

## CAMBRIDGE 'A' LEVEL PROGRAMME SEMESTER ONE EXAMINATION JUNE 2007

(Jan 2007 Intake)

Friday

15June 2007

8.30 am - 10.30 am

**FURTHER MATHEMATICS** 

9231/01

PAPER 1

2 hours

Additional materials: Answer Booklet/Paper

List of formulae (MF 10)

## **READ THESE INSTRUCTIONS FIRST**

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your name and class on all the work you hand in.

Write in dark blue or black pen on both sides of the paper.

You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer all the questions.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of a calculator is expected, where appropriate.

Results obtained solely from a graphic calculator, without supporting working or reasoning, will not receive credit.

You are reminded of the need for clear presentation in your answers

The number of marks is given in brackets [] at the end of each question or part question.

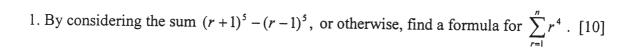
The total marks for this paper is 75.

At the end of the examination, fasten all your work securely together.

This document consists of 3 printed pages.

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[Turn over



2. Prove that 
$$4^n > 3n^2 + 5$$
 for every positive integer  $n > 2$ . [10]

3. If the equation  $7x^3 - 6x^2 + 5x + 9 = 0$  has roots  $\alpha$ ,  $\beta$ ,  $\gamma$  find the value of

$$\left(\frac{3}{\alpha\beta} - \frac{\gamma}{4}\right)^2 + \left(\frac{3}{\alpha\gamma} - \frac{\beta}{4}\right)^2 + \left(\frac{3}{\beta\gamma} - \frac{\alpha}{4}\right)^2.$$
 [10]

- 4. The line  $l_1$  passes through the points with position vectors  $4\mathbf{i} \mathbf{j} 9\mathbf{k}$  and  $9\mathbf{i} 7\mathbf{k}$ . The line  $l_2$  has equation  $\mathbf{r} = \mathbf{i} + 2\mathbf{j} 3\mathbf{k} + t(\mathbf{i} + 3\mathbf{j} \mathbf{k})$ . The line  $l_3$  is perpendicular to  $l_1$  and  $l_2$ , and passes through the point with position vector  $2\mathbf{i} + \mathbf{j} 5\mathbf{k}$ .
  - (i) Find the equation of the plane which contains  $l_2$  and  $l_3$ , giving your answer in the form ax + by + cz = d. [6]
  - (ii) Show that  $l_1$  and  $l_3$  intersect. [5]
  - (iii) Find the shortest distance between  $l_1$  and  $l_2$ . [4]

5. Find the acute angle between the planes with equations

$$x + y - z + 2 = 0$$
 and  $x - 2y + z - 9 = 0$ . [4]

The planes meet in the line l, and P is the point on l whose position vector is  $\alpha \mathbf{i} + \beta \mathbf{j} + 10 \mathbf{k}$ .

(i) Find 
$$\alpha$$
 and  $\beta$ . [4]

(ii) Find the vector equation for 
$$l$$
. [3]

The planes  $\Pi_1$  and  $\Pi_2$  are both perpendicular to l. The perpendicular distance from P to  $\Pi_1$  is  $\sqrt{14}$  and the perpendicular distance from P to  $\Pi_2$  is also  $\sqrt{14}$ . Find the equations for  $\Pi_1$  and  $\Pi_2$  in the form ax + by + cz = d.

6. The curve C has equation

$$y = \frac{2x^2 - 6x + 8}{x^2 - 5x + 4} \ .$$

(iii) Draw a sketch of **C**, stating the coordinates of all the points of intersection with the coordinate axes. [4]