

CANDIDATE
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FURTHER MATHEMATICS

9231/12

Paper 1

May/June 2017

3 hours

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF10)

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** the questions.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of a calculator is expected, where appropriate.

Results obtained solely from a graphic calculator, without supporting working or reasoning, will not receive credit.

You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **27** printed pages and **1** blank page.



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1 It is given that $\sum_{r=1}^n u_r = n^2(2n + 3)$, where n is a positive integer.

(i) Find $\sum_{r=n+1}^{2n} u_r$. [2]

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(ii) Find u_r . [3]

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3 A curve C has equation $\tan y = x$, for $x > 0$.

(i) Use implicit differentiation to show that

$$\frac{d^2y}{dx^2} = -2x \left(\frac{dy}{dx} \right)^2. \quad [3]$$

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(ii) Hence find the value of $\frac{d^2y}{dx^2}$ at the point $(1, \frac{1}{4}\pi)$ on C . [2]

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- (ii) The matrix \mathbf{B} is given by $\mathbf{B} = \mathbf{A} - 2\mathbf{I}$, where \mathbf{I} is the 3×3 identity matrix. Write down the eigenvalues of \mathbf{B} , and state a set of corresponding eigenvectors. [2]

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9 The curve C has equation $y = \frac{x^2 - 3x + 6}{1 - x}$.

(i) Find the equations of the asymptotes of C . [3]

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(ii) Find the coordinates of the turning points of C . [3]

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(iii) Find the coordinates of any intersections with the coordinate axes. [2]

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(iv) Sketch *C*. [3]

11 The curve C has polar equation $r = a(1 + \sin \theta)$ for $-\pi < \theta \leq \pi$, where a is a positive constant.

(i) Sketch C . [2]

(ii) Find the area of the region enclosed by C . [4]

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