UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Subsidiary Level

MATHEMATICS **9709/22**

Paper 2 Pure Mathematics 2 **(P2)** **May/June 2011**

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)

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READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
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 an electronic calculator is expected, where appropriate.
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 number of marks for this paper is 50.
Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.

This document consists of **3** printed pages and **1** blank page.

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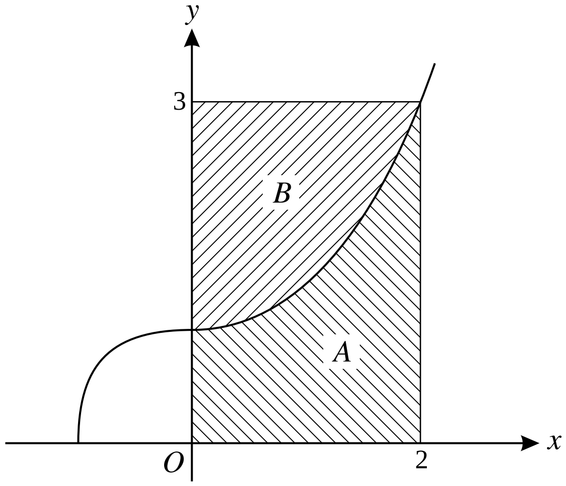
1 Use logarithms to solve the equation $3^x = 2^{x+2}$, giving your answer correct to 3 significant figures. [4]

2



The diagram shows the curve $y = \sqrt{(1 + x^3)}$. Region A is bounded by the curve and the lines $x = 0$, $x = 2$ and $y = 0$. Region B is bounded by the curve and the lines $x = 0$ and $y = 3$.

(i) Use the trapezium rule with two intervals to find an approximation to the area of region A. Give your answer correct to 2 decimal places. [3]

(ii) Deduce an approximation to the area of region B and explain why this approximation under-estimates the true area of region B. [2]

3 The sequence $x_1, x_2, x_3, \ldots$ defined by

$$x_1 = 1, \quad x_{n+1} = \tfrac{1}{2}\sqrt[3]{\left(x_n^2 + 6\right)}$$

converges to the value α.

(i) Find the value of α correct to 3 decimal places. Show your working, giving each calculated value of the sequence to 5 decimal places. [3]

(ii) Find, in the form $ax^3 + bx^2 + c = 0$, an equation of which α is a root. [2]

4 **(a)** Find the value of $\displaystyle\int_0^{\frac{2}{3}\pi} \sin\left(\tfrac{1}{2}x\right)\,dx$. [3]

(b) Find $\displaystyle\int e^{-x}(1 + e^x)\,dx$. [3]

5 A curve has equation $x^2 + 2y^2 + 5x + 6y = 10$. Find the equation of the tangent to the curve at the point $(2, -1)$. Give your answer in the form $ax + by + c = 0$, where a, b and c are integers. [6]

6 The curve $y = 4x^2 \ln x$ has one stationary point.

(i) Find the coordinates of this stationary point, giving your answers correct to 3 decimal places. [5]

(ii) Determine whether this point is a maximum or a minimum point. [2]

7 The cubic polynomial $\mathrm{p}(x)$ is defined by

$$\mathrm{p}(x) = 6x^3 + ax^2 + bx + 10,$$

where a and b are constants. It is given that $(x + 2)$ is a factor of $\mathrm{p}(x)$ and that, when $\mathrm{p}(x)$ is divided by $(x + 1)$, the remainder is 24.

(i) Find the values of a and b. [5]

(ii) When a and b have these values, factorise $\mathrm{p}(x)$ completely. [3]

8 **(i)** Prove that $\sin^2 2\theta(\operatorname{cosec}^2\theta - \sec^2\theta) \equiv 4\cos 2\theta$. [3]

(ii) Hence

(a) solve for $0^\circ \leqslant \theta \leqslant 180^\circ$ the equation $\sin^2 2\theta(\operatorname{cosec}^2\theta - \sec^2\theta) = 3$, [4]

(b) find the exact value of $\operatorname{cosec}^2 15^\circ - \sec^2 15^\circ$. [2]

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