Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

7861512160

ADDITIONAL MATHEMATICS **0606/12**

Paper 1 **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.

© UCLES 2023

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

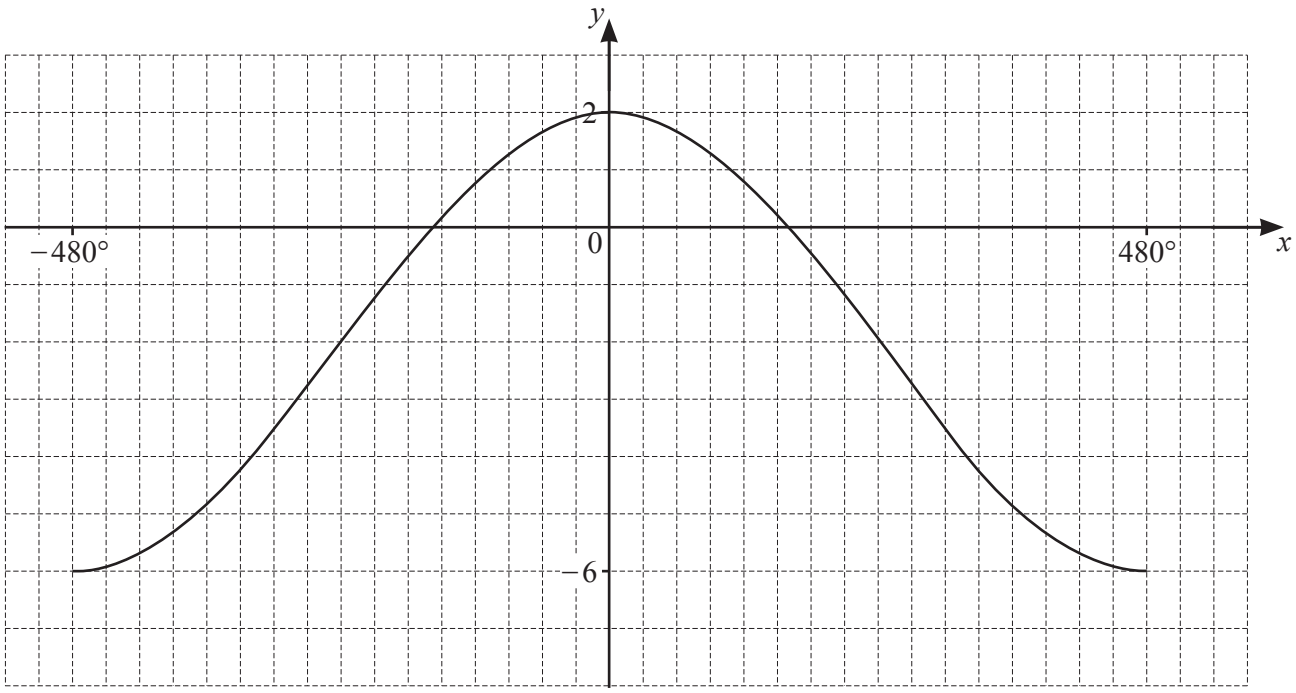
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

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

© UCLES 2023

1 The diagram shows the graph of $y = a\cos bx + c$. Find the values of the constants a, b and c. [3]

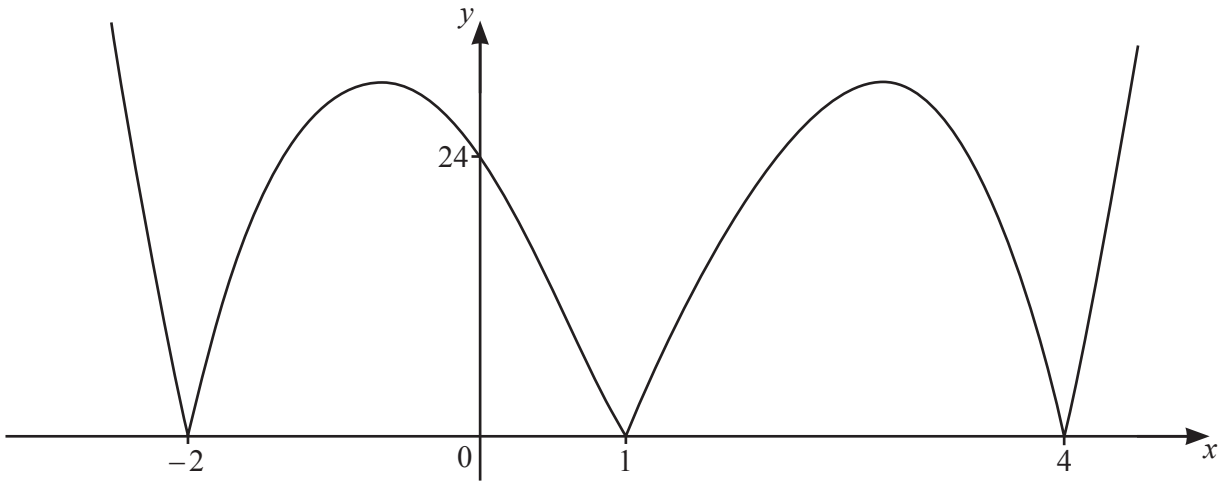


2 DO NOT USE A CALCULATOR IN THIS QUESTION.

Solve the equation $\left(2+\sqrt{5}\right)x^2 = 4x+3\left(2-\sqrt{5}\right)$, giving your answers in the form $a+b\sqrt{5}$ where a and b are integers. [5]

© UCLES 2023

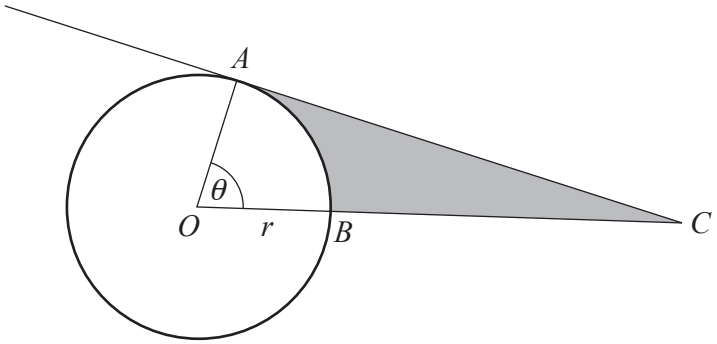
3 **(a)**



The diagram shows the graph of $y = |f(x)|$, where $f(x)$ is a cubic polynomial. Find, in factorised form, the possible expressions for $f(x)$. [3]

(b) Solve the inequality $|5x-2| \leqslant |4x+1|$. [4]

4 In this question all lengths are in centimetres and all angles are in radians.



The diagram shows a circle with centre O and radius r. The points A and B lie on the circumference of the circle such that the angle AOB is θ and the length of the minor arc AB is 12. The area of the minor sector AOB is $57.6\,\text{cm}^2$. The point C lies on the tangent to the circle at A such that OBC is a straight line.

(a) Find the values of r and θ. [4]

(b) Find the area of the shaded region. Give your answer correct to 1 decimal place. [3]

© UCLES 2023

5 **(a)** Find the exact solutions of the equation $6p^{\frac{1}{3}} - 5p^{-\frac{1}{3}} - 13 = 0$. [4]

(b) Solve the equation $2\lg(2x+5) - \lg(x+2) = 1$, giving your answers in exact form. [6]

6 **(a)** Given that $\cot^2\theta = \frac{1}{y+2}$ and $\sec\theta = x-4$, find y in terms of x. [2]

(b) Solve the equation $\sqrt{3}\,\text{cosec}\left(2\phi + \frac{3\pi}{4}\right) = 2$, for $-\pi < \phi < \pi$, giving your answers in terms of π. [5]

© UCLES 2023

7 **(a)** Find the number of ways in which 14 people can be put into 4 groups containing 2, 3, 4 and 5 people. [3]

(b) 6-digit numbers are to be formed using the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. Each digit may be used only once in any 6-digit number. A 6-digit number must not start with 0. Find how many 6-digit numbers can be formed if

(i) there are no further restrictions [1]

(ii) the 6-digit number is divisible by 10 [1]

(iii) the 6-digit number is greater than 500 000 and even. [3]

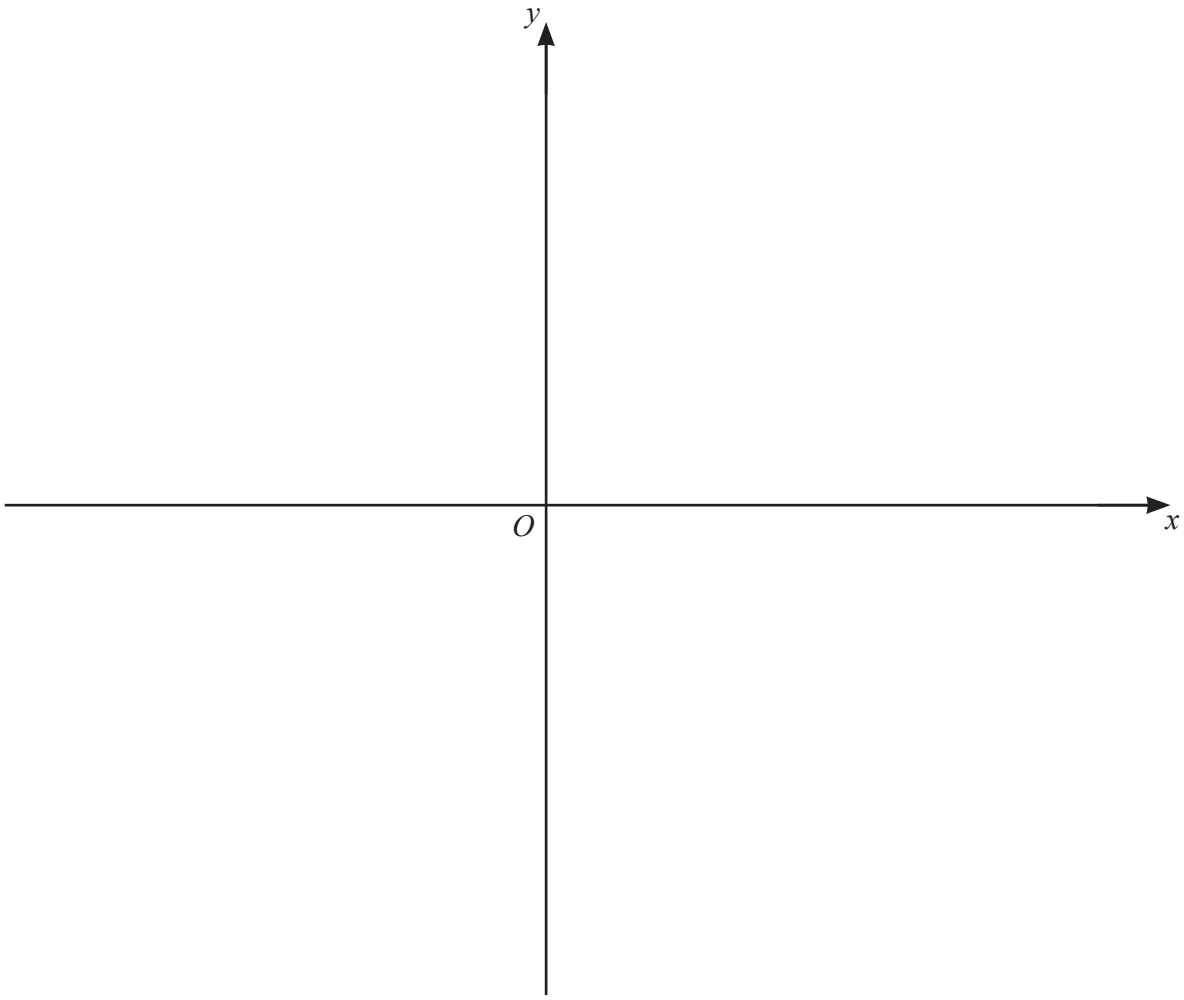
© UCLES 2023

8 It is given that $f(x) = 2\ln(3x-4)$ for $x > a$.

(a) Write down the least possible value of a. [1]

(b) Write down the range of f. [1]

(c) It is given that the equation $f(x) = f^{-1}(x)$ has two solutions. (You do not need to solve this equation). Using your answer to **part (a)**, sketch the graphs of $y = f(x)$ and $y = f^{-1}(x)$ on the axes below, stating the coordinates of the points where the graphs meet the axes. [4]



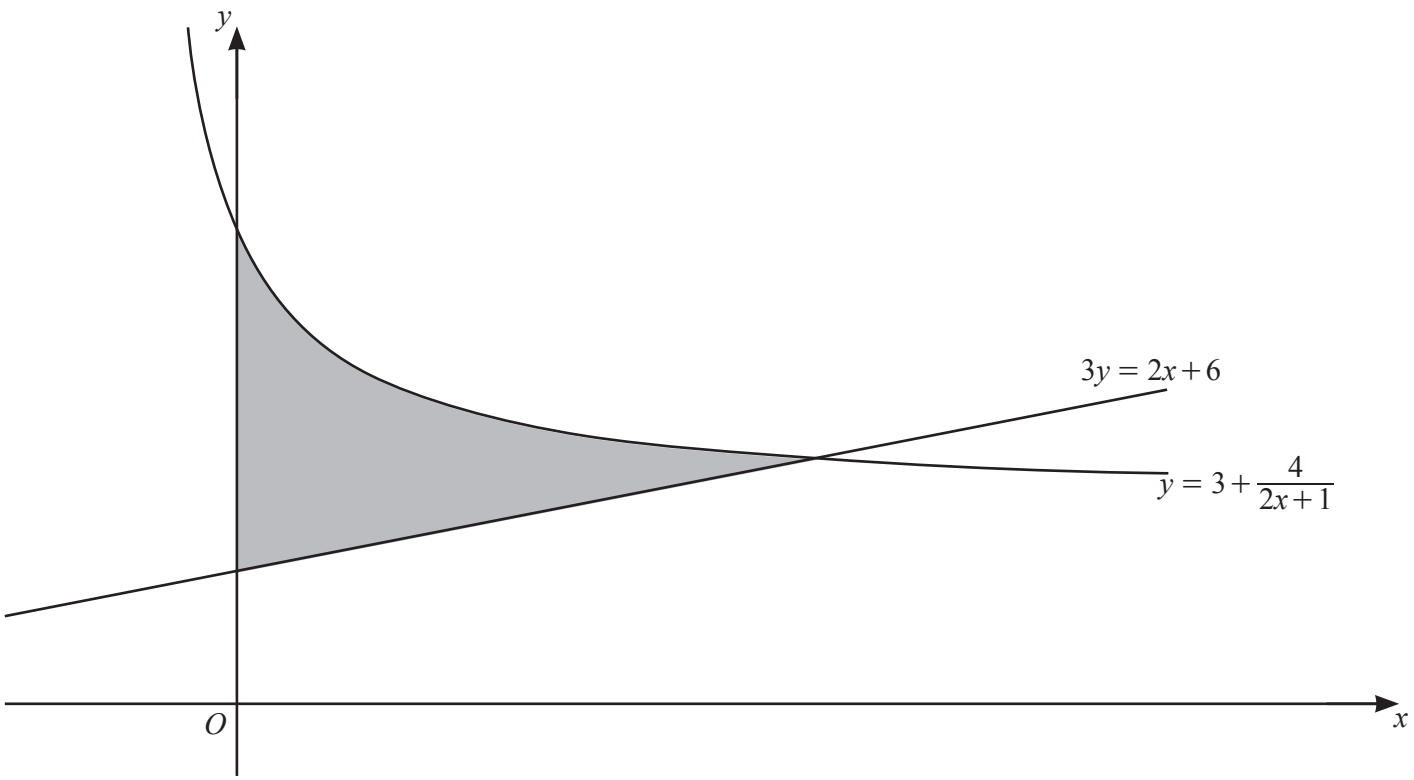
© UCLES 2023

It is given that $g(x) = 2x - 3$ for $x \geqslant 3$.

(d) (i) Find an expression for $g(g(x))$. [1]

(ii) Hence solve the equation $fg(g(x)) = 4$ giving your answer in exact form. [3]

9



The diagram shows part of the curve $y = 3 + \frac{4}{2x+1}$ and the straight line $3y = 2x + 6$. Find the area of the shaded region, giving your answer in exact form. [10]

© UCLES 2023

Continuation of working space for Question 9.

10 **(a)** The first three terms of an arithmetic progression are $(2x+1)$, $4(2x+1)$ and $7(2x+1)$, where $x \neq -\frac{1}{2}$.

(i) Show that the sum to n terms can be written in the form $\frac{n}{2}(2x+1)(An+B)$, where A and B are integers to be found. [2]

(ii) Given that the sum to n terms is $(54n+37)(2x+1)$, find the value of n. [2]

(iii) Given also that the sum to n terms in **part (ii)** is equal to 1017.5, find the value of x. [2]

© UCLES 2023

(b) The first three terms of a geometric progression are $(2y+1)$, $3(2y+1)^2$ and $9(2y+1)^3$, where $y \neq -\frac{1}{2}$.

Given that the nth term of the progression is equal to 4 times the $(n+2)$th term, find the possible values of y, giving your answers as fractions. [4]

(c) The first three terms of a different geometric progression are $\sin\theta$, $2\sin^3\theta$ and $4\sin^5\theta$, for $0 < \theta < \frac{\pi}{2}$. Find the values of θ for which the progression has a sum to infinity. [3]

© UCLES 2023

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

© UCLES 2023