



**CAMBRIDGE A LEVEL PROGRAMME
SEMESTER ONE EXAMINATION JUNE 2010**

(Jan 2010 Intake)

Wednesday

9 June 2010

1.30 am – 3.30 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.

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

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

The total marks for this paper is **50**.

This document consists of **2** printed pages.

1 Find the sum of the series $1^4 - 2^4 + 3^4 - 4^4 + \dots + (2n-1)^4 - (2n)^4$. [8]

2 Find the line of intersection of the planes $x + y + z = 0$, $ax + by + cz = 0$ and $(b+c)x + (a+c)y + (a+b)z = 0$, where a , b and c are constants. [8]

3 The sequence of numbers x_1, x_2, x_3, \dots is defined by

$$x_{n+1} = 2 + \sqrt{x_n + 7}$$

where $x_1 = 1$. Prove by induction that $5 < x_n < 6$ for all $n \geq 3$. [10]

4 The curve C has equation $y = \frac{2x-1}{(x-2)^2}$.

(i) Write down the equations of all asymptotes of C . [2]

(ii) Show that the curve has only 1 turning point and determine its nature. [5]

(iii) Sketch the curve C , marking clearly the turning point and intercepts. [5]

5 (i) If the equation $ax^3 + bx^2 + cx + d = 0$ has roots α, β, γ , find the equation having roots

$$\frac{3\alpha}{\beta + \gamma - \alpha}, \frac{3\beta}{\alpha + \gamma - \beta}, \frac{3\gamma}{\alpha + \beta - \gamma}. \quad [8]$$

(ii) If the equation $2x^4 - 8Ax^3 + 9x^2 - 5x + 3 = 0$ has roots $\alpha, \beta, \gamma, \delta$, and

$$\alpha + \beta + \gamma + \delta = \frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma} + \frac{1}{\delta} \text{ find } A. \quad [4]$$