



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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ADDITIONAL MATHEMATICS

4037/12

Paper 1

October/November 2013

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.

This document consists of **16** printed pages.



*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

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

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

2. TRIGONOMETRY*Identities*

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

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

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

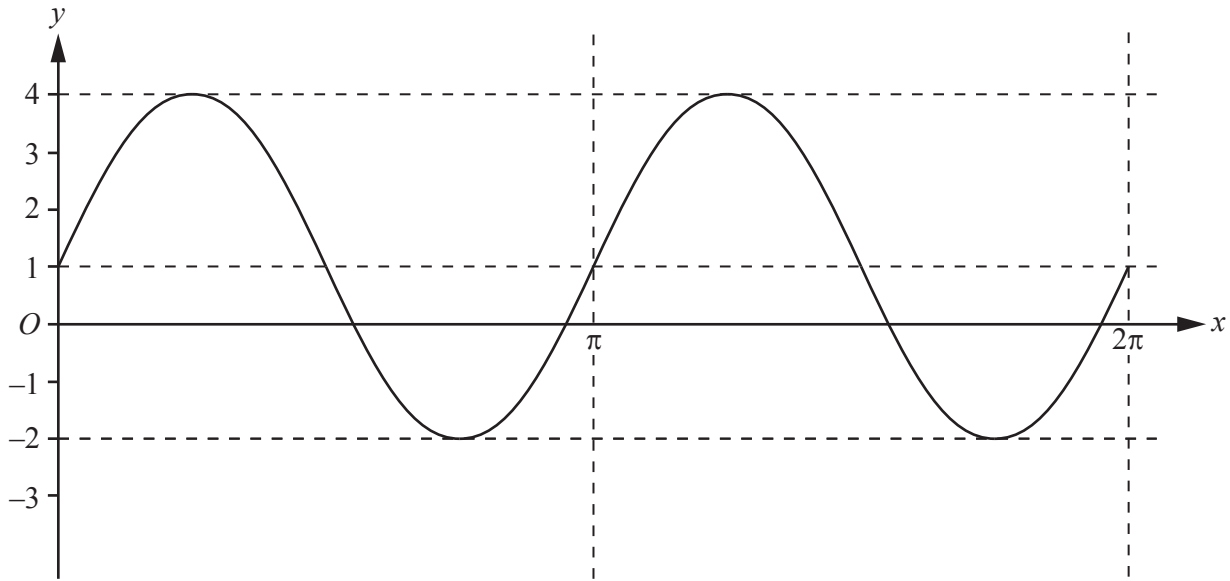
Formulae for $\triangle ABC$

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

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

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

- 1 The diagram shows the graph of $y = a \sin(bx) + c$ for $0 \leq x \leq 2\pi$, where a , b and c are positive integers.



State the value of a , of b and of c .

[3]

$a =$

$b =$

$c =$

- 2 Find the set of values of k for which the curve $y = (k + 1)x^2 - 3x + (k + 1)$ lies below the x -axis.

[4]

3 Show that $\frac{1 + \sin \theta}{\cos \theta} + \frac{\cos \theta}{1 + \sin \theta} = 2 \sec \theta$.

[4]

*For
Examiner's
Use*

4 The sets A and B are such that

$$A = \left\{x: \cos x = \frac{1}{2}, 0^\circ \leq x \leq 620^\circ\right\},$$

$$B = \left\{x: \tan x = \sqrt{3}, 0^\circ \leq x \leq 620^\circ\right\}.$$

*For
Examiner's
Use*

(i) Find $n(A)$. [1]

(ii) Find $n(B)$. [1]

(iii) Find the elements of $A \cup B$. [1]

(iv) Find the elements of $A \cap B$. [1]

5 (i) Find $\int (9 + \sin 3x) dx$.

[3]

*For
Examiner's
Use*

(ii) Hence show that $\int_{\frac{\pi}{9}}^{\pi} (9 + \sin 3x) dx = a\pi + b$, where a and b are constants to be found. [3]

- 6 The function $f(x) = ax^3 + 4x^2 + bx - 2$, where a and b are constants, is such that $2x - 1$ is a factor. Given that the remainder when $f(x)$ is divided by $x - 2$ is twice the remainder when $f(x)$ is divided by $x + 1$, find the value of a and of b . [6]

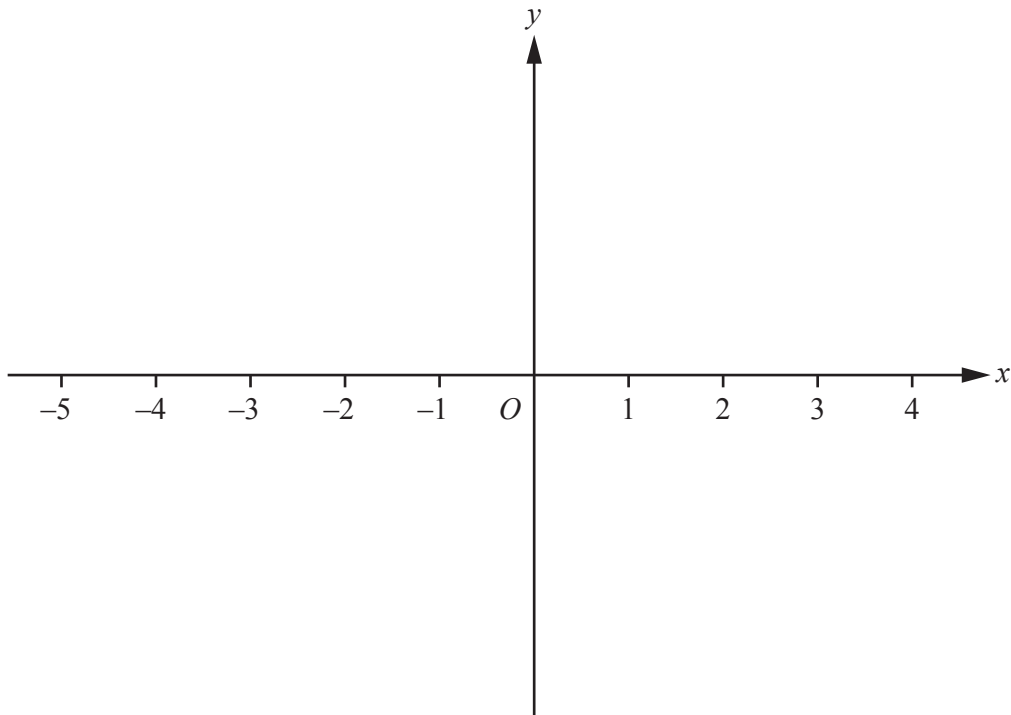
*For
Examiner's
Use*

- 7 (a) (i) Find how many different 4-digit numbers can be formed from the digits 1, 3, 5, 6, 8 and 9 if each digit may be used only once. [1]
- (ii) Find how many of these 4-digit numbers are even. [1]
- (b) A team of 6 people is to be selected from 8 men and 4 women. Find the number of different teams that can be selected if
- (i) there are no restrictions, [1]
- (ii) the team contains all 4 women, [1]
- (iii) the team contains at least 4 men. [3]

*For
Examiner's
Use*

- 8 (i) On the grid below, sketch the graph of $y = |(x - 2)(x + 3)|$ for $-5 \leq x \leq 4$, and state the coordinates of the points where the curve meets the coordinate axes.

[4]

For
Examiner's
Use

- (ii) Find the coordinates of the stationary point on the curve $y = |(x - 2)(x + 3)|$. [2]

- (iii) Given that k is a positive constant, state the set of values of k for which $|(x - 2)(x + 3)| = k$ has 2 solutions only. [1]

9 (a) Differentiate $4x^3 \ln(2x + 1)$ with respect to x .

[3]

*For
Examiner's
Use*

(b) (i) Given that $y = \frac{2x}{\sqrt{x+2}}$, show that $\frac{dy}{dx} = \frac{x+4}{(\sqrt{x+2})^3}$.

[4]

(ii) Hence find $\int \frac{5x + 20}{(\sqrt{x + 2})^3} dx$.

[2]

*For
Examiner's
Use*

(iii) Hence evaluate $\int_2^7 \frac{5x + 20}{(\sqrt{x + 2})^3} dx$.

[2]

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

The points $A(-3, 2)$ and $B(1, 4)$ are vertices of an isosceles triangle ABC , where angle $B = 90^\circ$.

*For
Examiner's
Use*

(i) Find the length of the line AB . [1]

(ii) Find the equation of the line BC . [3]

- (iii) Find the coordinates of each of the two possible positions of C .

[6]

*For
Examiner's
Use*

11 (a) It is given that the matrix $\mathbf{A} = \begin{pmatrix} 2 & 3 \\ 4 & 1 \end{pmatrix}$.

(i) Find $\mathbf{A} + 2\mathbf{I}$.

[1]

*For
Examiner's
Use*

(ii) Find \mathbf{A}^2 .

[2]

(iii) Using your answer to part (ii) find the matrix \mathbf{B} such that $\mathbf{A}^2\mathbf{B} = \mathbf{I}$.

[2]

(b) Given that the matrix $\mathbf{C} = \begin{pmatrix} x & -1 \\ x^2 - x + 1 & x - 1 \end{pmatrix}$, show that $\det \mathbf{C} \neq 0$.

[4]

*For
Examiner's
Use*

12 (a) A function f is such that $f(x) = 3x^2 - 1$ for $-10 \leq x \leq 8$.

(i) Find the range of f .

[3]

(ii) Write down a suitable domain for f for which f^{-1} exists.

[1]

Question 12(b) is printed on the next page.

(b) Functions g and h are defined by

$$g(x) = 4e^x - 2 \text{ for } x \in \mathbb{R},$$

$$h(x) = \ln 5x \text{ for } x > 0.$$

*For
Examiner's
Use*

(i) Find $g^{-1}(x)$. [2]

(ii) Solve $gh(x) = 18$. [3]

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