

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Friday 22 January 2021

Afternoon (Time: 1 hour 30 minutes)

Paper Reference **WFM03/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Further Pure Mathematics F3

You must have:

Mathematical Formulae and Statistical Tables (Blue), 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 9 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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1. Relative to a fixed origin O , the points A , B , C and D have coordinates $(0, 4, 1)$, $(4, 0, 0)$, $(3, 5, 2)$ and $(2, 2, k)$ respectively, where k is a constant.

(a) Determine the exact area of triangle ABC .

(3)

(b) Determine in terms of k , the volume of the tetrahedron $ABCD$, simplifying your answer.

(3)

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Question 1 continued

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Question 1 continued

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Question 1 continued

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(Total 6 marks)

Q1



2.

$$y = \ln(\tanh 2x) \quad x > 0$$

(a) Show that

$$\frac{dy}{dx} = p \operatorname{cosech} 4x$$

where p is a constant to be determined.

(4)

(b) Hence determine, in simplest form, the exact value of x for which $\frac{dy}{dx} = 1$

(2)

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Question 2 continued

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(Total 6 marks)

Q2



$$\mathbf{A} = \begin{pmatrix} 2 & k & 2 \\ 2 & 2 & k \\ 1 & 2 & 2 \end{pmatrix} \quad \text{where } k \text{ is a constant}$$

- (2)

(4)

[illegible]

Question 3 continued

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Question 3 continued

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(Total 6 marks)

Q3



4. Using the substitution $x = 4 \cosh \theta$ show that

$$\int \frac{1}{(x^2 - 16)^{\frac{3}{2}}} dx = \frac{ax}{\sqrt{x^2 - 16}} + c \quad |x| > 4$$

where a is a constant to be determined and c is an arbitrary constant.

(6)

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Question 4 continued

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Question 4 continued

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(Total 6 marks)

Q4



5.

$$\mathbf{M} = \begin{pmatrix} 6 & -2 & -1 \\ -2 & 6 & -1 \\ -1 & -1 & 5 \end{pmatrix}$$

Given that 8 is an eigenvalue of $\mathbf{M}$

(a) determine an eigenvector corresponding to the eigenvalue 8 (2)

(b) Determine the other two eigenvalues of $\mathbf{M}$. (3)

(c) Hence find an orthogonal matrix $\mathbf{P}$ and a diagonal matrix $\mathbf{D}$ such that $\mathbf{P}^T \mathbf{M} \mathbf{P} = \mathbf{D}$ (4)

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Question 5 continued

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Question 5 continued

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(Total 9 marks)

Q5





Question 6 continued

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Question 6 continued

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(Total 10 marks)

Q6



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- (c) determine the possible values of k . (4)

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Question 7 continued

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Question 7 continued

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(Total 11 marks)

Q7





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Question 8 continued

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Question 8 continued

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Question 8 continued

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(Total 9 marks)

Q8



$$\frac{x^2}{25} + \frac{y^2}{16} = 1$$

The line l is the normal to the ellipse at the point P .

$$5x \sin \theta - 4y \cos \theta = 9 \sin \theta \cos \theta \quad (5)$$

(b) Determine the coordinates of F . (2)

(c) Show that

$$\frac{|QF|}{|PF|} = e$$

where e is the eccentricity of E . (5)

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Question 9 continued

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Question 9 continued

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TOTAL FOR PAPER: 75 MARKS