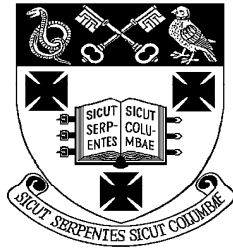


**RADLEY COLLEGE  
Entrance Scholarships**



**MATHEMATICS II**

Thursday 6th March 2003

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. I heard recently on the radio the following remark.

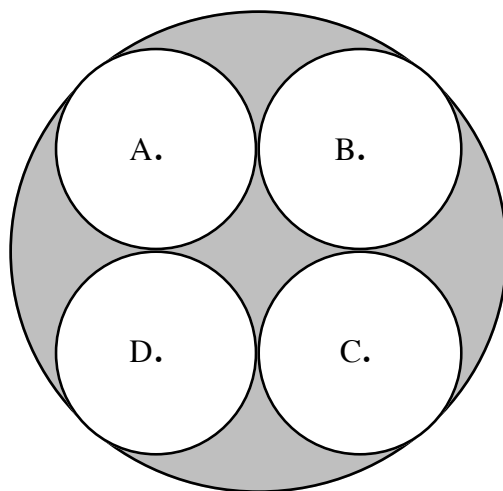
“Only seven out of every ten aircraft seats are occupied on the average flight, and so there are 30% more aircraft in the skies than we actually need.”

Explain what is wrong with this statement, and calculate the correct percentage.

2. One week I go shopping and buy quarter of a pound of stilton and half a pound of brie, and the cost is £4.35. The next week I go shopping and buy half a pound of stilton and three quarters of a pound of brie and the cost is £7.33. Find the cost of one pound of stilton.



3. A rocket engine on a space-ship consists of four identical circular nozzles with centres A,B,C and D mounted inside a cylinder so that the four nozzles are in contact with each other and with the outer cylinder, as shown in the diagram. It is necessary to paint the area shaded in the diagram with a special heat-resistant paint. If the radius of each nozzle is 10 cm, find:
- (a) the radius of the outer cylinder, and
  - (b) the area which needs to be painted.

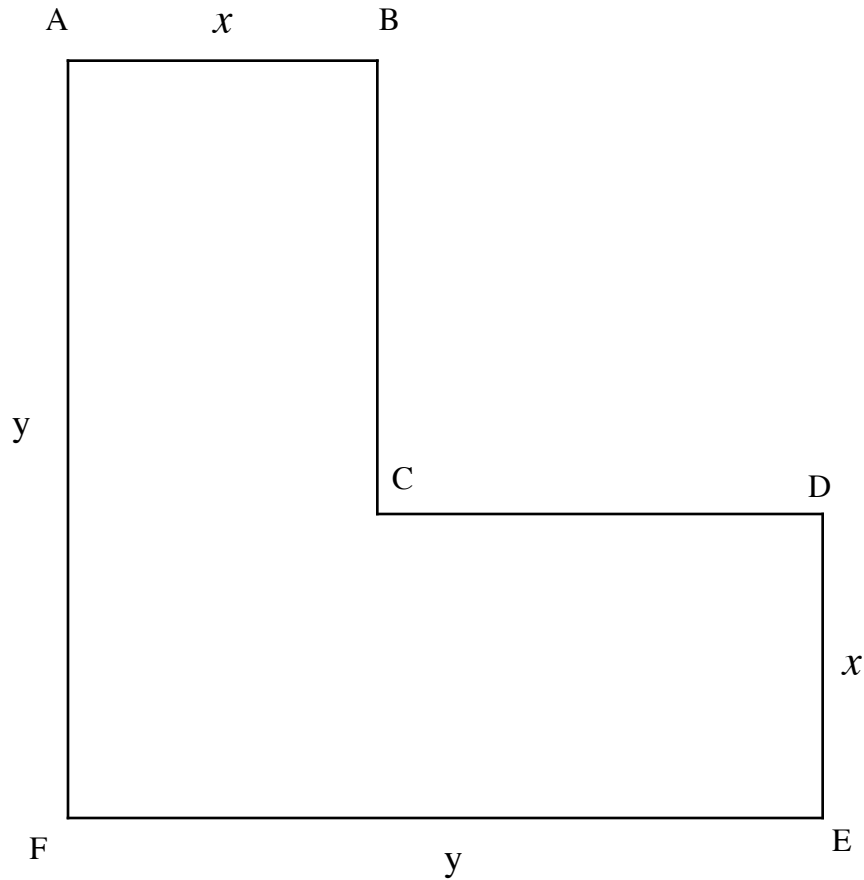


[Hint: start by finding the distance AC]

4. To calculate a telephone bill the formula  $C = \frac{NP}{100} + R$  is used where  $C$  is the amount of the bill, in pounds,  $N$  is the number of units used,  $P$  is the cost per unit in pence, and  $R$  is the rental charges in pounds.
- (a) Calculate  $C$  given that  $N = 200$ ,  $P = 4$ , and  $R = 12$
  - (b) Calculate  $N$  given that  $C = 18$ ,  $P = 5$ , and  $R = 11$ .
  - (c) Rearrange the formula to make  $P$  the subject
  - (d) Given that  $C = 5R$ , and  $N = 2000R$ , calculate the value of  $P$ .



5.

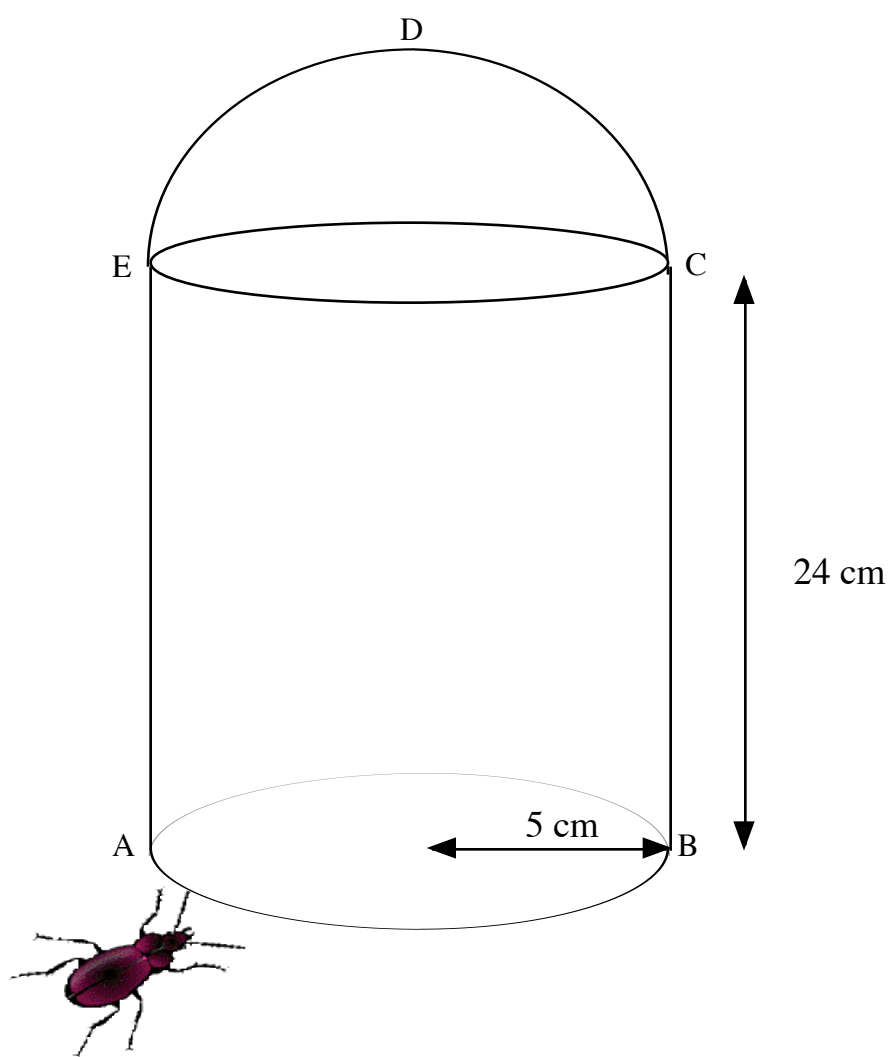


The diagram shows a right-angled template in the shape of a letter L.  
 $AB = DE = x$  cm, and  $AF = FE = y$  cm.

- (a) Find, in terms of  $x$  and  $y$ , a formula for the area of the template.
- (b) Given also that  $y = 6$  cm and that the area of the template is  $32 \text{ cm}^2$  derive the equation  $x^2 - 12x + 32 = 0$
- (c) Solve this equation to find the value of  $x$ .



6.

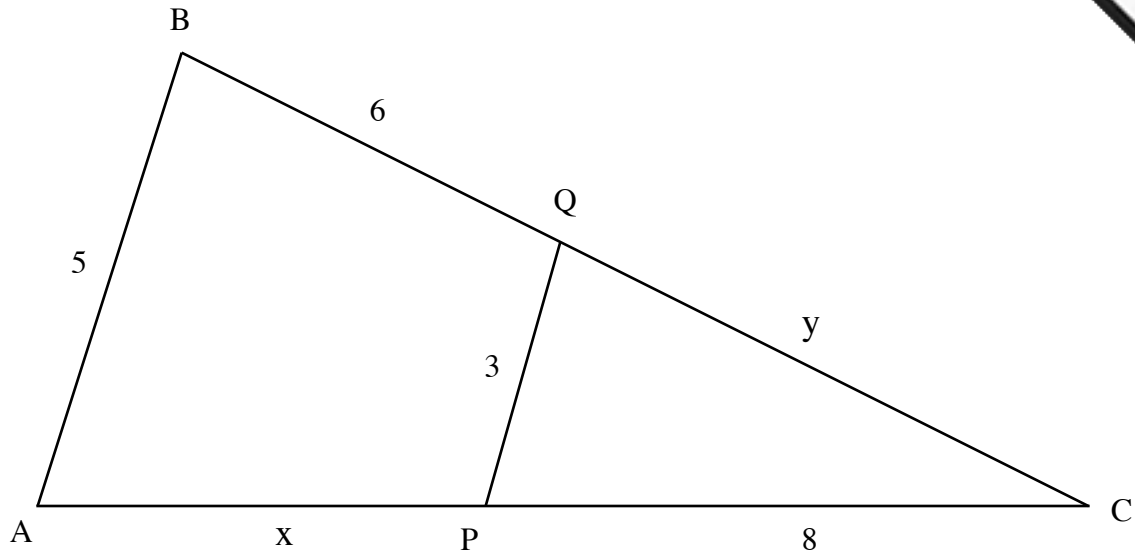


This year the Radley College Scholarship Beetle is tackling a tin of paint. The tin consists of a cylinder of base radius 5 cm and height 24 cm. The tin has a handle CDE which is a vertical semi-circular arc. The beetle is at A and wishes to go to D. B is diametrically opposite to A, E is vertically above A, and C is vertically above B.

Find how far it goes if it

- (a) burrows directly from A to C, then flies directly from C to D,
- (b) crawls up the edge from A to E, then along the handle from E to D,
- (c) burrows and flies in a straight line from A to D,
- (d) crawls over the surface by            est possible route from A to C,

7.



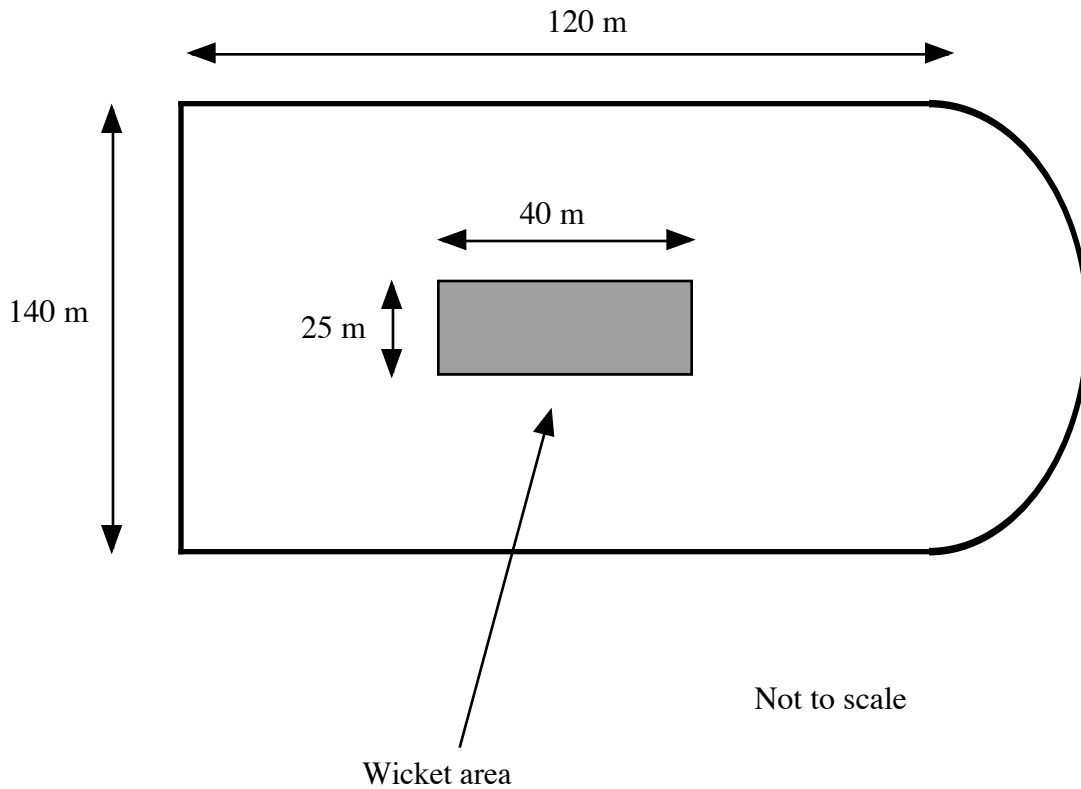
In the diagram triangle ABC is similar to triangle PQC. Lengths, in cm, are as given on the diagram.

- (a) Calculate the value of  $x$
- (b) Calculate the value of  $y$

Given that the area of triangle PQC is approximately  $11.8 \text{ cm}^2$ , calculate an approximate value of the area of the triangle ABC.



8. The Radley groundsman is asked to prepare a new cricket ground from the field shown below - that is a rectangle with a semicircle at one end. He needs two types of grass seed, one for the wicket area and one for the outfield. The wicket seed costs £50 per bag and that for the outfield £10 per bag. Both types will provide enough seed to sow  $500 \text{ m}^2$  of ground per bag.



Calculate:

- The length of fence needed to enclose the complete cricket ground
- The number of bags of each type of seed that must be purchased
- The total cost of the seed
- The percentage of the money spent on seed which is spent on wicket seed.

To help him sow the expensive seed evenly he decides to mark out a 5 m square grid over the wicket area using lengths of string. Determine the minimum length of string required.



9.



The diagram shows a box  $ABCDEF$  in the shape of a regular hexagon of side 1 m. The Radley Scholarship Tortoise,  $T$ , is attached to  $B$  by a string of length 6 m. Initially  $ABT$  lie in a straight line.

- (a) The Radley College Scholarship Tortoise sets off in a clockwise direction keeping the string taut. Find how far he walks before bumping into the box at  $B$ .
  - (b) If instead the tortoise had set off in an anticlockwise direction, find how far he would have walked.
10. In Great Britain, money before decimal currency consisted of three basic units, pounds, shillings and pence. There were twelve pence in each shilling and twenty shillings in each pound.
- (a) How many pence were there in
    - (i) one pound
    - (ii) seven pounds, twelve shillings and eight pence.
  - (b) Change 1276 pence into pounds, shillings and pence.

In the remote country of Abbserd, the currency consists of shells, pebbles and nuts.  $x$  shells equal 1 pebble and  $y$  pebbles equal 1 nut.

Given that 3 nuts and 4 pebbles equals 125 shells and that 210 shells equal 6 nuts, write two equations and solve them to find  $x$  and  $y$ .

11. (a) (i) Show that the equation

$$4^{x-1} = 8^{x+1}$$

can be written as  $2^{2x-2} = 2^{3x+3}$ .

- (ii) Hence solve the equation

$$4^{x-1} = 8^{x+1}$$

- (b) Use a similar method to solve each of the following equations

(i)  $4^{2x+3} = 8^{3x-4}$

(ii)  $16^{x-1} = 32^{4-x}$

(iii)  $9^{3x+1} = 27^{4x-5}$

12. (a) In a drawer are two red socks, three green socks and four blue socks. Given I select two together, at random, find the probability

- (i) both are red,  
(ii) both are of the same colour.

- (b) In another drawer are seven sandals. Three are for the right foot, and four are for the left foot. Given I select two together, at random, find the probability

- (i) both are for the right foot,  
(ii) one is for the right foot and the other is for the left foot.

