

# Cambridge IGCSE™

CANDIDATE  
NAME

CENTRE  
NUMBER

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## 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.

**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*

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \dots + \binom{n}{r}a^{n-r}b^r + \dots + b^n$$

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*       $u_n = ar^{n-1}$

$$S_n = \frac{a(1-r^n)}{1-r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1-r} \quad (|r| < 1)$$

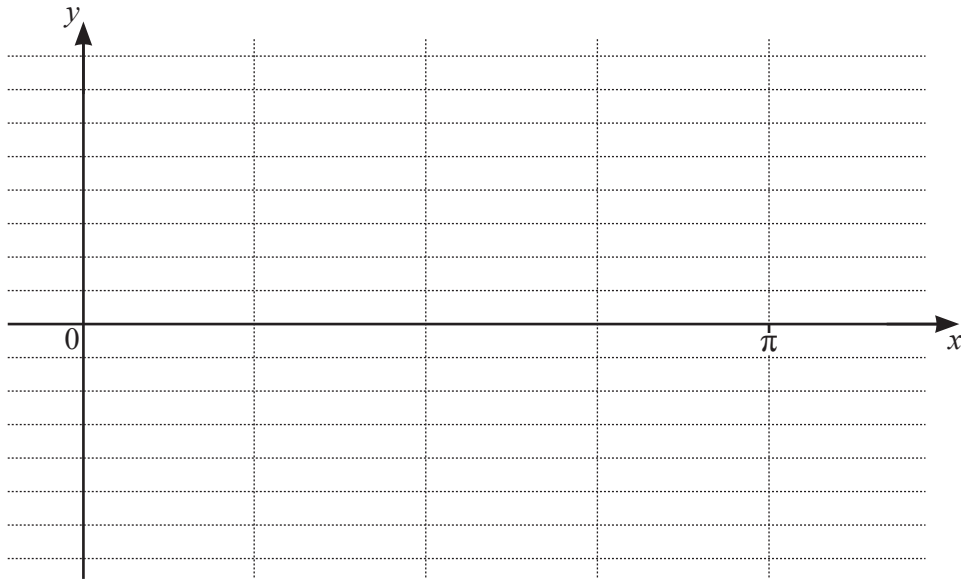
**2. TRIGONOMETRY***Identities*

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

*Formulae for  $\triangle ABC$* 

$$\begin{aligned}\frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A\end{aligned}$$

- 1 On the axes below, sketch the graph of  $y = |4 \cos 2x|$  for  $0 \leq x \leq \pi$ , 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]

- 3 Solve the inequality  $|5x + 4| \leq |2x - 3|$ . [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  $\int_0^{\frac{\pi}{5}} y \, dx$ . [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]

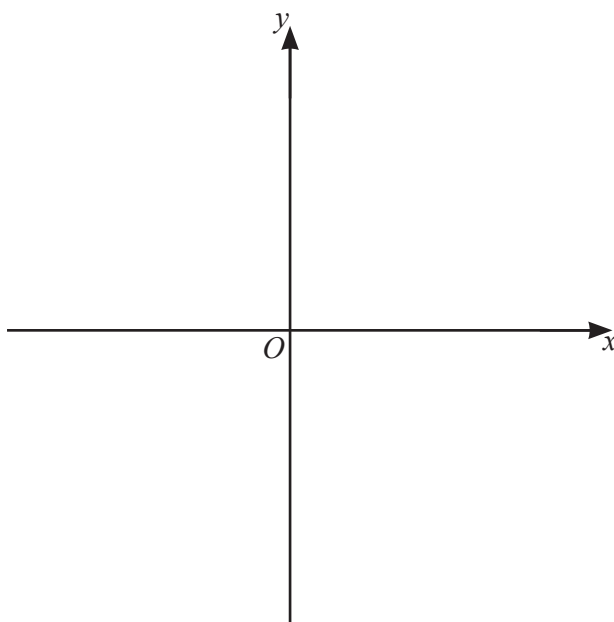
(b) Given that  $y = \frac{1}{(x-3)^3}$  show that  $y - \frac{dy}{dx} - \frac{1}{3} \left( \frac{d^2y}{dx^2} \right)$  can be written as  $\frac{(x+1)(x-4)}{(x-3)^5}$ . [4]

8 The function  $f$  is defined for  $x \geq 0$  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]

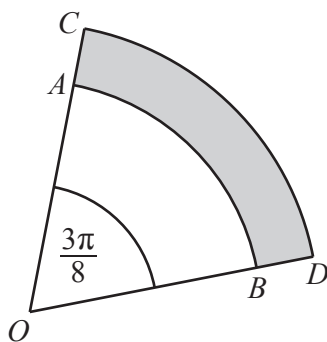


- (b) The function  $g$  is defined for  $0 \leq x \leq 0.2$  by  $g(x) = \frac{3}{1-x}$ .  
Find and simplify an expression for  $f^{-1}g(x)$ .

[4]

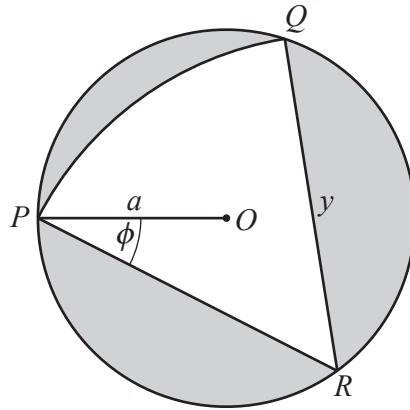
- 9 In this question, all lengths are in centimetres and all angles are in radians.

(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  $\phi$ . Find, in terms of  $a$  and  $\phi$  only, the total area of the three shaded regions. Simplify your answer. [4]

- 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

$$\begin{aligned} a &= 6t && \text{for } 0 \leq t \leq 3, \\ a &= \frac{18e^3}{e^t} && \text{for } t \geq 3. \end{aligned}$$

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  $t \geq 3$ . [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]

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