

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel
Level 3 GCE**

Centre Number

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Candidate Number

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Time 1 hour 30 minutes

Paper
reference

9FM0/02

Further Mathematics

Advanced

PAPER 2: Core Pure Mathematics 2

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 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.
- Good luck with your examination.

Turn over ►

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2.

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

The matrix \mathbf{A} represents the linear transformation M .

Prove that, for the linear transformation M , there are no invariant lines.

(5)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



Question 4 continued

Lined writing area for the answer.

DO NOT WRITE IN THIS AREA

(Total for Question 4 is 9 marks)



5. The curve C has equation

$$y = \arccos\left(\frac{1}{2}x\right) \quad -2 \leq x \leq 2$$

(a) Show that C has no stationary points.

(3)

The normal to C , at the point where $x = 1$, crosses the x -axis at the point A and crosses the y -axis at the point B .

Given that O is the origin,

(b) show that the area of the triangle OAB is $\frac{1}{54}(p\sqrt{3} + q\pi + r\sqrt{3}\pi^2)$ where p , q and r are integers to be determined.

(5)



6. The curve C has equation

$$r = a(p + 2 \cos \theta) \quad 0 \leq \theta < 2\pi$$

where a and p are positive constants and $p > 2$

There are exactly four points on C where the tangent is perpendicular to the initial line.

(a) Show that the range of possible values for p is

$$2 < p < 4 \quad (5)$$

(b) Sketch the curve with equation

$$r = a(3 + 2 \cos \theta) \quad 0 \leq \theta < 2\pi \quad \text{where } a > 0 \quad (1)$$

John digs a hole in his garden in order to make a pond.

The pond has a uniform horizontal cross section that is modelled by the curve with equation

$$r = 20(3 + 2 \cos \theta) \quad 0 \leq \theta < 2\pi$$

where r is measured in centimetres.

The depth of the pond is 90 centimetres.

Water flows through a hosepipe into the pond at a rate of 50 litres per minute.

Given that the pond is initially empty,

(c) determine how long it will take to completely fill the pond with water using the hosepipe, according to the model. Give your answer to the nearest minute. (7)

(d) State a limitation of the model. (1)



9. (a) Given that $|z| < 1$, write down the sum of the infinite series

$$1 + z + z^2 + z^3 + \dots \quad (1)$$

(b) Given that $z = \frac{1}{2}(\cos \theta + i \sin \theta)$,

(i) use the answer to part (a), and de Moivre's theorem or otherwise, to prove that

$$\frac{1}{2} \sin \theta + \frac{1}{4} \sin 2\theta + \frac{1}{8} \sin 3\theta + \dots = \frac{2 \sin \theta}{5 - 4 \cos \theta} \quad (5)$$

(ii) show that the sum of the infinite series $1 + z + z^2 + z^3 + \dots$ cannot be purely imaginary, giving a reason for your answer.

(2)



