Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1846310240

ADDITIONAL MATHEMATICS **0606/21**

Paper 2 **May/June 2024**

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.

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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

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

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

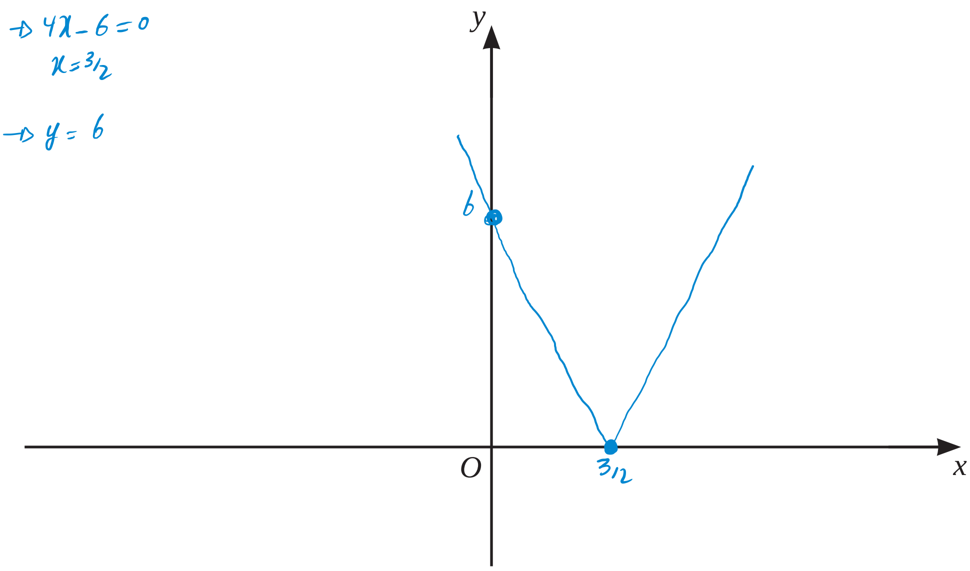
$$\Delta = \frac{1}{2}bc\sin A$$

1 **(a)** On the axes, sketch the graph of $y = |4x - 6|$, showing the points where the graph meets the axes. [2]

$y = 0 \rightarrow 4x - 6 = 0$

$x = 3/2$

$x = 0 \rightarrow y = 6$



(b) Solve the equation $|4x - 6| = |2x|$. [3]

$4x - 6 = 2x \rightarrow 2x = 6 \rightarrow x = 3$

$4x - 6 = -2x \rightarrow 6x = 6 \rightarrow x = 1$

2 **(a)** Write $3+4x-2x^2$ in the form $a+b(x+c)^2$, where a, b and c are integers. [3]

$3+4x-2x^2 = 3-2(x^2-2x)$

$= 3-2\left[\underbrace{x^2-2x+1}_{(x-1)^2}-1\right] = 3-2(x-1)^2+2 = 5-2(x-1)^2$ #

(b) Hence write down the range of the function $f(x) = 3+4x-2x^2$, where $x \in \mathbb{R}$. [1]

$f(x) = 5-2(x-1)^2$

$(x-1)^2 \geq 0 \rightarrow -2(x-1)^2 \leq 0$

$\rightarrow 5-2(x-1)^2 \leq 5$

$\rightarrow$ Range: $y \leq 5$ #

3 Use algebra to show that the equation $5x(x-3) = 5x-26$ has no real solutions. [3]

$5x^2-15x = 5x-26$

$5x^2-20x+26 = 0$

$b^2-4ac = (-20)^2-4(5)(26) < 0$

$\rightarrow$ no real roots #

4 **DO NOT USE A CALCULATOR IN THIS QUESTION.**

(a) Find the exact distance between the two points where the curve $9(x-1)^2 + 4(y-3)^2 = 36$ cuts the y-axis. [4]

$x = 0 \rightarrow 9 + 4(y-3)^2 = 36 \rightarrow 4(y-3)^2 = 27 \rightarrow (y-3)^2 = \frac{27}{4} \rightarrow y - 3 = \pm\sqrt{27/4}$

$\rightarrow y = 3 \pm \sqrt{27/4}$

$\left(3 + \sqrt{\frac{27}{4}}\right) - \left(3 - \sqrt{\frac{27}{4}}\right) = 2 \times \sqrt{\frac{27}{4}} = 2 \times \frac{\sqrt{27}}{2} = \sqrt{27} = 3\sqrt{3}$ ✗

(b) Find the coordinates of the points where the curve with equation $2x^2 + 83xy = x^3y - 20x$ intersects the curve with equation $y = \frac{1}{x}$. Give each of your answers in the form $a + b\sqrt{c}$, where a and b are rational and c is the smallest integer possible. [6]

$2x^2 + 83x\left(\frac{1}{x}\right) = x^3\left(\frac{1}{x}\right) - 20x \rightarrow 2x^2 + 83 = x^2 - 20x$

$\rightarrow x^2 + 20x + 83 = 0$

$b^2 - 4ac = (20)^2 - 4(1)(83) = 400 - 332 = 68$

$x = \frac{-20 \pm \sqrt{68}}{2} = \frac{-20 \pm 2\sqrt{17}}{2} = -10 \pm \sqrt{17}$

$x_1 = -10 + \sqrt{17} \rightarrow y_1 = \frac{1}{-10 + \sqrt{17}} \times \frac{-10 - \sqrt{17}}{-10 - \sqrt{17}} = \frac{-10 - \sqrt{17}}{100 - 17} = \frac{-10 - \sqrt{17}}{83} = \frac{-10}{83} - \frac{\sqrt{17}}{83}$

$x_2 = -10 - \sqrt{17} \rightarrow y_2 = \frac{1}{-10 - \sqrt{17}} \times \frac{-10 + \sqrt{17}}{-10 + \sqrt{17}} = \frac{-10 + \sqrt{17}}{100 - 17} = \frac{-10}{83} + \frac{\sqrt{17}}{83}$