Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1019294221

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.

DC (PQ/JG) 327627/2

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 $\binom{n}{r} = \dfrac{n!}{(n-r)!r!}$

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

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

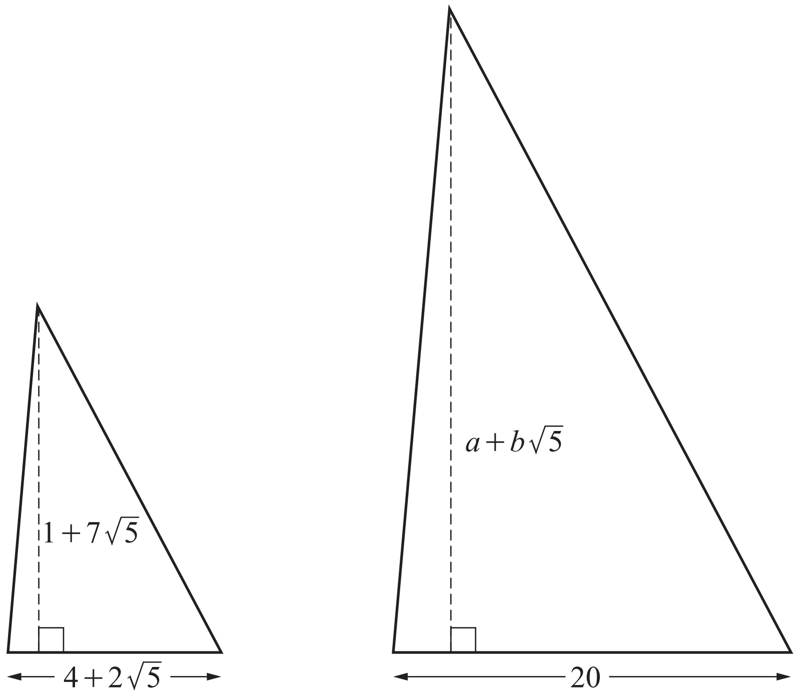
$$a^2 = b^2 + c^2 - 2bc\cos A$$

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

1 **(a)** Solve the equation $2|8-4x|+5=25$. [3]

(b) Solve the inequality $16x-5x^2-3<\frac{57-9x}{6}$. [4]

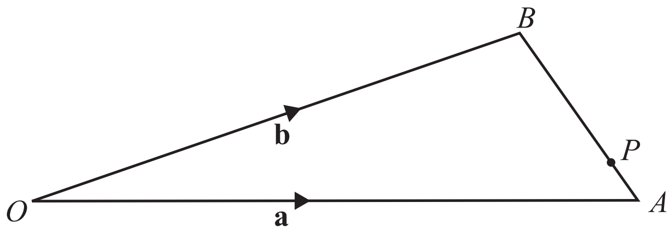
2 **DO NOT USE A CALCULATOR IN THIS QUESTION.**
In this question all lengths are in centimetres.



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 $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$, find an expression for $\overrightarrow{OP}$ 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 $y + \cot x \dfrac{\mathrm{d}y}{\mathrm{d}x} = k(1 + \cos^2 x)$, where k is an integer. [4]

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

(b) **(i)** Differentiate $y = \tan\left(x - \sqrt{x}\right)$ with respect to x. [2]

(ii) Hence find $\displaystyle\int \frac{2\sqrt{x} - 1}{\sqrt{x}\cos^2\left(x - \sqrt{x}\right)}\mathrm{d}x$. [2]

5 Variables x and y are related by the equation $y = \dfrac{x}{\ln 3x}$. 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]

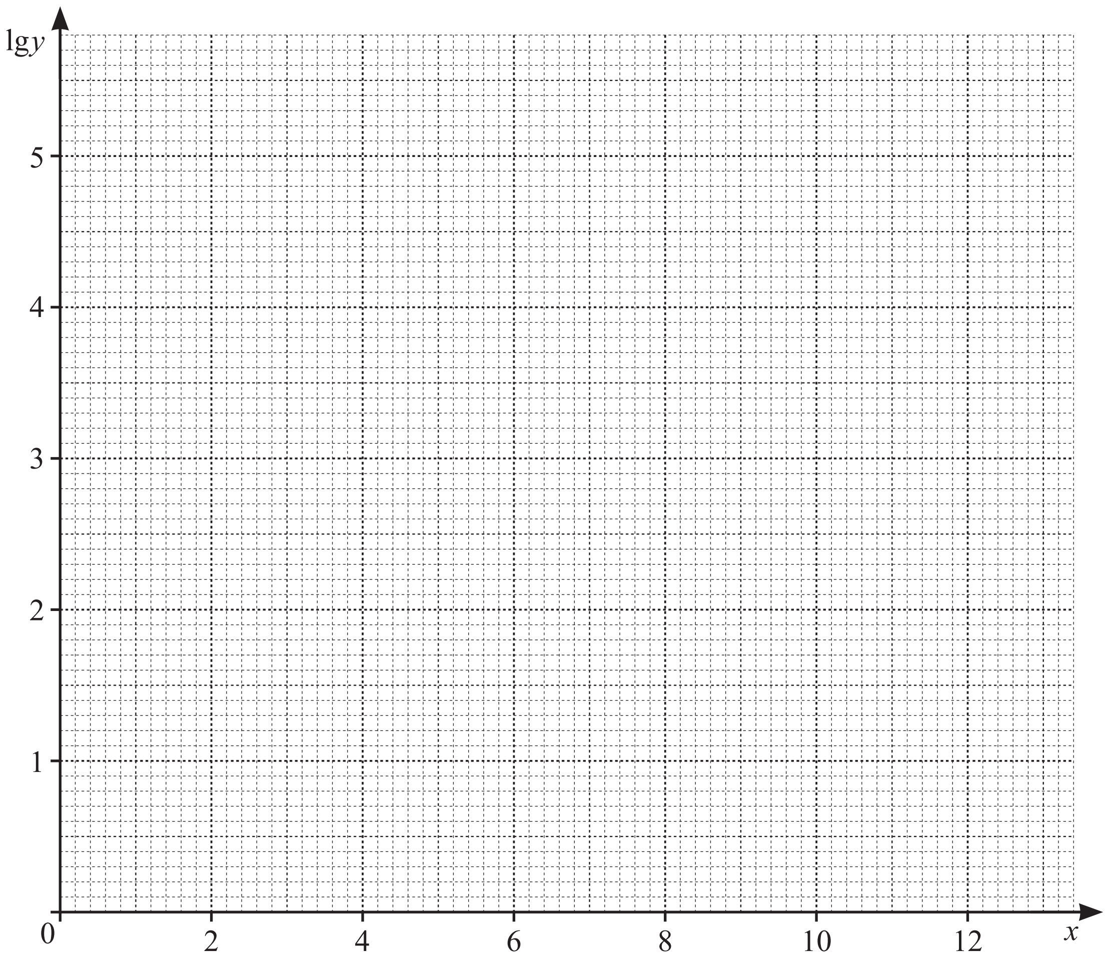
7 **(a)** The curves $4x^2 - 3y^2 + xy = 24$ and $y = \dfrac{2}{x}$ intersect at the points P and Q. Find the coordinates of P and Q. [5]

(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

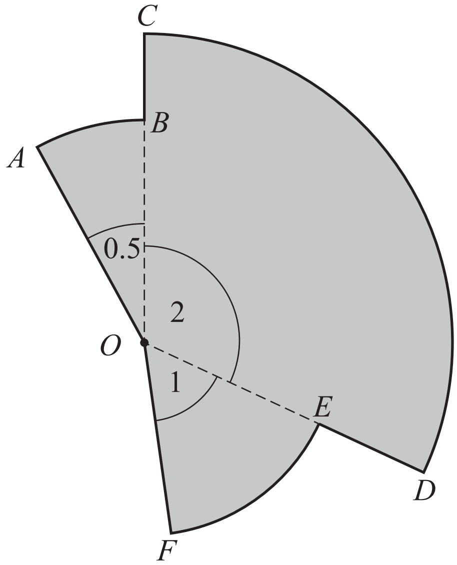
(a) Draw the graph of $\lg y$ against x. [2]



(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]