



# **Cambridge IGCSE™**

CANDIDATE  
NAME

CENTRE  
NUMBER

--	--	--	--	--

CANDIDATE  
NUMBER

--	--	--	--



## **ADDITIONAL MATHEMATICS**

**0606/22**

Paper 2

**February/March 2024**

**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  $\Delta ABC$*

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

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

1 (a) Solve the equation  $2|8-4x|+5 = 25$ .

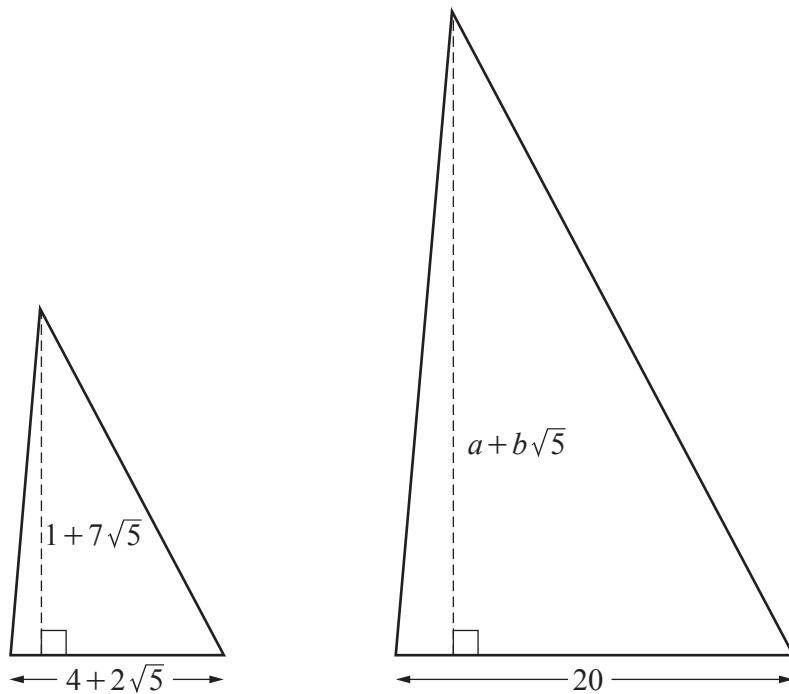
[3]

(b) Solve the inequality  $16x - 5x^2 - 3 < \frac{57 - 9x}{6}$ .

[4]

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

In this question all lengths are in centimetres.



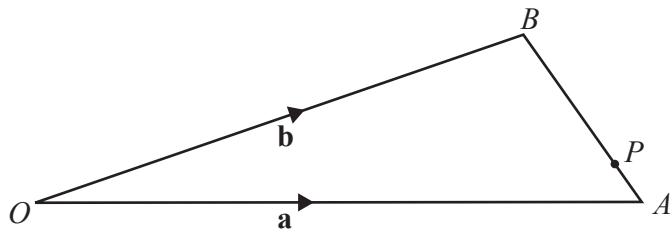
The diagram shows two similar triangles.

The height of the smaller triangle is  $1 + 7\sqrt{5}$  and the height of the larger triangle is  $a + b\sqrt{5}$ , where  $a$  and  $b$  are integers.

Find the values of  $a$  and  $b$ .

[4]

3 (a)



The diagram shows a triangle  $OAB$ . The point  $P$  lies on  $AB$ . The ratio  $AP:PB$  is  $1:3$ .

Given that  $\vec{OA} = \mathbf{a}$  and  $\vec{OB} = \mathbf{b}$ , find an expression for  $\vec{OP}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ . Simplify your answer.

[2]

(b) Vector  $\mathbf{q}$  has magnitude  $12\sqrt{5}$  and direction  $\begin{pmatrix} 6 \\ -3 \end{pmatrix}$ .

Vector  $\mathbf{r}$  has magnitude  $15\sqrt{2}$  and direction  $\begin{pmatrix} -5 \\ 5 \end{pmatrix}$ .

Find the unit vector in the direction of  $\mathbf{q} + \mathbf{r}$ .

[6]

4 (a) (i) Given that  $y = 3 \sin^2 x + \cos x$ , show that  $y + \cot x \frac{dy}{dx} = k(1 + \cos^2 x)$ , where  $k$  is an integer. [4]

(ii) Using your value of  $k$ , solve the equation  $k(1 + \cos^2 x) = 4$  for  $-\pi \leq x \leq \pi$ . [4]

(b) (i) Differentiate  $y = \tan(x - \sqrt{x})$  with respect to  $x$ .

[2]

(ii) Hence find  $\int \frac{2\sqrt{x}-1}{\sqrt{x}\cos^2(x-\sqrt{x})} dx$ .

[2]

- 5 Variables  $x$  and  $y$  are related by the equation  $y = \frac{x}{\ln 3x}$ . Use differentiation to find the approximate change in  $y$  when  $x$  increases from 1 to  $1 + h$ , where  $h$  is small.

[4]

- 6 Find the exact area of the region enclosed by the curve  $y = e^{2-4x}$ , the  $x$ -axis, the line  $x = -0.25$  and the line  $x = 0.5$ . [4]

- 7 (a) The curves  $4x^2 - 3y^2 + xy = 24$  and  $y = \frac{2}{x}$  intersect at the points  $P$  and  $Q$ . Find the coordinates of  $P$  and  $Q$ . [5]

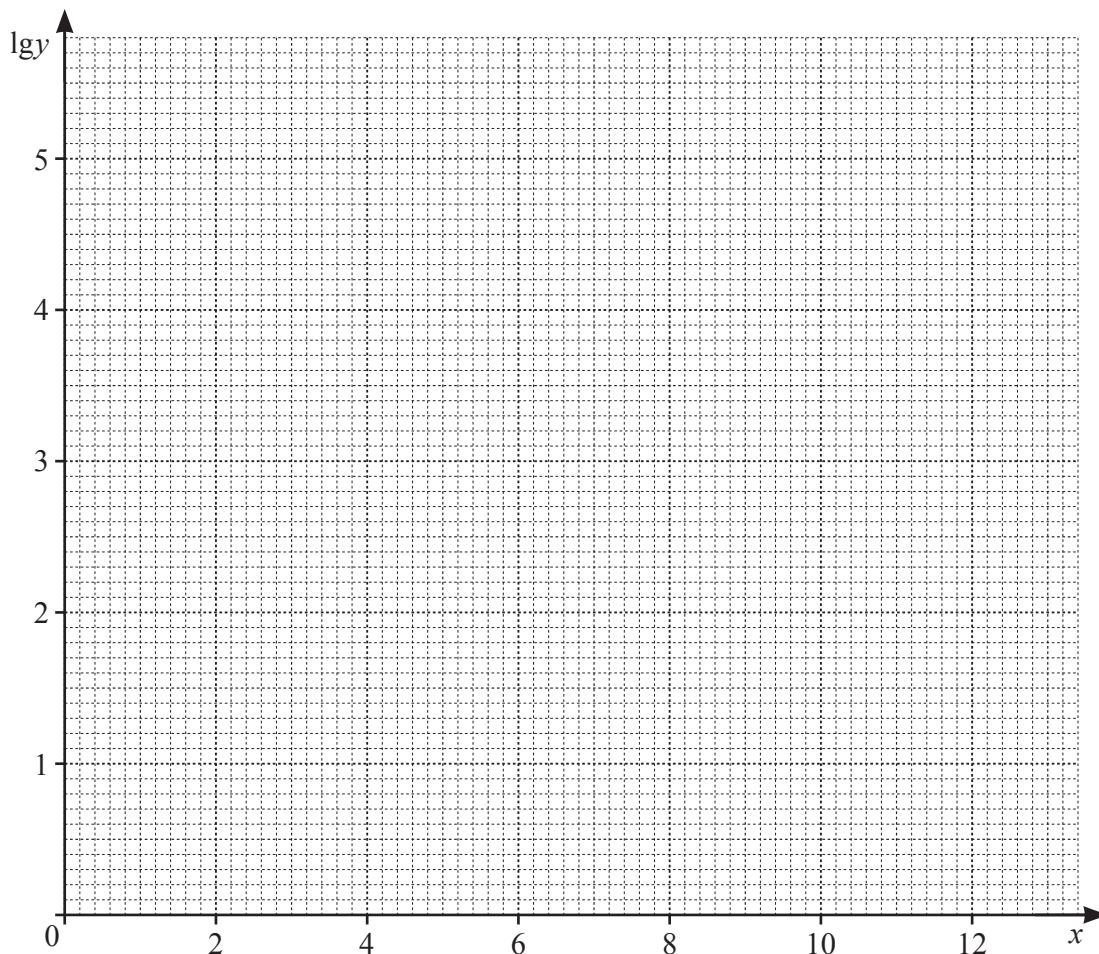
- (b) Find the length of  $PQ$ . Give your answer in the form  $a\sqrt{b}$ , where  $a$  is rational and  $b$  is the smallest possible integer. [2]

- 8 Variables  $y$  and  $x$  are known to be connected by the relationship  $y = Ab^x$  where  $A$  and  $b$  are constants. The table shows values of  $y$  for certain values of  $x$ .

$x$	1	3	5	10	12
$y$	38	150	600	20 500	82 000

- (a) Draw the graph of  $\lg y$  against  $x$ .

[2]



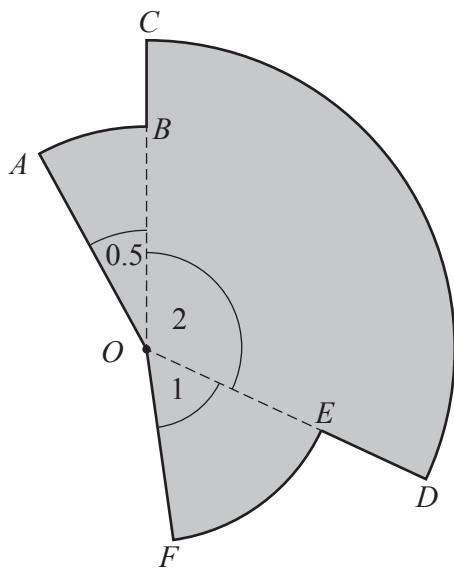
(b) Use your graph to find values of  $A$  and  $b$ , giving each to 1 significant figure.

[6]

(c) Find an estimate of  $x$  when  $y = 1500$ .

[2]

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



The diagram shows a company logo. Each part of the logo is a sector of a circle with centre  $O$ .

Sector  $AOB$  has radius  $x$ .

Sector  $COD$  has radius  $x+2$ .

Sector  $EOF$  has radius  $y$ .

The shaded region has area  $A\text{cm}^2$  and perimeter 24.

It is given that  $x$  and  $y$  can vary.

(a) Show that  $A = \frac{91}{8}x^2 - 68x + 132$ .

[4]

(b) Use differentiation to find the minimum possible area of the logo.

[5]

- 10 The expansion of  $\left(a + \frac{x}{a}\right)^n$  in ascending powers of  $x$  begins  $b^4 + 48b^3x$ , where  $n$ ,  $a$  and  $b$  are positive integers.

(a) Show that  $a^{\frac{n}{2}-4} = \left(\frac{48}{n}\right)^2$ . [4]

(b) Given also that the third term is  $1056b^2x^2$ , find the values of  $n$ ,  $a$  and  $b$ .

[6]

**Question 11 is printed on the next page.**

11 A cylinder, open at both ends, has base radius  $r$  cm and height  $4r$  cm. Its curved surface area is  $S$  cm $^2$ .

Given that  $r$  varies with time  $t$ , find  $S$  at the instant when  $\frac{dS}{dt} = 6\frac{dr}{dt}$ . [5]

---

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](http://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.