

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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## Pearson Edexcel Level 3 GCE

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 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.

Turn over ►

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Q:1/1/1/1/1/



  
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1. A student was asked to answer the following:

For the complex numbers  $z_1 = 3 - 3i$  and  $z_2 = \sqrt{3} + i$ , find the value of  $\arg\left(\frac{z_1}{z_2}\right)$

The student's attempt is shown below.

Line 1  $\longrightarrow$   $\arg(z_1) = \tan^{-1}\left(\frac{3}{3}\right) = \frac{\pi}{4}$

Line 2  $\longrightarrow$   $\arg(z_2) = \tan^{-1}\left(\frac{1}{\sqrt{3}}\right) = \frac{\pi}{6}$

Line 3  $\longrightarrow$   $\arg\left(\frac{z_1}{z_2}\right) = \frac{\arg(z_1)}{\arg(z_2)}$

Line 4  $\longrightarrow$   $= \frac{\left(\frac{\pi}{4}\right)}{\left(\frac{\pi}{6}\right)} = \frac{3}{2}$

The student made errors in line 1 and line 3

Correct the error that the student made in

(a) (i) line 1

(ii) line 3

(2)

(b) Write down the correct value of  $\arg\left(\frac{z_1}{z_2}\right)$

(1)

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**Question 6 continued**

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P 7 1 8 0 1 A 0 1 9 3 2















8. Two birds are flying towards their nest, which is in a tree.

Relative to a fixed origin, the flight path of each bird is modelled by a straight line.

In the model, the equation for the flight path of the first bird is

$$\mathbf{r}_1 = \begin{pmatrix} -1 \\ 5 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ a \\ 0 \end{pmatrix}$$

and the equation for the flight path of the second bird is

$$\mathbf{r}_2 = \begin{pmatrix} 4 \\ -1 \\ 3 \end{pmatrix} + \mu \begin{pmatrix} 0 \\ 1 \\ -1 \end{pmatrix}$$

where  $\lambda$  and  $\mu$  are scalar parameters and  $a$  is a constant.

In the model, the angle between the birds' flight paths is  $120^\circ$

- (a) Determine the value of  $a$ . (4)

- (b) Verify that, according to the model, there is a common point on the flight paths of the two birds and find the coordinates of this common point. (5)

The position of the nest is modelled as being at this common point.

The tree containing the nest is in a park.

The ground level of the park is modelled by the plane with equation

$$2x - 3y + z = 2$$

- (c) Hence determine the shortest distance from the nest to the ground level of the park. (3)

- (d) By considering the model, comment on whether your answer to part (c) is reliable, giving a reason for your answer. (1)

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**Question 8 continued**

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