OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS 4752

Concepts for Advanced Mathematics (C2)

Monday **23 MAY 2005** Morning 1 hour 30 minutes

Additional materials:
Answer booklet
Graph paper
MEI Examination Formulae and Tables (MF2)

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The total number of marks for this paper is 72.

This question paper consists of 5 printed pages and 3 blank pages.

[Turn over

Section A (36 marks)

1 Differentiate $x + \sqrt{x^3}$. [4]

2 The nth term of an arithmetic progression is $6 + 5n$. Find the sum of the first 20 terms. [4]

3 Given that $\sin\theta = \frac{\sqrt{3}}{4}$, find in surd form the possible values of $\cos\theta$. [3]

4 A curve has equation $y = x + \frac{1}{x}$.

Use calculus to show that the curve has a turning point at $x = 1$.

Show also that this point is a minimum. [5]

5 **(i)** Write down the value of $\log_5 5$. [1]

(ii) Find $\log_3\left(\frac{1}{9}\right)$. [2]

(iii) Express $\log_a x + \log_a(x^5)$ as a multiple of $\log_a x$. [2]

6 Sketch the graph of $y = 2^x$.

Solve the equation $2^x = 50$, giving your answer correct to 2 decimal places. [5]

7 The gradient of a curve is given by $\frac{dy}{dx} = \frac{6}{x^3}$. The curve passes through $(1, 4)$.

Find the equation of the curve. [5]

8 **(i)** Solve the equation $\cos x = 0.4$ for $0° \leqslant x \leqslant 360°$.

(ii) Describe the transformation which maps the graph of $y = \cos x$ onto the graph of $y = \cos 2x$. [5]

Section B (36 marks)

9

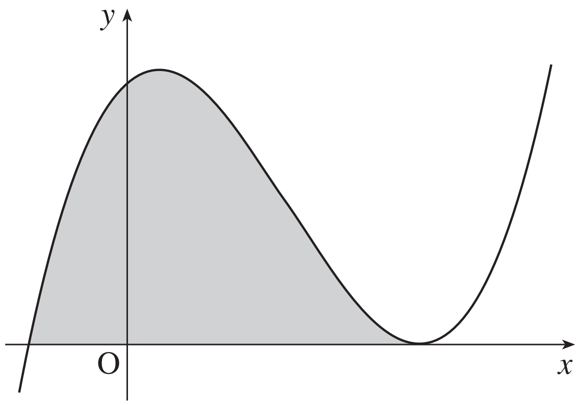


Fig. 9

Fig. 9 shows a sketch of the graph of $y = x^3 - 10x^2 + 12x + 72$.

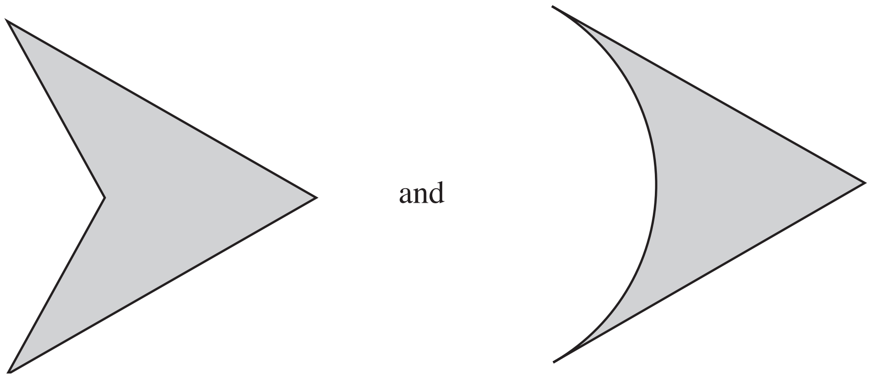
(i) Write down $\dfrac{dy}{dx}$. [2]

(ii) Find the equation of the tangent to the curve at the point on the curve where $x = 2$. [4]

(iii) Show that the curve crosses the x-axis at $x = -2$. Show also that the curve touches the x-axis at $x = 6$. [3]

(iv) Find the area of the finite region bounded by the curve and the x-axis, shown shaded in Fig. 9. [4]

10 *Arrowline Enterprises* is considering two possible logos:



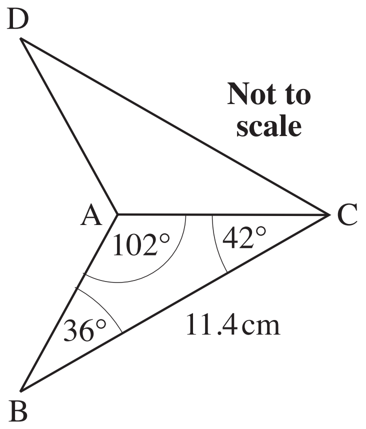


Fig. 10.1

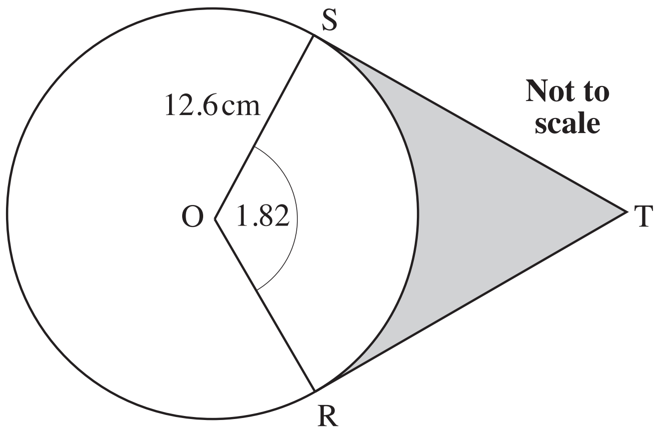


Fig. 10.2

(i) Fig. 10.1 shows the first logo ABCD. It is symmetrical about AC.

Find the length of AB and hence find the area of this logo. [4]

(ii) Fig. 10.2 shows a circle with centre O and radius 12.6 cm. ST and RT are tangents to the circle and angle SOR is 1.82 radians. The shaded region shows the second logo.

Show that ST = 16.2 cm to 3 significant figures.

Find the area and perimeter of this logo. [8]

11 There is a flowerhead at the end of each stem of an oleander plant. The next year, each flowerhead is replaced by three stems and flowerheads, as shown in Fig. 11.

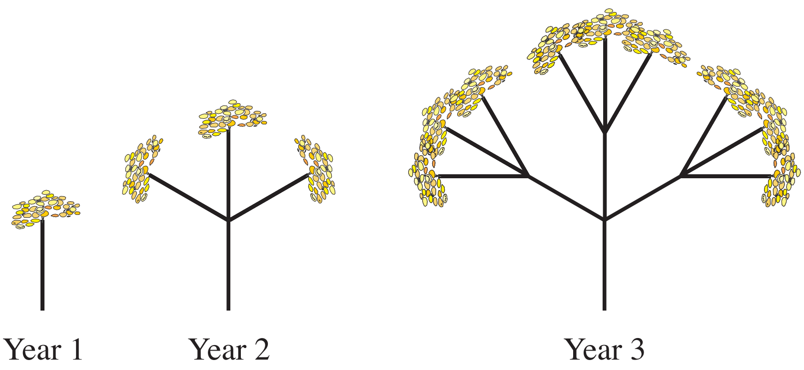


Fig. 11

(i) How many flowerheads are there in year 5? [1]

(ii) How many flowerheads are there in year n? [1]

(iii) As shown in Fig. 11, the total number of stems in year 2 is 4, (that is, 1 old one and 3 new ones). Similarly, the total number of stems in year 3 is 13, (that is, $1 + 3 + 9$).

Show that the total number of stems in year n is given by $\dfrac{3^n - 1}{2}$. [2]

(iv) Kitty's oleander has a total of 364 stems. Find

(A) its age, [2]

(B) how many flowerheads it has. [1]

(v) Abdul's oleander has over 900 flowerheads.

Show that its age, y years, satisfies the inequality $y > \dfrac{\log_{10}900}{\log_{10}3} + 1$.

Find the smallest integer value of y for which this is true. [4]

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