Cambridge Assessment International Education
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

ADDITIONAL MATHEMATICS **4037/12**

Paper 1 **October/November 2019**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, 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.

DC (CE/TP) 188779

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

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

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

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

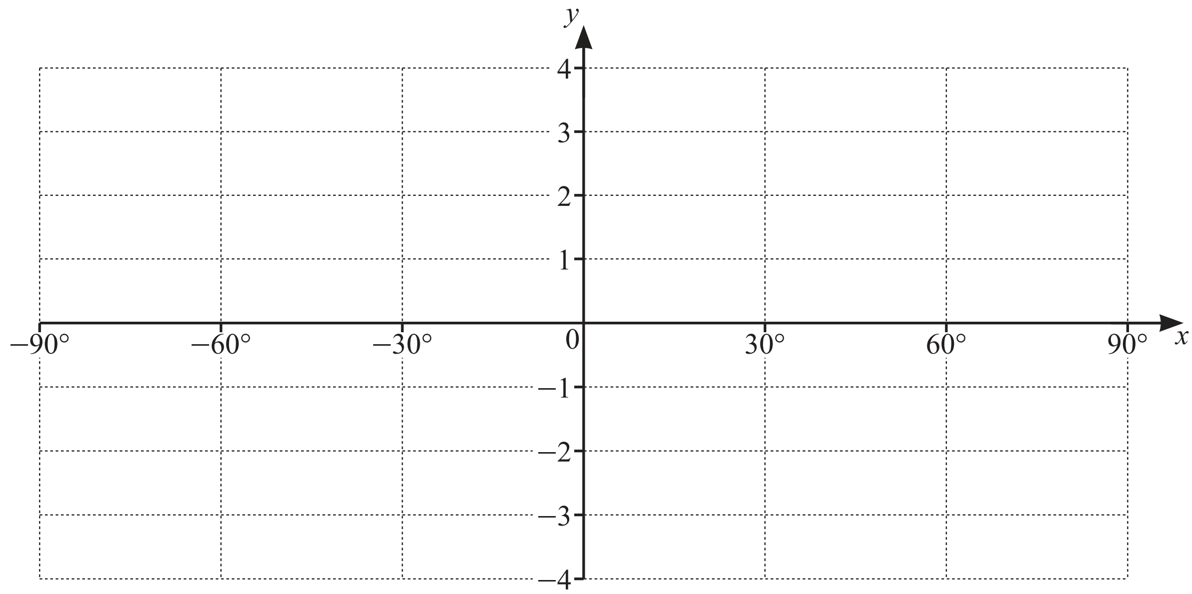
Formulae for ΔABC

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

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

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

1 **(i)** On the axes below, sketch the graph of $y = 2\cos 3x - 1$ for $-90° \leqslant x \leqslant 90°$.



[3]

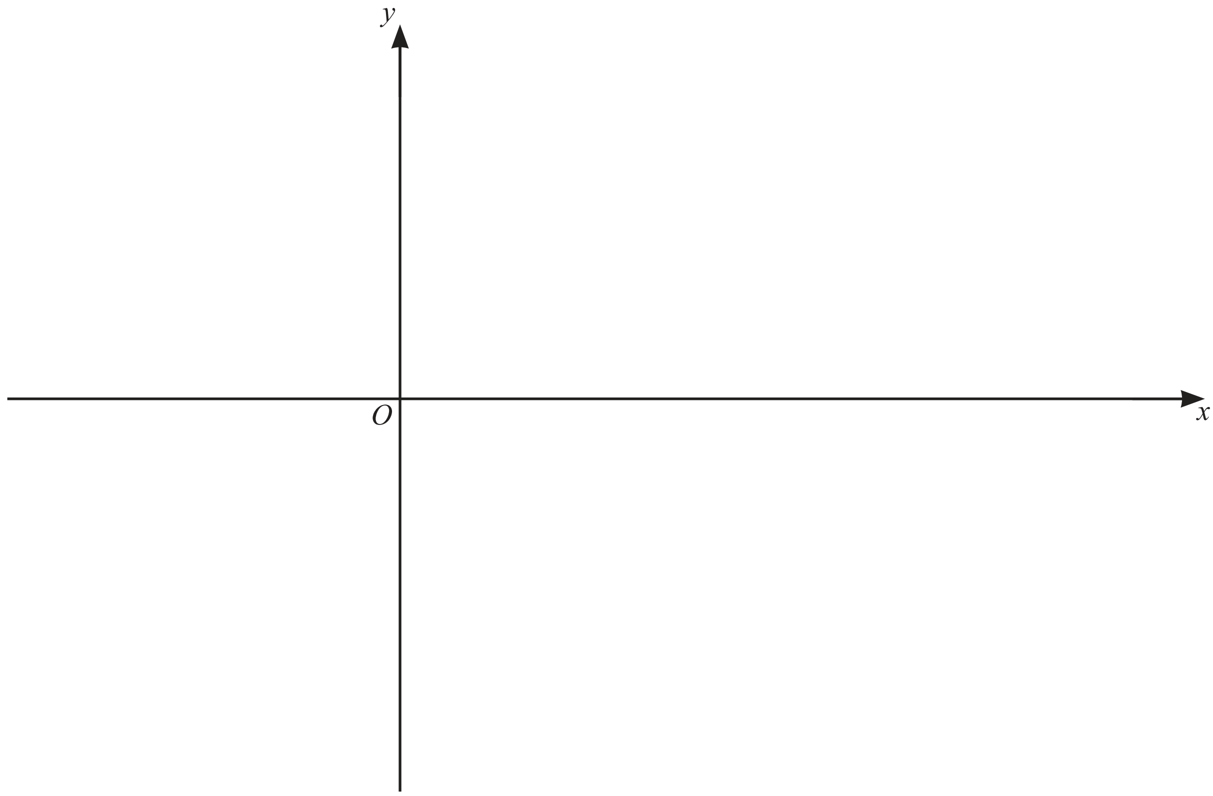
(ii) Write down the amplitude of $2\cos 3x - 1$. [1]

(iii) Write down the period of $2\cos 3x - 1$. [1]

2 When $\lg y^2$ is plotted against x, a straight line is obtained passing through the points $(5, 12)$ and $(3, 20)$. Find y in terms of x, giving your answer in the form $y = 10^{ax+b}$, where a and b are integers. [5]

3 The first three terms in the expansion of $\left(1-\frac{x}{7}\right)^{14}(1-2x)^4$ can be written as $1+ax+bx^2$. Find the value of each of the constants a and b. [6]

4 **(i)** On the axes below, sketch the graph of $y = \left|2x^2 - 9x - 5\right|$ showing the coordinates of the points where the graph meets the axes. [4]



(ii) Find the values of k for which $\left|2x^2 - 9x - 5\right| = k$ has exactly 2 solutions. [3]

5 **(a)** It is given that $\mathrm{f} : x \mapsto \sqrt{x}$ for $x \geqslant 0$,
$\mathrm{g} : x \mapsto x+5$ for $x \geqslant 0$.

Identify each of the following functions with one of f^{-1}, g^{-1}, fg, gf, f^2, g^2.

(i) $\sqrt{x+5}$ [1]

(ii) $x-5$ [1]

(iii) x^2 [1]

(iv) $x+10$ [1]

(b) It is given that $\mathrm{h}(x) = a + \dfrac{b}{x^2}$ where a and b are constants.

(i) Why is $-2 \leqslant x \leqslant 2$ not a suitable domain for $\mathrm{h}(x)$? [1]

(ii) Given that $\mathrm{h}(1) = 4$ and $\mathrm{h}'(1) = 16$, find the value of a and of b. [2]

6 **(a)** Write $\dfrac{\sqrt{p}\left(\dfrac{qp}{r}\right)^2}{p^{-1}\sqrt[3]{qr}}$ in the form $p^a q^b r^c$, where a, b and c are constants. [3]

(b) Solve $\log_7 x + 2\log_x 7 = 3$. [4]

7 It is given that $y = (1 + e^{x^2})(x + 5)$.

(i) Find $\frac{dy}{dx}$. [3]

(ii) Find the approximate change in y as x increases from 0.5 to $0.5 + p$, where p is small. [2]

(iii) Given that y is increasing at a rate of 2 units per second when $x = 0.5$, find the corresponding rate of change in x. [2]

8 **(a)** Five teams took part in a competition in which each team played each of the other 4 teams. The following table represents the results after all the matches had been played.

Team	Won	Drawn	Lost
A	2	1	1
B	1	3	0
C	1	1	2
D	0	1	3
E	3	0	1

Points in the competition were awarded to the teams as follows

4 for each match won, 2 for each match drawn, 0 for each match lost.

(i) Write down two matrices whose product under matrix multiplication will give the total number of points awarded to each team. [2]

(ii) Evaluate the matrix product from **part (i)** and hence state which team was awarded the most points. [2]

(b) It is given that $\mathbf{A} = \begin{pmatrix} 1 & -1 \\ 2 & 4 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 5 & 0 \\ 1 & -2 \end{pmatrix}$.

(i) Find $\mathbf{A}^{-1}$. [2]

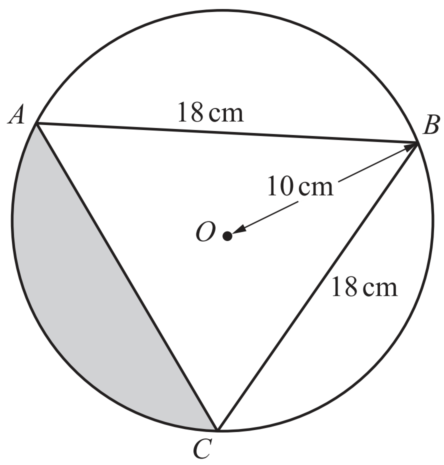
(ii) Hence find the matrix **C** such that **AC** = **B**. [3]

9 A solid circular cylinder has a base radius of r cm and a height of h cm. The cylinder has a volume of $1200\pi\ \text{cm}^3$ and a total surface area of $S\ \text{cm}^2$.

(i) Show that $S = 2\pi r^2 + \dfrac{2400\pi}{r}$. [3]

(ii) Given that h and r can vary, find the stationary value of S and determine its nature. [5]

10



The diagram shows a circle centre O, radius 10 cm. The points A, B and C lie on the circumference of the circle such that $AB = BC = 18$ cm.

(i) Show that angle $AOB = 2.24$ radians correct to 2 decimal places. [3]

(ii) Find the perimeter of the shaded region. [5]

Continuation of working space for Question 10(ii).

(iii) Find the area of the shaded region. [3]

Question 11 is printed on the next page.

11 A curve is such that $\frac{d^2y}{dx^2} = 2(3x-1)^{-\frac{2}{3}}$. Given that the curve has a gradient of 6 at the point (3, 11), find the equation of the curve. [8]