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

MATHEMATICS **9709/21**

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.

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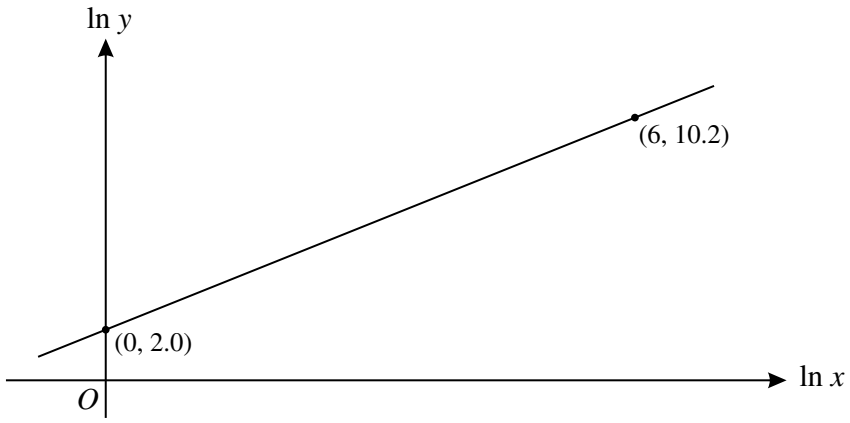
1 Solve the equation $|3x + 4| = |2x + 5|$. [3]

2 A curve has parametric equations

$$x = 3t + \sin 2t, \quad y = 4 + 2\cos 2t.$$

Find the exact gradient of the curve at the point for which $t = \frac{1}{6}\pi$. [4]

3



The variables x and y satisfy the equation $y = Kx^m$, where K and m are constants. The graph of $\ln y$ against $\ln x$ is a straight line passing through the points (0, 2.0) and (6, 10.2), as shown in the diagram. Find the values of K and m, correct to 2 decimal places. [5]

4 The polynomial $\mathrm{f}(x)$ is defined by

$$\mathrm{f}(x) = 3x^3 + ax^2 + ax + a,$$

where a is a constant.

(i) Given that $(x + 2)$ is a factor of $\mathrm{f}(x)$, find the value of a. [2]

(ii) When a has the value found in part **(i)**, find the quotient when $\mathrm{f}(x)$ is divided by $(x + 2)$. [3]

5 Find the value of $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ when $x = 4$ in each of the following cases:

(i) $y = x\ln(x - 3)$, [4]

(ii) $y = \dfrac{x - 1}{x + 1}$. [3]

6 **(a)** Find $\displaystyle\int 4\mathrm{e}^x(3 + \mathrm{e}^{2x})\,\mathrm{d}x$. [4]

(b) Show that $\displaystyle\int_{-\frac{1}{4}\pi}^{\frac{1}{4}\pi} (3 + 2\tan^2\theta)\,\mathrm{d}\theta = \tfrac{1}{2}(8 + \pi)$. [4]

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7 **(i)** By sketching a suitable pair of graphs, show that the equation

$$e^{2x} = 14 - x^2$$

has exactly two real roots. [3]

(ii) Show by calculation that the positive root lies between 1.2 and 1.3. [2]

(iii) Show that this root also satisfies the equation

$$x = \tfrac{1}{2}\ln(14 - x^2).$$ [1]

(iv) Use an iteration process based on the equation in part **(iii)**, with a suitable starting value, to find the root correct to 2 decimal places. Give the result of each step of the process to 4 decimal places. [3]

8 **(i)** Express $4\sin\theta - 6\cos\theta$ in the form $R\sin(\theta - \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. Give the exact value of R and the value of α correct to 2 decimal places. [3]

(ii) Solve the equation $4\sin\theta - 6\cos\theta = 3$ for $0^\circ \leqslant \theta \leqslant 360^\circ$. [4]

(iii) Find the greatest and least possible values of $(4\sin\theta - 6\cos\theta)^2 + 8$ as θ varies. [2]

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