C

2500/104

MATHEMATICS
STANDARD GRADE
Credit Level

1 Answer as many questions as you can.

2 Full credit will be given only where the solution contains appropriate working.
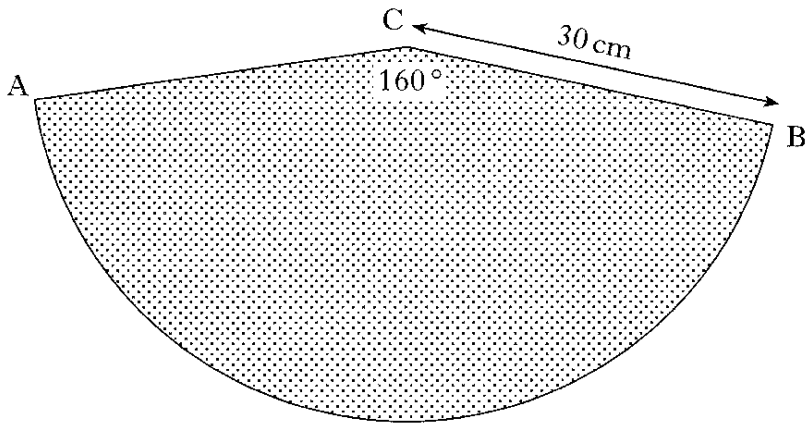
3 Square-ruled paper is provided.

FORMULAE LIST

The roots of $ax^2 + bx + c = 0$ are $x = \dfrac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Sine rule: $\quad \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine rule: $\quad a^2 = b^2 + c^2 - 2bc \cos A \quad \text{or} \quad \cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$

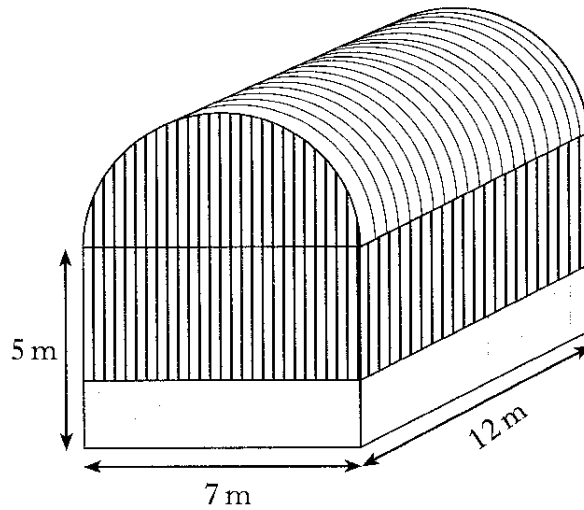**Area of a triangle:** $\quad \text{Area} = \tfrac{1}{2}ab \sin C$

1.

The diagram shows a sector of a circle, centre C.

Angle ACB is 160° and the radius of the circle is 30 cm.

Calculate the length of the arc AB.

3

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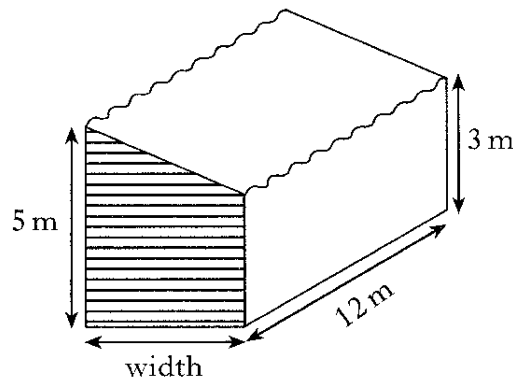
2. A storage barn is prism shaped, as shown below.

The cross-section of the storage barn consists of a rectangle measuring 7 metres by 5 metres and a semi-circle of radius 3·5 metres.

(a) Find the volume of the storage barn.

Give your answer in cubic metres, **correct to 2 significant figures**.

(b) An extension to the barn is planned to increase the volume by 200 cubic metres.

The uniform cross-section of the extension consists of a rectangle and a right-angled triangle.

Find the width of the extension.

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3. While on holiday, John's family decide to hire a car.

There are two different schemes for hiring the same type of car, Eurocar and Apex.

EUROCAR HIRE	APEX HIRE
No deposit required £15 per day	£50 deposit required **plus** £10 per day

(a) Write down a formula to find the cost, £C, of hiring the car from Eurocar for d days.

(b) Write down a formula to find the cost, £C, of hiring the car from Apex for d days.

(c) John's family have £170 to spend on car hire.

Which scheme should they use to have the car for as long as possible?

Show clearly all your working.

4. The sketch below shows a plot of ground, PQRS, split into two triangles.
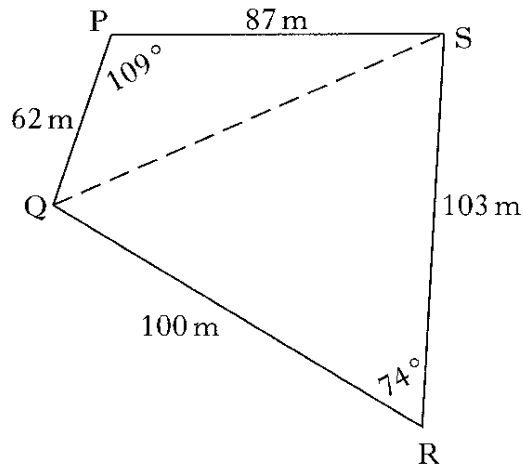
Calculate the area of the plot of ground.

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[Turn over

5. On a £500 holiday, a company offers an easy payment scheme.

£100 is repaid on the 15th of each month.

Interest is charged at a rate of 2·5% per month on the amount outstanding **at the end** of each month.

The first payment is to be made in May.

Find the amount outstanding at the beginning of August.

<div style="text-align: right">3</div>

6. The diagram shows the design of an earring.
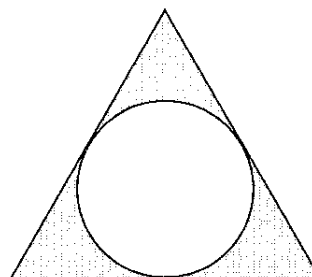
The earring consists of a circle placed inside an equilateral triangle.

The sides of the triangle are tangents to the circle.

The radius of the circle is 8 mm.

The distance from the centre of the circle to **each** vertex of the triangle is 17 mm.

Calculate the perimeter of the triangle.

<div style="text-align: right">4</div>

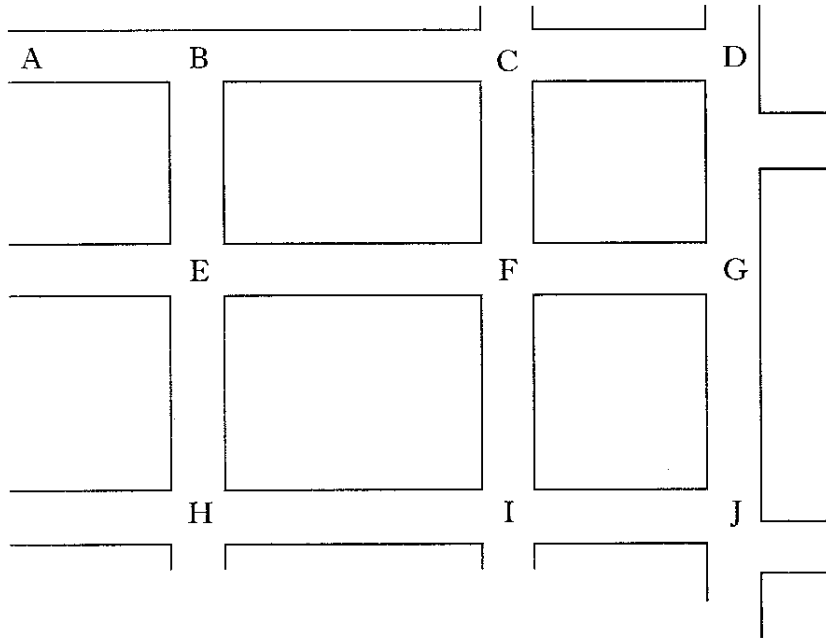**7.** Figure 1 shows part of the street plan of a town.

figure 1

Vehicles can travel in both directions along each street.

As a vehicle travels on the straight parts of any street it can reach the maximum speed.

The speed is always reduced on the bends.

The graph in figure 2 shows how the speed of a vehicle changes as it travels from **A to J**.
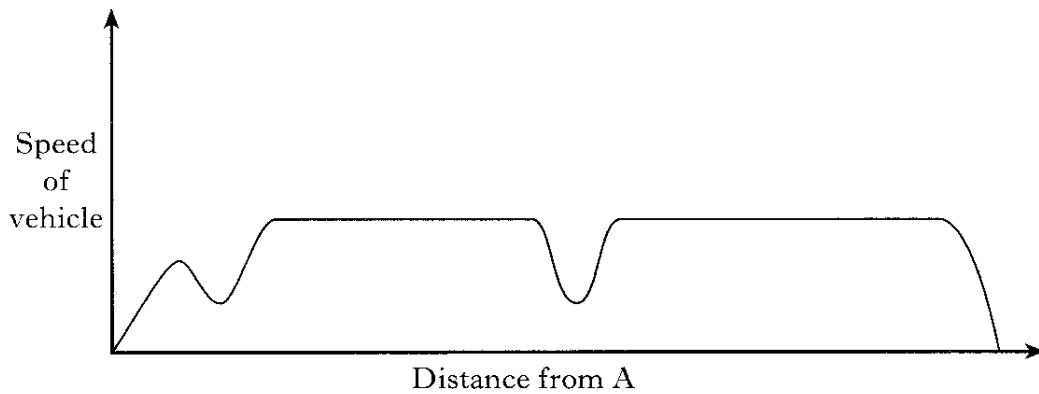

figure 2

(a) What route did the vehicle travel? Use the letters from figure 1 to indicate this route.

2

(b) Another vehicle took the route A, B, C, F, G and J.

Sketch a graph to show how the speed of this vehicle changes during the journey.

3

8. (a) $h(t) = 15t - 3t^2$

Find $h(-2)$.

(b) (i) Factorise **completely**
$$2x^2 - 6x.$$

(ii) Express $\dfrac{2x^2 - 6x}{x^2 - 9}$ in its simplest form.

9. Consecutive cubic numbers can be added using the following pattern.

$$1^3 + 2^3 = \frac{2^2 \times 3^2}{4}$$

$$1^3 + 2^3 + 3^3 = \frac{3^2 \times 4^2}{4}$$

$$1^3 + 2^3 + 3^3 + 4^3 = \frac{4^2 \times 5^2}{4}$$

(a) Express $1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3$ in the same way.

(b) Write down an expression for the sum of the first n consecutive cubic numbers.

(c) Write down an expression for $8^3 + 9^3 + 10^3 + \ldots + n^3$.

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	2	
		2
		3
		2

10. The number of litres of petrol, L, used by a car on a journey varies directly as the distance travelled, D kilometres, and as the square root of the average speed, S kilometres per hour.

(a) Write down a relationship connecting L, D and S.

The car uses 30 litres of petrol for a journey of 550 kilometres when it travels at an average speed of 81 kilometres per hour.

(b) How many litres of petrol does the car use for a journey of 693 kilometres travelling at an average speed of 100 kilometres per hour?

11. (a) Remove the brackets and collect like terms

$$(3a - b)(2a - 5b).$$

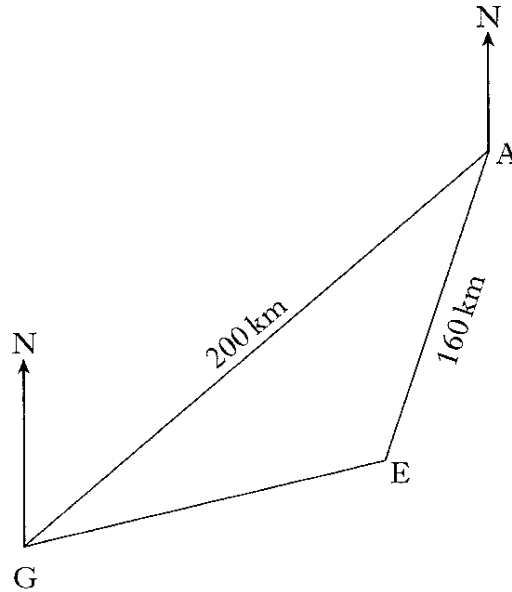(b) Solve **algebraically** the equation

$$2x^2 - 9x - 5 = 0.$$

(c) Solve **algebraically** the equation

$$\frac{x}{2} - \frac{(x+1)}{3} = 4.$$

[Turn over

12. The diagram shows the positions of three airports, A, E and G.
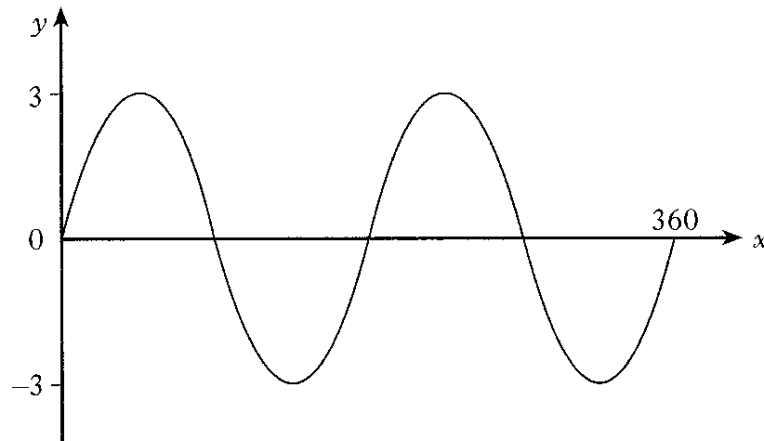

G is 200 kilometres from A.

E is 160 kilometres from A.

From G the bearing of A is 052°.

From A the bearing of E is 216°.

How far apart are airports G and E?

6

13.

The diagram shows the graph of $y = k\sin ax°$, $0 \le x < 360$.

Find the values of a and k.

2

14. A number tower is built from bricks as shown in figure 1.

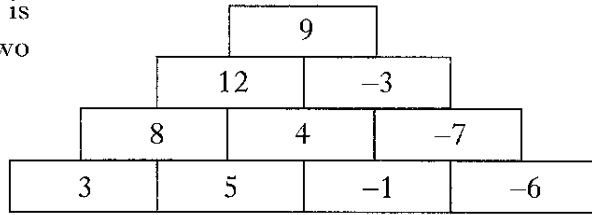The number on the brick above is always equal to the sum of the two numbers below.

		9		
	12		−3	
8		4		−7
3	5		−1	−6

figure 1

(a) Find the number on the shaded brick in figure 2.
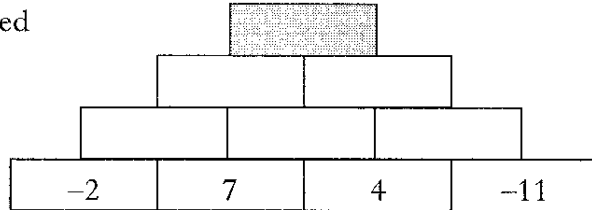
		▓		
−2	7		4	−11

figure 2

1

(b) In figure 3, two of the numbers on the base bricks are represented by p and q.
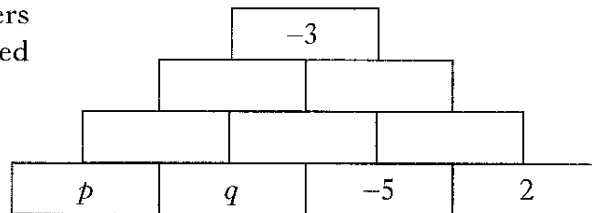
Show that $p + 3q = 10$.

		−3		
p	q		−5	2

figure 3

2

(c) Use figure 4 to write down a second equation in p and q.

		14		
$2q$	−2		5	$-p$

figure 4

2
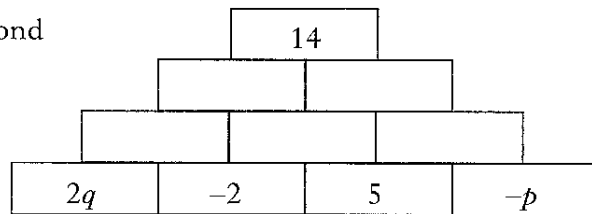
(d) Find the values of p and q.

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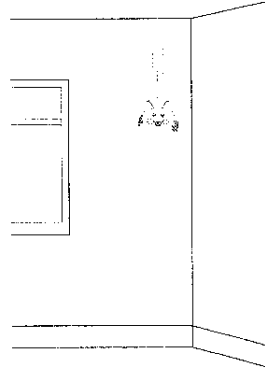**[Turn over for Questions 15 and 16 on *Page twelve***

15. (*a*) Express $\sqrt{72} - \sqrt{2} + \sqrt{50}$ as a surd in its simplest form.

(*b*) Express $\dfrac{3y^5 \times 4y^{-1}}{6y}$ in its simplest form.

16. A toy is hanging by a spring from the ceiling.

Once the toy is set moving, the height, H metres, of the toy above the floor is given by the formula

$$H = 1\cdot9 + 0\cdot3\cos (30t)°$$

t seconds after starting to move.

(*a*) State the maximum value of H.

(*b*) Calculate the height of the toy above the floor after 8 seconds.

(*c*) When is the height of the toy **first** 2·05 metres above the floor?

[END OF QUESTION PAPER]