Cambridge O Level

CANDIDATE NAME										
CENTRE NUMBER						CANDIDATE NUMBER				

5991572738

ADDITIONAL MATHEMATICS **4037/13**

Paper 1 **October/November 2021**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

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 $\binom{n}{r} = \dfrac{n!}{(n-r)!r!}$

Arithmetic series $\quad u_n = a + (n-1)d$

$$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series $\quad u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

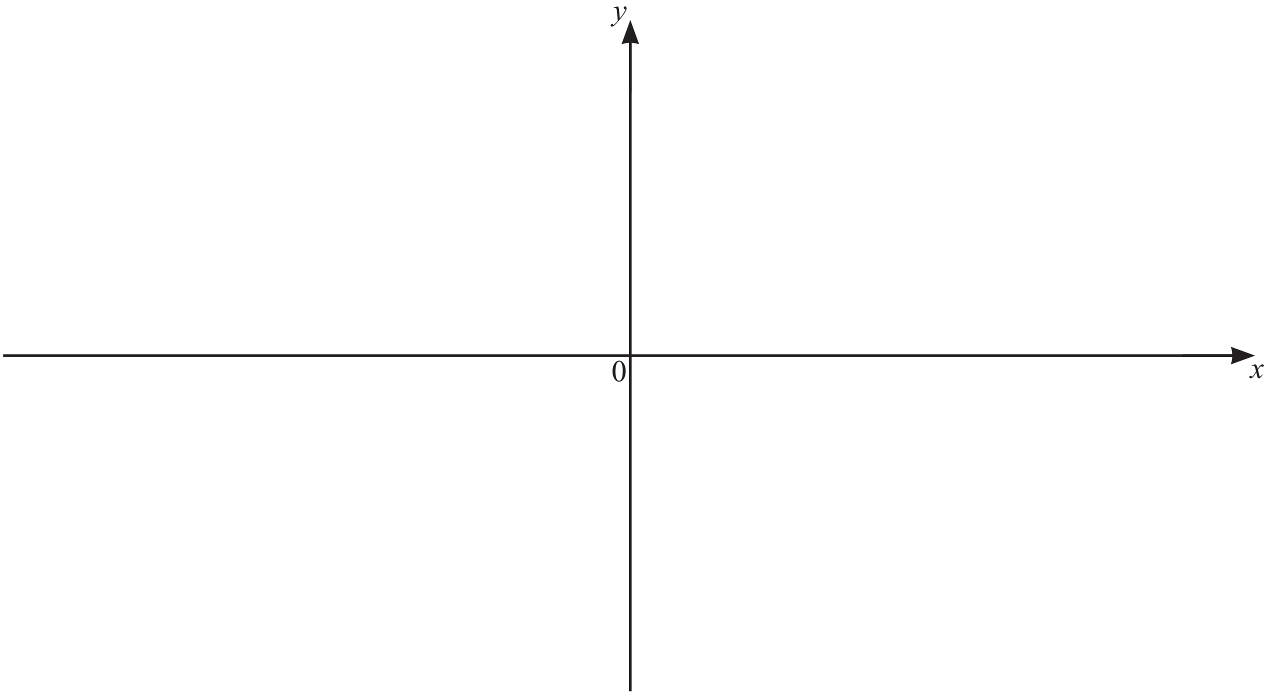
Formulae for ΔABC

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

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

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

1 On the axes below, sketch the graph of $y = -\frac{1}{4}(2x+1)(x-3)(x+4)$ stating the intercepts with the coordinate axes. [3]



2 A particle moves in a straight line such that its velocity, $v\,\text{ms}^{-1}$, at time t seconds after passing through a fixed point O, is given by $v = e^{3t} - 25$. Find the speed of the particle when $t = 1$. [2]

3 Solve the equation $\cot^2\left(2x - \frac{\pi}{3}\right) = \frac{1}{3}$, where x is in radians and $0 \leqslant x < \pi$. [5]

4 **(a)** Find the first three terms, in ascending powers of x^2, in the expansion of $\left(\frac{1}{2}-\frac{2}{3}x^2\right)^8$. Write your coefficients as rational numbers. [3]

(b) Find the coefficient of x^2 in the expansion of $\left(\frac{1}{2}-\frac{2}{3}x^2\right)^8\left(2x+\frac{1}{x}\right)^2$. [3]

5 A geometric progression is such that its sum to 4 terms is 17 times its sum to 2 terms. It is given that the common ratio of this geometric progression is positive and not equal to 1.

(a) Find the common ratio of this geometric progression. [3]

(b) Given that the 6th term of the geometric progression is 64, find the first term. [2]

(c) Explain why this geometric progression does not have a sum to infinity. [1]

6 **(a)** A 5-digit number is made using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. No digit may be used more than once in any 5-digit number. Find how many such 5-digit numbers are odd and greater than 70 000. [3]

(b) The number of combinations of n objects taken 3 at a time is 2 times the number of combinations of n objects taken 2 at a time. Find the value of n. [4]

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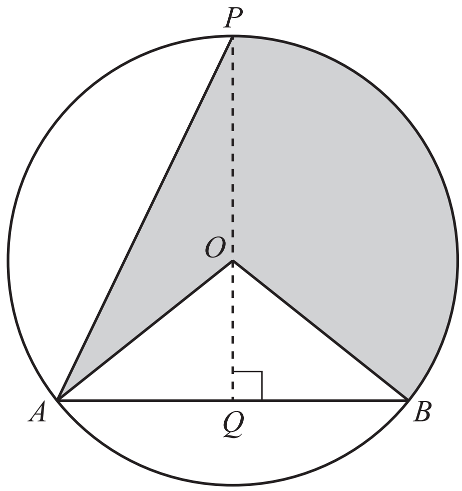

The diagram shows a circle, centre O, radius 10 cm. The points A, B and P lie on the circumference of the circle. The chord AB is of length 14 cm. The point Q lies on AB and the line POQ is perpendicular to AB.

(a) Show that angle POA is 2.366 radians, correct to 3 decimal places. [2]

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

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

8 The curves $y = x^2 + x - 1$ and $2y = x^2 + 6x - 2$ intersect at the points A and B.

(a) Show that the mid-point of the line AB is (2, 9). [5]

The line l is the perpendicular bisector of AB.

(b) Show that the point C (12, 7) lies on the line l. [3]

(c) The point D also lies on l, such that the distance of D from AB is two times the distance of C from AB. Find the coordinates of the two possible positions of D. [4]

9 When e^{2y} is plotted against x^2, a straight line graph passing through the points (4, 7.96) and (2, 3.76) is obtained.

(a) Find y in terms of x. [5]

(b) Find y when $x = 1$. [2]

(c) Using your equation from **part (a)**, find the positive values of x for which the straight line exists. [3]

10 A curve with equation $y = \mathrm{f}(x)$ is such that $\dfrac{\mathrm{d}^2y}{\mathrm{d}x^2} = (2x+3)^{-\frac{1}{2}} + 5$ for $x > 0$. The curve has gradient 10 at the point $\left(3, \dfrac{19}{2}\right)$.

(a) Show that, when $x = 11$, $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 52$. [5]

(b) Find $\mathrm{f}(x)$. [4]

11 A curve has equation $y = \dfrac{\left(x^2-5\right)^{\frac{1}{3}}}{x+1}$ for $x > -1$.

(a) Show that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{Ax^2+Bx+C}{3\left(x+1\right)^2\left(x^2-5\right)^{\frac{2}{3}}}$ where A, B and C are integers. [6]

(b) Find the x-coordinate of the stationary point on the curve. [2]

(c) Explain how you could determine the nature of this stationary point. [2]
[You are not required to find the nature of this stationary point.]

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