Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Mock Paper Set 1

(Time: 1 hour 30 minutes) | Paper Reference **9FM0/01**

Further Mathematics

Advanced

Paper 1: Core Pure Mathematics 1

You must have:
Mathematical Formulae and Statistical Tables, calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic 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.
- Answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 8 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.

Turn over ▶

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Pearson

Answer ALL questions. Write your answers in the spaces provided.

1. Given that

$$f(x) = e^{2x} \cos x$$

(a) Show that

$$f''(x) = pf(x) + qf'(x)$$

where p and q are integers to be determined.

(5)

(b) Hence find the Maclaurin series for $f(x)$, in ascending powers of x, up to and including the term in x^5, giving each coefficient in its simplest form.

(3)

Question 1 continued

(Total for Question 1 is 8 marks)

2. (a) Use de Moivre's theorem to show that

$$\cos^5\theta = \frac{1}{16}(\cos 5\theta + 5\cos 3\theta + 10\cos\theta)$$

(5)

(b) Hence solve, for $\pi < \theta < 2\pi$, the equation

$$\cos\theta - \cos 5\theta = 5\cos 3\theta$$

(5)

Question 2 continued

Question 2 continued

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Question 2 continued

(Total for Question 2 is 10 marks)

3.

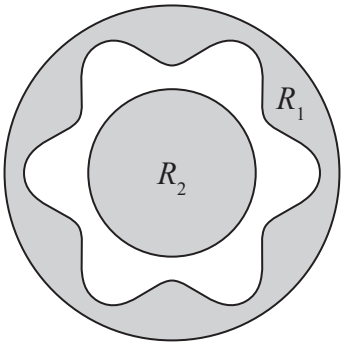

Figure 1

Figure 1 shows the design for a new type of security wheel nut for a car.
The inner circle has a radius of 5 mm and the outer circle has a radius of 10 mm.
The curve, C, between the two circles, is modelled by the polar equation

$$r = 7.5 + 1.5\cos 6\theta \qquad 0 \leqslant \theta < 2\pi$$

where r is measured in millimetres.

The regions R_1 and R_2 are shown shaded in Figure 1 and both regions must be coated in a special paint.

The region R_1 is enclosed between the outer circle and C.

The region R_2 is enclosed by the inner circle.

Find the area that must be coated in the special paint, according to the model.

Give your answer in cm^2 to 2 decimal places.

[*Solutions based entirely on graphical or numerical methods are not acceptable.*]

(7)

Question 3 continued

Question 3 continued

Question 3 continued

(Total for Question 3 is 7 marks)

4. (a) Prove that, for all positive integers n,

$$\sum_{r=1}^{n} \frac{1}{(5r-2)(5r+3)} \equiv \frac{n}{a(bn+c)}$$

where a, b and c are integers to be determined.

(5)

(b) Hence, showing your working, find the exact value of

$$\sum_{r=10}^{50} \frac{1}{(5r-2)(5r+3)}$$

(2)

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Question 4 continued

Question 4 continued

Question 4 continued

(Total for Question 4 is 7 marks)

5. A student models the motion of a raindrop as it falls towards the ground by the differential equation

$$(t + 4)\frac{dv}{dt} + 5v = 10(t + 4)$$

where $v\,\text{m}\,\text{s}^{-1}$ is the velocity of the raindrop t seconds after it starts to fall from a cloud.

The student assumes that the raindrop is initially at rest.

(a) Find, according to the model, the velocity of the raindrop after 3 seconds.

(6)

(b) Describe the motion of the raindrop for large values of t according to the student's model.

(1)

(c) State a limitation of the model.

(1)

Question 5 continued

(Total for Question 5 is 8 marks)

6. A sequence of numbers is defined by

$$u_1 = 1 \qquad u_2 = 5$$

$$u_{n+2} = 5u_{n+1} - 6u_n \qquad n \geqslant 1$$

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

$$u_n = 3^n - 2^n$$

(6)

Question 6 continued

(Total for Question 6 is 6 marks)

7. The plane Π_1 has equation

$$\mathbf{r}.(2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}) = -8$$

(a) Find the perpendicular distance from the point (8, 2, 10) to Π_1

(3)

The plane Π_2 has equation

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

where λ and μ are scalar parameters.

(b) Show that the vector $4\mathbf{i} + \mathbf{j} - 7\mathbf{k}$ is perpendicular to Π_2

(2)

(c) Find, to the nearest degree, the acute angle between Π_1 and Π_2

(3)

(d) Find a vector equation of the line of intersection of the planes Π_1 and Π_2

(4)

Question 7 continued

Question 7 continued

Question 7 continued

(Total for Question 7 is 12 marks)

8. A doctor is studying the concentration of an antibiotic in the blood and the body tissue of a patient.
Let x be the number of micrograms of the antibiotic in the blood.
Let y be the number of micrograms of the antibiotic in the body tissue.
The doctor models her results by the differential equations

$$\frac{dx}{dt} = -5x + y + 51$$

$$\frac{dy}{dt} = 12x - 6y$$

where t is the time in hours after a dose of the antibiotic has been administered to the patient.

(a) Show that

$$\frac{d^2x}{dt^2} + 11\frac{dx}{dt} + 18x = 306$$

(3)

(b) Find a general solution for the number of micrograms of the antibiotic in the blood at time t hours.

(6)

(c) Hence find a general solution for the number of micrograms of the antibiotic in the body tissue at time t hours.

(2)

Initially there is none of this antibiotic in the blood and none of this antibiotic in the body tissue.

(d) Find, in minutes, to 2 decimal places, the time when the rate of increase of the antibiotic in the blood is equal to the rate of increase of the antibiotic in the body tissue.

(5)

(e) Evaluate the model.

(1)

Question 8 continued

Question 8 continued

Question 8 continued

Question 8 continued

(Total for Question 8 is 17 marks)

TOTAL FOR PAPER IS 75 MARKS