



CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0606/22

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. Any blank pages are indicated.

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) Solve the inequality $3x^2 - 12x + 16 > 3x + 4$. [3]

- (b) (i) Write $3x^2 - 12x + 16$ in the form $a(x + b)^2 + c$ where a , b and c are integers. [3]

- (ii) Hence, write down the equation of the tangent to the curve $y = 3x^2 - 12x + 16$ at the minimum point of the curve. [1]

2 A curve has equation $y = 32x^2 + \frac{1}{8x^2}$ where $x \neq 0$.

(a) Find the coordinates of the stationary points of the curve.

[5]

(b) These stationary points have the same nature. Use the second derivative test to determine whether they are maximum points or minimum points.

[3]

3 DO NOT USE A CALCULATOR IN THIS QUESTION.

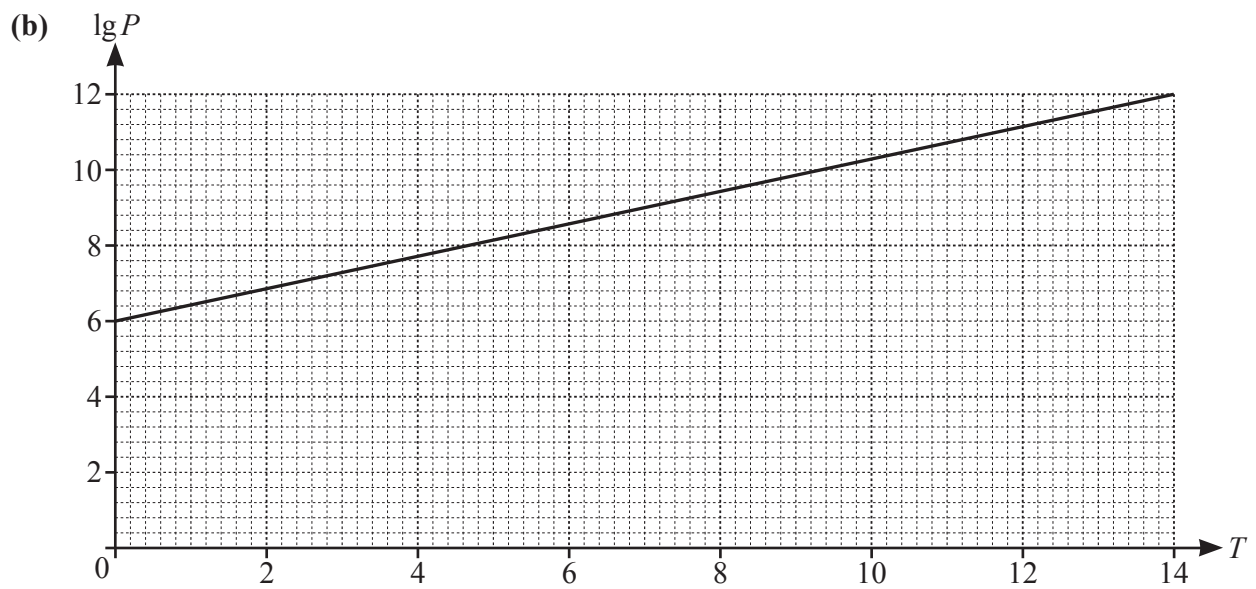
(a) Show that $x+3$ is a factor of $-12+23x+3x^2-2x^3$. [1]

(b) The curve $y=-5+33x+3x^2-2x^3$ and the line $y=10x+7$ intersect at three points, A , B and C . These points are such that the x -coordinate of A has the least value and the x -coordinate of C has the greatest value. Show that B is the mid-point of AC . [7]

- 4 Variables x and y are related by the equation $y = 2 + \tan(1 - x)$ where $0 \leq x \leq \frac{\pi}{2}$. Given that x is increasing at a constant rate of 0.04 radians per second, find the corresponding rate of change of y when $y = 3$. [6]

- 5 Variables P and T are known to be connected by the relationship $P = Ab^T$, where A and b are constants. Values of P are found for certain values of time, T .

(a) Show that a graph of $\lg P$ against T will be a straight line. [2]



The diagram shows the graph of $\lg P$ against T . The graph passes through $(0, 6)$ and $(14, 12)$. Find the values of A and b . [4]

- (c) Using the graph or otherwise, find the length of time for which P is between 100 million and 1000 million. [3]

- 6 (a) (i) Find the first three terms in the expansion of $\left(1 + \frac{x}{7}\right)^5$, in ascending powers of x . Simplify the coefficient of each term. [2]

- (ii) The expansion of $7(1+x)^n\left(1 + \frac{x}{7}\right)^5$, where n is a positive integer, is written in ascending powers of x . The first two terms in the expansion are $7 + 89x$. Find the value of n . [2]

- (b) In the expansion of $(k - 2x)^8$, where k is a constant, the coefficient of x^4 divided by the coefficient of x^2 is $\frac{5}{8}$. The coefficient of x is positive. Form an equation and hence find the value of k . [5]

7 (a) $f(x) = \sqrt{3 + (4x - 2)^5}$ where $x > 1$.

Find an expression for $f'(x)$, giving your answer as a simplified algebraic fraction. [3]

(b) Variables x and y are related by the equation $y = \frac{5x}{3x+2}$. Using differentiation, find the approximate change in x when y increases from 10 by the small amount 0.01. [4]

(c) (i) Differentiate $y = x^3 \ln x$ with respect to x . [2]

(ii) Hence find $\int \left(\frac{x^2}{6} (2 + 3 \ln x) \right) dx$. [3]

- 8 A curve has equation $y = \cos \frac{x}{4}$ where x is in radians. The normal to the curve at the point where $x = \frac{4\pi}{3}$ cuts the x -axis at the point P . Find the exact coordinates of P . [7]

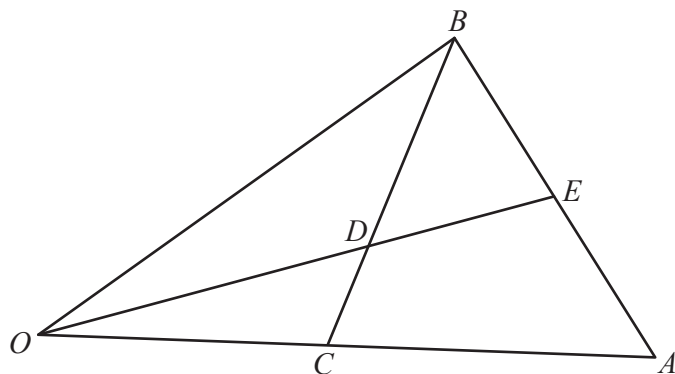
- 9 A particle travels in a straight line so that, t seconds after passing a fixed point, its velocity, $v \text{ ms}^{-1}$, is given by

$$v = e^{\frac{t}{4}} \quad \text{for } 0 \leq t \leq 4,$$

$$v = \frac{16e}{t^2} \quad \text{for } 4 \leq t \leq k.$$

The total distance travelled by the particle between $t = 0$ and $t = k$ is 13.4 metres. Find the value of k .
[6]

10



The diagram shows a triangle OAB . The point C is the mid-point of OA . The point D lies on CB such that $CD : DB = 2 : 3$.

$$\overrightarrow{OC} = \mathbf{c} \quad \overrightarrow{CB} = \mathbf{b}$$

The point E lies on AB such that $\overrightarrow{OE} = \lambda \overrightarrow{OD}$ and $\overrightarrow{AE} = \mu \overrightarrow{AB}$ where λ and μ are scalars. Find two expressions for $\overrightarrow{OE}$, each in terms of $\mathbf{b}$, $\mathbf{c}$ and a scalar, and hence find $AE : EB$.

[8]

Continuation of working space for Question 10.

BLANK PAGE

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.