1.
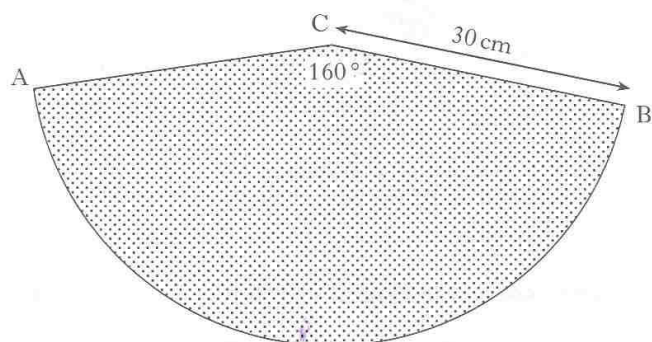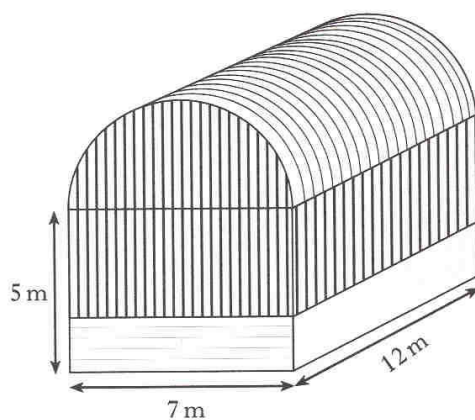

The diagram shows a sector of a circle, centre C.

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

Calculate the length of the arc AB.

3

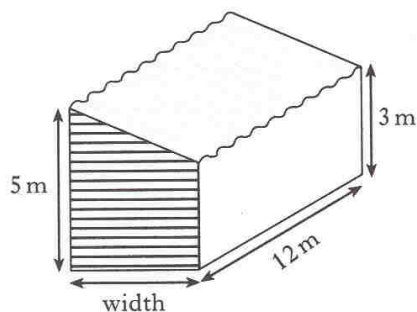**2.** A storage barn is prism shaped, as shown below.

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**.

4

(*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.

3

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 No deposit required £15 per day	**APEX HIRE** £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.
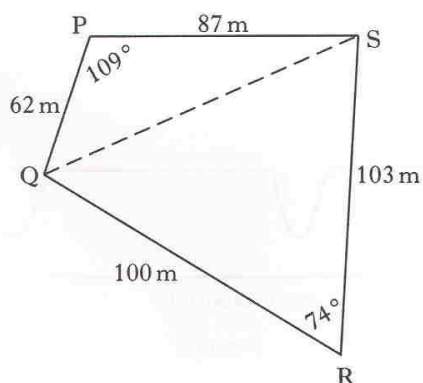
Calculate the area of the plot of ground.

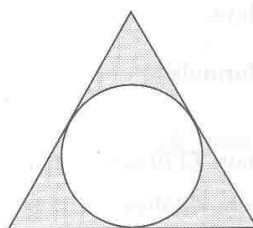**5.** On a £500 holiday, a company offers an easy payment scheme.

£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.

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.

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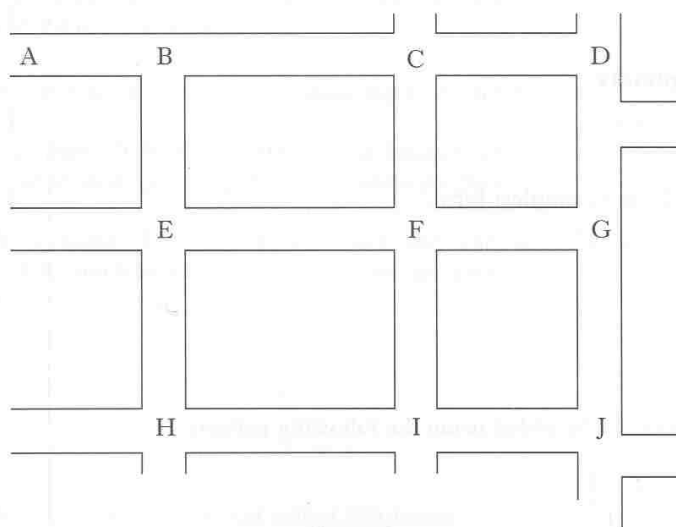
figure 1

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**
$$2x^2 - 6x.$$

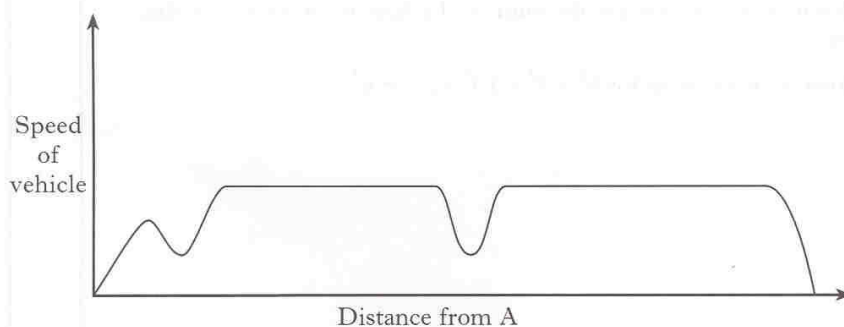(ii) Express $\dfrac{2x^2 - 6x}{x^2 - 9}$ in its simplest form.

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

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

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

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

(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 $8^3 + 9^3 + 10^3 + \ldots + n^3$.

KU	RA
2	
1	
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

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

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

N

A

200 km

160 km

N

E

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.

y

3

0

360

x

−3

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

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.
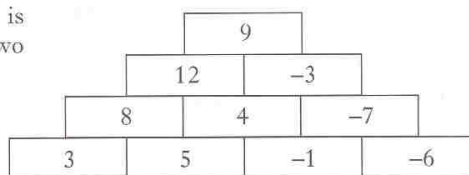
```
              ┌──────┐
              │  9   │
          ┌───┴──┬───┴──┐
          │  12  │  -3  │
      ┌───┴──┬───┴──┬───┴──┐
      │  8   │  4   │  -7  │
  ┌───┴──┬───┴──┬───┴──┬───┴──┐
  │  3   │  5   │  -1  │  -6  │
  └──────┴──────┴──────┴──────┘
```

figure 1

(*a*) Find the number on the shaded brick in figure 2.

```
              ┌──────┐
              │▒▒▒▒▒▒│
          ┌───┴──┬───┴──┐
          │      │      │
      ┌───┴──┬───┴──┬───┴──┐
      │      │      │      │
  ┌───┴──┬───┴──┬───┴──┬───┴──┐
  │  -2  │  7   │  4   │ -11  │
  └──────┴──────┴──────┴──────┘
```
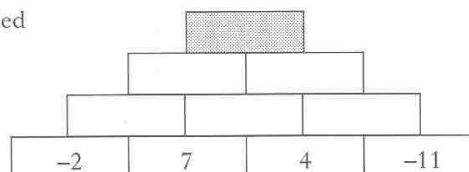
figure 2

(*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   │
  └──────┴──────┴──────┴──────┘
```
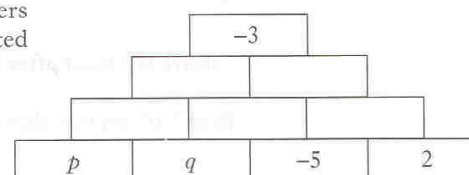
figure 3

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

```
              ┌──────┐
              │  14  │
          ┌───┴──┬───┴──┐
          │      │      │
      ┌───┴──┬───┴──┬───┴──┐
      │      │      │      │
  ┌───┴──┬───┴──┬───┴──┬───┴──┐
  │  2q  │  -2  │  5   │  -p  │
  └──────┴──────┴──────┴──────┘
```
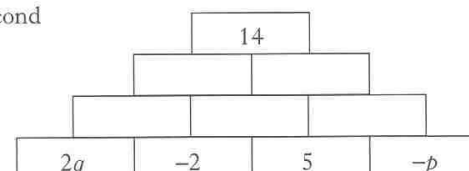
figure 4

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

KU	RA
1	2
	2
	3

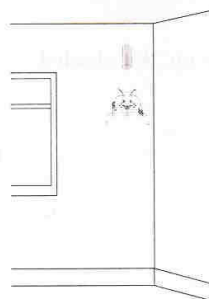|	KU	RA

15. (a) Express $\sqrt{72} - \sqrt{2} + \sqrt{50}$ as a surd in its simplest form.   **3**

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

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.   **1**

(b) Calculate the height of the toy above the floor after 8 seconds.   **3**

(c) When is the height of the toy **first** 2·05 metres above the floor?   **3**

[*END OF QUESTION PAPER*]