

1. Solve the equation

$$5 - 2(1 + 3x) = 27.$$

KU	RA
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3

2. Large distances in space are measured in light years.

A camera on a space telescope photographs a galaxy, a distance of 50 million light years away.

One light year is approximately  $9.46 \times 10^{12}$  kilometres.

Calculate the distance of the galaxy from the space telescope in kilometres.

**Give your answer in scientific notation.**

2

3. The cost of sending a parcel depends on the weight of the parcel and the time of delivery.

The cost is calculated as shown below.

TIME OF DELIVERY	COST
by 10 am the next working day	£18.20 for 10 kg and £0.85 for each extra kg.
by noon the next working day	£13.50 for 10 kg and £0.75 for each extra kg.
by 5pm the next working day	£10.50 for 10 kg and £0.50 for each extra kg.

(a) Find the cost of sending a parcel, of weight 14 kg, for delivery **by noon** the next working day.

2

(b) Write down a formula to find the cost, £C, of sending a parcel, of weight w kg, where w is greater than 10.

The parcel has to be delivered **by noon** the next working day.

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4. The Brown family want to convert the roof space in their bungalow into an extra room.

The roof space, with some of its measurements, is shown in figure 1.

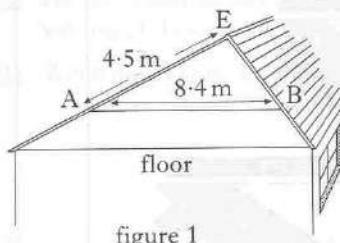


figure 1

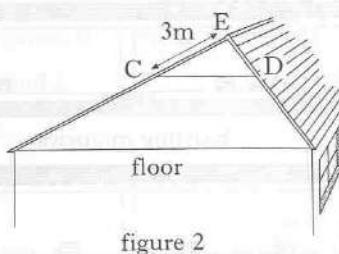


figure 2

The position, AB, of the wooden beam must be changed to position CD, as shown in figure 2.

The wooden beam must always be parallel to the floor.

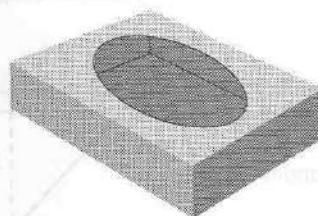
By considering the similar triangles EAB and ECD, calculate the length of the wooden beam in position CD.

**Do not use a scale drawing.**

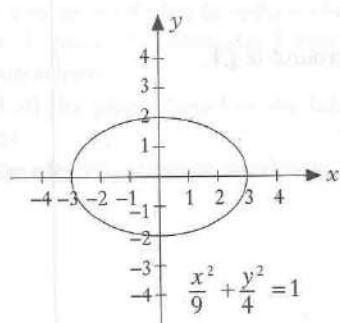
KU	RA
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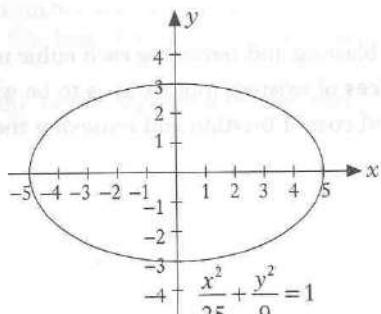
5. The opening on this box of tissues is in the shape of an ellipse.



The graphs of two ellipses and their equations are shown below.



$$\frac{x^2}{9} + \frac{y^2}{4} = 1$$



$$\frac{x^2}{25} + \frac{y^2}{9} = 1$$

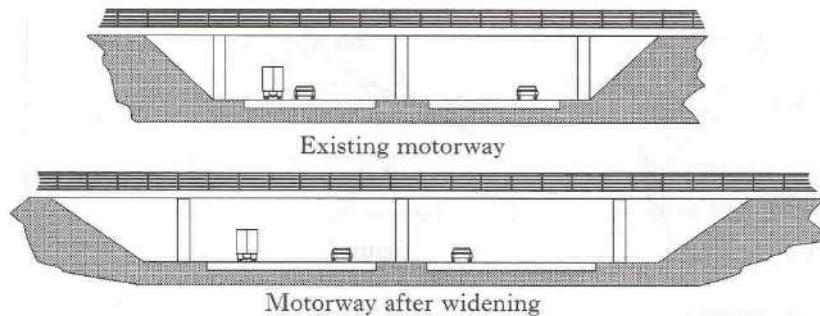
Sketch the ellipse with equation

$$\frac{x^2}{36} + \frac{y^2}{16} = 1.$$

3

6. Ground has to be blasted and removed so that a motorway can be widened. The existing motorway and the motorway after widening are shown below.

KU	RA
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The uniform cross-section of the existing motorway consists of a rectangle and two congruent right-angled triangles as shown in figure 1.

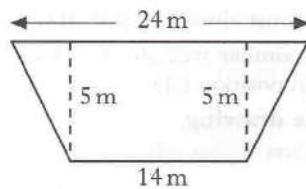


figure 1

The uniform cross-section of the motorway after widening consists of a rectangle and two congruent right-angled triangles as shown in figure 2.

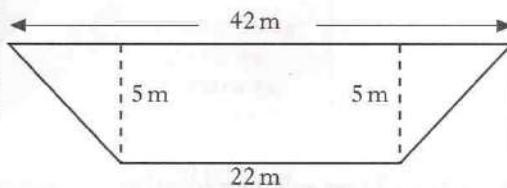


figure 2

The cost of blasting and removing each cubic metre of ground is £4.

**10 kilometres** of existing motorway is to be widened.

Find the total cost of blasting and removing the ground.

7. A tank contains 10 litres of water.

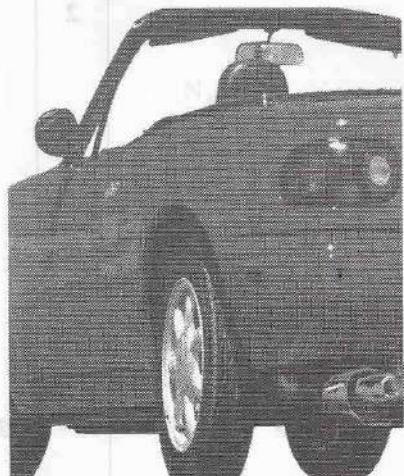
A further 30 litres of water is poured into the tank at a steady rate of 5 litres per minute.

(a) On the 2 mm square-ruled graph paper provided, draw a graph of the volume,  $V$  litres, of water in the tank against the time,  $t$  minutes.

(b) Write down an equation connecting  $V$  and  $t$ .

KU	RA
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4	2

8. The table shows the emission levels of harmful gases at different places in a city.



Emission Levels	
City Sq	111 units
Albert Sq	41 units
Wellgate Centre	161 units
Bus Station	146 units
High St	114 units

Health regulations state that the emission levels of harmful gases should be **less** than 135 units.

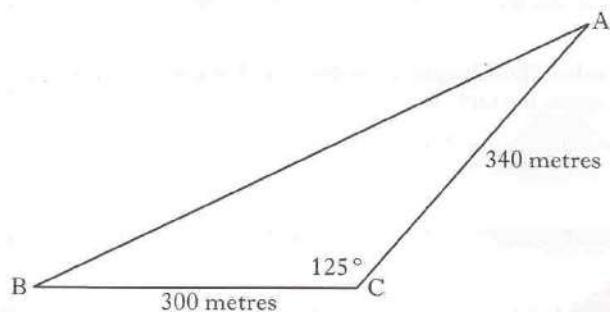
The city council plan to reduce the levels in such a way that for each of the next 3 years the emission levels will be 5% less than the level in the previous year.

Will all the places listed in the table meet the health regulations in 3 years time?

**Show clearly all your working.**

4

9. A field, ABC, is shown below.



Find the area of the field.

KU	RA
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2

10. Brackets can be multiplied out in the following way.

$$(y+1)(y+2)(y+3) = y^3 + (1+2+3)y^2 + (1 \times 2 + 1 \times 3 + 2 \times 3)y + 1 \times 2 \times 3$$

$$(y+2)(y+3)(y+4) = y^3 + (2+3+4)y^2 + (2 \times 3 + 2 \times 4 + 3 \times 4)y + 2 \times 3 \times 4$$

$$(y+3)(y+4)(y+5) = y^3 + (3+4+5)y^2 + (3 \times 4 + 3 \times 5 + 4 \times 5)y + 3 \times 4 \times 5$$

(a) In the same way, multiply out

$$(y+4)(y+5)(y+6).$$

2

(b) In the same way, multiply out

$$(y+a)(y+b)(y+c).$$

2

11. (a)  $f(x) = 3\sqrt{x}$

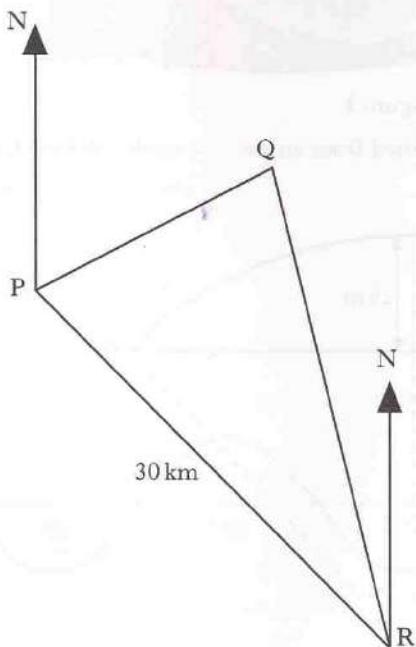
Find the exact value of  $f(12)$ , giving your answer as a **surd**, in its **simplest form**.

(b) Express  $\frac{y^4 \times y}{y^{-2}}$  in its simplest form.

(c) Factorise  $9a^2 - 25$ .

KU	RA
2	
2	
2	

12.



A ship, at position P, observes a lighthouse at position Q on a bearing of  $040^\circ$ .

The ship travels 30 kilometres on a bearing of  $125^\circ$  to position R.

From position R, the ship observes the lighthouse on a bearing of  $340^\circ$ .

When the ship is at position R, how far is it from the lighthouse?

6

13. Solve the equation

$$x^2 + 2x - 6 = 0.$$

Give your answers correct to 2 significant figures.

KU	RA
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5

14. Figure 1 shows a road bridge.

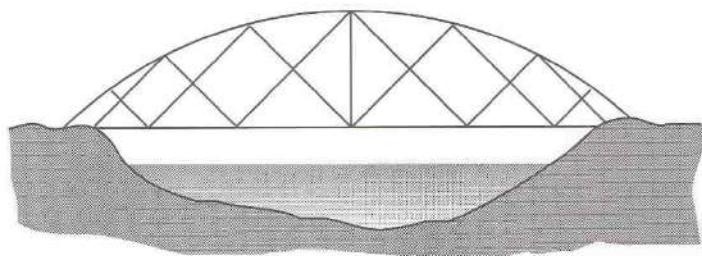


figure 1

The curved part of the bridge is formed from an arc of a circle, centre O, as shown in figure 2.

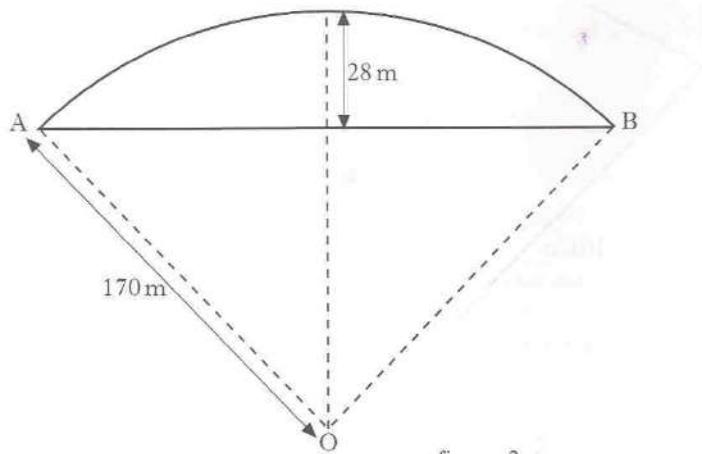


figure 2

OA and OB are radii of length 170 metres.

The height of the middle of the bridge above its ends is 28 metres as shown in figure 2.

Calculate the horizontal distance, AB.

**Do not use a scale drawing.**

4
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KU	RA
	2
	2
	3
16.	$M = R^2 t - 3$
	Change the subject of the formula to $R$ .
	3
17.	
	The diagram shows the graph of $y = a \cos bx^\circ$ , $0 \leq x < 360$ . Find the values of $a$ and $b$ .
	2

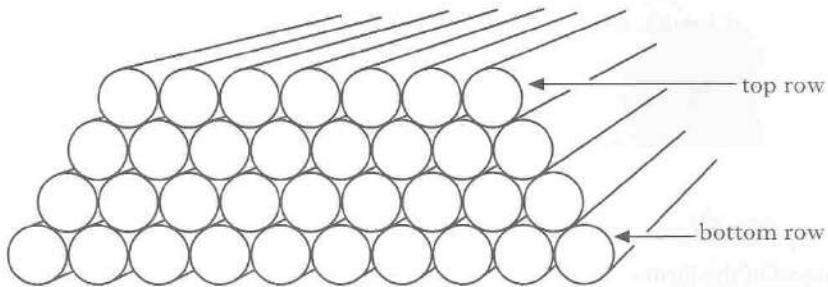
18. A table of pairs of values of  $x$  and  $y$  is shown below.

$x$	1.5	2	2.5
$y$	6	4.5	3.6

(a) Explain why  $y$  varies inversely as  $x$ .  
 (b) Write down the formula connecting  $x$  and  $y$ .

KU	RA
	2
1	

19. Pipes with equal diameters are arranged in a stack.



To find the number of pipes,  $P$ , in a stack, the following formula can be used

$$P = \frac{(b + a)(b - a + 1)}{2}$$

where  $b$  is the number of pipes on the bottom row and  $a$  is the number of pipes on the top row.

(a) Use this formula to find the number of pipes in a stack where  $b = 40$  and  $a = 15$ .  
 (b) In a particular stack, the number of pipes on the bottom row is twice the number on the top row.  
 Show that in this stack  $P = \frac{3a^2 + 3a}{2}$ , where  $a$  is the number of pipes on the top row.  
 (c) Would it be possible to arrange exactly 975 pipes in the kind of stack described in part (b)?

**Justify your answer.**

1

3

3