

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 8 January 2021**

Afternoon (Time: 1 hour 30 minutes)

Paper Reference **WFM01/01**

**Mathematics**

**International Advanced Subsidiary/Advanced Level**  
**Further Pure Mathematics F1**

**You must have:**

Mathematical Formulae and Statistical Tables (Lilac), calculator

Total Marks

**Candidates may use any calculator allowed 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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2. Given that  $x = \frac{3}{8} + \frac{\sqrt{71}}{8}i$  is a root of the equation

$$4x^3 - 19x^2 + px + q = 0$$

(a) write down the other complex root of the equation. **(1)**

Given that  $x = 4$  is also a root of the equation,

(b) find the value of  $p$  and the value of  $q$ . **(4)**

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4. The equation  $2x^2 + 5x + 7 = 0$  has roots  $\alpha$  and  $\beta$

Without solving the equation

(a) determine the exact value of  $\alpha^3 + \beta^3$  **(3)**

(b) form a quadratic equation, with integer coefficients, which has roots

$\frac{\alpha^2}{\beta}$  and  $\frac{\beta^2}{\alpha}$  **(5)**

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5. (a) Using the formulae for  $\sum_{r=1}^n r$  and  $\sum_{r=1}^n r^2$ , show that

$$\sum_{r=1}^n (r+1)(r+5) = \frac{n}{6}(n+7)(2n+7)$$

for all positive integers  $n$ .

(5)

- (b) Hence show that

$$\sum_{r=n+1}^{2n} (r+1)(r+5) = \frac{7n}{6}(n+1)(an+b)$$

where  $a$  and  $b$  are integers to be determined.

(2)

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**Question 5 continued**

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6. The complex number  $z$  is defined by

$$z = -\lambda + 3i \quad \text{where } \lambda \text{ is a positive real constant}$$

Given that the modulus of  $z$  is 5

(a) write down the value of  $\lambda$  (1)

(b) determine the argument of  $z$ , giving your answer in radians to one decimal place. (2)

**In part (c) you must show detailed reasoning.**

**Solutions relying on calculator technology are not acceptable.**

(c) Express in the form  $a + ib$  where  $a$  and  $b$  are real,

(i)  $\frac{z + 3i}{2 - 4i}$

(ii)  $z^2$  (5)

(d) Show on a single Argand diagram the points  $A, B, C$  and  $D$  that represent the complex numbers

$$z, z^*, \frac{z + 3i}{2 - 4i} \text{ and } z^2 \quad (3)$$

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7. The matrix **A** is defined by

$$\mathbf{A} = \begin{pmatrix} 4 & -5 \\ -3 & 2 \end{pmatrix}$$

The transformation represented by **A** maps triangle  $T$  onto triangle  $T'$

Given that the area of triangle  $T$  is  $23 \text{ cm}^2$

- (a) determine the area of triangle  $T'$  (2)

The point  $P$  has coordinates  $(3p + 2, 2p - 1)$  where  $p$  is a constant. The transformation represented by **A** maps  $P$  onto the point  $P'$  with coordinates  $(17, -18)$

- (b) Determine the value of  $p$ . (2)

Given that

$$\mathbf{B} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$$

- (c) describe fully the single geometrical transformation represented by matrix **B** (2)

The transformation represented by matrix **A** followed by the transformation represented by matrix **C** is equivalent to the transformation represented by matrix **B**

- (d) Determine **C** (3)

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**Question 7 continued**

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**Question 7 continued**

Handwriting practice area consisting of 30 horizontal lines.

**(Total 9 marks)**

Q7



8. The hyperbola  $H$  has Cartesian equation  $xy = 25$

The parabola  $P$  has parametric equations  $x = 10t^2, y = 20t$

The hyperbola  $H$  intersects the parabola  $P$  at the point  $A$

(a) Use algebra to determine the coordinates of  $A$  (3)

The point  $B$  with coordinates  $(10, 20)$  lies on  $P$

(b) Find an equation for the normal to  $P$  at  $B$   
Give your answer in the form  $ax + by + c = 0$ , where  $a, b$  and  $c$  are integers to be determined. (5)

(c) Use algebra to determine, in simplest form, the exact coordinates of the points where this normal intersects the hyperbola  $H$  (6)

(Area containing horizontal lines for student answers)

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Question 8 continued

A series of horizontal lines for writing.

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Question 9 continued

Lined writing area for the answer.

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Question 9 continued

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Question 9 continued

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