UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

ADDITIONAL MATHEMATICS **4037/01**

Paper 1 **October/November 2009**

2 hours

Additional Materials: Answer Booklet/Paper
Mathematical tables

0430674148

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.
Write your answers on the separate Answer Booklet/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.

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 80.

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

SPA (SC) T70874/5

UNIVERSITY *of* CAMBRIDGE
International Examinations

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 Given that $f(x) = 2x^3 - 7x^2 + 7ax + 16$ is divisible by $x - a$, find

(i) the value of the constant a,

(ii) the remainder when $f(x)$ is divided by $2x + 1$. [2]

2

Place / Team	1st	2nd	3rd	4th
Harriers	6	3	1	2
Strollers	3	2	4	3
Road Runners	2	5	5	0
Olympians	1	2	2	7

The table shows the results achieved by four teams in twelve events of an athletics match. In each event, 1st place scores 5 points, 2nd place scores 3 points, 3rd place scores 2 points and 4th place scores 1 point.

(i) Write down two matrices whose product shows the total number of points scored by each team. [2]

(ii) Evaluate this product of matrices. [2]

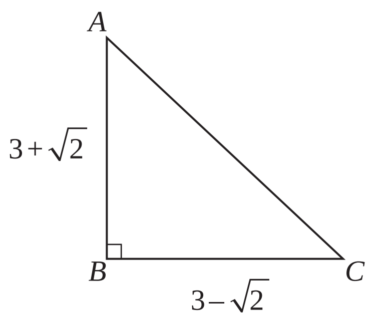
3 Find the values of k for which the equation $x^2 - 2(2k + 1)x + (k + 2) = 0$ has two equal roots. [4]

4 Solve the simultaneous equations

$$x + 3y = 13,$$

$$x^2 + 3y^2 = 43.$$ [5]

5



The diagram shows a triangle ABC, where angle B is a right angle, the length of $AB = 3 + \sqrt{2}$ and the length of $BC = 3 - \sqrt{2}$.

(i) Find the length of AC in the form $\sqrt{k}$, where k is an integer. [2]

(ii) Find $\tan A$ in the form $\frac{a + b\sqrt{2}}{c}$, where a, b and c are integers. [3]

6 Set A is such that $A = \{x : 3x^2 - 10x - 8 \leqslant 0\}$.

(i) Find the set of values of x which define the set A.

Set B is such that $B = \{x : 7 - 2x \leqslant 1\}$.

(ii) Find the set of values of x which define the set $A \cap B$. [2]

7 A committee of 8 people is to be selected from 7 teachers and 6 students. Find the number of different ways in which the committee can be selected if

(i) there are no restrictions, [2]

(ii) there are to be more teachers than students on the committee. [4]

8 The number, N, of bacteria present in an experiment, t minutes after measurements begin, is given by $N = 1000e^{-kt}$, where k is a constant.

(i) State the number of bacteria when $t = 0$. [1]

When $t = 0$, the number of bacteria is decreasing at the rate of 20 per minute. Find

(ii) the value of k, [3]

(iii) the time taken for the number of bacteria to decrease by 50%. [3]

9 Differentiate, with respect to x,

(i) $(1 - 2x)^{20}$, [2]

(ii) $x^2 \ln x$, [3]

(iii) $\dfrac{\tan(2x + 1)}{x}$. [3]

10 A curve has equation $y = 3x^3 - 2x^2 + 2x$.

(i) Show that the equation of the tangent to the curve at the point where $x = 1$ is

$$y = 7x - 4.$$ [4]

(ii) Find the coordinates of the point where this tangent meets the curve again. [5]

11 **(a)** Show that $\tan\theta + \cot\theta = \operatorname{cosec}\theta\sec\theta$.

(b) Solve the equation

(i) $\tan x = 3\sin x$ for $0° < x < 360°$,

(ii) $2\cot^2 y + 3\operatorname{cosec} y = 0$ for $0 < y < 2\pi$ radians. [5]

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

EITHER

A solid circular cylinder has radius r cm and height h cm. The volume of the cylinder is 1000 cm^3.

(i) Find an expression for h in terms of r. [2]

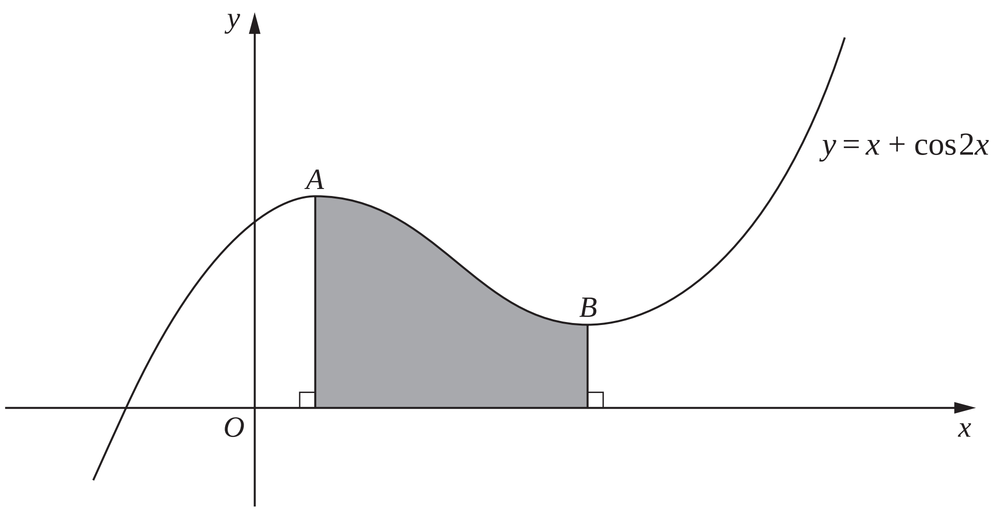
(ii) Hence show that the total surface area, A cm^2, of the cylinder is given by

$$A = 2\pi r^2 + \frac{2000}{r}.$$ [2]

(iii) Given that r varies, find, correct to 2 decimal places, the value of r when A has a stationary value. [4]

(iv) Find this stationary value of A and determine its nature. [3]

OR



The diagram shows part of the curve $y = x + \cos 2x$. The curve has a maximum point at A and a minimum point at B.

(i) Find the x-coordinate of the point A and of the point B. [6]

(ii) Find, in terms of π, the area of the shaded region. [5]

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