Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5434464500

ADDITIONAL MATHEMATICS **0606/13**

Paper 1 **May/June 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 (PQ/CGW) 312489/1

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

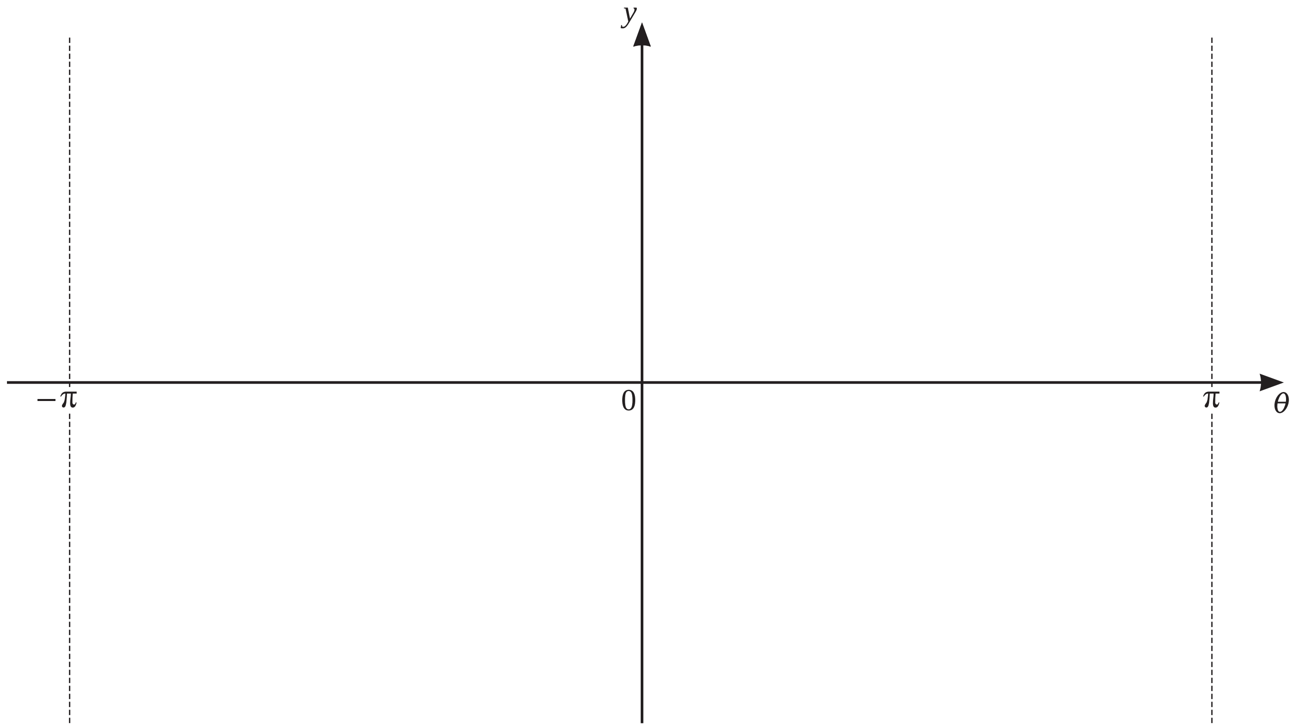
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

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

1 **(a)** Write down the period, in radians, of $3\tan\frac{\theta}{2} - 3$. [1]

(b) On the axes, sketch the graph of $y = 3\tan\frac{\theta}{2} - 3$ for $-\pi \leqslant \theta \leqslant \pi$, stating the coordinates of the points where the graph meets the axes. [3]



2 **(a)** Write $2x^2+5x+3$ in the form $2(x+a)^2+b$, where a and b are rational numbers. [2]

(b) Hence write down the coordinates of the stationary point on the curve $y=2x^2+5x+3$. [2]

(c) Solve the inequality $2x^2+5x+3<\frac{15}{8}$. [3]

3 **(a)** Write $3+2\lg a-\frac{1}{2}\lg\left(4b^2\right)$, where a and b are both positive, as a single logarithm to base 10. Give your answer in its simplest form. [3]

(b) Given that $2\log_c 3 = 7+4\log_3 c$, find the possible values of the positive constant c, giving your answers in exact form. [5]

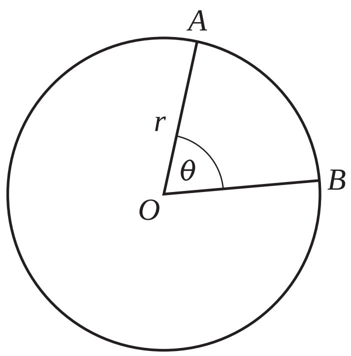
4 The straight line $y = 3x - 11$ and the curve $xy = 4 - 3x - 2x^2$ intersect at the points A and B. The point C, with coordinates $(a, -8)$ where a is a constant, lies on the perpendicular bisector of the line AB. Find the value of a. [8]

5 **(a)** Find the first three terms in the expansion of $\left(x^2 - \frac{4}{x^2}\right)^{10}$ in descending powers of x. Give each term in its simplest form. [3]

(b) Hence find the coefficient of x^{16} in the expansion of $\left(x^2 - \frac{4}{x^2}\right)^{10}\left(x^2 + \frac{2}{x^2}\right)^2$. [3]

  [Turn over

6 In this question lengths are in centimetres and angles are in radians.



The diagram shows a circle with centre O and radius r. The points A and B lie on the circumference of the circle. The area of the minor sector OAB is $25\,\text{cm}^2$. The angle AOB is θ.

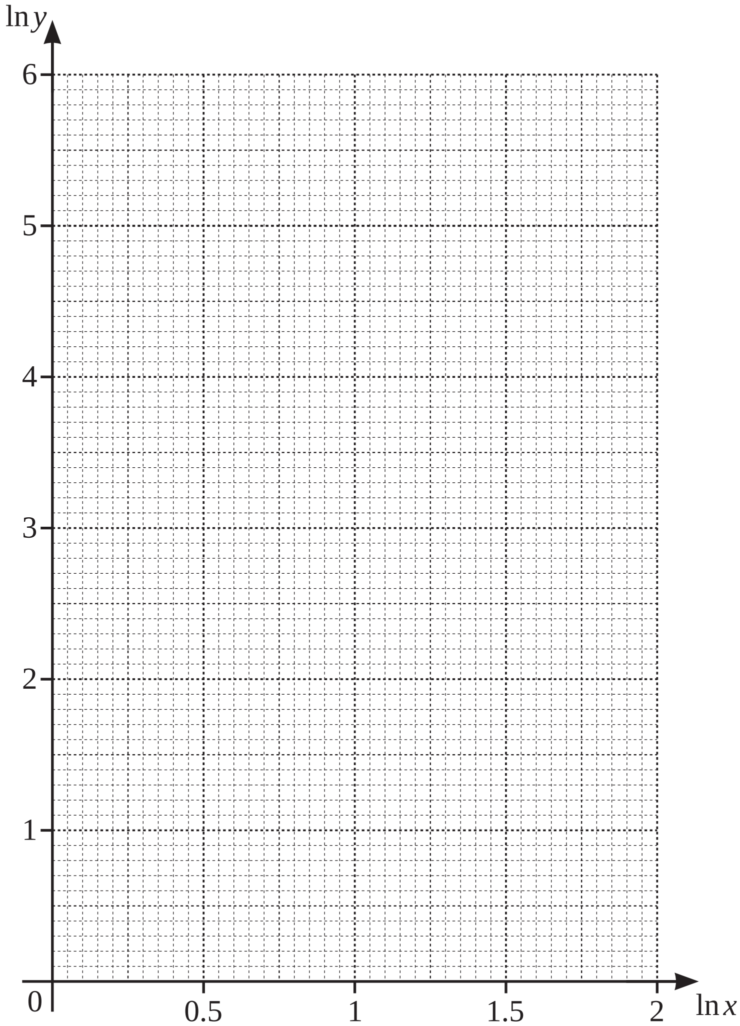
(a) Find an expression for the perimeter, P, of the minor sector AOB, in terms of r. [3]

(b) Given that r can vary, show that P has a minimum value and find this minimum value. [4]

7 The table shows values of the variables x and y which are related by an equation of the form $y = Ax^b$, where A and b are constants.

x	1.5	2	2.5	3	4
y	13.8	27.5	46.9	72.6	145

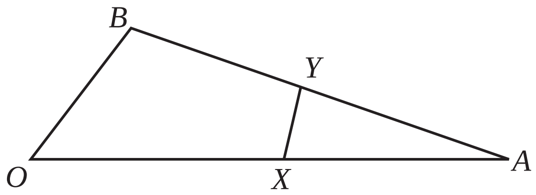
(a) Use the data to draw a straight line graph of $\ln y$ against $\ln x$. [3]



(b) Use your graph to estimate the values of A and b. [5]

(c) Estimate the value of x when $y = 100$. [2]

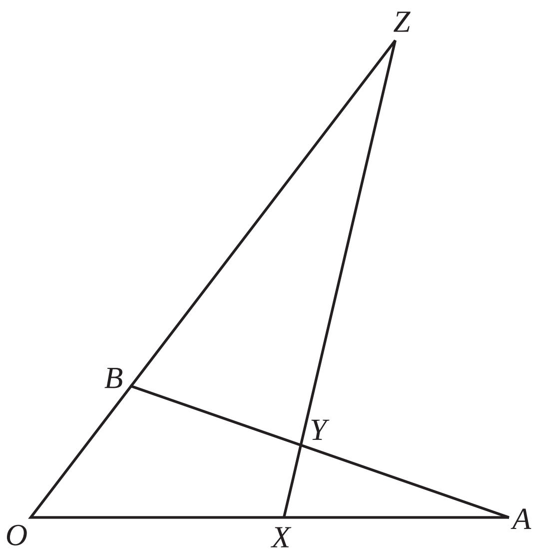
8



The diagram shows the triangle *OAB* with $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$. The point *X* lies on the line *OA* such that $\overrightarrow{OX} = \frac{3}{5}\mathbf{a}$. The point *Y* is the mid-point of the line *AB*. Find, in terms of **a** and **b**,

(a) $\overrightarrow{AB}$ [1]

(b) $\overrightarrow{XY}$. [2]



The lines *OB* and *XY* are extended to meet at the point *Z*. It is given that $\overrightarrow{YZ} = \lambda\overrightarrow{XY}$ and $\overrightarrow{BZ} = \mu\mathbf{b}$.

(c) Find $\overrightarrow{XZ}$ in terms of λ, **a** and **b**. [2]

(d) Find $\overrightarrow{XZ}$ in terms of μ, **a** and **b**. [2]

(e) Hence find the values of λ and μ. [3]

9 In this question lengths are in centimetres and time is in seconds.

A particle P moves in a straight line such that its displacement s, from a fixed point at a time t, is given by $s = 3(t+2)(t-4)^2$ for $0 \leqslant t \leqslant 5$.

(a) Find the values of t for which the velocity, v, of P is zero. [4]

(b) On the axes below, sketch the displacement–time graph of P, stating the intercepts with the axes. [3]

(c) On the axes below, sketch the velocity–time graph of P, stating the intercepts with the axes. [2]

(d) **(i)** Find an expression for the acceleration of P at time t. [1]

(ii) Hence, on the axes below, sketch the acceleration–time graph of P, stating the intercepts with the axes. [2]

Question 10 is printed on the next page.

10 **(a)** Show that $\cos^4\theta - \sin^4\theta + 1 = 2\cos^2\theta$. [3]

(b) Solve the equation $\cos^4\frac{\phi}{3} - \sin^4\frac{\phi}{3} + 1 = \frac{1}{2}$, for $-3\pi < \phi < 3\pi$, giving your answers in terms of π. [5]