



Cambridge Assessment
International Education

Cambridge International AS & A Level

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



FURTHER MATHEMATICS

9231/12

Paper 1 Further Pure Mathematics 1

October/November 2022

2 hours

You must answer on the question paper.

You will need: List of formulae (MF19)

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.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- 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 75.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

1 (a) Use the list of formulae (MF19) to find $\sum_{r=1}^n r(r+2)$ in terms of n , simplifying your answer. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Express $\frac{1}{r(r+2)}$ in partial fractions and hence find $\sum_{r=1}^n \frac{1}{r(r+2)}$ in terms of n . [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

This image shows a blank sheet of white paper with ten horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and extend across the width of the page. There is no handwriting or other markings on the paper.

- [4]

[illegible]

5

- (b) Find the value of $\beta^2\gamma^2\delta^2 + \alpha^2\gamma^2\delta^2 + \alpha^2\beta^2\delta^2 + \alpha^2\beta^2\gamma^2$. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (c) Find the value of $\frac{1}{\alpha^4} + \frac{1}{\beta^4} + \frac{1}{\gamma^4} + \frac{1}{\delta^4}$. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- State the type of each transformation, and make clear the order in which they are applied. [2]

.....

.....

.....

-
-
-
-

- [illegible]

- Find the value of k for which the area of triangle DEF is equal to the area of triangle ABC . [2]

[illegible]

$$\frac{d^{2n-1}}{dx^{2n-1}}(xf(x)) = xf'(x) + (2n-1)f(x). \quad [7]$$
This image shows a full page of a document template. It consists of approximately 28 evenly spaced horizontal dotted lines across the entire width of the page, providing a guide for handwriting practice or structured note-taking. There are no margins, text, or other markings present.

- 5 The curve C has polar equation $r = a \sec^2 \theta$, where a is a positive constant and $0 \leq \theta \leq \frac{1}{4}\pi$.
- (a) Sketch C , stating the polar coordinates of the point of intersection of C with the initial line and also with the half-line $\theta = \frac{1}{4}\pi$. [3]

.....

.....

- (b) Find the maximum distance of a point of C from the initial line. [2]

.....

.....

.....

.....

- (c) Find the area of the region enclosed by C , the initial line and the half-line $\theta = \frac{1}{4}\pi$. [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(d) Find, in the form $y = f(x)$, the Cartesian equation of C . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(a) Find the length PQ . [5]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

The plane Π_1 contains PQ and l_1 .

The plane Π_2 contains PQ and l_2 .

(b) (i) Write down an equation of Π_1 , giving your answer in the form $\mathbf{r} = \mathbf{a} + s\mathbf{b} + t\mathbf{c}$. [1]

.....

.....

(ii) Find an equation of Π_2 , giving your answer in the form $ax + by + cz = d$. [4]

.....

.....

.....

.....

.....

.....

.....

.....

(c) Find the acute angle between Π_1 and Π_2 . [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

-
- This image shows a single sheet of white paper with ten horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

-
- This image shows a full page of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.

15

- (c) Sketch C , stating the coordinates of any intersections with the axes. [3]

-
- (d) Sketch the curve with equation $y = \left| \frac{x^2 - x}{x + 1} \right|$ and find in exact form the set of values of x for which $\left| \frac{x^2 - x}{x + 1} \right| < 6$. [5]

[illegible]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

BLANK PAGE

BLANK PAGE

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.