

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel Award

Tuesday 24 June 2025

Afternoon (Time: 3 hours)

Paper reference **9811/01**

Advanced Extension Award

Mathematics

You must have:
 Mathematical Formulae and Statistical Tables
 An insert for questions 5, 6 and 7 (enclosed)

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- **Calculators may not be used.**
- You must **show all your working.**
- Answers should be given in as simple a form as possible, e.g. $\frac{2\pi}{3}$, $\sqrt{2}$, $3\sqrt{2}$.

Information

- The total mark for this paper is 100 of which **7** marks are for style and clarity of presentation.
- The style and clarity of presentation marks will be indicated as **(+S1) or (+S2)**.
- There are 7 questions in this question paper.
- The marks for each question are shown in brackets.
- The total mark for each question is shown at the end of the 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. Using the substitution $u = \frac{\pi}{2}\sqrt{1+x}$ evaluate

$$\int_{\frac{5}{4}}^{\frac{21}{4}} \sec^2\left(\frac{\pi}{2}\sqrt{1+x}\right) dx$$

(10)

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Question 1 continued

Lined area for writing the answer to Question 1.



Question 1 continued

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Question 1 continued

Handwriting practice area with horizontal lines.

(Total for Question 1 is 10 marks)



2. (a) On separate diagrams sketch the graph of

(i) $y = |x^2 - 4|$ (3)

(ii) $y = ||x^2 - 4| - 5|$ (4)

Indicate clearly on each sketch the coordinates of

- any vertices
- any points where the graph touches or crosses the coordinate axes

(b) Hence solve the equation

$$||x^2 - 4| - 5| = \frac{1}{2}x^2$$

(4)



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Question 2 continued



Question 2 continued

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Question 2 continued

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(Total for Question 2 is 11 marks)



3. Solve the equation

$$\arcsin 2x = \arccos x - \frac{\pi}{6} \quad 0 \leq x \leq 0.5 \quad (5)$$

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Question 3 continued

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(Total for Question 3 is 5 marks)



4. In this question you may assume that $\sqrt{p}$ is irrational for any prime number p .

- (a) Use proof by contradiction to show that there is no rational number a and integer b for which

$$\sqrt{5} = a + b\sqrt{7} \quad (5)$$

- (b) Hence prove that $\sqrt{5} + \sqrt{7}$ is not a rational number.

(2)
(+S1)



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Question 4 continued

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Question 4 continued

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Question 4 continued

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(Total for Question 4 is 8 marks)



5. The discrete random variable X has the probability distribution

n	2	4	6	8	10
$P(X = n)$	$\frac{1}{10} \operatorname{cosec}^2 x$	a	$\frac{1}{5} \cot^2 x$	$\frac{1}{10} \sec^2 x$	$\frac{1}{5} \tan^2 x$

where a and x are constants.

(a) Show that

$$\sin^2 2x = \frac{6}{7-5a} \quad (7)$$

(b) Use the result from part (a) to find a restriction on the maximum possible value of a . (2)

The random variables X_1 and X_2 are independent and each have the same distribution as X .

Given that $P(X_1 \times X_2 = 16) = a - \frac{1}{25}$

(c) determine any possible values of a , justifying your answer.

(8)
(+S2)



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Question 5 continued

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Question 5 continued

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Question 5 continued

Lined area for writing the answer to Question 5.



Question 5 continued

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Question 5 continued

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(Total for Question 5 is 19 marks)



6. Relative to a fixed origin O , the points A , B and C have position vectors

$$\vec{OA} = 10\mathbf{i} + 5\mathbf{j} + 4\mathbf{k} \quad \vec{OB} = -4\mathbf{i} + 7\mathbf{j} - \mathbf{k} \quad \vec{OC} = -2\mathbf{i} + 17\mathbf{j} + 10\mathbf{k}$$

- (a) Show that triangle ABC is isosceles.

(2)

The circle S lies inside triangle ABC such that each side of the triangle is a tangent to S .

The centre, X , of S lies on the angle bisector of each vertex of the triangle.

The point D lies on AC such that $|\vec{AD}| = |\vec{AB}|$

- (b) Find the position vector of D .

(2)

- (c) Find the position vector of the midpoint of BD .

(2)

- (d) Hence show that the position of X is given by

$$\vec{OX} = 10\mathbf{i} + 5\mathbf{j} + 4\mathbf{k} + p(-2\mathbf{i} + \mathbf{j})$$

where p is a scalar constant.

(4)

- (e) Use the angle bisector of vertex B to find another expression for $\vec{OX}$ in terms of a scalar constant q .

(3)

- (f) By equating the $\mathbf{k}$ components of the two expressions for $\vec{OX}$, determine the value of q .

(2)

- (g) Find

- (i) the position vector of the centre of S ,

(2)

- (ii) the radius of S .

(4)

(+S2)



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Question 6 continued

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Question 6 continued

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Question 6 continued

Lined area for writing the answer to Question 6.



Question 6 continued

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Question 6 continued

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(Total for Question 6 is 23 marks)



7. Given $u = y^x$

- (a) by taking $\ln$ of both sides, or otherwise, determine $\frac{du}{dx}$ in terms of x , y and $\frac{dy}{dx}$ only. (5)

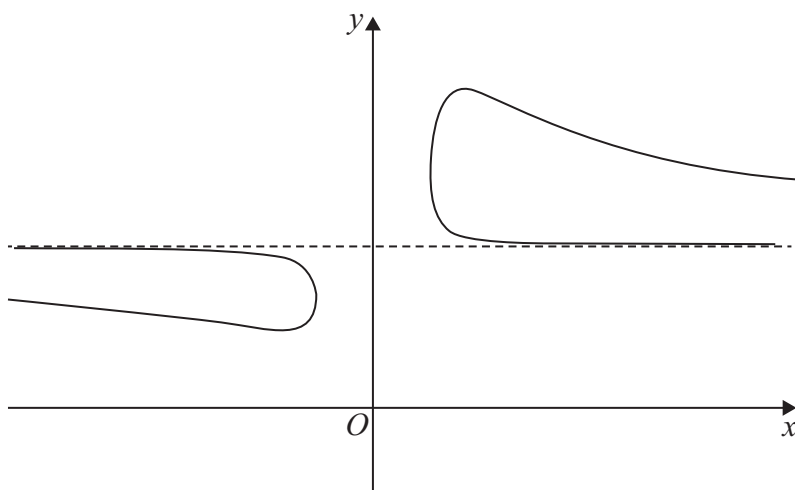


Figure 1

Figure 1 shows a sketch of the curve given by the equation

$$3y^x - x^3 \ln y = 0$$

The curve has a horizontal asymptote $y = 1$, and is defined for

- $x \leq -a, \quad x \geq a$
- $b \leq y \leq c \quad y \neq 1$

where a , b and c are positive constants.

- (b) Determine $\frac{dy}{dx}$ for this curve. (4)
- (c) Find the value of a . (6)
- (d) Find the value of b and the value of c . (7)
- (+S2)



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Question 7 continued

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Question 7 continued

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Question 7 continued

Lined area for writing the answer to Question 7.



Question 7 continued

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(Total for Question 7 is 24 marks)

TOTAL FOR PAPER IS 100 MARKS



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Insert for questions 5, 6 and 7

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5. The discrete random variable X has the probability distribution

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(c) determine any possible values of a , justifying your answer. (8)
(+S2)

(Total for Question 5 is 19 marks)

6. Relative to a fixed origin O , the points A , B and C have position vectors

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(4)

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(2)

(ii) the radius of S .

(4)

(+S2)

(Total for Question 6 is 23 marks)

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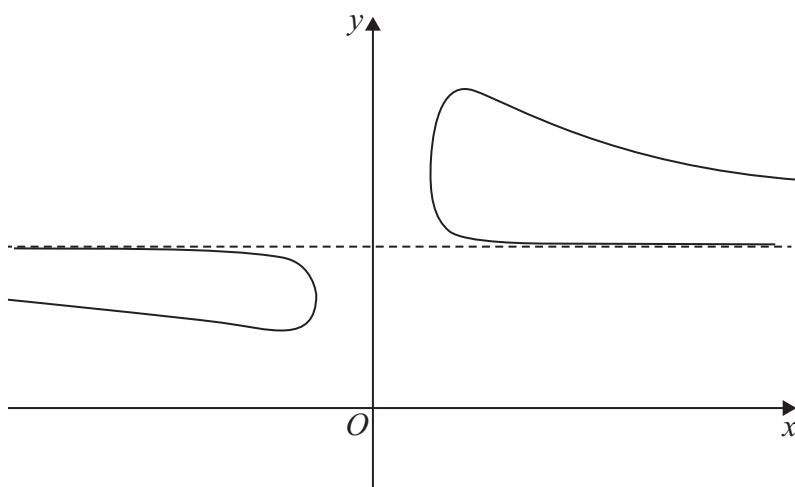


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- (d) Find the value of b and the value of c . (7)
(+S2)

(Total for Question 7 is 24 marks)