Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 7 4 1 9 3 6 9 3 1 6 *

ADDITIONAL MATHEMATICS **4037/23**

Paper 2 **October/November 2022**

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.

DC (LO) 319572

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

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

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

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

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

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

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 Solve the following inequality.

$$(2x+3)(x-4) > (3x+4)(x-1)$$ [5]

2 The tangent to the curve $y = ax^2 - 5x + 2$ at the point where $x = 2$ has equation $y = 7x + b$. Find the values of the constants a and b. [5]

3 Solve the equation $\lg(2x - 1) + \lg(x + 2) = 2 - \lg 4$. [5]

4 The line $y = kx + 6$ intersects the curve $y = x^3 - 4x^2 + 3kx + 2$ at the point where $x = 2$.

(a) Find the value of k. [2]

(b) Show that, for this value of k, the line cuts the curve only once. [4]

5 **(a)** Show that $\dfrac{\cos x}{1-\sin x}+\dfrac{1-\sin x}{\cos x}=2\sec x$. [4]

(b) Hence solve the equation $\dfrac{\cos\dfrac{\theta}{2}}{1-\sin\dfrac{\theta}{2}}+\dfrac{1-\sin\dfrac{\theta}{2}}{\cos\dfrac{\theta}{2}}=8\cos^2\dfrac{\theta}{2}$ for $-360° < \theta < 360°$. [4]

6 The first four terms in ascending powers of x in the expansion $(3+ax)^4$ can be written as $81+bx+cx^2+\frac{3}{2}x^3$. Find the values of the constants a, b and c. [6]

7 Given that ${}^nC_4 = 13 \times {}^nC_2$, find the value of ${}^nC_8$. [5]

8 **(a)** Particle A starts from the point with position vector $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$ and travels with speed $26\,\text{ms}^{-1}$ in the direction of the vector $\begin{pmatrix} 12 \\ 5 \end{pmatrix}$. Find the position vector of A after t seconds. [3]

(b) At the same time, particle B starts from the point with position vector $\begin{pmatrix} 67 \\ -18 \end{pmatrix}$. It travels with speed $20\,\text{ms}^{-1}$ at an angle of α above the positive x-axis, where $\tan\alpha = \frac{3}{4}$. Find the position vector of B after t seconds. [4]

(c) Hence find the time at which *A* and *B* meet, and the position where this occurs. [3]

9 The equation of a curve is $y = kxe^{-2x}$, where k is a constant.

(a) Find $\frac{dy}{dx}$. [2]

(b) Find the coordinates of the stationary point on the curve $y = 10xe^{-2x}$. [3]

(c) Use your answer to **part (a)** to find $\int 4x\mathrm{e}^{-2x}\,\mathrm{d}x$. [3]

(d) Find the exact value of $\int_0^1 4x\mathrm{e}^{-2x}\,\mathrm{d}x$. [2]

10 **(a)** The third term of an arithmetic progression is 10 and the sum of the first 8 terms is 116. Find the first term and common difference. [5]

(b) Find the sum of nineteen terms of the progression, starting with the twelfth term. [4]

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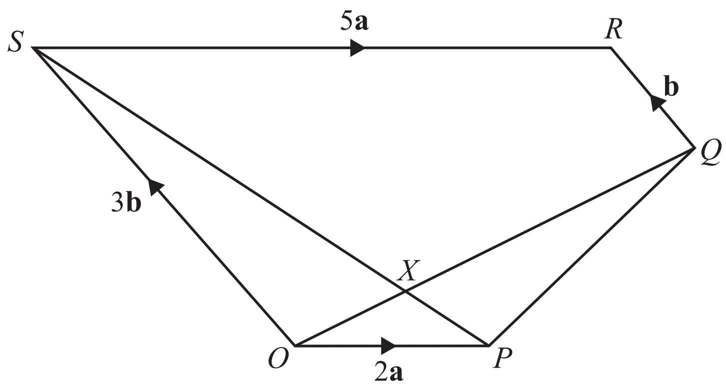

In the vector diagram, $\overrightarrow{OP} = 2\mathbf{a}$, $\overrightarrow{SR} = 5\mathbf{a}$, $\overrightarrow{OS} = 3\mathbf{b}$ and $\overrightarrow{QR} = \mathbf{b}$.

(a) Given that $\overrightarrow{PX} = \lambda\overrightarrow{PS}$, write $\overrightarrow{OX}$ in terms of **a**, **b** and λ. [3]

(b) Given that $\overrightarrow{OX} = \mu\overrightarrow{OQ}$, write $\overrightarrow{OX}$ in terms of **a**, **b** and μ. [2]

(c) Find the values of λ and μ. [4]

(d) Write down the value of $\frac{OX}{OQ}$. [1]

(e) Find the value of $\frac{PX}{XS}$. [1]

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