



## Cambridge O Level

CANDIDATE  
NAME

--

CENTRE  
NUMBER

--	--	--	--	--

CANDIDATE  
NUMBER

--	--	--	--



**ADDITIONAL MATHEMATICS**

**4037/24**

Paper 2

**May/June 2021**

**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 Find the exact solution of the equation  $\frac{p^{\frac{3}{2}} + p^{\frac{1}{2}}}{p^{-\frac{1}{2}}} = 4$ . [3]

2 Find  $\int \left( \frac{1}{2x-3} + \sqrt{x} \right) dx$ . [3]

- 3 Variables  $x$  and  $y$  are such that when  $\lg y$  is plotted against  $\lg x$  a straight line passing through the points  $(-1, -4)$  and  $(2, 11)$  is obtained. Show that  $y = ax^n$ , where  $a$  and  $n$  are integers. [6]

- 4 The normal to the curve  $y = x^5 - 2x^3 + x^2 + 3$  at the point on the curve where  $x = -1$ , cuts the  $x$ -axis at the point  $P$ . Find the equation of the normal and the coordinates of  $P$ . [7]

5 Solve the simultaneous equations  $3y = x - 20$  and  $x^2 + y^2 - 2x + 6y = 0$ . [4]

6 The variables  $x$  and  $y$  are such that  $y = \sqrt[3]{x^3 - 91}$ .

(a) Find an expression for  $\frac{dy}{dx}$ . [2]

(b) Hence, find the approximate change in  $y$  as  $x$  increases from 6 to  $6 + h$ , where  $h$  is small. [2]

7 (a) Write the expression  $4x^2 - 4x + 7$  in the form  $p(x+q)^2 + r$ , where  $p$ ,  $q$  and  $r$  are constants. [3]

(b) Hence find the greatest value of  $\frac{1}{4x^2 - 4x + 7}$  and state the value of  $x$  at which this occurs. [2]



8 (a) (i) Show that  $\frac{\cos^2 2x}{1 + \sin 2x} = 1 - \sin 2x$ . [2]

(ii) Hence solve  $\frac{3 \cos^2 2x}{1 + \sin 2x} = 1$  for  $0^\circ \leq x \leq 90^\circ$ . [4]

(b) Solve  $\cot\left(y - \frac{\pi}{2}\right) = \sqrt{3}$  for  $0 \leq y \leq \pi$  radians. [3]

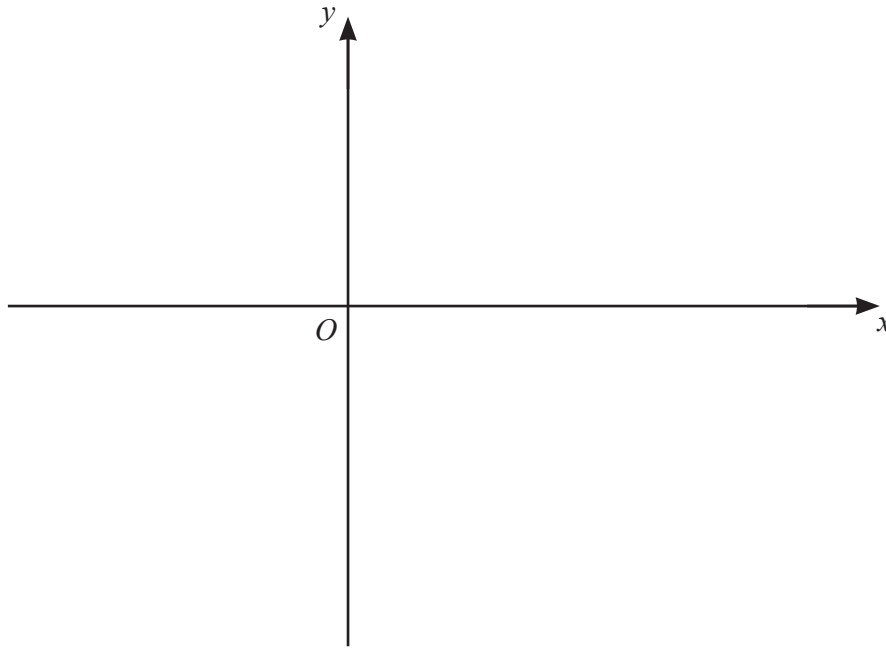
9 A function  $f$  is defined, for all real values of  $x$ , by  $f(x) = 3 + e^{5x}$ .

(a) Find the range of  $f$ . [1]

(b) Find an expression for  $f^{-1}(x)$  and state its domain. [3]

(c) Solve  $f^{-1}(x) = 0$ . [2]

- (d) Sketch the graph of  $y = f(x)$ . Hence, on the same axes, sketch the graph of  $y = f^{-1}(x)$ . Give the coordinates of any points where the graphs cross the axes. [4]



- 10 (a) A particle  $P$  travels in a straight line so that,  $t$  seconds after passing through a fixed point  $O$ , its displacement,  $s$  metres from  $O$ , is given by

$$s = \frac{31}{3} - \frac{e^t}{3} - 10e^{-t}.$$

- (i) Find the value of  $t$  when  $P$  is at instantaneous rest, giving your answer correct to 2 significant figures. [4]

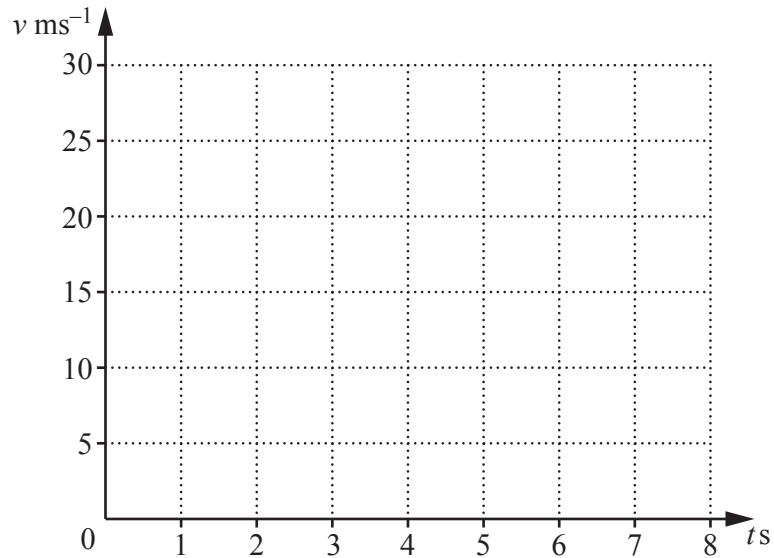
- (ii) Find the distance travelled in the first two seconds. [3]

- (b) A particle  $Q$  travels in a straight line so that  $t$  seconds after leaving a fixed point  $O$ , its velocity,  $v \text{ ms}^{-1}$ , is given by

$$v = 2t \quad \text{for } 0 \leq t \leq 5,$$

$$v = t^2 - 8t + 25 \quad \text{for } t > 5.$$

- (i) On the axes below, sketch the velocity-time graph for the first 8 seconds of the motion of particle  $Q$ . [2]



- (ii) Showing all your working, find the distance travelled by  $Q$  in the first 8 seconds of its motion. [5]

11  $OAB$  is a triangle. The position vectors of points  $A$  and  $B$  relative to the origin  $O$  are  $\mathbf{a}$  and  $\mathbf{b}$  respectively.

The side  $AB$  is extended to point  $C$  such that  $AB = \frac{1}{4}AC$ .

(a) Show that  $\overrightarrow{OC} = 4\mathbf{b} - 3\mathbf{a}$ .

[2]

- (b) The point  $D$  lies on  $OA$  such that  $OD : DA$  is  $3 : 2$ . The line  $CD$  meets  $OB$  at the point  $E$ . Find the position vector of the point  $E$ . [5]

**Question 12 is printed on the next page.**

- 12 (a) The first term of an arithmetic progression is  $-5$  and the fifth term is  $7$ . Find the sum of the first 40 terms of this progression. [4]

- (b) A geometric progression has third term of  $8$  and sixth term of  $0.064$ . Find the sum to infinity of this progression. [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](http://www.cambridgeinternational.org) after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.