Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

4810484657

ADDITIONAL MATHEMATICS **0606/22**

Paper 2 **February/March 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.

DC (CJ/SG) 370551/3

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

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

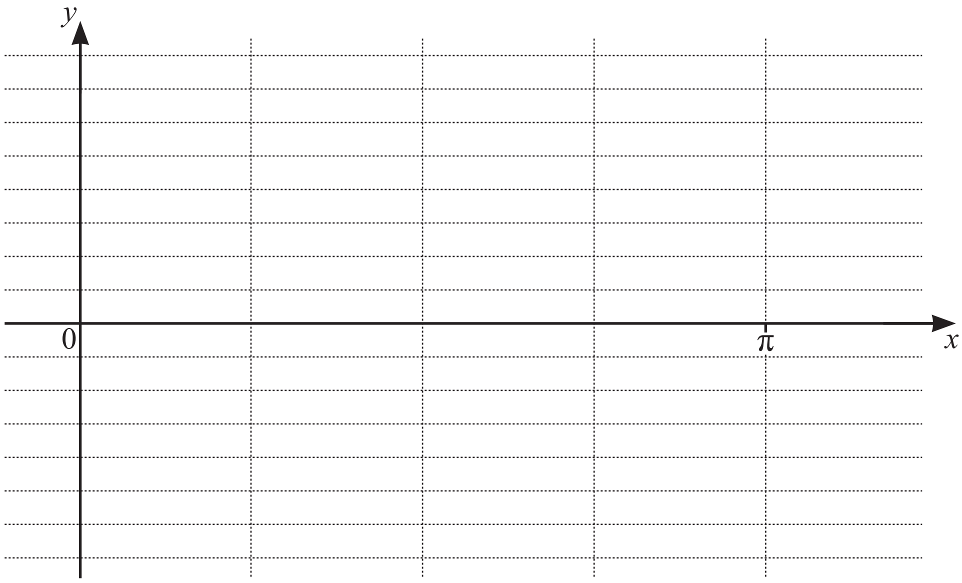
Formulae for ΔABC

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

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

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

1 On the axes below, sketch the graph of $y = |4\cos 2x|$ for $0 \leqslant x \leqslant \pi$, giving the coordinates of any points where the graph meets the axes. [3]



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

Expand and simplify $\left(\dfrac{x\sqrt{11}}{2\sqrt{3}-1}\right)^2$, giving your answer with a rational denominator. [4]

3 Solve the inequality $|5x+4| \leqslant |2x-3|$. [4]

4 $$y = \frac{\sec^2 5x - \tan^2 5x}{\operatorname{cosec} 5x}$$

Show that $y = a\sin bx$, where a and b are integers, and hence find the value of $\int_0^{\frac{\pi}{5}} y\,\mathrm{d}x$. [4]

5 DO NOT USE A CALCULATOR IN THIS QUESTION.

(a) Show that $x-1$ is a factor of the expression $x^3-2x^2-19x+20$. [1]

(b) Hence write $x^3-2x^2-19x+20$ as a product of its linear factors. [3]

(c) Hence find the exact solutions of the equation $e^{3y}-2e^{2y}-19e^{y}+20=0$. [2]

6 **(a)** A geometric progression has first term 64 and common ratio 0.5.

(i) Find the 10th term. [2]

(ii) Find the sum of the first 10 terms. [2]

(iii) Find the sum to infinity. [1]

(b) An arithmetic progression is such that $S_{20} - 400 = 2S_{10}$ and $u_1 : u_6$ is 1 : 5.
Find the sum of the first 3 terms of this progression. [6]

7 **(a)** Variables x and y are such that $y = \frac{1+\cos^2 x}{\tan x}$. Use differentiation to find the approximate change in y as x increases from $\frac{\pi}{4}$ to $\frac{\pi}{4}+h$, where h is small. [5]

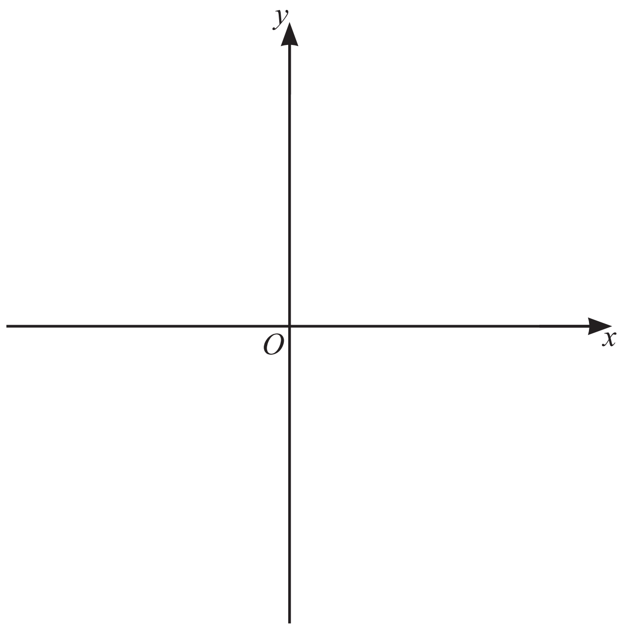
(b) Given that $y = \frac{1}{(x-3)^3}$ show that $y - \frac{dy}{dx} - \frac{1}{3}\left(\frac{d^2y}{dx^2}\right)$ can be written as $\frac{(x+1)(x-4)}{(x-3)^5}$. [4]

8 The function f is defined for $x \geqslant 0$ by $f(x) = 5 - 2e^{-x}$.

(a) **(i)** Find the domain of f^{-1}. [2]

(ii) Solve $ff^{-1}(x) = \sqrt{5x-4}$. [3]

(iii) On the axes, sketch the graph of $y = f(x)$ and hence sketch the graph of $y = f^{-1}(x)$. Show clearly the positions of any points where your graphs meet the coordinate axes and the positions of any asymptotes. [4]

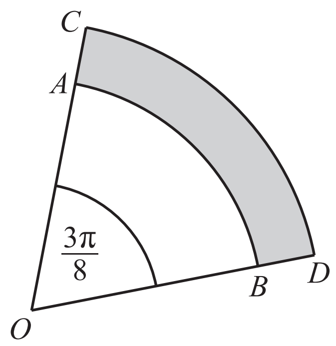


(b) The function g is defined for $0 \leqslant x \leqslant 0.2$ by $\mathrm{g}(x) = \dfrac{3}{1-x}$.

Find and simplify an expression for $\mathrm{f}^{-1}\mathrm{g}(x)$. [4]

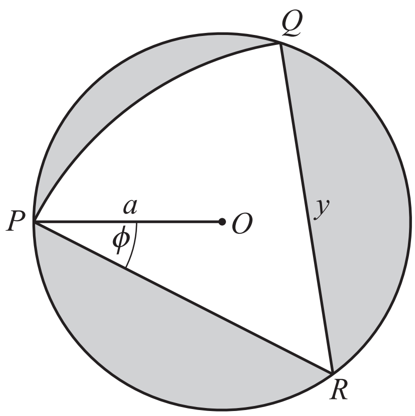
9 In this question, all lengths are in centimetres and all angles are in radians.

(a)



The diagram shows sectors *AOB* and *COD* of two circles with the same centre, *O*. Angle *AOB* is $\frac{3\pi}{8}$ and the length of *OC* is 6.5. It is given that *OAC* and *OBD* are straight lines and *OA* : *OC* is 4 : 5. Find the perimeter of the shaded region. [3]

(b)



The diagram shows a circle with centre O and radius a. Sector PQR is a sector of a different circle with centre R and radius y. Angle OPR is ϕ. Find, in terms of a and ϕ only, the total area of the three shaded regions. Simplify your answer. [4]

10 A particle P moves in a straight line passing a fixed point O. At time t seconds, its acceleration, $a\,\text{ms}^{-2}$, is given by

$$a = 6t \qquad \text{for } 0 \leqslant t \leqslant 3,$$
$$a = \frac{18\text{e}^3}{\text{e}^t} \qquad \text{for } t \geqslant 3.$$

When $t = 1$, the velocity of P is $2\,\text{ms}^{-1}$ and its displacement from O is $-4\,\text{m}$.

(a) **(i)** Find the velocity of P when $t = 3$. [3]

(ii) Find the displacement of P from O when $t = 3$. [3]

(b) Find an expression in terms of t for the displacement of P from O when $t \geqslant 3$. [4]

Question 11 is printed on the next page.

11 The normal to the curve $y = \sin(4x - \pi)$ at the point $A(a, 0)$, where $\frac{\pi}{2} < a < \pi$, meets the y-axis at the point B. Find the exact area of triangle OAB, where O is the origin. [9]