UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

6260308166

ADDITIONAL MATHEMATICS **4037/12**

Paper 1 **May/June 2012**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

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 pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

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 80.

For Examiner's Use	
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Total	

This document consists of **20** printed pages.

DC (CW/SW) 41601/3

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

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

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

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

Formulae for ΔABC

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

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

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

For Examiner's Use

1 **(i)** Find $\int \sqrt{7x - 5}\ \mathrm{d}x$. [3]

(ii) Hence evaluate $\int_2^3 \sqrt{7x - 5}\ \mathrm{d}x$. [2]

2 Using the substitution $u = 2^x$, find the values of x such that $2^{2x+2} = 5\,(2^x) - 1$. [5]

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3 Show that $\cot A + \dfrac{\sin A}{1 + \cos A} = \operatorname{cosec} A$. [4]

For Examiner's Use

4 Solve the simultaneous equations $5x + 3y = 2$ and $\frac{2}{x} - \frac{3}{y} = 1$. [5]

For Examiner's Use

5 Differentiate the following with respect to x.

For Examiner's Use

(i) $(2 - x^2)\ln(3x + 1)$ [3]

(ii) $\dfrac{4 - \tan 2x}{5x}$ [3]

6 You must not use a calculator in this question.

For Examiner's Use

(i) Express $\frac{8}{\sqrt{3}+1}$ in the form $a\left(\sqrt{3}-1\right)$, where a is an integer. [2]

An equilateral triangle has sides of length $\frac{8}{\sqrt{3}+1}$.

(ii) Show that the height of the triangle is $6-2\sqrt{3}$. [2]

(iii) Hence, or otherwise, find the area of the triangle in the form $p\sqrt{3} - q$, where p and q are integers. [2]

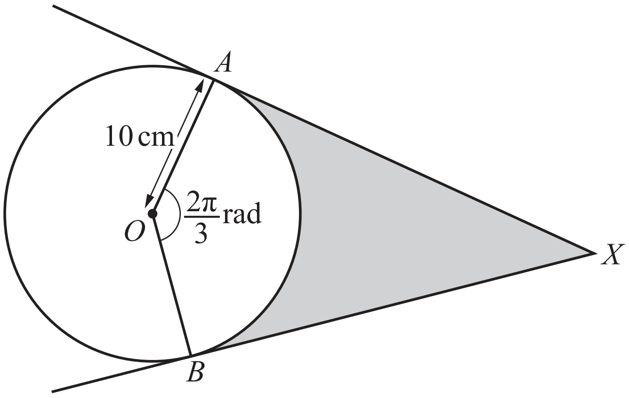
For Examiner's Use

7 **(i)** Sketch the graph of $y = |x^2 - x - 6|$, showing the coordinates of the points where the curve meets the coordinate axes. [3]

For Examiner's Use

(ii) Solve $|x^2 - x - 6| = 6$. [3]

8



The figure shows a circle, centre O, with radius 10 cm. The lines XA and XB are tangents to the circle at A and B respectively, and angle AOB is $\frac{2\pi}{3}$ radians.

(i) Find the perimeter of the shaded region. [3]

(ii) Find the area of the shaded region. [4]

9 Variables N and x are such that $N = 200 + 50e^{\frac{x}{100}}$.

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(i) Find the value of N when $x = 0$. [1]

(ii) Find the value of x when $N = 600$. [3]

(iii) Find the value of N when $\frac{dN}{dx} = 45$. [4]

For Examiner's Use

10 **(a)** It is given that $f(x) = \dfrac{1}{2+x}$ for $x \neq -2, x \in \mathbb{R}$.

For Examiner's Use

(i) Find $f''(x)$. [2]

(ii) Find $f^{-1}(x)$. [2]

(iii) Solve $f^2(x) = -1$. [3]

For Examiner's Use

(b) The functions g, h and k are defined, for $x \in \mathbb{R}$, by

$$g(x) = \frac{1}{x+5}, \quad x \neq -5,$$
$$h(x) = x^2 - 1,$$
$$k(x) = 2x + 1.$$

Express the following in terms of g, h and/or k.

(i) $\dfrac{1}{(x^2-1)+5}$ [1]

(ii) $\dfrac{2}{x+5} + 1$ [1]

11 The point P lies on the line joining $A(-1, -5)$ and $B(11, 13)$ such that $AP = \frac{1}{3}AB$.

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(i) Find the equation of the line perpendicular to AB and passing through P. [5]

The line perpendicular to AB passing through P and the line parallel to the x-axis passing through B intersect at the point Q.

(ii) Find the coordinates of the point Q. [2]

(iii) Find the area of the triangle PBQ. [2]

For Examiner's Use

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

For Examiner's Use

12 EITHER

At 12 00 hours, a ship has position vector $(54\mathbf{i} + 16\mathbf{j})$ km relative to a lighthouse, where $\mathbf{i}$ is a unit vector due East and $\mathbf{j}$ is a unit vector due North. The ship is travelling with a speed of $20\,\text{km h}^{-1}$ in the direction $3\mathbf{i} + 4\mathbf{j}$.

(i) Show that the position vector of the ship at 15 00 hours is $(90\mathbf{i} + 64\mathbf{j})$ km. [2]

(ii) Find the position vector of the ship t hours after 12 00 hours. [2]

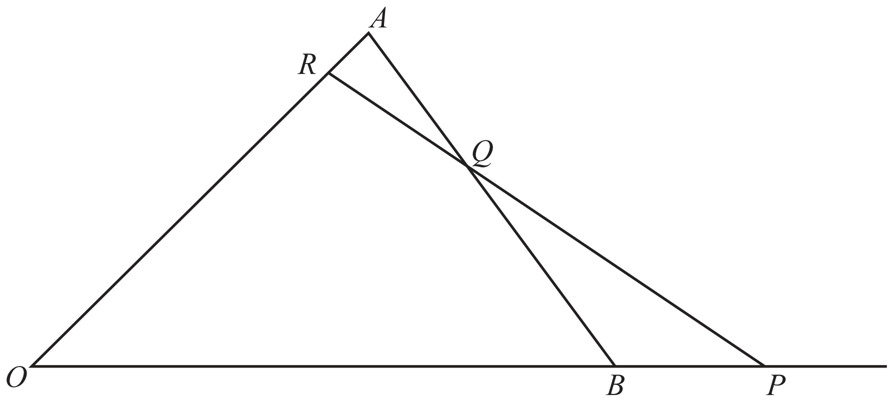
A speedboat leaves the lighthouse at 14 00 hours and travels in a straight line to intercept the ship. Given that the speedboat intercepts the ship at 16 00 hours, find

(iii) the speed of the speedboat, [3]

(iv) the velocity of the speedboat relative to the ship, [1]

(v) the angle the direction of the speedboat makes with North. [2]

OR



The position vectors of points A and B relative to an origin O are $\mathbf{a}$ and $\mathbf{b}$ respectively. The point P is such that $\overrightarrow{OP} = \frac{5}{4}\overrightarrow{OB}$. The point Q is such that $\overrightarrow{AQ} = \frac{1}{3}\overrightarrow{AB}$. The point R lies on OA such that RQP is a straight line where $\overrightarrow{OR} = \lambda\overrightarrow{OA}$ and $\overrightarrow{QR} = \mu\overrightarrow{PR}$.

(i) Express $\overrightarrow{OQ}$ and $\overrightarrow{PQ}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [2]

(ii) Express $\overrightarrow{QR}$ in terms of λ, $\mathbf{a}$ and $\mathbf{b}$. [2]

(iii) Express $\overrightarrow{QR}$ in terms of μ, $\mathbf{a}$ and $\mathbf{b}$. [3]

(iv) Hence find the value of λ and of μ. [3]

Start your answer to Question 12 here.

Indicate which question you are answering.

EITHER	
OR	

For Examiner's Use

Continue your answer here if necessary.

For Examiner's Use

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