

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.

Section A (36 marks)

- 1 Differentiate $x + \sqrt{x^3}$. [4]
- 2 The n th 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 $0^\circ \leq x \leq 360^\circ$.
(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

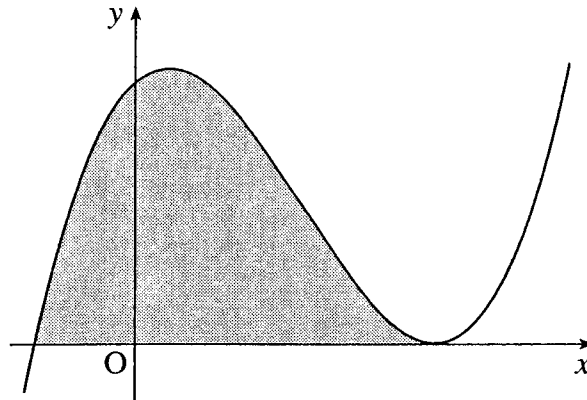
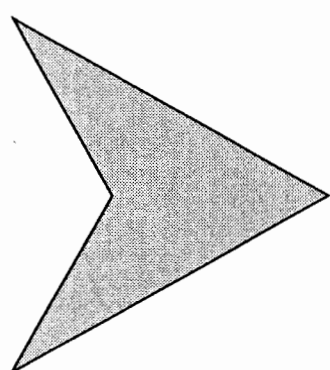


Fig. 9

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

- (i) Write down $\frac{dy}{dx}$. [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:



and

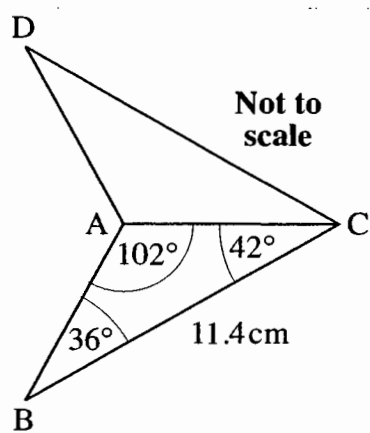
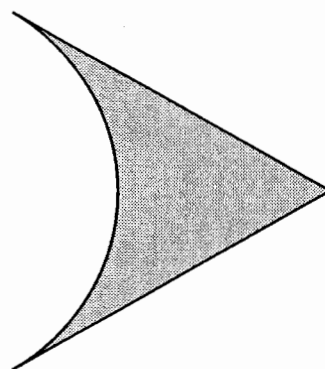


Fig. 10.1

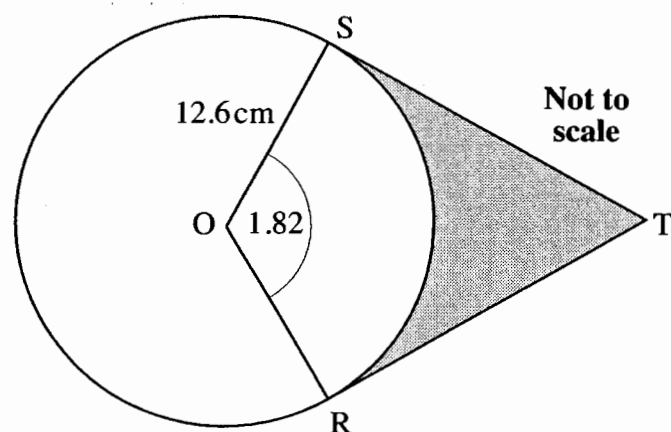


Fig. 10.2

- (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.

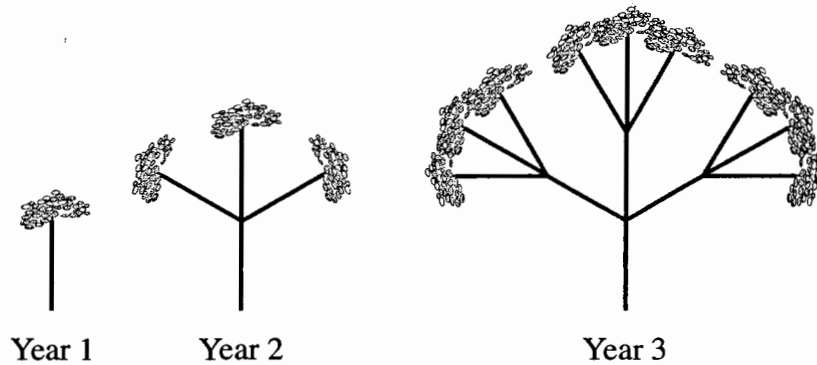


Fig. 11

- (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 $\frac{3^n - 1}{2}$. [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 $y > \frac{\log_{10} 900}{\log_{10} 3} + 1$.

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