

# MARLBOROUGH COLLEGE

ENTRANCE & FOUNDATION SCHOLARSHIPS EXAMINATIONS 2006

## Mathematics I

*Compulsory Paper*

TUESDAY 7<sup>th</sup> MARCH 2006

---

Time: 1 hour 30 minutes

---

*Attempt all questions. You are advised to show enough working.  
If an answer is not exact, you should give it to 2 decimal places unless otherwise stated.*

1. Find the value of

$$\frac{-x + \sqrt{x^2 - 16}}{2}$$

- (a) when  $x = 5$ ,  
(b) when  $x = -5$ ,  
(c) explain why it is not possible to find an answer when  $x = 3$ .

2. Solve the equations:

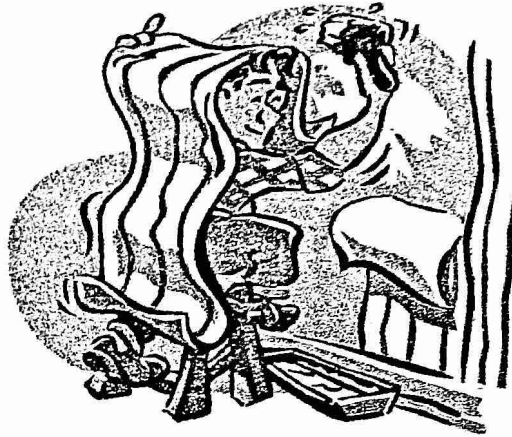
(a)  $3x + 2 = 4(2x + 3)$

(b)  $\frac{1}{3}(2x - 1) + 5 = \frac{1}{2}(3x + 1)$

(c)  $4x = 3y + 13$   
 $3x - 1 = 4y$

Please turn over

3. (a) My sitting room is being re-decorated. One of the walls is 8.75m long and it is to be wallpapered. A roll of wallpaper is 53cm wide and, because of pattern matching, I can get 4 pieces (drops) from each roll of wallpaper. How many rolls of wallpaper must I buy for this wall?

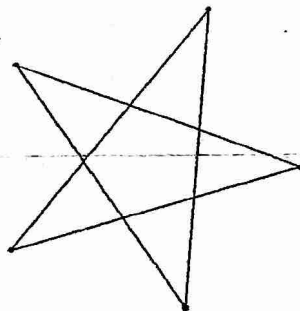


(b) The other walls will be painted. The room is a rectangle measuring 8.75m by 5.35m and the height of the walls is 2.3m. Each of the two smaller walls has a window with area  $3.65 \text{ m}^2$  and there is a large entrance door on the non-wallpapered long wall of area  $3.15 \text{ m}^2$ . (Windows and doors do not need painting.)

On the tin of paint it says that 1 litre will cover  $12.5 \text{ m}^2$  and two coats of paint are needed. Each tin of paint contains 2.5 litres.

How many tins of paint do I need to buy?

4. This shape, which is not drawn accurately, is called a pentagram. It consists of 5 long, equal straight lines which intersect to make a regular pentagon at the centre. The five triangles at the edges are all identical and isosceles.



- (a) Find the angles in the central pentagon.  
(b) Give the values of the angles in the triangles.  
(c) In a larger model of the pentagram, wire is used to make the shape. The sides of the central pentagon are 13cm long and the height of each triangle (measured along its line of symmetry) is 20cm. Calculate to the nearest centimetre, the length of wire needed.

5. Emma runs for charity.  
Last year she ran a 5 kilometre fun run in 27 minutes 30 seconds.
- If she managed a steady pace, how long did each kilometre take?
  - What was her average speed in kilometres per hour?
- This year she ran a longer race, it was 4 miles and Emma completed the race in 47 minutes.
- Given that 1 mile = 1.609 kilometres (to 3 d.p.), How long, in kilometres, was this year's race?
  - Calculate the difference between her speeds for the two races in kilometres per hour.

6. Some children were asked how many television programmes they had watched on the previous day. The table shows the results:

Number of programmes watched	0	1	2	3
Number of children	7	3	1	$x$

- If the median number of programmes is 2, find the value of  $x$  and the probability that a child chosen at random has watched one programme on the previous day.
  - If the median number of programmes is 1, what values could  $x$  take?
  - If  $x = 4$ , draw a labelled pie chart to show this information.  
(Suggested radius 5cm)
7. (a) The 20<sup>th</sup> June this year is a nice date, as it is 20/06/2006. The next such date is 20<sup>th</sup> July 2007. Show clearly how many days there are between these two dates.
- (b) Malcolm is thirteen today, and it is a Tuesday. How many years will it be before his birthday falls on a Tuesday again? Next year (2007) his birthday will be on a Wednesday. In which year after 2007 will he next have a Wednesday birthday? Good explanation is needed.
- (c) I have some wooden cubes and a pot of paint.

One cube is left unpainted; this is called a zero-cube.

One cube has one face painted; this is called a one-cube.

There are two different cubes which have two faces painted, describe how this can occur. These are called two-cubes.

How many different three-cubes can be made? Describe how they are painted.

How about four-cubes, five-cubes and six-cubes?

When all the types had been made, the cubes had all been used. How many cubes were there and how many faces were painted?

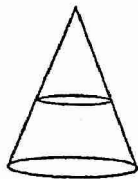
Please turn over

8. In this question you may use the formulas:

$$\text{Volume of cone} = \frac{1}{3} \pi r^2 h$$

$$\text{Curved Surface area of cone} = \pi r \sqrt{r^2 + h^2},$$

Where  $r$  is the radius of the cone and  $h$  is the vertical height of the cone.



Truncated cone



- (a) A candle is made in the shape of a truncated cone, that is, a large cone with the upper smaller cone removed. The heights of the small cone and of the remaining shape are the same and equal 5cm. The base radius of the original large cone is 6cm, and the base radius of the removed small cone is 3cm. Calculate the volume of the candle.
- (b) A lampshade is to be made from a larger version of the truncated cone. Again the heights of the smaller cone and the remaining shape are the same but now they equal 16cm. The base radius of the original large cone is 30cm and the base radius of the removed small cone is 15cm. Material is wrapped around the curved surface of the lampshade. Calculate the curved surface area of this material, giving your answer to 2 significant figures.

**End of examination, please go back and check your answers**