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9231/11

May/June 2024

2 hours

You must answer on the question paper.

You will need: List of formulae (MF19)

- 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.

- 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 **16** pages.

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[illegible]

[1]

[illegible]

- [2]

[illegible]

This image shows a full page of a worksheet designed for handwriting practice. It consists of approximately 20 evenly spaced horizontal dotted lines across the entire width of the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

[illegible]

$$\sum_{r=1}^N \frac{3r+4}{r(r+1)} \left(\frac{1}{4}\right)^{r+1}$$

[4]

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

(c) Deduce the value of $\sum_{r=1}^{\infty} \frac{3r+4}{r(r+1)} \left(\frac{1}{4}\right)^{r+1}$. [1]

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4 The matrix **M** is given by $\mathbf{M} = \begin{pmatrix} \frac{1}{2} & -\frac{1}{2}\sqrt{3} \\ \frac{1}{2}\sqrt{3} & \frac{1}{2} \end{pmatrix} \begin{pmatrix} 14 & 0 \\ 0 & 1 \end{pmatrix}$.

(a) The matrix **M** represents a sequence of two geometrical transformations in the *x*-*y* plane.

Give full details of each transformation, and make clear the order in which they are applied. [4]

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(b) Write $\mathbf{M}^{-1}$ as the product of two matrices, neither of which is **I**. [2]

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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.

- Given that the area of triangle DEF is 28 cm^2 , find the area of triangle ABC . [2]

[illegible]

respectively, relative to the origin O .

- (a) Find the equation of the plane ABC , giving your answer in the form $ax + by + cz = d$. [5]

[illegible]

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- [illegible]

[illegible][illegible]

13

- (c) Sketch C , stating the coordinates of the point of intersection with the y -axis and labelling the asymptotes. [3]

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- (d) (i) Sketch the curve with equation $y = \left| \frac{x^2 + ax + 1}{x + 2} \right|$. [2]

- (ii) On your sketch in part (i), draw the line $y = a$. [1]

- (iii) It is given that $\left| \frac{x^2 + ax + 1}{x + 2} \right| < a$ for $-5 - \sqrt{14} < x < -3$ and $-5 + \sqrt{14} < x < 3$.

Find the value of a . [2]

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- (b) Using the substitution $u = \pi - \theta$, or otherwise, find the area of the region enclosed by C and the initial line. [7]

and verify that this equation has a root for θ between 1.2 and 1.3. [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.

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