

Pearson Edexcel International Advanced Level

Wednesday 10 June 2026

Afternoon (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 ►

P85022A

©2026 Pearson Education Ltd.
P:1/1/1/1/




Pearson

1. The hyperbola H has equation

$$\frac{x^2}{4} - \frac{y^2}{3} = 1$$

- (a) Use calculus to show that an equation of the normal to H at the point P with

coordinates $(2 \sec \theta, \sqrt{3} \tan \theta)$ is

$$2x \tan \theta + \sqrt{3} y \sec \theta = k \tan \theta \sec \theta$$

where k is a constant to be determined.

(4)

The normal to H at the point $Q(4, 3)$ meets H again at the point R .

- (b) Determine the coordinates of R .

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

(4)

(Total for Question 1 is 8 marks)



2.

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

(a) Use integration to show that

$$\int \frac{1}{1-x^2} dx = \operatorname{artanh} x + c \quad |x| < 1$$

where c is an arbitrary constant.

(3)

The curve with equation

$$y = \operatorname{artanh} 2x - 8 \arctan 4x \quad 0 < x < \frac{1}{2}$$

has a stationary point P .

(b) Determine

(i) the exact x coordinate of P (ii) the exact y coordinate of P , giving the answer in the form

$$\frac{1}{2} \ln(p + q\sqrt{3}) + \frac{r\pi}{3}$$

where p , q and r are integers.

(5)

(Total for Question 2 is 8 marks)

3.

$$\mathbf{M} = \begin{pmatrix} -2 & 1 & -3 \\ 0 & 3 & k \\ -2 & -2 & 3 \end{pmatrix}$$

where k is a constant.

Given that λ is an eigenvalue of the matrix $\mathbf{M}$

(a) show that

$$\lambda^3 - 4\lambda^2 + f(k)\lambda + 6k + 36 = 0$$

where $f(k)$ is a function to be determined.

(3)

Given that 2 is an eigenvalue of $\mathbf{M}$

(b) use the answer to part (a) to show that $k = -1$

(2)

Given that -3 is also an eigenvalue of $\mathbf{M}$

(c) write down the third eigenvalue of $\mathbf{M}$

(1)

(d) Determine an eigenvector, with integer components, which corresponds to the eigenvalue -3

(2)

(Total for Question 3 is 8 marks)



4.

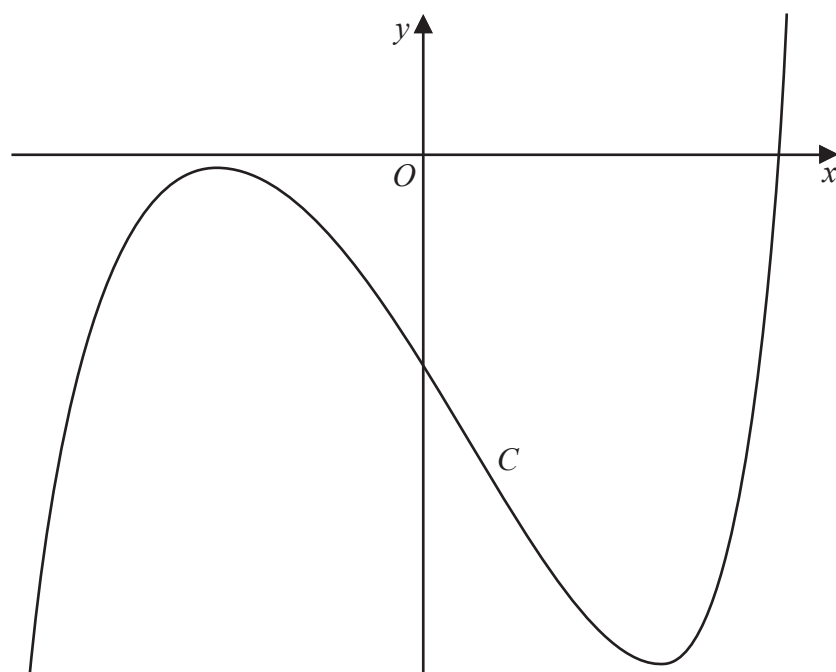


Figure 1

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

(a) Show that

$$\operatorname{arsinh} x = \ln(x + \sqrt{x^2 + 1}) \quad (3)$$

The curve C has equation

$$y = (\sinh x - 3)\cosh x - 6x$$

A sketch of C is shown in Figure 1.

(b) Determine the exact range of values of x for which C is decreasing, giving the answer in terms of simplified natural logarithms.

(6)

(Total for Question 4 is 9 marks)

5. Relative to a fixed origin O , the points P , Q and R have coordinates

$$P(2, 5, 0) \quad Q(-2, 6, 3) \quad R(1, 2, -1)$$

(a) (i) Determine $\vec{OP} \times \vec{OQ}$

(ii) Hence determine the exact volume of the tetrahedron $OPQR$ (3)

Given that the plane Π_1 contains the points P , Q and R

(b) determine a Cartesian equation for Π_1 (4)

The points O , Q and R are in the plane Π_2 which has equation $\mathbf{r} \cdot (12\mathbf{i} - \mathbf{j} + 10\mathbf{k}) = 0$

Given that the point S has coordinates $(-4, -3, 2)$

(c) determine the perpendicular distance from S to Π_2 , giving the answer in the form $k\sqrt{5}$ where k is a fully simplified rational number. (2)

(Total for Question 5 is 9 marks)

6.

$$\mathbf{A} = \begin{pmatrix} p & 3 & -1 \\ 0 & 2 & -1 \\ 3 & -1 & 1 \end{pmatrix}$$

where p is a constant and $p \neq 3$

(a) Determine $\mathbf{A}^{-1}$, giving the answer in simplest form in terms of p . (4)

The transformation represented by $\mathbf{A}$ transforms the point with position vector $2\mathbf{i} + \mathbf{j} - 5\mathbf{k}$ to the point with position vector $16\mathbf{i} + 7\mathbf{j}$

(b) Show that $p = 4$ (1)

The transformation represented by $\mathbf{A}$ transforms the point B to the point with coordinates $(2, q, -1)$ where q is a constant.

(c) Use the answer to part (a) with $p = 4$ to determine the coordinates of B .
Give the answer in simplest form in terms of q . (3)

(Total for Question 6 is 8 marks)



7. The ellipse E has equation

$$\frac{x^2}{45} + \frac{y^2}{20} = 1$$

and eccentricity e

(a) Determine

- (i) the exact value of e
- (ii) the equations of the directrices of E

(4)

The curve C has parametric equations

$$x = 2 \cosh 2t \qquad y = 8 \sinh t \qquad t > 0$$

(b) Show that a Cartesian equation for C is

$$y^2 = 16x - 32 \qquad y > 0$$

(3)

The curve C

- intersects E at the point A
- intersects a directrix of E at the point B

The arc AB of C is rotated through 2π radians about the x -axis.

(c) Use the result in part (b) and algebraic integration to determine the area of the surface generated, giving the answer in the form

$$\frac{p\pi}{3} (q\sqrt{q} - r\sqrt{r})$$

where p , q and r are integers.

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

(7)

(Total for Question 7 is 14 marks)

8.

$$y = \sin^{n-1} x \cos x$$

(a) Show that

$$\frac{dy}{dx} = (n-1)\sin^{n-2} x - n\sin^n x \quad (2)$$

$$I_n = \int e^{6x} \sin^n x \, dx \quad n \geq 0$$

(b) Use integration by parts to show that, for $n \geq 2$

$$(n^2 + 36)I_n = e^{6x} \sin^{n-1} x (6 \sin x - n \cos x) + n(n-1)I_{n-2} \quad (5)$$

(c) Hence show that

$$\int_0^{\frac{\pi}{6}} e^{6x} \sin^2 x \, dx = \frac{1}{240} \left(e^{\pi} (p + q\sqrt{3}) + r \right)$$

where p , q and r are integers to be determined.

(4)

(Total for Question 8 is 11 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	

Pearson Edexcel International Advanced Level

Wednesday 10 June 2026

Afternoon (Time: 1 hour 30 minutes) **Paper reference** **WFM03/01A**

Mathematics

International Advanced Subsidiary/Advanced Level

Further Pure Mathematics F3

Answer Book

You must have:

Question paper (sent separately)

Mathematical Formulae and Statistics 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 8 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 ►

P87952A

©2026 Pearson Education Ltd.
P:1/1/1/1/



Question 1

Write the answer to Question 1 on these 4 pages.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 1 continued

Lined area for writing the answer to Question 1.



Question 1 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

(Total for Question 1 is 8 marks)



Question 2

Write the answer to Question 2 on these 4 pages.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 2 continued

Lined area for writing the answer to Question 2.



Question 2 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

(Total for Question 2 is 8 marks)



Question 3

Write the answer to Question 3 on these 4 pages.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 3 continued

Lined area for writing the answer to Question 3.



Question 3 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(Total for Question 3 is 8 marks)



Question 4

Write the answer to Question 4 on these 4 pages.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 4 continued

Lined area for writing the answer to Question 4.



Question 4 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

(Total for Question 4 is 9 marks)



Question 5

Write the answer to Question 5 on these 4 pages.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 5 continued

Lined area for writing the answer to Question 5.



Question 5 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(Total for Question 5 is 9 marks)



Question 6

Write the answer to Question 6 on these 4 pages.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 6 continued

Lined area for writing the answer to Question 6.



Question 6 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

(Total for Question 6 is 8 marks)



Question 7

Write the answer to Question 7 on these 4 pages.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 7 continued

Lined area for writing the answer to Question 7.



Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

(Total for Question 7 is 14 marks)



Question 8

Write the answer to Question 8 on these 3 pages.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

Question 8 continued

Lined area for writing the answer to Question 8.



Question 8 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(Total for Question 8 is 11 marks)

TOTAL FOR PAPER IS 75 MARKS

