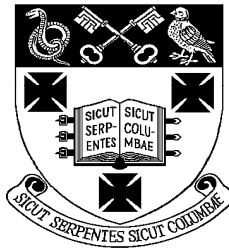**RADLEY COLLEGE**
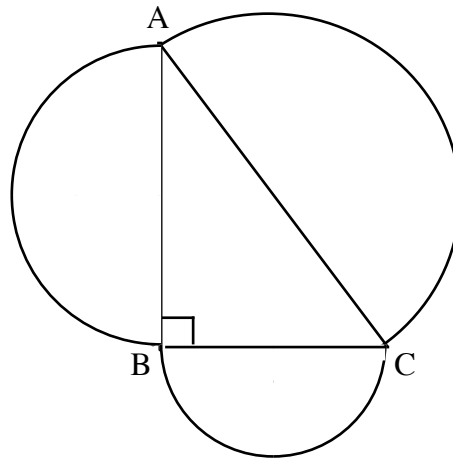**Entrance Scholarships**

MATHEMATICS II

Thursday 4th March 2004

Time allowed 2 hours

You may try the questions in any order and
you are not expected to complete them all.

Show all working.

1.

The diagram shows a logo for a new stationery shop. The logo consists of a right-angled triangle, ABC, in which AB = 8 cm and BC = 6 cm. On each of the three sides of the triangle is attached a semicircle.

Calculate

(a)   the length AC

(b)   the area of the triangle ABC

(c)   the total area of the logo.

2. A cycle shop sells only bicycles and tricycles. The total number of whe~~els in~~ the shop is 95, and the total number of cycles in the shop is 40.

Use simultaneous equations to calculate how many of each type of cycle are in the shop.

3. A coat is advertised for £350. As a result of change in tax, the price has to be increased by 10%.

   (a) Calculate the new price.

   In the sale this price is reduced by 10%.

   (b) Calculate the sale price.

   Now suppose the price had increased by $x\%$ as a result of the change in tax, and that this price had been reduced by $x\%$ in the sale.

   Given that the sale price of the £350 coat is now £294,

   (c) write down an equation for x.

   (d) Solve your equation to calculate the value of x.

4. Pooh has three quarters of a pot of honey. He eats 70g and now has only two fifths of a pot left. How many grams are in the full pot?

5. I have to complete a journey of 20 km. I walk the first 8 km at a speed of v kmh^{-1}, and then jog the remaining bit at a speed which is 2 kmh^{-1} faster than my walking speed.

   (a) Write down an expression, in terms of v, for the time for which I am walking.

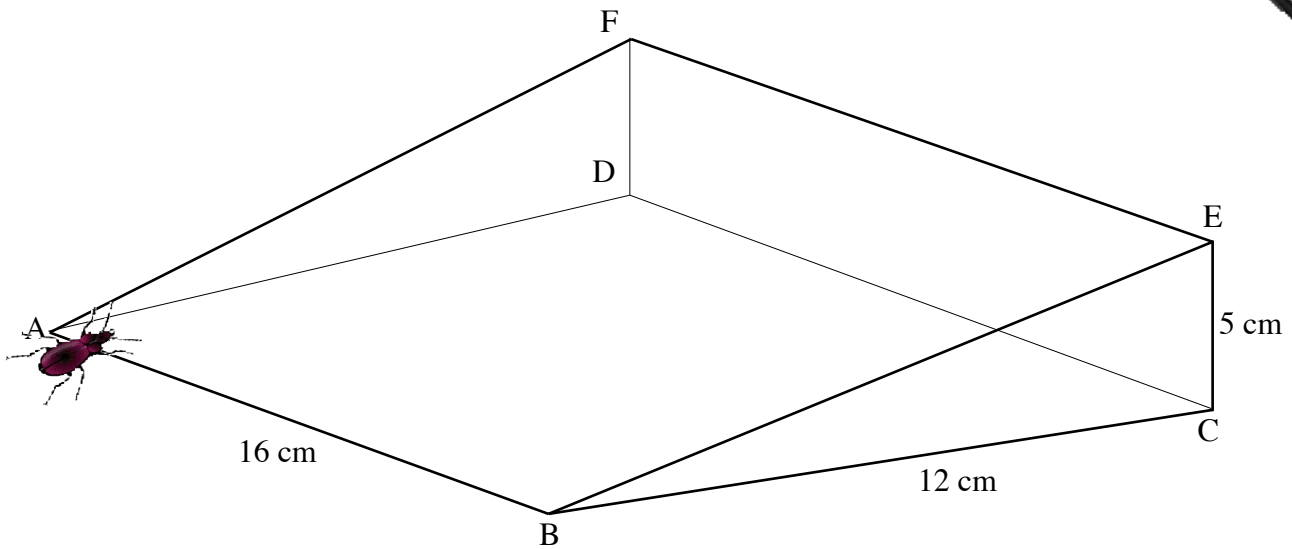   (b) Write down an expression, in terms of v, for the time which I am jogging.

   Given that the journey takes 4 hours

   (c) write down an equation for v.

   (d) Show that your equation simplifies to $v^2 - 3v - 4 = 0$.

   (e) Solve this equation to find the value of v.

6.   This year the Radley College Scholarship Beetle is tackling a wedge.

The wedge has a horizontal rectangular base ABCD where AB = 16 cm and BC = 12 cm. E is vertically above C, F is vertically above D, and CE = DF = 5 cm.

The beetle is at A and wishes to get to E. Find how far it goes if it

(a)   crawls along the edges from A to B to C to E.

(b)   crawls along the edges from A to F to E.

(c)   crawls across the slope in a straight line from A to E.

(d)   burrows in a straight line from A to C, and then crawls up the straight edge from C to E.

7.

6 cm
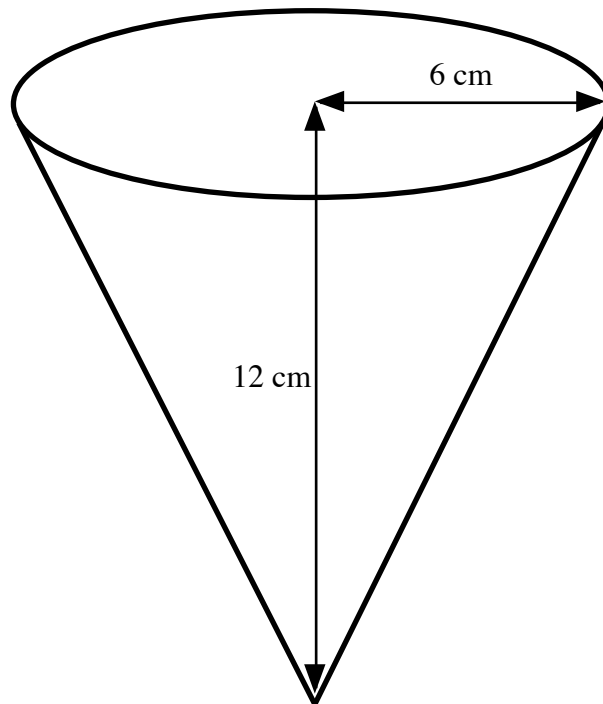
12 cm

A hollow inverted cone has a height, h, of 12 cm, and a radius, r, of 6 cm. The cone is filled with water at a rate of 5 cm^3 per second.

(a)   Calculate the surface area of the circular cross-section of the water when the depth of water is 8 cm.

(b)   Calculate how long it takes the cone to fill.

(c)   How long would it take to fill a cone which had twice the height and twice the radius?

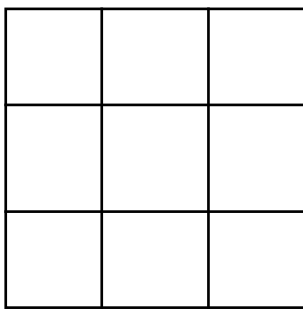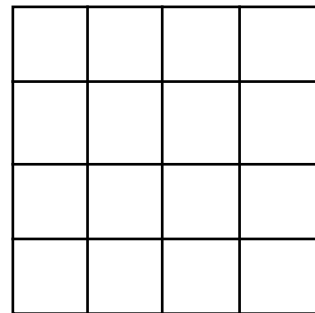[The formula for the volume of a cone is $\dfrac{1}{3}\pi r^2 h$]

8.
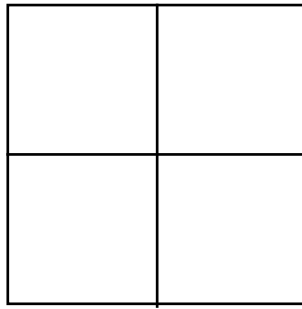
In this figure you can count 5 squares: 4 "little" ones and 1 "big" one.

How many squares are there in

(a)   (b)
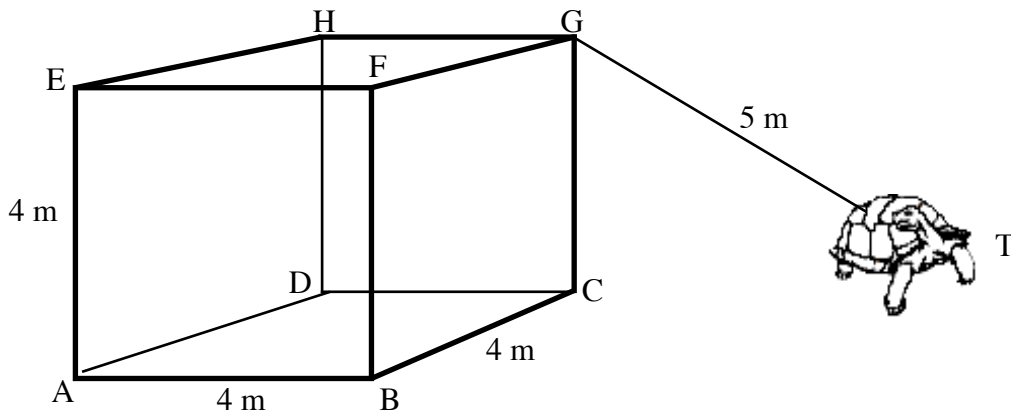

(c)   a grid of $n \times n$ little squares?

9.

The diagram shows a solid cube of side 4 m. The Radley College Scholarship Tortoise, T, is attached by a string of length 5 m to the point G. The box and tortoise are placed on a large lawn.

(a)   Calculate the area of the grass which the tortoise can eat.

Suppose instead the length of the string had been $\sqrt{80}$ m.

(b)   Calculate the new area.

10. The formula for the sum of the integers between 1 and n is $\frac{n}{2}(n+1)$

i.e. $1+2+3+......+n = \frac{n}{2}(n+1)$

So, for example, $1+2+3+4+5 = \frac{5}{2}(5+1) = 15$

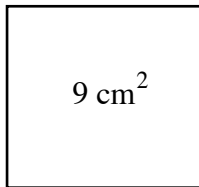(a) Use this formula to find the value of each of the following:

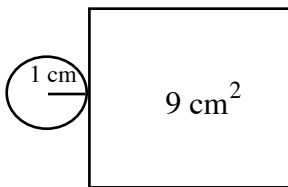(i) $1+2+3+.......+100$

(ii) $2+4+6+.......+100$

(iii) $1+3+5+.......+99$

(iv) $1-2+3-4...... -100$

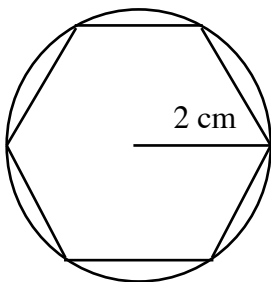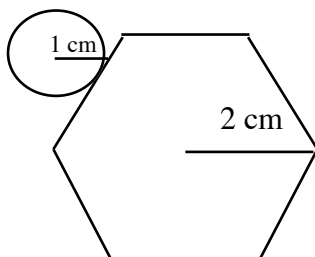(b) Given that $1+2+3+......+n = 1540$ find the value of n.

11.

(a) A square has area 9 cm^2. Find the perimeter.

9 cm^2

(b) A circle of radius 1 cm is rolled around the edges of the square, and a line drawn following the centre of the circle as it goes round. Find the length of the line.

1 cm   9 cm^2

(c) A regular hexagon is drawn inside the circle of radius 2 cm. Find the perimeter of the hexagon.

2 cm

(d) Again, a circle of radius 1 cm is rolled around the edges of the hexagon. Find the length of the line this time.

1 cm   2 cm

12.   A money box contains three £1 coins, four 50p coins, six 20p coins an~~d~~
      10p coins.

   (a)   If I select a coin at random from the box what is the probability that it
         will be a £1 coin?

   (b)   If I take two coins from the box, having replaced the original coin,
         what will be the probability that

         (i)   they are both 20p coins,

         (ii)   they are coins of the same value,

         (iii)   the total value of the two coins will be less than 60p,

         (iv)   the total value of the two coins will be at least 60p.