

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel
Level 3 GCE**

Centre Number

--	--	--	--	--

Candidate Number

--	--	--

Monday 11 May 2020

Morning (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 (Green), 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.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 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 ▶

P62672A

©2020 Pearson Education Ltd.

1/1/1/1/1/



P 6 2 6 7 2 A 0 1 2 8



Pearson

1.

$$f(z) = 3z^3 + pz^2 + 57z + q$$

where p and q are real constants.

Given that $3 - 2\sqrt{2}i$ is a root of the equation $f(z) = 0$

- (a) show all the roots of $f(z) = 0$ on a single Argand diagram,

(7)

- (b) find the value of p and the value of q .

(3)



Question 1 continued



P 6 2 6 7 2 A 0 3 2 8

Question 1 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 1 continued

(Total for Question 1 is 10 marks)



2. (a) Explain why $\int_1^{\infty} \frac{1}{x(2x+5)} dx$ is an improper integral. (1)

(b) Prove that

$$\int_1^{\infty} \frac{1}{x(2x+5)} dx = a \ln b$$

where a and b are rational numbers to be determined.

(6)



Question 2 continued

(Total for Question 2 is 7 marks)



3.

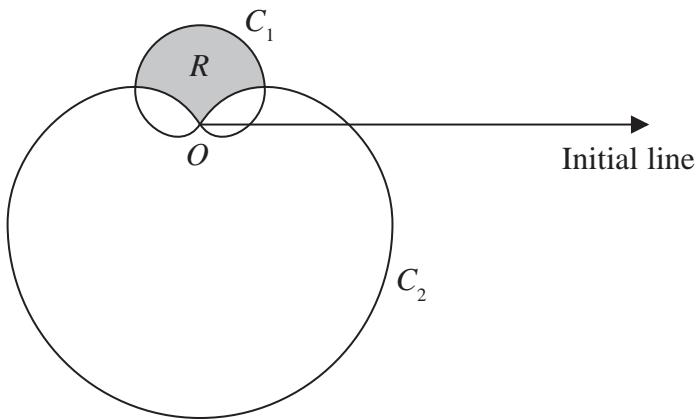
**Figure 1**

Figure 1 shows a sketch of two curves C_1 and C_2 with polar equations

$$C_1: r = (1 + \sin \theta) \quad 0 \leq \theta < 2\pi$$

$$C_2: r = 3(1 - \sin \theta) \quad 0 \leq \theta < 2\pi$$

The region R lies inside C_1 and outside C_2 and is shown shaded in Figure 1.

Show that the area of R is

$$p\sqrt{3} - q$$

where p and q are integers to be determined.

(9)



Question 3 continued



Question 3 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 3 continued

(Total for Question 3 is 9 marks)



4. The plane Π_1 has equation

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

where λ and μ are scalar parameters.

- (a) Find a Cartesian equation for Π_1

(4)

The line l has equation

$$\frac{x-1}{5} = \frac{y-3}{-3} = \frac{z+2}{4}$$

- (b) Find the coordinates of the point of intersection of l with Π_1

(3)

The plane Π_2 has equation

$$\mathbf{r} \cdot (2\mathbf{i} - \mathbf{j} + 3\mathbf{k}) = 5$$

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

(2)



Question 4 continued



Question 4 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 4 continued

(Total for Question 4 is 9 marks)



5. Two compounds, X and Y , are involved in a chemical reaction. The amounts in grams of these compounds, t minutes after the reaction starts, are x and y respectively and are modelled by the differential equations

$$\frac{dx}{dt} = -5x + 10y - 30$$

$$\frac{dy}{dt} = -2x + 3y - 4$$

- (a) Show that

$$\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + 5x = 50$$

(3)

- (b) Find, according to the model, a general solution for the amount in grams of compound X present at time t minutes.

(6)

- (c) Find, according to the model, a general solution for the amount in grams of compound Y present at time t minutes.

(3)

Given that $x = 2$ and $y = 5$ when $t = 0$

- (d) find

(i) the particular solution for x ,

(ii) the particular solution for y .

(4)

A scientist thinks that the chemical reaction will have stopped after 8 minutes.

- (e) Explain whether this is supported by the model.

(1)



Question 5 continued



Question 5 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 5 continued

(Total for Question 5 is 17 marks)



6. (i) Prove by induction that for $n \in \mathbb{Z}^+$

$$\sum_{r=1}^n (3r+1)(r+2) = n(n+2)(n+3) \quad (6)$$

- (ii) Prove by induction that for all positive **odd** integers n

$$f(n) = 4^n + 5^n + 6^n$$

is divisible by 15

(6)



Question 6 continued



Question 6 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 6 continued

(Total for Question 6 is 12 marks)



7. A sample of bacteria in a sealed container is being studied.

The number of bacteria, P , in thousands, is modelled by the differential equation

$$(1+t) \frac{dP}{dt} + P = t^{\frac{1}{2}}(1+t)$$

where t is the time in hours after the start of the study.

Initially, there are exactly 5000 bacteria in the container.

- (a) Determine, according to the model, the number of bacteria in the container 8 hours after the start of the study.

(6)

- (b) Find, according to the model, the rate of change of the number of bacteria in the container 4 hours after the start of the study.

(4)

- (c) State a limitation of the model.

(1)



Question 7 continued



Question 7 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA





Question 7 continued

(Total for Question 7 is 11 marks)

TOTAL FOR PAPER IS 75 MARKS

