



Cambridge IGCSE™

CANDIDATE
NAME

CENTRE
NUMBER

CANDIDATE
NUMBER



ADDITIONAL MATHEMATICS

0606/11

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 [].

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 $\triangle ABC$

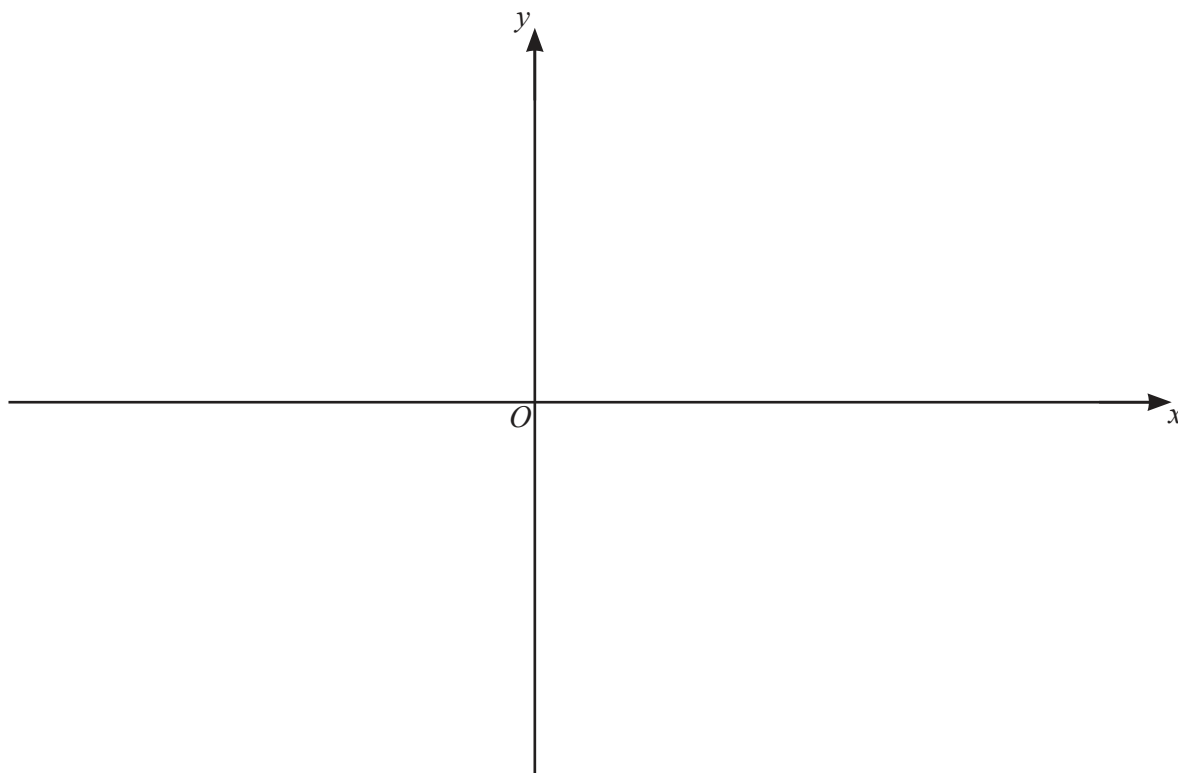
$$\begin{aligned}\frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} \\ a^2 &= b^2 + c^2 - 2bc \cos A \\ \Delta &= \frac{1}{2}bc \sin A\end{aligned}$$

3

1 (a) Write $5x^2 - 14x + 8$ in the form $a(x + b)^2 + c$, where a , b and c are constants to be found. [3]

(b) Hence write down the coordinates of the stationary point on the curve $y = 5x^2 - 14x + 8$. [2]

(c) On the axes below, sketch the graph of $y = |5x^2 - 14x + 8|$, stating the coordinates of the points where the graph meets the coordinate axes. [3]



(d) Write down the range of values of k for which the equation $|5x^2 - 14x + 8| = k$ has 4 distinct roots. [2]

4

2 The polynomial p is such that $p(x) = ax^3 + 7x^2 + bx + c$, where a , b and c are integers.

(a) Given that $p''\left(\frac{1}{2}\right) = 32$, show that $a = 6$. [2]

(b) Given that $p(x)$ has a factor of $3x - 4$ and a remainder of 7 when divided by $x + 1$, find the values of b and c . [4]

5

(c) Write $p(x)$ in the form $(3x - 4)q(x)$, where $q(x)$ is a quadratic factor. [2]

(d) Hence write $p(x)$ as a product of linear factors with integer coefficients. [1]

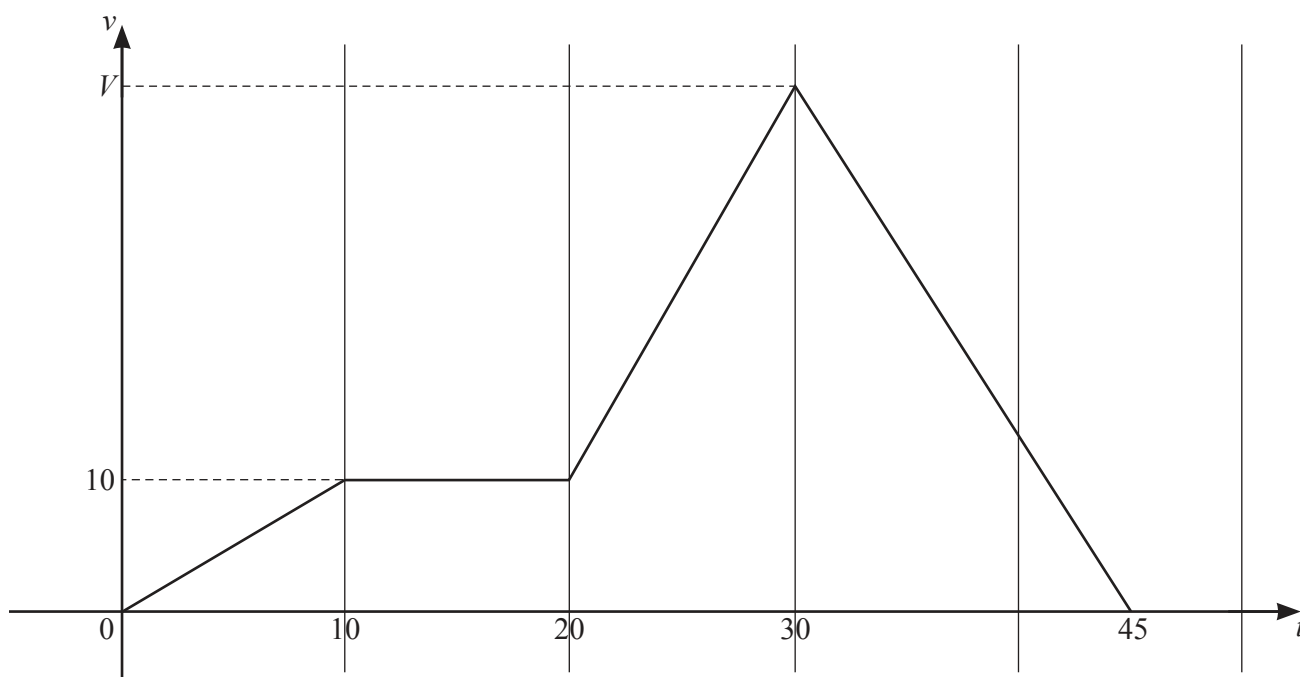
6

- 3** The points A and B have coordinates $(2, 5)$ and $(10, -15)$ respectively. The point P lies on the perpendicular bisector of the line AB . The y -coordinate of P is -9 .

(a) Find the x -coordinate of P . [5]

(b) The point R is the reflection of P in the line AB . Find the coordinates of R . [2]

4



The diagram shows the velocity–time graph for a particle travelling in a straight line with velocity, $v\text{ms}^{-1}$, at time t seconds. When $t = 30$ the velocity of the particle is $V\text{ms}^{-1}$. The particle travels 800 metres in 45 seconds.

(a) Find the value of V . [2]

(b) Find the acceleration of the particle when $t = 35$. [2]

5 DO NOT USE A CALCULATOR IN THIS QUESTION.

In this question, all lengths are in centimetres.

- (a) You are given that $\cos 120^\circ = -\frac{1}{2}$, $\sin 120^\circ = \frac{\sqrt{3}}{2}$ and $\tan 120^\circ = -\sqrt{3}$.

In the triangle ABC , $AB = 5\sqrt{3} - 6$, $BC = 5\sqrt{3} + 6$ and angle $ABC = 120^\circ$. Find AC , giving your answer in the form $a\sqrt{b}$ where a and b are integers greater than 1. [4]

9

- (b) You are given that $\cos 30^\circ = \frac{\sqrt{3}}{2}$, $\sin 30^\circ = \frac{1}{2}$ and $\tan 30^\circ = \frac{1}{\sqrt{3}}$.

In the triangle PQR , $PQ = 3 + 2\sqrt{5}$ and angle $PQR = 30^\circ$. Given that the area of this triangle is $\frac{2+5\sqrt{5}}{4}$, find QR , giving your answer in the form $c + d\sqrt{5}$, where c and d are integers. [4]

10

6 **(a)** Show that $\frac{\cot \theta + \tan \theta}{\sec \theta} = \operatorname{cosec} \theta$.

[4]

11

(b) Hence solve the equation $\left(\frac{\cot \frac{\phi}{3} + \tan \frac{\phi}{3}}{\sec \frac{\phi}{3}} \right)^2 = 2$, for $-540^\circ < \phi < 540^\circ$. [6]

12

7 (a) A team of 8 people is to be chosen from a group of 15 people.

(i) Find the number of different teams that can be chosen. [1]

(ii) Find the number of different teams that can be chosen if the group of 15 people contains a family of 4 people who must be kept together. [3]

(b) Given that $(n+9) \times {}^n P_{10} = (n^2 + 243) \times {}^{n-1} P_9$, find the value of n . [3]

13

8 A curve has the equation $y = \frac{(3x-4)^{\frac{1}{3}}}{2x+1}$.

(a) Show that $\frac{dy}{dx} = \frac{Ax+B}{(2x+1)^2(3x-4)^{\frac{2}{3}}}$, where A and B are integers to be found. [5]

(b) Find the coordinates of the stationary point on the curve. [2]

14

- 9 (a) The first three terms of an arithmetic progression are $\ln q$, $\ln q^4$ and $\ln q^7$, where q is a positive constant. The sum to n terms of this progression is $4845 \ln q$. Find the value of n . [3]

- (b) The first three terms of a geometric progression are p^{3x} , p^x and p^{-x} , where p is a positive integer. Find the n th term of this progression giving your answer in the form $p^{(a+bn)x}$. [3]

15

- (c) The first three terms of a different geometric progression are $\frac{4}{3}\cos^2 3\theta$, $\frac{16}{9}\cos^4 3\theta$ and $\frac{64}{27}\cos^6 3\theta$, for $0 < \theta < \frac{\pi}{3}$. Find the set of values of θ for which this progression has a sum to infinity. [5]

Question 10 is printed on the next page.

10 It is given that $y = (3x + 1)^2 \ln(3x + 1)$.

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

(b) Hence find $\int (3x + 1) \ln(3x + 1) dx$. [4]

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.