



Cambridge O Level

CANDIDATE NAME



CENTRE NUMBER

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

CANDIDATE NUMBER

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|



ADDITIONAL MATHEMATICS

4037/22

Paper 2

October/November 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 $\triangle ABC$

$$\begin{aligned} \frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A \end{aligned}$$





1 Solve the following simultaneous equations.

$$\frac{y}{x} = \frac{3}{2}$$

$$\frac{y^4}{x^5} = \frac{27}{16}$$

[3]

DO NOT WRITE IN THIS MARGIN





2 Variables x and y are related by the equation $y = x\sqrt{1+2x}$.

(a) Find $\frac{dy}{dx}$. [3]

(b) It is given that when $y = 12$, $x = 4$. Find the approximate change in x when y increases from 12 by the small amount 0.06. [3]

(c) Find the x -coordinate of the stationary point on the curve $y = x\sqrt{1+2x}$. [2]





3 DO NOT USE A CALCULATOR IN THIS QUESTION.

The polynomial p is defined by $p(x) = ax^3 - 3x^2 - 3x + b$, where a and b are constants.

(a) Given that $x = 2$ and $x = -1$ are roots of the equation $p(x) = 0$, find a and b . [3]

(b) Solve the equation $p(x) = 0$. [2]

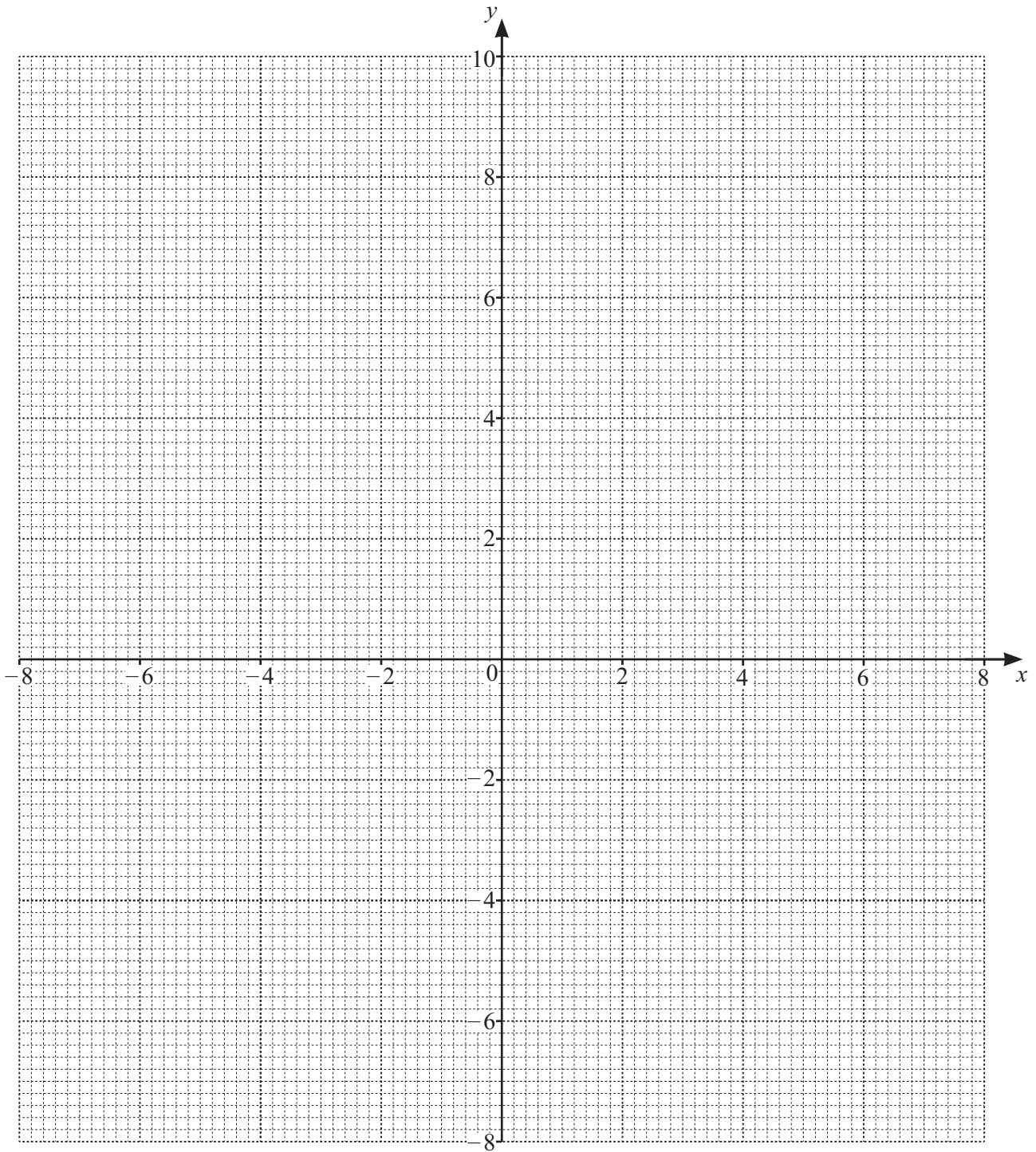


DO NOT WRITE IN THIS MARGIN



4 Use a graphical method to solve the inequality $|2x - 8| > 4$.

[5]



DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN





5 Solve the following equations.

(a) $\log_2 x^2 + \log_{16} x = 18$

[4]

(b) $e^{2x+1} - 10e^{-2x-1} = 3$

[4]



DO NOT WRITE IN THIS MARGIN



6 DO NOT USE A CALCULATOR IN THIS QUESTION.

Write $(5 - \sqrt{3})(\sqrt{6} + \sqrt{2})^{-2}$ in the form $a + b\sqrt{3}$, where a and b are constants.

[5]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN





7 A class of 10 students includes Abby and Ben.

(a) A group of 5 students is to be selected from the class. Find the number of possible groups in the following cases.

(i) There are no restrictions. [1]

(ii) The group includes both Abby and Ben. [2]

(iii) The group includes either Abby or Ben, but not both. [2]

(b) All 10 students are arranged in a line. How many arrangements are possible if there are exactly three students between Abby and Ben? [3]



DO NOT WRITE IN THIS MARGIN



8 Solve the equation $\cot^2 2\theta + 3 \operatorname{cosec} 2\theta = 9$ for $-90^\circ \leq \theta \leq 90^\circ$.

[6]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

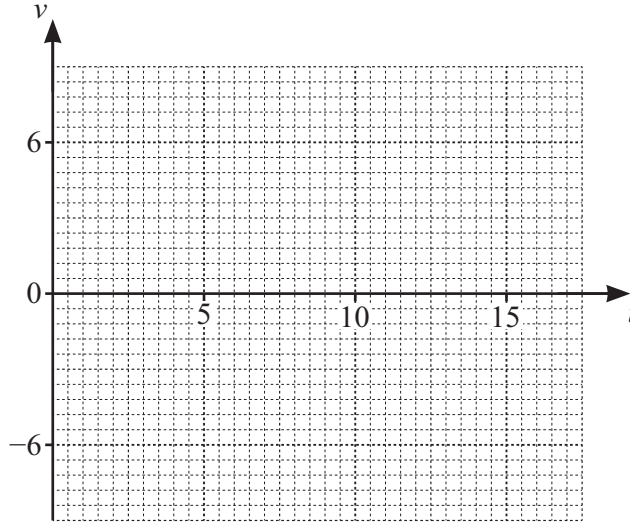
DO NOT WRITE IN THIS MARGIN



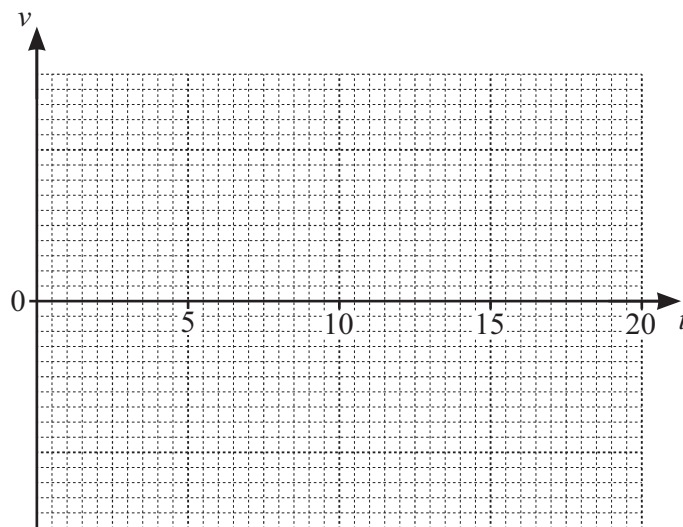


9 In this question time is measured in seconds.

- (a) A particle is moving in a straight line with constant velocity of 6ms^{-1} . At time $t = 0$, it passes a fixed point A . At time $t = 5$ it suddenly changes direction and moves with a different constant velocity along the same straight line. It passes the point A again at time $t = 15$. Sketch the velocity–time graph for the motion. [3]



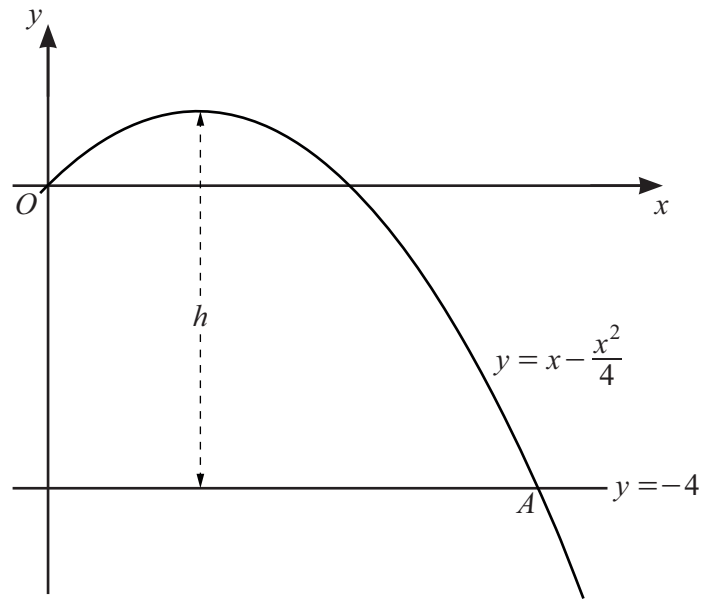
- (b) Another particle is moving in a straight line with constant acceleration. At time $t = 0$ it passes a fixed point B with velocity -8ms^{-1} . It passes the point B again at time $t = 20$. Sketch the velocity–time graph for the motion. [3]



DO NOT WRITE IN THIS MARGIN



- 10 The diagram shows part of the curve $y = x - \frac{x^2}{4}$ and the line $y = -4$. The curve and the line intersect at the point A .



- (a) The maximum point on the curve is at a perpendicular distance h from the line $y = -4$. Find the value of h .

[4]





(b) Find the exact x -coordinate of A .

[3]

(c) Find the acute angle between the tangent to the curve at A and the line $y = -4$.

[4]

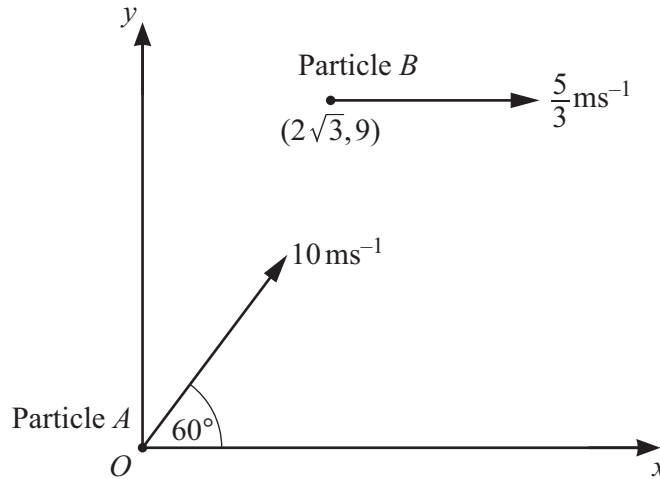
DO NOT WRITE IN THIS MARGIN





- 11 In this question \mathbf{i} is a unit vector in the positive x -direction and \mathbf{j} is a unit vector in the positive y -direction. Time is in seconds and distances are in metres.

The diagram shows the initial positions and velocities of two particles, A and B , that move in the x - y plane.



Particle A starts from the origin O at time $t = 0$. It moves with constant speed 10 ms^{-1} in the direction 60° above the x -axis.

- (a) Find the exact values of the components of the velocity of particle A in the x -direction and the y -direction. [2]

- (b) Find, in terms of t , the position vector of particle A at time t . [1]





Particle B starts from the point $(2\sqrt{3}, 9)$ at time $t = 0$. It moves with constant speed $\frac{5}{3} \text{ms}^{-1}$ parallel to the positive x -axis.

(c) Find, in terms of t , the position vector of particle B at time t . [2]

(d) Hence show that the particles collide. [4]

Question 12 is printed on the next page.



DO NOT WRITE IN THIS MARGIN



- 12 A metal tank is in the shape of a cuboid with a square base of side x m and an open top. The tank has a volume of 5 m^3 . Given that x can vary, and that the area of the metal used to make the tank is a minimum, find the dimensions of the tank. [6]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

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.

