OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS 4751

Introduction to Advanced Mathematics (C1)

Tuesday **6 JUNE 2006** Afternoon 1 hour 30 minutes

Additional materials:
8 page 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.
- There is an **insert** for use in Question **13**.
- You are **not** permitted to use a calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

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.
- The total number of marks for this paper is 72.

WARNING

You are not allowed to use a calculator in this paper

This question paper consists of 4 printed pages and an insert.

Section A (36 marks)

1 The volume of a cone is given by the formula $V = \frac{1}{3}\pi r^2 h$. Make r the subject of this formula. [3]

2 One root of the equation $x^3 + ax^2 + 7 = 0$ is $x = -2$. Find the value of a. [2]

3 A line has equation $3x + 2y = 6$. Find the equation of the line parallel to this which passes through the point $(2, 10)$. [3]

4 In each of the following cases choose one of the statements

$$P \Rightarrow Q \qquad P \Leftrightarrow Q \qquad P \Leftarrow Q$$

to describe the complete relationship between P and Q.

(i) P: $x^2 + x - 2 = 0$
Q: $x = 1$ [1]

(ii) P: $y^3 > 1$
Q: $y > 1$ [1]

5 Find the coordinates of the point of intersection of the lines $y = 3x + 1$ and $x + 3y = 6$. [3]

6 Solve the inequality $x^2 + 2x < 3$. [4]

7 **(i)** Simplify $6\sqrt{2} \times 5\sqrt{3} - \sqrt{24}$. [2]

(ii) Express $(2 - 3\sqrt{5})^2$ in the form $a + b\sqrt{5}$, where a and b are integers. [3]

8 Calculate ${}^6C_3$.

Find the coefficient of x^3 in the expansion of $(1 - 2x)^6$. [4]

9 Simplify the following.

(i) $\dfrac{16^{\frac{1}{2}}}{81^{\frac{3}{4}}}$ [2]

(ii) $\dfrac{12(a^3b^2c)^4}{4a^2c^6}$ [3]

10 Find the coordinates of the points of intersection of the circle $x^2 + y^2 = 25$ and the line $y = 3x$. Give your answers in surd form. [5]

Section B (36 marks)

11 $\mathrm{A}(9, 8)$, $\mathrm{B}(5, 0)$ and $\mathrm{C}(3, 1)$ are three points.

(i) Show that AB and BC are perpendicular. [3]

(ii) Find the equation of the circle with AC as diameter. You need not simplify your answer.

Show that B lies on this circle. [6]

(iii) BD is a diameter of the circle. Find the coordinates of D. [3]

12 You are given that $\mathrm{f}(x) = x^3 + 9x^2 + 20x + 12$.

(i) Show that $x = -2$ is a root of $\mathrm{f}(x) = 0$. [2]

(ii) Divide $\mathrm{f}(x)$ by $x + 6$. [2]

(iii) Express $\mathrm{f}(x)$ in fully factorised form. [2]

(iv) Sketch the graph of $y = \mathrm{f}(x)$. [3]

(v) Solve the equation $\mathrm{f}(x) = 12$. [3]

[Question 13 is printed overleaf.]

13 Answer the whole of this question on the insert provided.

The insert shows the graph of $y = \frac{1}{x}$, $x \neq 0$.

(i) Use the graph to find approximate roots of the equation $\frac{1}{x} = 2x + 3$, showing your method clearly. [3]

(ii) Rearrange the equation $\frac{1}{x} = 2x + 3$ to form a quadratic equation. Solve the resulting equation, leaving your answers in the form $\frac{p \pm \sqrt{q}}{r}$. [5]

(iii) Draw the graph of $y = \frac{1}{x} + 2$, $x \neq 0$, on the grid used for part (**i**). [2]

(iv) Write down the values of x which satisfy the equation $\frac{1}{x} + 2 = 2x + 3$. [2]