Pearson Edexcel International Advanced Level

Friday 23 January 2026

Morning (Time: 1 hour 30 minutes)

Paper reference **WFM03/01A**

Mathematics

International Advanced Subsidiary/ Advanced Level
Further Pure Mathematics F3
Question paper

You must have:
Answer book (sent separately).
Do not return this question paper with the answer book.

Turn over ▶

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P 8 7 5 9 1 A

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1. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

Determine the exact values of x for which

$$\cosh 2x - 7\sinh x = 5$$

giving your answers as natural logarithms.

(7)

(Total for Question 1 is 7 marks)

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2. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

Determine

(a) $\displaystyle\int_{-2}^{1} \frac{1}{x^2 + 4x + 13}\,\mathrm{d}x$, giving your answer as a multiple of π

(5)

(b) $\displaystyle\int_{-1}^{4} \frac{1}{\sqrt{4x^2 - 12x + 34}}\,\mathrm{d}x$, giving your answer in the form $p\ln\left(q + r\sqrt{2}\right)$,

where p, q and r are rational numbers.

(7)

(Total for Question 2 is 12 marks)

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3. The hyperbola H has equation

$$\frac{x^2}{16} - \frac{y^2}{4} = 1$$

The line l is a tangent to H at the point $P(4\cosh\alpha, 2\sinh\alpha)$, where α is a constant, $\alpha \neq 0$

(a) Using calculus, show that an equation for l is

$$2y\sinh\alpha - x\cosh\alpha + 4 = 0$$

(4)

The line l cuts the y-axis at the point A.

(b) Find the coordinates of A in terms of α

(2)

The point B has coordinates $(0, 10\sinh\alpha)$ and the point S is the focus of H for which $x > 0$

(c) Show that the line segment AS is perpendicular to the line segment BS.

(5)

(Total for Question 3 is 11 marks)

4.

$$I_n = \int \sec^n x \, dx \qquad n \geqslant 0$$

(a) Prove that for $n \geqslant 2$

$$(n-1)I_n = \tan x \sec^{n-2} x + (n-2)I_{n-2}$$

(6)

(b) Hence, showing each step of your working, find the exact value of

$$\int_0^{\frac{\pi}{4}} \sec^6 x \, dx$$

(*Solutions relying entirely on calculator technology are not acceptable.*)

(4)

(Total for Question 4 is 10 marks)

5.

$$\mathbf{M} = \begin{pmatrix} 4 & -5 & 0 \\ k & 2 & 0 \\ -3 & -5 & k \end{pmatrix}$$

where k is a real constant, $k \neq 0, k \neq -\frac{8}{5}$

(a) Find, in terms of k, the inverse of the matrix $\mathbf{M}$.

(5)

A transformation $T : \mathbb{R}^3 \to \mathbb{R}^3$ is represented by the matrix

$$\begin{pmatrix} 4 & -5 & 0 \\ -1 & 2 & 0 \\ -3 & -5 & -1 \end{pmatrix}$$

The transformation T maps the plane Π_1 onto the plane Π_2

Given that the plane Π_2 has equation $2x - z = 4$

(b) find a Cartesian equation of the plane Π_1

(6)

(Total for Question 5 is 11 marks)

6. The curve C has parametric equations

$$x = \cosh t + t \qquad y = \cosh t - t \qquad 0 \leqslant t \leqslant \ln 3$$

(a) Show that

$$\left(\frac{\mathrm{d}x}{\mathrm{d}t}\right)^2 + \left(\frac{\mathrm{d}y}{\mathrm{d}t}\right)^2 = 2\cosh^2 t$$

(3)

The curve C is rotated through 2π radians about the x-axis. The area of the curved surface generated is given by S.

(b) Show that

$$S = 2\pi\sqrt{2}\int_0^{\ln 3}\left(\cosh^2 t - t\cosh t\right)\mathrm{d}t$$

(2)

(c) Hence find the value of S, giving your answer in the form

$$\frac{\pi\sqrt{2}}{9}\left(a + b\ln 3\right)$$

where a and b are constants to be determined.

(*Solutions relying entirely on calculator technology are not acceptable.*)

(7)

(Total for Question 6 is 12 marks)

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7. With respect to a fixed origin O, the points $A(-1, 5, 1)$, $B(1, 0, 3)$, $C(2, -1, 2)$ and $D(3, 6, -1)$ are the vertices of a tetrahedron.

(a) Find the volume of the tetrahedron $ABCD$.

(4)

The plane Π contains the points A, B, and C.

(b) Find a Cartesian equation of Π.

(4)

The point T lies on the plane Π.

The line DT is perpendicular to Π.

(c) Find the exact coordinates of the point T.

(4)

(Total for Question 7 is 12 marks)

TOTAL FOR PAPER IS 75 MARKS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

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Mathematics

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Answer Book

You must have:
Question paper (sent separately).
Mathematical Formulae and Statistical Tables (Yellow), calculator.

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ▶

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Question 1

Write the answer to Question 1 on these 2 pages

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 1 continued

This is the end of Question 1 answer space. Please turn the page for Question 2 answer space.

(Total for Question 1 is 7 marks)

Question 2

Write the answer to Question 2 on these 4 pages

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 2 continued

Question 2 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 2 continued

This is the end of Question 2 answer space. Please turn the page for Question 3 answer space.

(Total for Question 2 is 12 marks)

Question 3

Write the answer to Question 3 on these 4 pages

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Question 3 continued

Question 3 continued

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DO NOT WRITE IN THIS AREA

Question 3 continued

This is the end of Question 3 answer space. Please turn the page for Question 4 answer space.

(Total for Question 3 is 11 marks)

Question 4

Write the answer to Question 4 on these 4 pages

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Question 4 continued

Question 4 continued

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Question 4 continued

This is the end of Question 4 answer space. Please turn the page for Question 5 answer space.

(Total for Question 4 is 10 marks)

Question 5

Write the answer to Question 5 on these 4 pages

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Question 5 continued

Question 5 continued

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Question 5 continued

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(Total for Question 5 is 11 marks)

Question 6

Write the answer to Question 6 on these 4 pages

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Question 6 continued

Question 6 continued

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Question 6 continued

This is the end of Question 6 answer space. Please turn the page for Question 7 answer space.

(Total for Question 6 is 12 marks)

Question 7

Write the answer to Question 7 on these 5 pages

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Question 7 continued

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 12 marks)

TOTAL FOR PAPER IS 75 MARKS

DO NOT WRITE IN THIS AREA

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