shown.



The depth of the water at the deepest point is 5 centimetres.

The width of the water surface, AB, is 18 centimetres.

The radius of the pipe is r centimetres.

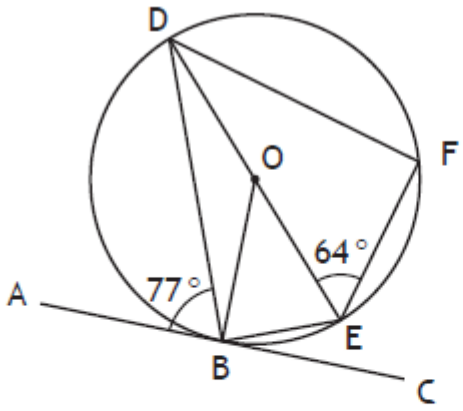
The distance from the centre, O, of the pipe to the water surface is x centimetres.

(a) Write down an expression for x in terms of r. 1

(b) Calculate r, the radius of the pipe. 3

Total Marks 4

3.



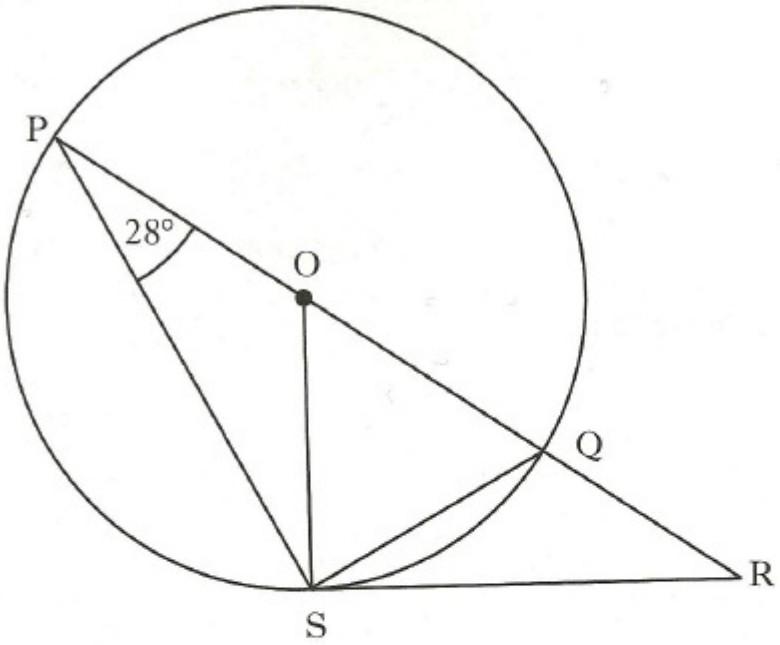
AC is a tangent to the circle, centre O, with point of contact B.

DE is a diameter of the circle and F is a point on the circumference.

Angle ABD is 77° and angle DEF is 64°.

Calculate the size of angle BDF. 3

4.



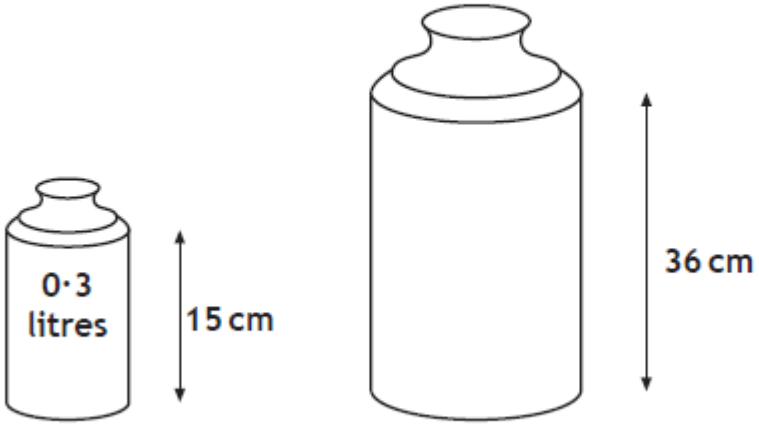
In the above diagram,

- O is the centre of the circle
- PQ is a diameter of the circle
- PQR is a straight line
- RS is a tangent to the circle at S
- angle QPS is 28°

Calculate the size of angle QRS. 3

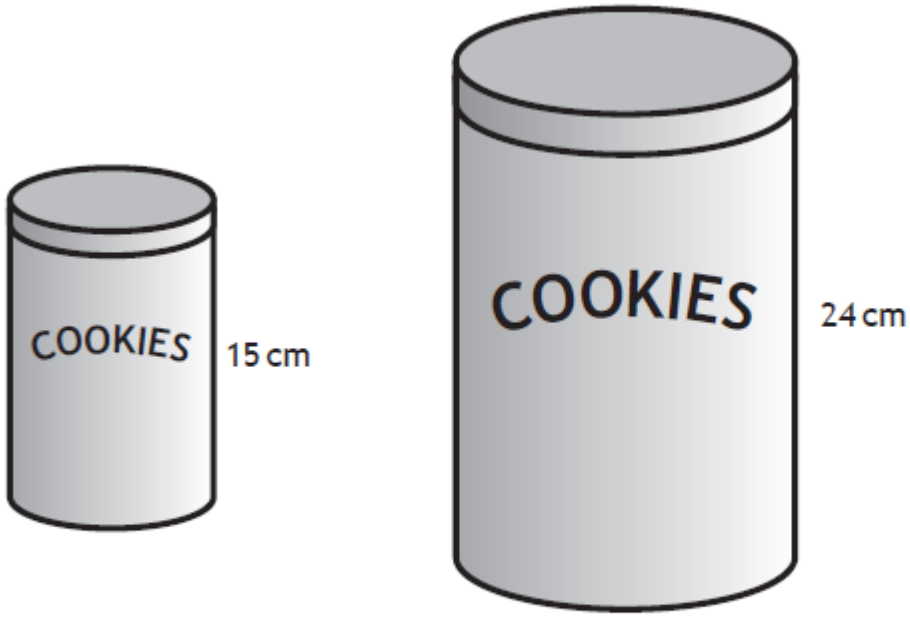
5. Screenwash is available in two different sized bottles, 'Mini' and 'Maxi'.

The bottles are mathematically similar.



Calculate the volume of the 'Maxi' bottle. 3

6. A supermarket sells cylindrical cookie jars which are mathematically similar.



The smaller jar has a height of 15 centimetres and a volume of 750 cubic centimetres.

The larger jar has a height of 24 centimetres.

Calculate the volume of the larger jar. **3**

7. The diagram below shows the position of three towns.

Lowtown is due west of Midtown.

The distance from

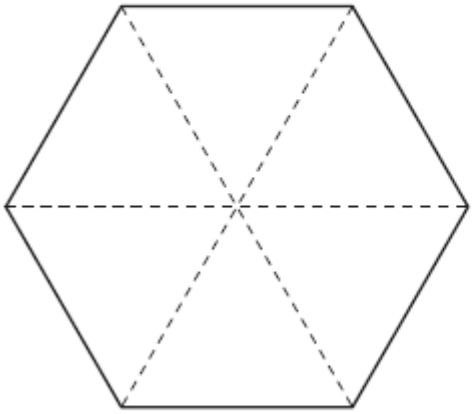
- Lowtown to Midtown is 75 kilometres.
- Midtown to Hightown is 110 kilometres.
- Hightown to Lowtown is 85 kilometres.

Is Hightown directly north of Lowtown?

Justify your answer. **4**

8. The top of a table is in the shape of a regular hexagon.

The three diagonals of the hexagon which are shown as dotted lines in the diagram below each have length 40 centimetres.



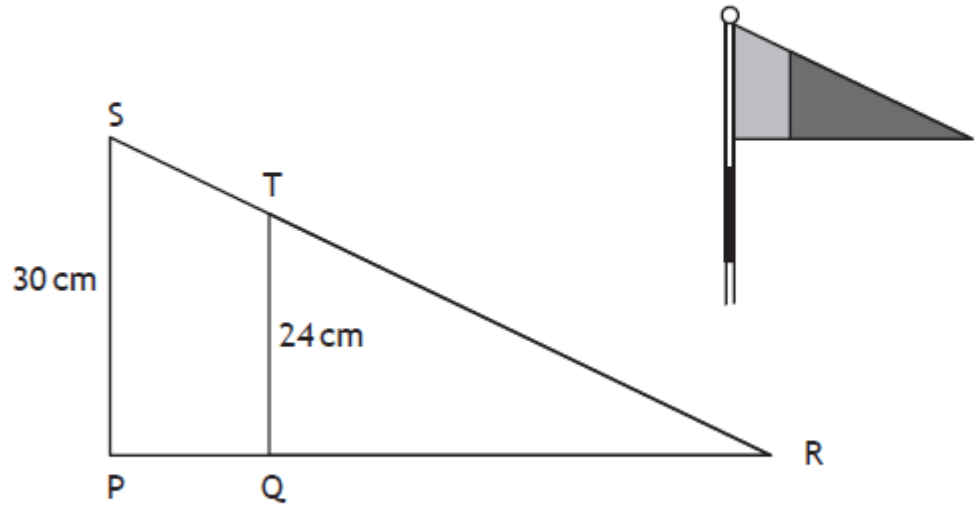
Calculate the area of the top of the table. 4

9. The flag at each hole on a golf course is coloured red and blue.

The diagram below represents a flag.

Triangle QRT represents the red section.

PQTS represents the blue section.

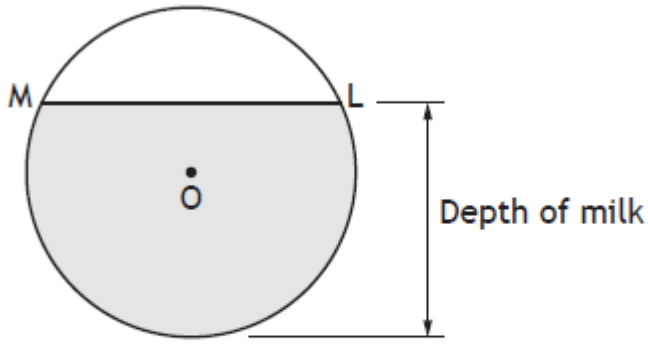


Triangles PRS and QRT are mathematically similar.

The area of triangle QRT is 400 square centimetres.

Calculate the area of PQTS, the blue section of the flag. 4

10. The diagram below shows the circular cross-section of a milk tank.



The radius of the circle, centre O, is 1·2 metres.

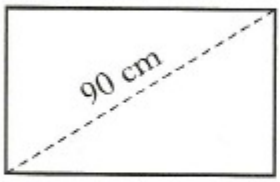
The width of the surface of the milk in the tank, represented by ML in the diagram, is 1·8 metres.

Calculate the depth of the milk in the tank. **4**

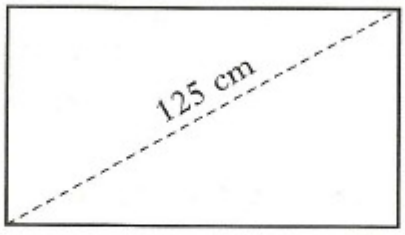
11. Two rectangular solar panels, A and B, are mathematically similar.

Panel A has a diagonal of 90 centimetres and an area of 4020 square centimetres.

A



B

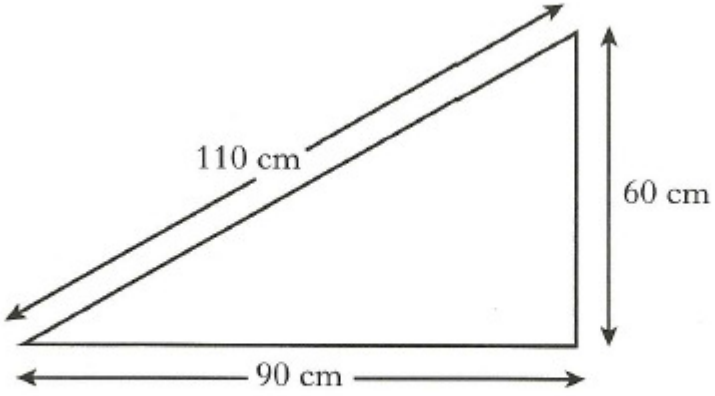


A salesman claims that panel B, with a diagonal of 125 centimetres, will be double the area of panel A.

Is this claim justified?

Show all your working. **4**

12. A triangular paving slab has measurements as shown.

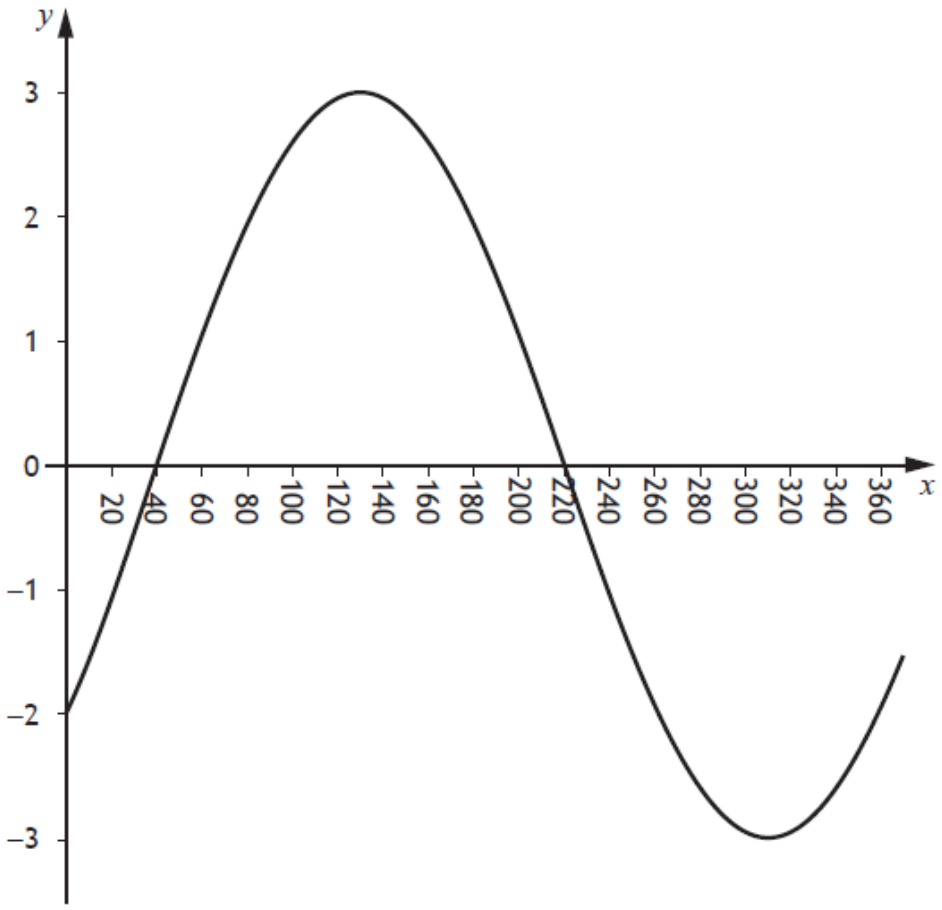


Is the slab in the shape of a right angled triangle?

Show your working. **3**

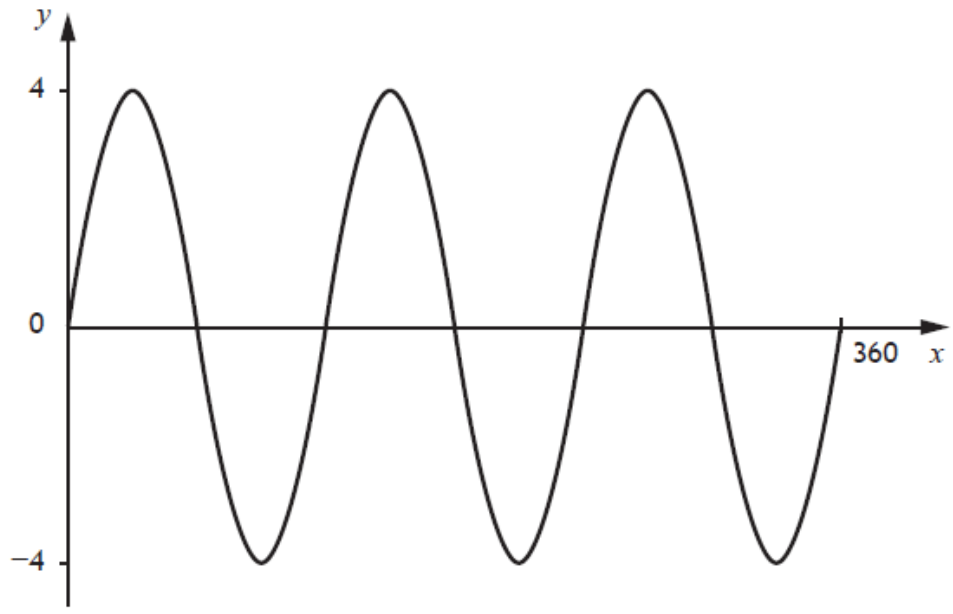
Relationships 1.5: Trig Graphs & Equations

1. The graph of $y = a\sin(x+b)°$, $0 \le x \le 360$, is shown below.



Write down the values of a and b. 2

2. Part of the graph of $y = a\sin bx°$ is shown in the diagram.



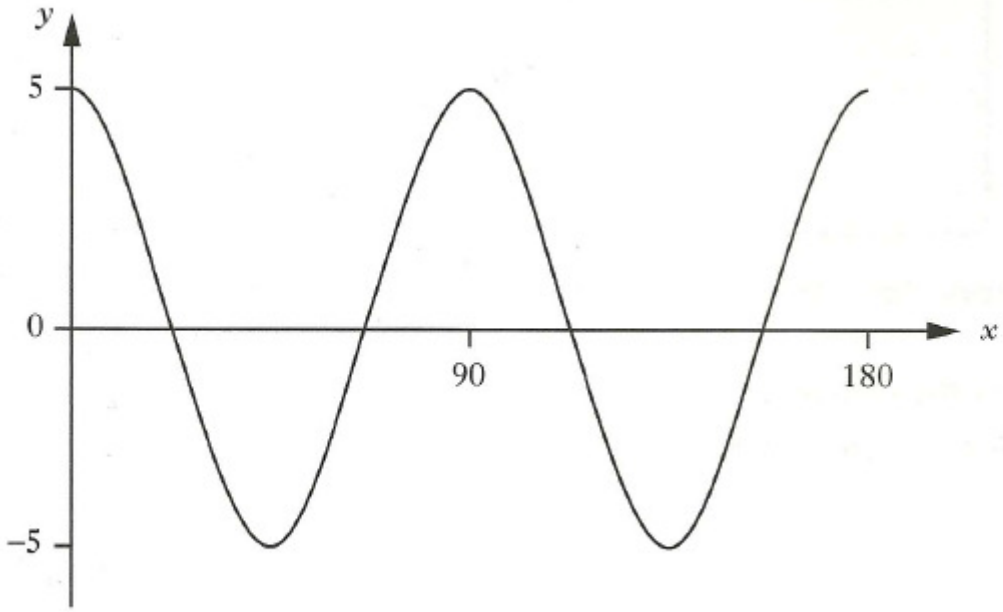
State the values of a and b. 2

3. Write the following in order of size starting with the smallest.

$\cos 90°$ $\cos 100°$ $\cos 300°$

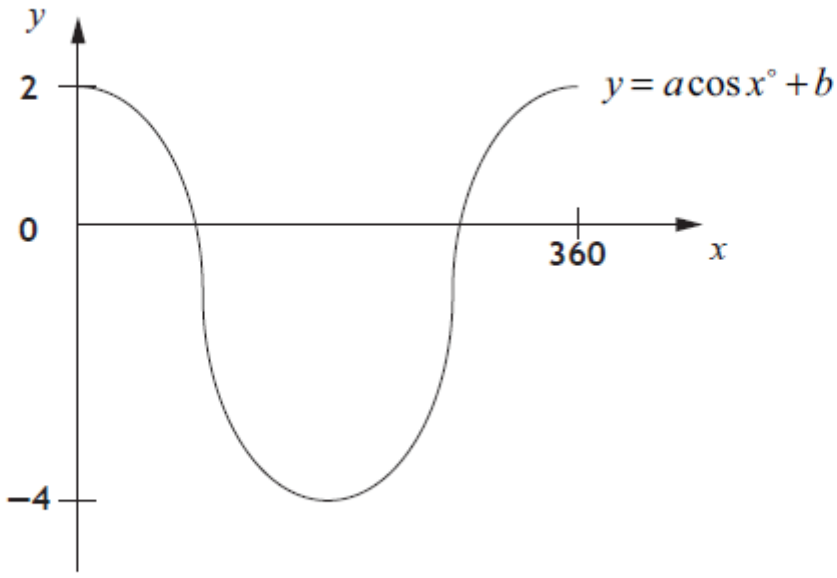
Justify your answer. **2**

4. Part of the graph of $y = a\cos bx^{o}$ is shown in the diagram.



State the values of a and b. **2**

4. Part of the graph of $y = a\cos x^{\circ} + b$ is shown below.



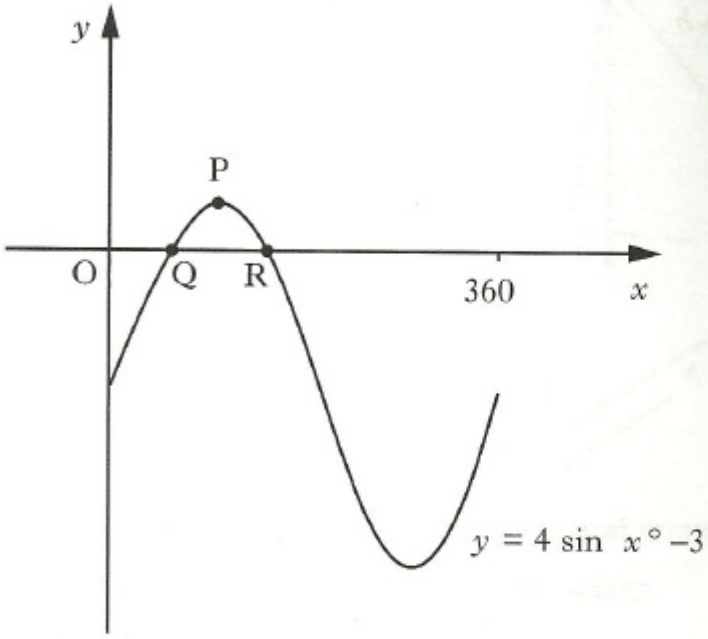
(a) Explain how you can tell from the graph that $a = 3$ and $b = -1$. **2**

(b) Calculate the x-coordinates of the points where the graph cuts the x-axis. **4**

Total marks 6

5. Solve the equation $11\cos x^{\circ} - 2 = 3$, for $0 \leq x \leq 360$. **3**

6. Part of the graph of $y = 4\sin x^o - 3$ is shown below.



The graph cuts the x - axis at Q and R.

P is the maximum turning point.

(a) Write down the coordinates of P. 1

(b) Calculate the x - coordinates of Q and R. 4

Total marks 5