



CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0606/13

May/June 2023

2 hours

You must answer on the question paper.

No additional materials are needed.

- 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.

- 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*

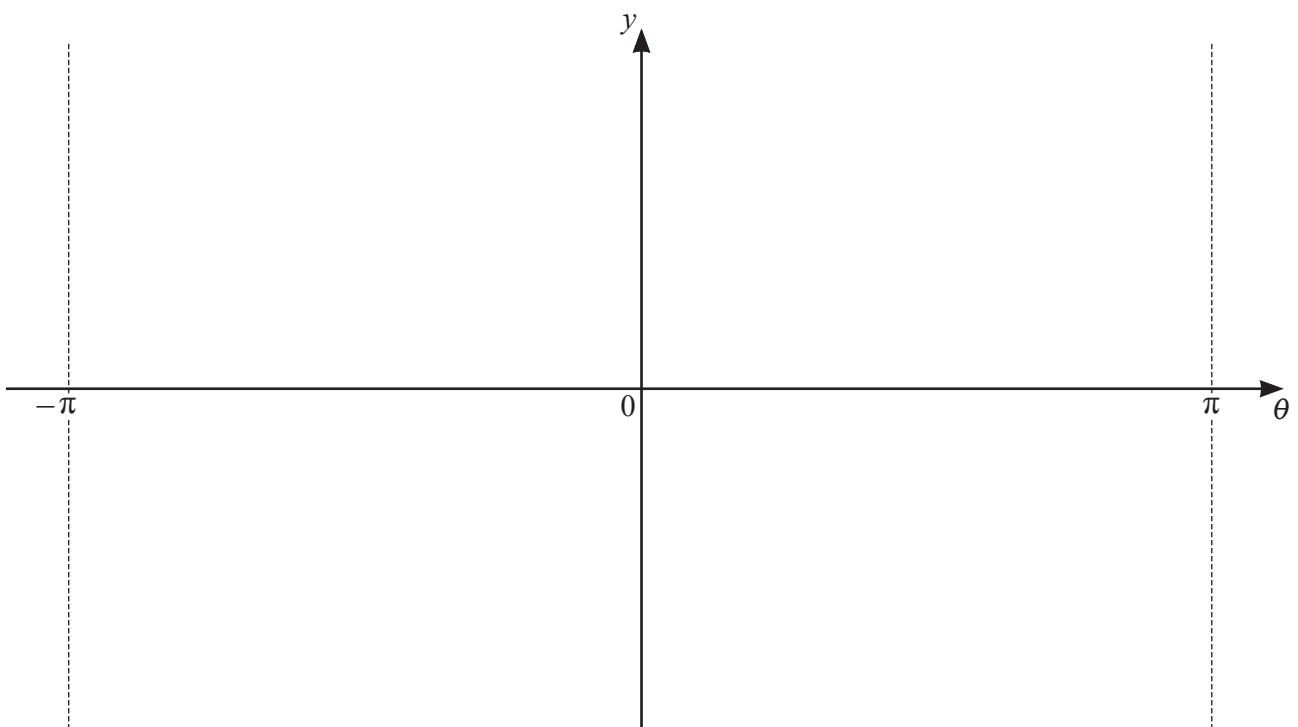
$$\begin{aligned}\sin^2 A + \cos^2 A &= 1 \\ \sec^2 A &= 1 + \tan^2 A \\ \operatorname{cosec}^2 A &= 1 + \cot^2 A\end{aligned}$$

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

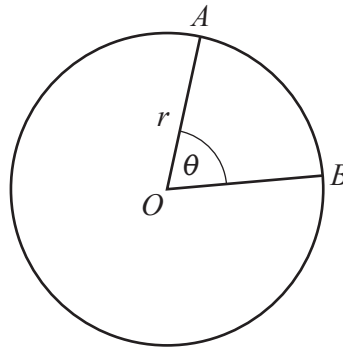
- (b) Given that $2 \log_c 3 = 7 + 4 \log_3 c$, find the possible values of the positive constant c , giving your answers in exact form. [5]

- 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]

- 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 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]

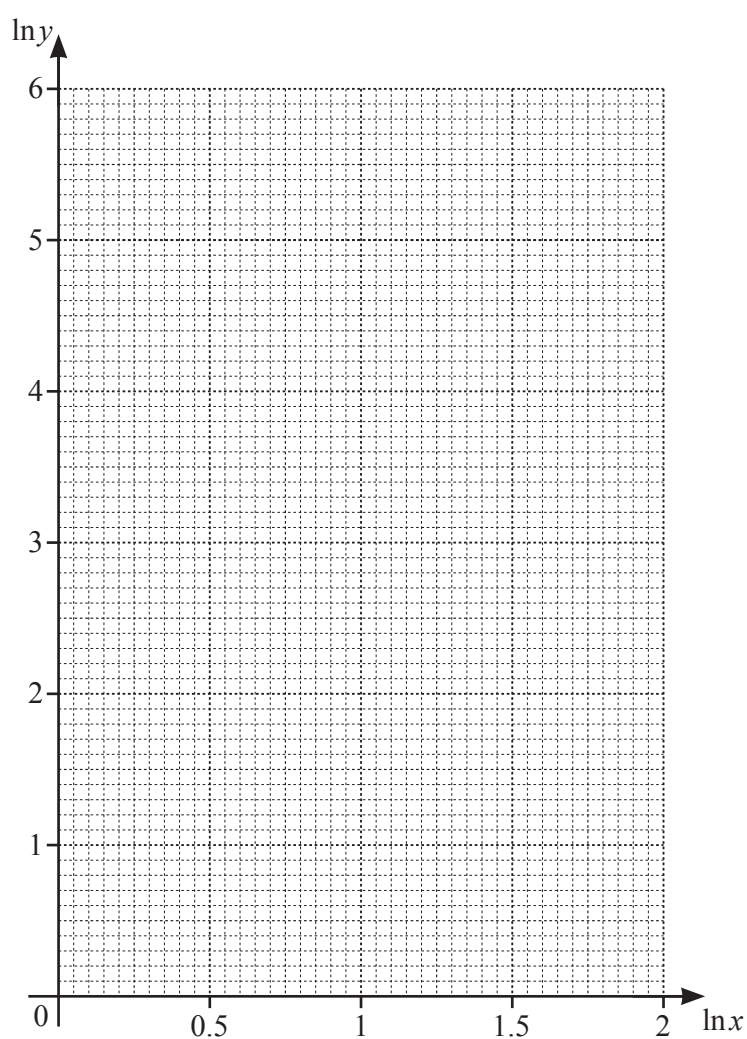
- (b) Given that r can vary, show that P has a minimum value and find this minimum value. [4]

- 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]



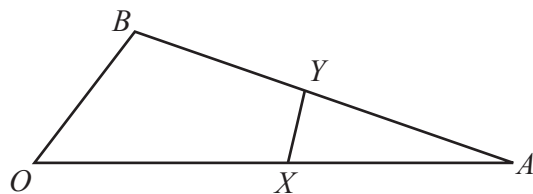
(b) Use your graph to estimate the values of A and b .

[5]

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

[2]

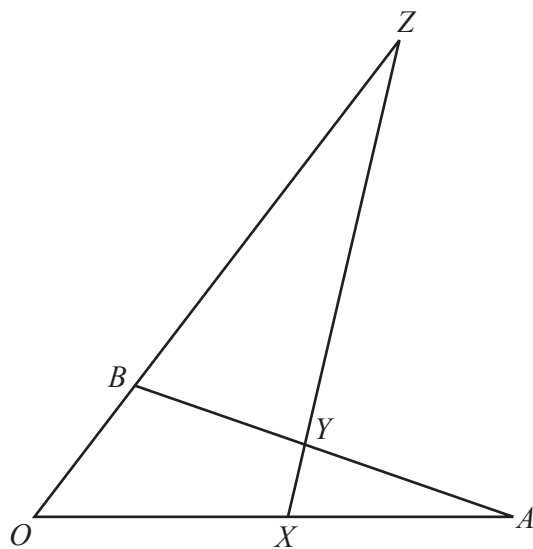
8



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 $\mathbf{a}$ and $\mathbf{b}$,

(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 , $\mathbf{a}$ and $\mathbf{b}$. [2]

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

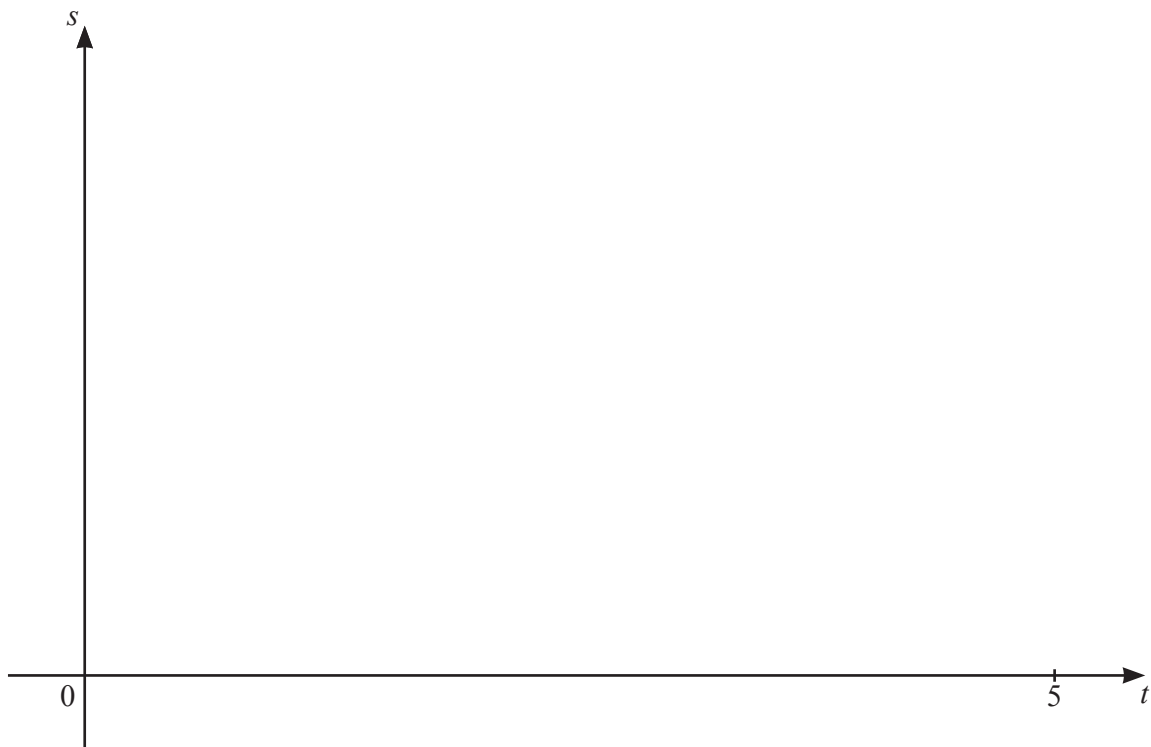
(e) Hence find the values of λ and μ . [3]

- 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 $0 \leq t \leq 5$.

- (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]

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 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.