

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

Candidate Number

--	--	--	--	--

--	--	--

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 ▶

P66640A

©2021 Pearson Education Ltd.

1/1/



P 6 6 6 4 0 A 0 1 3 2



Pearson

Leave
blank

1. (a) Show that the equation $4x - 2 \sin x - 1 = 0$, where x is in radians, has a root α in the interval $[0.2, 0.6]$ (2)

(2)

- (b) Starting with the interval $[0.2, 0.6]$, use interval bisection twice to find an interval of width 0.1 in which α lies.

(3)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 1 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q1

(Total 5 marks)



P 6 6 6 4 0 A 0 3 3 3 2

Leave
blank

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)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 2 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q2

(Total 5 marks)



P 6 6 6 4 0 A 0 5 3 2

Leave
blank

3. The matrix \mathbf{M} is defined by

$$\mathbf{M} = \begin{pmatrix} k+5 & -2 \\ -3 & k \end{pmatrix}$$

- (a) Determine the values of k for which \mathbf{M} is singular.

(2)

Given that \mathbf{M} is non-singular,

- (b) find \mathbf{M}^{-1} in terms of k .

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 3 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q3

(Total 4 marks)



P 6 6 6 4 0 A 0 7 3 2

Leave
blank

4. The equation $2x^2 + 5x + 7 = 0$ has roots α and β

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

$$\frac{\alpha^2}{\beta} \text{ and } \frac{\beta^2}{\alpha}$$

(5)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 4 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



P 6 6 6 4 0 A 0 9 3 2

Leave
blank

Question 4 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 4 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q4

(Total 8 marks)



Leave
blank

- 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)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 5 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 5 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 5 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q5

(Total 7 marks)



P 6 6 6 4 0 A 0 1 5 3 2

Leave
blank

6. The complex number z is defined by

$z = -\lambda + 3i$ where λ is a positive real constant

Given that the modulus of z is 5

- (a) write down the value of λ (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

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

(5)

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



Leave
blank

Question 6 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 6 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 6 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q6

(Total 11 marks)



P 6 6 6 4 0 A 0 1 9 3 2

Leave
blank

7. The matrix \mathbf{A} is defined by

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

The transformation represented by \mathbf{A} maps triangle T onto triangle T'

Given that the area of triangle T is 23 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 \mathbf{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)



Leave
blank

Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



P 6 6 6 6 4 0 A 0 2 1 3 2

Leave
blank

Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q7

(Total 9 marks)



Leave
blank

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)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 8 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 8 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 8 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Q8

(Total 14 marks)



P 6 6 6 6 4 0 A 0 2 7 3 2

Leave
blank

9. (i) A sequence of numbers u_1, u_2, u_3, \dots is defined by

$$u_{n+1} = \frac{1}{3}(2u_n - 1) \quad u_1 = 1$$

Prove by induction that, for $n \in \mathbb{Z}^+$

$$u_n = 3\left(\frac{2}{3}\right)^n - 1 \quad (6)$$

- $$(ii) \quad f(n) = 2^{n+2} + 3^{2n+1}$$

Prove by induction that, for $n \in \mathbb{Z}^+$, $f(n)$ is a multiple of 7

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 9 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 9 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 9 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Leave
blank

Question 9 continued

Q9

(Total 12 marks)

1

TOTAL FOR PAPER: 75 MARKS

