

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 9FM0/02	
Further Mathematics Advanced Paper 2: Core Pure Mathematics 2			
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 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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Answer ALL questions. Write your answers in the spaces provided.

1. The roots of the equation

$$2x^3 - 3x^2 + 4x + 7 = 0$$

are α , β and γ

Without solving the equation, determine the value of

(i) $\frac{3}{\alpha} + \frac{3}{\beta} + \frac{3}{\gamma}$

(ii) $(\alpha - 2)(\beta - 2)(\gamma - 2)$

(iii) $\alpha^2 + \beta^2 + \gamma^2$

(8)

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Question 1 continued

Lined area for writing the answer to Question 1.



Question 1 continued

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Question 1 continued

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(Total for Question 1 is 8 marks)



2.

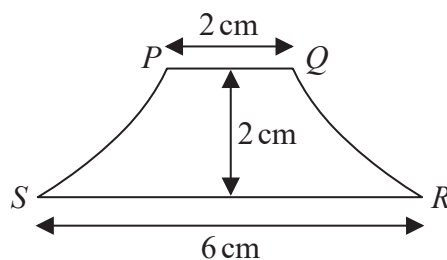


Figure 1

Figure 1 shows the central vertical cross section $PQRS$ of a handle for a drawer. Measurements were taken and the handle was found to have a height of 2 cm and the lengths of the straight lines PQ and SR were 2 cm and 6 cm respectively, as shown in Figure 1.

The handle is modelled by a solid of revolution of a curve C about the y -axis. The curve C has parametric equations

$$x = a \cos^2 \theta \quad y = b \tan \theta \quad \frac{\pi}{6} \leq \theta \leq \frac{\pi}{3}$$

where a and b are constants.

Find, according to the model,

(a) (i) the value of a ,

(ii) the value of b .

(4)

(b) Hence, using calculus, determine the volume of the handle, according to the model.

(6)



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Question 2 continued

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Question 2 continued

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Question 2 continued

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(Total for Question 2 is 10 marks)





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Question 3 continued

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Question 3 continued

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Question 3 continued

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(Total for Question 3 is 9 marks)



4. (a) Determine the values of k for which the system of equations

$$x - 3y + 2z = -7$$

$$kx + y - z = -5$$

$$6x - 5y + (k - 1)z = 1$$

does not have a unique solution.

(4)

Given that $k = 5$

- (b) (i) by finding an appropriate inverse matrix, solve this system of equations,

- (ii) interpret the solution geometrically.

(5)



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Question 4 continued

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Question 4 continued

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Question 4 continued

Lined area for writing answers.

(Total for Question 4 is 9 marks)



5.

$$f(x) = \frac{1}{\sqrt{x^2 + 2x + 10}}$$

(a) Determine $\int f(x) dx$ (3)

(b) Hence show that the mean value of $f(x)$ over the interval $[2, 20]$ may be expressed in the form $a \ln(b + c\sqrt{2})$, where a , b and c are rational constants to be determined. (3)

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Question 5 continued

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(Total for Question 5 is 6 marks)



6. Prove by induction, that for all positive integers n ,

$$\begin{pmatrix} 1 & 1 & 2 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{pmatrix}^n = \begin{pmatrix} 1 & n & \frac{1}{2}(n^2 + 3n) \\ 0 & 1 & n \\ 0 & 0 & 1 \end{pmatrix}$$

(6)



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Question 6 continued

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Question 6 continued

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7. (a) Using the definition of $\cosh x$ in terms of exponentials, prove that

$$4 \cosh^3 x - 3 \cosh x \equiv \cosh 3x \quad (3)$$

- (b) Hence, or otherwise, solve the equation

$$\cosh 3x = 9 \cosh x \quad (4)$$



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Question 7 continued

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(Total for Question 7 is 7 marks)



8. (a) Explain why $\int_0^5 \frac{2}{\sqrt[3]{2-x}} dx$ is an improper integral.

(1)

- (b) Prove that

$$\int_0^5 \frac{2}{\sqrt[3]{2-x}} dx = a(\sqrt[3]{b} - \sqrt[3]{c})$$

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

(5)



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Question 8 continued

Lined area for writing the answer to Question 8.

(Total for Question 8 is 6 marks)



9. The watering of crops on a farm is thought to affect the concentration of nitrates in a nearby river. In a study, the concentration of nitrates in the river is measured at a point downstream from the farm.

The concentration of nitrates is modelled by the differential equation

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = e^{-t} + 1$$

where y is the concentration in milligrams per litre, t hours after the crops were watered.

- (a) Find a general solution for the concentration of nitrates after time t hours. (6)

Initially

- the concentration of nitrates was measured as 1 milligram per litre,
- according to the model, the concentration was increasing at a rate of 9 milligram per litre every hour.

- (b) Find the particular solution for the concentration of nitrates after t hours. (3)

- (c) Hence determine the maximum concentration of nitrates after the crops are watered. (3)

The concentration of nitrates is believed to return to its initial concentration 8 hours after the crops are watered.

- (d) State, with justification, whether this is supported by the model. (2)



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Question 9 continued

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Question 9 continued

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Question 9 continued

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(Total for Question 9 is 14 marks)

TOTAL FOR PAPER IS 75 MARKS

