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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.

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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

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

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

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

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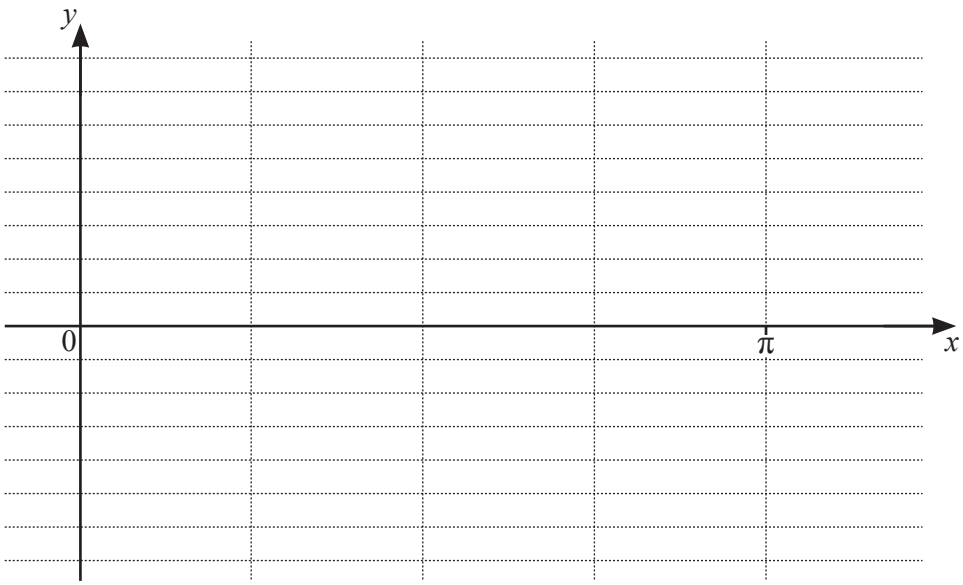
1 On the axes below, sketch the graph of $y = |4\cos 2x|$ for $0 \leqslant x \leqslant \pi$, giving the coordinates of any points where the graph meets the axes. [3]



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

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

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

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

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

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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]

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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]

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(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]

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

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(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]

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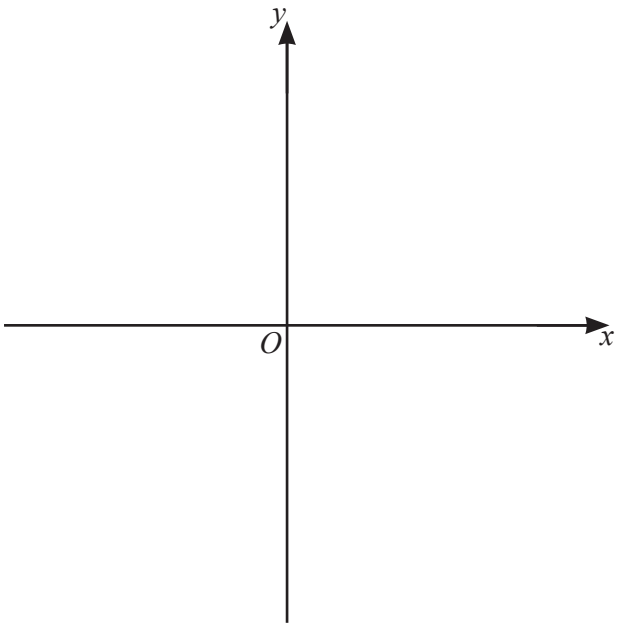
8 The function f is defined for $x \geqslant 0$ by $\mathrm{f}(x) = 5 - 2\mathrm{e}^{-x}$.

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

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

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



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

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

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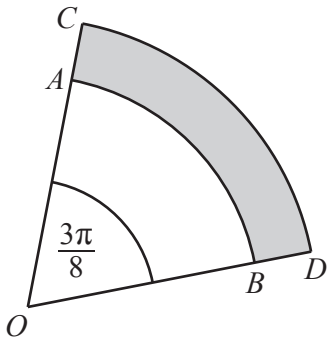
9 In this question, all lengths are in centimetres and all angles are in radians.

(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]

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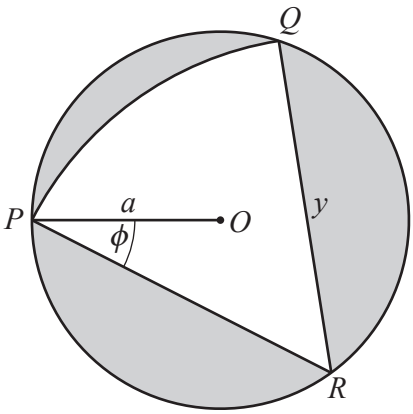
(b)



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]

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10 A particle P moves in a straight line such that, t seconds after passing a fixed point O, 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]

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(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.

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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]

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