Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1856076465

ADDITIONAL MATHEMATICS **0606/23**

Paper 2 **May/June 2023**

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

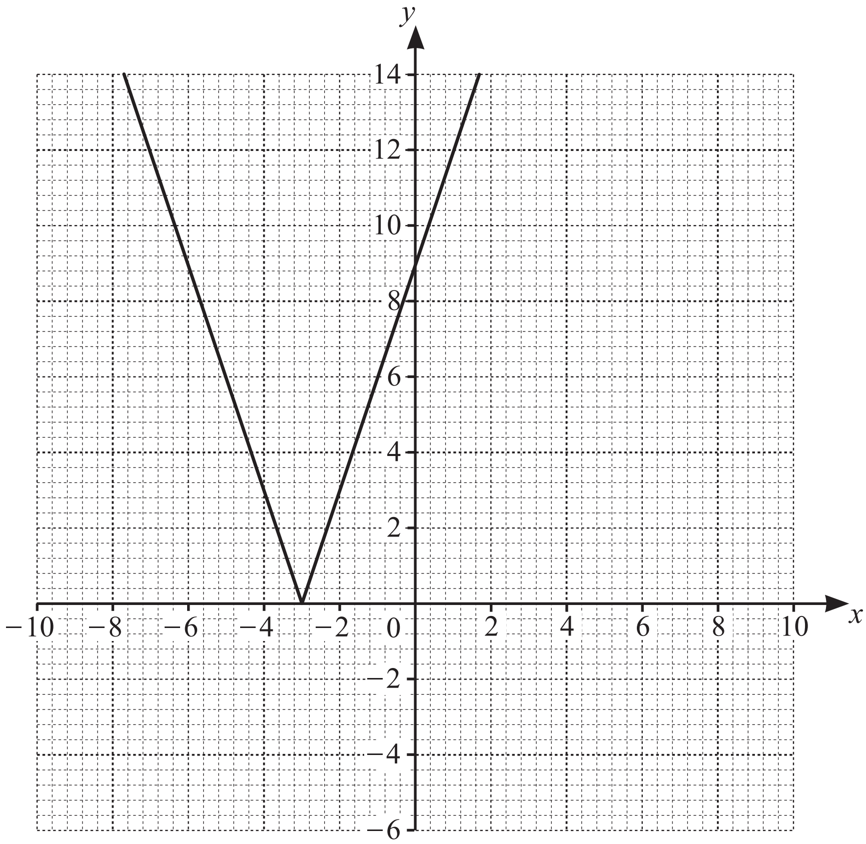
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

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

1 **(a)** Solve the equation $\frac{|4x-5|}{7} = 1$. [2]

(b)



The diagram shows the graph of $y = |3x+9|$.

By drawing a suitable graph on the same diagram, solve the inequality $|3x+9| \leqslant |x-5|$. [3]

2 DO NOT USE A CALCULATOR IN THIS QUESTION.

Write the expression $\dfrac{\sqrt{98x^{12}}}{3+\sqrt{2}}$ in the form $\left(a\sqrt{b}+c\right)x^{d}$ where a, b, c and d are integers. [4]

3 **(a)** Differentiate $\ln(x^3+3x^2)$ with respect to x, simplifying your answer. [2]

(b) Hence find $\displaystyle\int \frac{x+2}{x(x+3)}\,\mathrm{d}x$. [2]

4 The polynomial p is such that $p(x) = 2x^3 + 11x^2 + 22x + 40$.

(a) Show that $x = -4$ is a root of the equation $p(x) = 0$. [1]

(b) Factorise $p(x)$ and hence show that $p(x) = 0$ has no other real roots. [4]

5 **(a)** **(i)** A gardening group has 20 members. A committee of 6 members is to be selected. Anwar and Bo belong to the gardening group and at most one of them can be on the committee. How many different committees are possible? [2]

(ii) The gate for the garden has a lock with a 6-character passcode. The passcode is to be made from

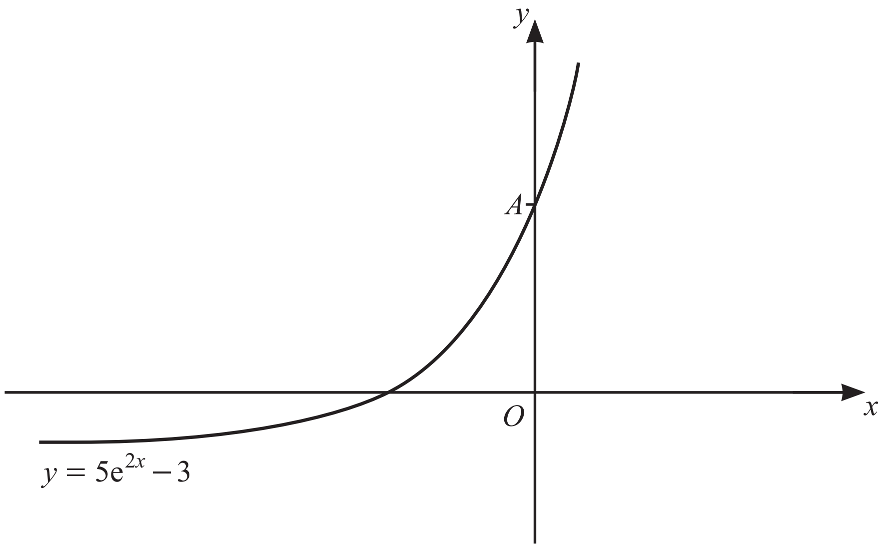
Letters	G	A	R	D	E	N				
Numbers	0	1	2	3	4	5	6	7	8	9.

No character may be used more than once in any passcode.
Find the number of possible passcodes that have 4 letters followed by 2 numbers. [2]

(b) **(i)** Given that $n \geqslant 4$, show that $(n-3) \times {}^nC_3 = 4 \times {}^nC_4$. [2]

(ii) Given that ${}^nC_3 = 5n$, where $n \geqslant 3$, show that n satisfies the equation $n^2 - 3n - 28 = 0$. Hence find the value of n. [4]

6



The diagram shows the curve $y = 5e^{2x} - 3$. The curve meets the y-axis at the point A. The tangent to the curve at A meets the x-axis at the point B. Find the length of AB. [6]

7 Variables x and y are such that $y = \frac{4x^3 + 2\sin 8x}{1-x}$. Use differentiation to find the approximate change in y as x increases from 0.1 to $0.1 + h$, where h is small. [6]

8 **(a)** The functions f and g are defined by

$$f(x) = \sec x \qquad \text{for } \frac{\pi}{2} < x < \frac{3\pi}{2}$$

$$g(x) = 3(x^2 - 1) \qquad \text{for all real } x.$$

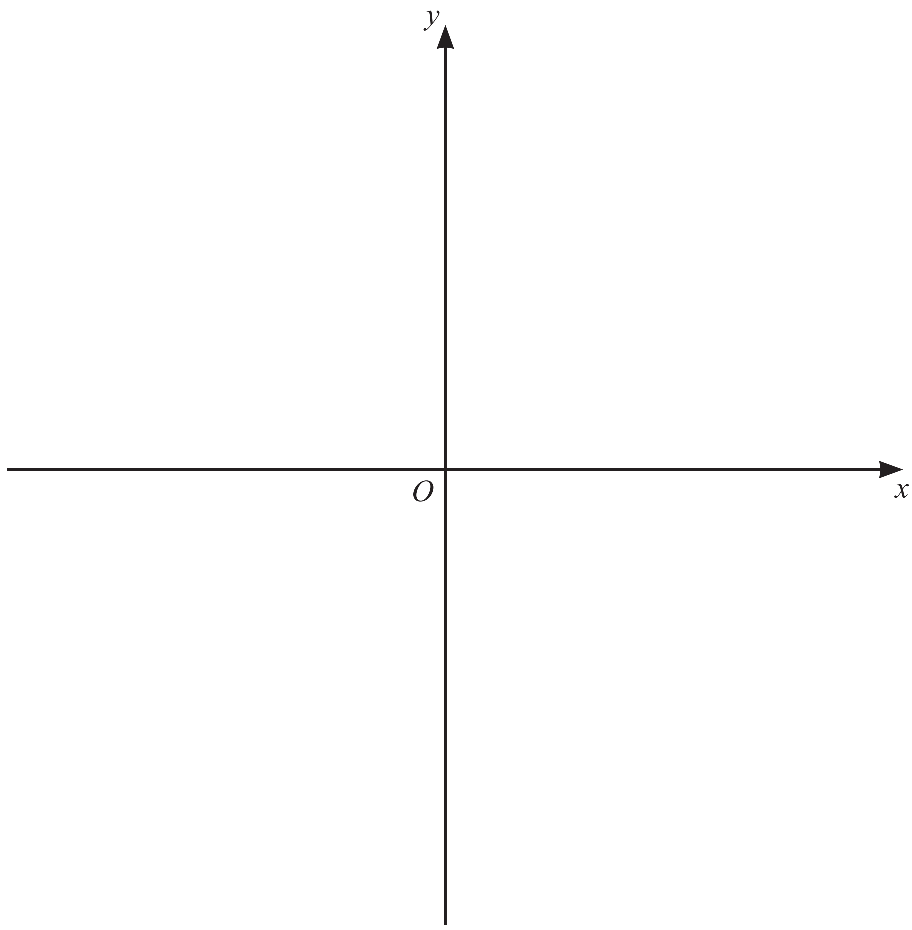
(i) Find the range of f. [1]

(ii) Solve the equation $f^{-1}(x) = \frac{2\pi}{3}$. [3]

(iii) Given that gf exists, state the domain of gf. [1]

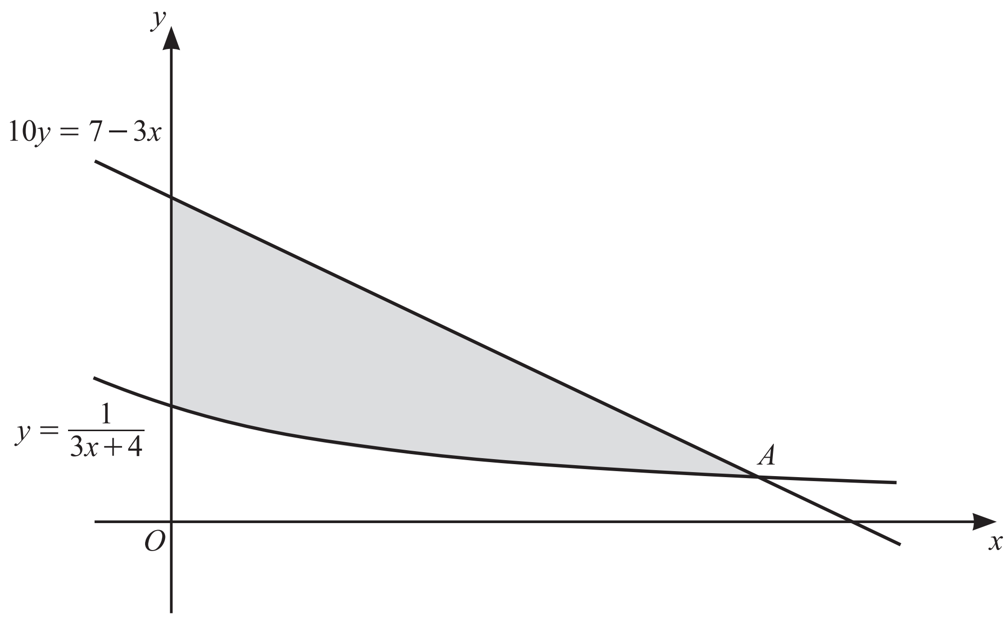
(iv) Solve the equation $gf(x) = 1$. [5]

(b) The function h is defined by $h(x) = \ln(4 - x)$ for $x < 4$. Sketch the graph of $y = h(x)$ and hence sketch the graph of $y = h^{-1}(x)$. Show the position of any asymptotes and any points of intersection with the coordinate axes. [4]



9 **(a)** Show that $\int_1^8 \frac{x+4}{\sqrt[3]{x}}\,\mathrm{d}x = 36.6$. [3]

(b)



The diagram shows part of the line $10y = 7 - 3x$ and part of the curve $y = \frac{1}{3x+4}$.
The line and curve intersect at the point A. Verify that the y-coordinate of A is 0.1 and calculate the area of the shaded region. [8]

Continuation of working space for Question 9(b).

10 An arithmetic progression, A, has first term a and common difference d.
The 2nd, 14th and 17th terms of A form the first three terms of a convergent geometric progression, G, with common ratio r.

(a) **(i)** Given that $d \neq 0$, find two expressions for r in terms of a and d and hence show that $a = -17d$. [6]

(ii) Find the value of r. [2]

(b) The first term of the geometric progression, G, is q and the sum to infinity is $\frac{256}{3}$.

Find the sum of the first 20 terms of the **arithmetic** progression, A. [7]

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