Vrite your name here Surname	Other names
Pearson Edexcel nternational Advanced Level	Centre Number Candidate Number
Further Pu	140
Mathemat Advanced/Advanced	tics F3
Mathemat	ics F3 d Subsidiary

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. 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). Coloured pencils and highlighter pens must not be used.
- **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.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

## Information

- 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.

Turn over ▶

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1. The line x = 8 is a directrix of the ellipse with equation

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, \quad a > 0, \ b > 0,$$

and the point (2, 0) is the corresponding focus.

Find the value of a and the value of b.

**(5)** 


Leave blank Question 1 continued Q1 (Total 5 marks)

169

Sample Assessment Materials

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Use calculus to find the exact value of $\int_{-2}^{1} \frac{1}{x^2 + 4x + 13} dx$ .	(5)

Question 2 continued	
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<b>3.</b> (a)	Starting from the definiti	ons of $\sinh x$ and $\cosh x$ in terms of exponentials, p $\cosh 2x = 1 + 2\sinh^2 x$	orove (3)
(b)	Solve the equation	$\cosh 2x - 3\sinh x = 15,$	
	giving your answers as ex	xact logarithms.	(5)

Leave blank Question 3 continued Q3 (Total 8 marks)

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- 4.  $I_n = \int_0^a (a-x)^n \cos x \, dx$ , a > 0,  $n \ge 0$ 
  - (a) Show that, for  $n \ge 2$ ,

$$I_n = na^{n-1} - n(n-1)I_{n-2}$$

(5)

(b) Hence evaluate  $\int_{0}^{\frac{\pi}{2}} \left(\frac{\pi}{2} - x\right)^{2} \cos x \, dx.$ 

(3)

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Leave blank **Question 4 continued** Q4 (Total 8 marks)

Sample Assessment Materials

5. Given that  $y = (\operatorname{arcosh} 3x)^2$ , where 3x > 1, show that

(a) 
$$(9x^2 - 1)\left(\frac{dy}{dx}\right)^2 = 36y$$
, (5)

(b) 
$$(9x^2 - 1)\frac{d^2y}{dx^2} + 9x\frac{dy}{dx} = 18$$
. (4)

Leave blank **Question 5 continued** 

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Question 5 continued	
	 (

$$\mathbf{M} = \begin{pmatrix} 1 & 0 & 3 \\ 0 & -2 & 1 \\ k & 0 & 1 \end{pmatrix}, \text{ where } k \text{ is a constant.}$$

Given that  $\begin{pmatrix} 6 \\ 1 \\ 6 \end{pmatrix}$  is an eigenvector of  $\mathbf{M}$ ,

- (a) find the eigenvalue of **M** corresponding to  $\begin{pmatrix} 6 \\ 1 \\ 6 \end{pmatrix}$ , (2)
- (b) show that k = 3, (2)
- (c) show that **M** has exactly two eigenvalues. (4)

A transformation  $T: \mathbb{R}^3 \to \mathbb{R}^3$  is represented by **M**.

The transformation T maps the line  $l_1$ , with cartesian equations  $\frac{x-2}{1} = \frac{y}{-3} = \frac{z+1}{4}$ , onto the line  $l_2$ .

(d) Taking k = 3, find cartesian equations of  $l_2$ .

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7.	The	nlane	П	has	vector	equation
/ ·	1110	prunc	11	Hus	V CCLOI	equation

$$\mathbf{r} = 3\mathbf{i} + \mathbf{k} + \lambda (-4\mathbf{i} + \mathbf{j}) + \mu (6\mathbf{i} - 2\mathbf{j} + \mathbf{k})$$

(a) Find an equation of  $\Pi$  in the form  $\mathbf{r.n} = p$ , where  $\mathbf{n}$  is a vector perpendicular to  $\Pi$  and p is a constant.

**(5)** 

The point P has coordinates (6, 13, 5). The line l passes through P and is perpendicular to  $\Pi$ . The line l intersects  $\Pi$  at the point N.

(b) Show that the coordinates of N are (3, 1, -1).

**(4)** 

The point R lies on  $\Pi$  and has coordinates (1,0,2).

(c) Find the perpendicular distance from N to the line PR. Give your answer to 3 significant figures.

**(5)** 

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8. The hyperbola *H* has equation  $\frac{x^2}{16} - \frac{y^2}{4} = 1$ .

The line  $l_1$  is the tangent to H at the point  $P(4 \sec t, 2 \tan t)$ .

(a) Use calculus to show that an equation of  $l_1$  is

$$2y\sin t = x - 4\cos t$$

**(5)** 

The line  $l_2$  passes through the origin and is perpendicular to  $l_1$ .

The lines  $l_1$  and  $l_2$  intersect at the point Q.

(b) Show that, as t varies, an equation of the locus of Q is

$$(x^2 + y^2)^2 = 16x^2 - 4y^2$$

(8)

Leave blank **Question 8 continued** 

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Question 8 continued			Leave
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			Q8
		(Total 13 marks)	
		TOTAL FOR PAPER: 75 MARKS	
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