UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

ADDITIONAL MATHEMATICS **0606/02**

Paper 2

October/November 2006

2 hours

Additional Materials: Answer Paper
Electronic calculator
Mathematical tables

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 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.
Write your answers on the separate Answer Paper provided.
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.

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 80.
At the end of the examination, fasten all your work securely together.

This document consists of **5** printed pages and **3** blank pages.
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Mathematical Formulae

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Binomial Theorem

$$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \ldots + \binom{n}{r}a^{n-r}b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$.

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1.$$

$$\sec^2 A = 1 + \tan^2 A.$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A.$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}.$$

$$a^2 = b^2 + c^2 - 2bc\cos A.$$

$$\Delta = \frac{1}{2}bc\sin A.$$

1 The functions f and g are defined for $x \in \mathbb{R}$ by

$$f : x \mapsto x^3,$$

$$g : x \mapsto x + 2.$$

Express each of the following as a composite function, using only f, g, f^{-1} and/or g^{-1} :

(i) $x \mapsto x^3 + 2,$ [1]

(ii) $x \mapsto x^3 - 2,$ [1]

(iii) $x \mapsto (x + 2)^{\frac{1}{3}}.$ [1]

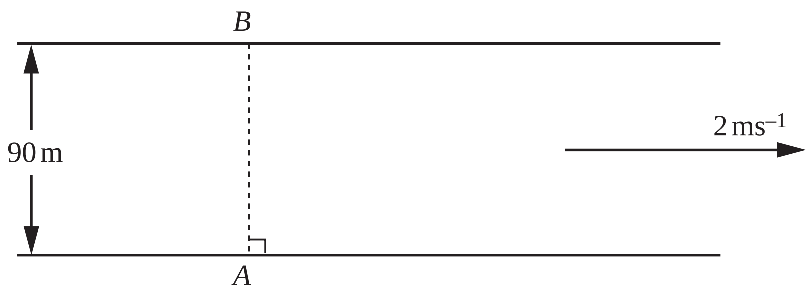
2 Prove the identity

$$\cos x \cot x + \sin x \equiv \operatorname{cosec} x .$$ [4]

3 Evaluate

$$\int_0^{\frac{\pi}{6}} \sin\left(2x + \frac{\pi}{6}\right) dx.$$ [4]

4



The diagram shows a river 90 m wide, flowing at $2\,\mathrm{ms}^{-1}$ between parallel banks. A ferry travels in a straight line from a point *A* to a point *B* directly opposite *A*. Given that the ferry takes exactly one minute to cross the river, find

(i) the speed of the ferry in still water, [3]

(ii) the angle to the bank at which the ferry must be steered. [2]

5 The straight line $2x + y = 14$ intersects the curve $2x^2 - y^2 = 2xy - 6$ at the points *A* and *B*. Show that the length of *AB* is $24\sqrt{5}$ units. [7]

6 A curve has equation $y = x^3 + ax + b$, where a and b are constants. The gradient of th point (2, 7) is 3. Find

(i) the value of a and of b,

(ii) the coordinates of the other point on the curve where the gradient is 3. [2]

7 **(a)** Find the value of m for which the line $y = mx - 3$ is a tangent to the curve $y = x + \frac{1}{x}$ and find the x-coordinate of the point at which this tangent touches the curve. [5]

(b) Find the value of c and of d for which $\{x : -5 < x < 3\}$ is the solution set of $x^2 + cx < d$. [2]

8 Given that $\mathbf{A} = \begin{pmatrix} 4 & -1 \\ -3 & 2 \end{pmatrix}$, use the inverse matrix of $\mathbf{A}$ to

(i) solve the simultaneous equations

$$y - 4x + 8 = 0,$$

$$2y - 3x + 1 = 0,$$

(ii) find the matrix $\mathbf{B}$ such that $\mathbf{BA} = \begin{pmatrix} -2 & 3 \\ 9 & -1 \end{pmatrix}$.

[8]

9 **(a)** Express $\left(2 - \sqrt{5}\right)^2 - \frac{8}{3 - \sqrt{5}}$ in the form $p + q\sqrt{5}$, where p and q are integers. [4]

(b) Given that $\frac{a^x}{b^{3-x}} \times \frac{b^y}{\left(a^{y+1}\right)^2} = ab^6$, find the value of x and of y. [4]

10 **(a)** How many different four-digit numbers can be formed from the digits 1, 2, 3, 4, 5, 6, 7, 8, 9 if no digit may be repeated? [2]

(b) In a group of 13 entertainers, 8 are singers and 5 are comedians. A concert is to be given by 5 of these entertainers. In the concert there must be at least 1 comedian and there must be more singers than comedians. Find the number of different ways that the 5 entertainers can be selected. [6]

11 The equation of a curve is $y = xe^{-\frac{x}{2}}$.

(i) Show that $\frac{dy}{dx} = \frac{1}{2}(2 - x)e^{-\frac{x}{2}}$. [3]

(ii) Find an expression for $\frac{d^2y}{dx^2}$. [2]

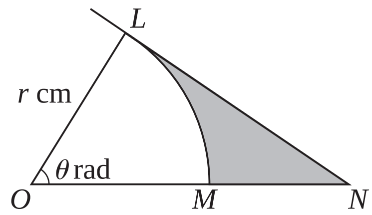
The curve has a stationary point at M.

(iii) Find the coordinates of M. [2]

(iv) Determine the nature of the stationary point at M. [2]

12 Answer only **one** of the following two alternatives.

EITHER



The diagram shows a sector of a circle, centre O and radius r cm. Angle LOM is θ radians. The tangent to the circle at L meets the line through O and M at N. The shaded region shown has perimeter P cm and area A cm^2. Obtain an expression, in terms of r and θ, for

(i) P, [4]

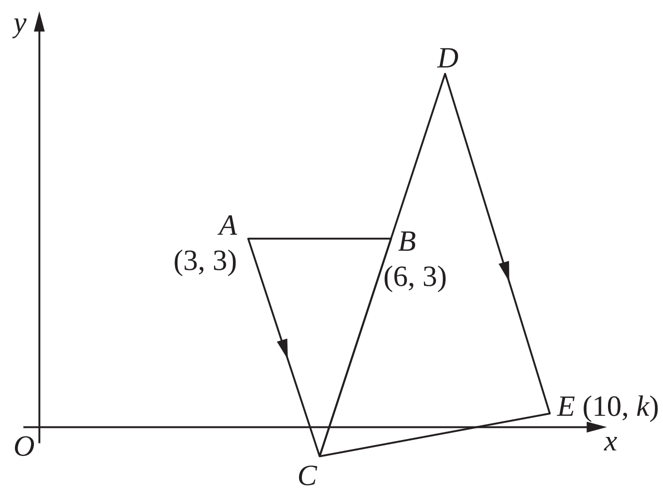
(ii) A. [3]

Given that $\theta = 1.2$ and that $P = 83$, find the value of

(iii) r, [2]

(iv) A. [1]

OR **Solutions to this question by accurate drawing will not be accepted.**



The diagram shows an isosceles triangle ABC in which A is the point (3, 3), B is the point (6, 3) and C lies below the x-axis. Given that the area of triangle ABC is 6 square units,

(i) find the coordinates of C. [3]

The line CB is extended to the point D so that B is the mid-point of CD.

(ii) Find the coordinates of D. [2]

A line is drawn from D, parallel to AC, to the point E (10, k) and C is joined to E.

(iii) Find the value of k. [3]

(iv) Prove that angle CED is **not** a right angle. [2]

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