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

**MATHEMATICS** **9709/22**

Paper 2 Pure Mathematics 2 **(P2)** **May/June 2012**

**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 Solve the inequality $|x + 3| < |2x + 1|$. [4]

2 (i) Given that $5^{2x} + 5^x = 12$, find the value of $5^x$. [3]

(ii) Hence, using logarithms, solve the equation $5^{2x} + 5^x = 12$, giving the value of $x$ correct to 3 significant figures. [2]

3 (i) Find the quotient when the polynomial

$$8x^3 - 4x^2 - 18x + 13$$

is divided by $4x^2 + 4x - 3$, and show that the remainder is 4. [3]

(ii) Hence, or otherwise, factorise the polynomial

$$8x^3 - 4x^2 - 18x + 9.$$ [2]

4 (i) Express $9\sin\theta - 12\cos\theta$ in the form $R\sin(\theta - \alpha)$, where $R > 0$ and $0° < \alpha < 90°$. Give the value of $\alpha$ correct to 2 decimal places. [3]

Hence

(ii) solve the equation $9\sin\theta - 12\cos\theta = 4$ for $0° \leqslant \theta \leqslant 360°$, [4]

(iii) state the largest value of $k$ for which the equation $9\sin\theta - 12\cos\theta = k$ has any solutions. [1]

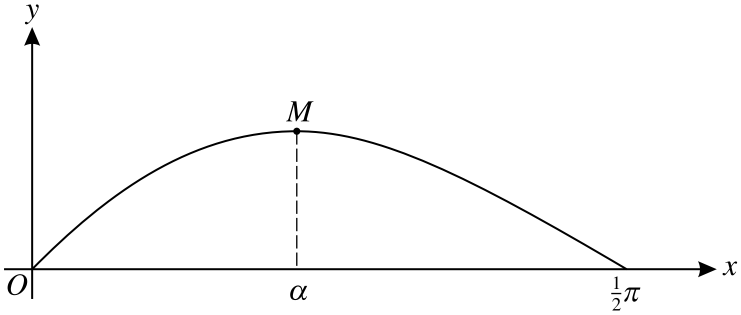
5 The parametric equations of a curve are

$$x = \ln(t + 1), \quad y = e^{2t} + 2t.$$

(i) Find an expression for $\dfrac{dy}{dx}$ in terms of $t$. [4]

(ii) Find the equation of the normal to the curve at the point for which $t = 0$. Give your answer in the form $ax + by + c = 0$, where $a$, $b$ and $c$ are integers. [4]

**6**




The diagram shows the curve $y = \dfrac{\sin 2x}{x+2}$ for $0 \leqslant x \leqslant \frac{1}{2}\pi$. The $x$-coordinate of the maximum point $M$ is denoted by $\alpha$.

**(i)** Find $\dfrac{dy}{dx}$ and show that $\alpha$ satisfies the equation $\tan 2x = 2x + 4$. [4]

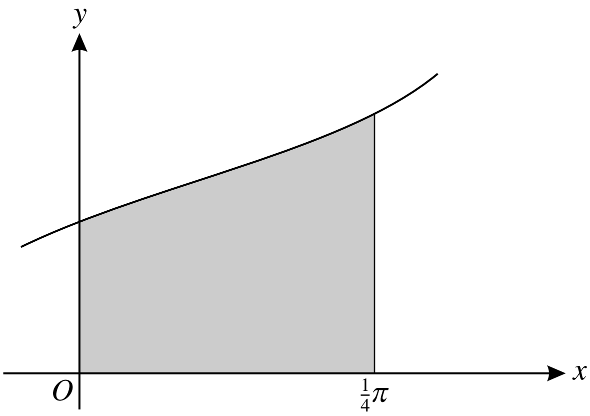
**(ii)** Show by calculation that $\alpha$ lies between 0.6 and 0.7. [2]

**(iii)** Use the iterative formula $x_{n+1} = \frac{1}{2}\tan^{-1}(2x_n + 4)$ to find the value of $\alpha$ correct to 3 decimal places. Give the result of each iteration to 5 decimal places. [3]

**7** **(i)** Show that $\tan^2 x + \cos^2 x \equiv \sec^2 x + \frac{1}{2}\cos 2x - \frac{1}{2}$ and hence find the exact value of

$$\int_0^{\frac{1}{4}\pi} (\tan^2 x + \cos^2 x)\, dx.$$ [7]

**(ii)**




The region enclosed by the curve $y = \tan x + \cos x$ and the lines $x = 0$, $x = \frac{1}{4}\pi$ and $y = 0$ is shown in the diagram. Find the exact volume of the solid produced when this region is rotated completely about the $x$-axis. [4]

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