

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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Specimen Paper

(Time: 1 hour 30 minutes)

Paper Reference **9FM0/4A**

**Further Mathematics**

**Advanced**

**Paper 4A: Further 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 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 ►

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**Pearson**



Question 1 continued

[Lined writing area for Question 1 continued]

(Total for Question 1 is 5 marks)

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**Question 2 continued**

Lined writing area for the response to Question 2.

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Question 2 continued

Lined writing area for the answer to Question 2.

(Total for Question 2 is 12 marks)



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3. (i) Lottery X requires each player to buy a ticket and choose 5 different numbers from the numbers 1 to 45 inclusive.  
 Lottery Y requires each player to buy a ticket and choose 6 different numbers from the numbers 1 to 35 inclusive.  
 A player wins if their chosen numbers match completely those drawn at random by the lotteries.  
 A person wishes to play one of these two lotteries.

The price of a ticket to play each lottery is the same.  
 The prize money for winning each lottery is the same.

Decide which lottery you would recommend that they play, giving a reason for your answer. (2)

- (ii) Use Fermat's little theorem to show that when  $128^{129}$  is divided by 17 the remainder is 9 (4)

- (iii) There are  $3x$  chairs in a room. When these chairs are set out in rows of 7 there are two chairs left over.

- (a) Form and solve a congruence equation for  $x$  (3)

Given that there are at least 100 chairs and that one third of the chairs can be arranged exactly into 5 equal rows,

- (b) find the least possible number of chairs in the room. (3)

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4. (i) Two distinct elements of a group  $G$  are  $a$  and  $b$ .  
The element  $a$  has order 5 and  $a^3b = ba^3$   
Prove that  $ab = ba$

(4)

Given that  $p, q, r$  and  $s$  are distinct elements

- (ii) (a) check each of the group axioms for the set  $A = \{p, q, r, s\}$  under the operation  $\oplus$  defined in the table below.

- (b) Hence determine whether the set  $A$  forms a group under the operation  $\oplus$ .

$\oplus$	$p$	$q$	$r$	$s$
$p$	$p$	$q$	$r$	$s$
$q$	$q$	$p$	$q$	$r$
$r$	$r$	$q$	$p$	$q$
$s$	$s$	$r$	$q$	$p$

(3)

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Question 4 continued

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(Total for Question 4 is 7 marks)

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5.

$$I_n = \int_0^{\frac{\pi}{2}} x^n \cos x \, dx, \quad n \geq 0$$

(a) Prove that, for  $n \geq 2$

$$I_n = \left(\frac{\pi}{2}\right)^n - n(n-1)I_{n-2} \quad (5)$$

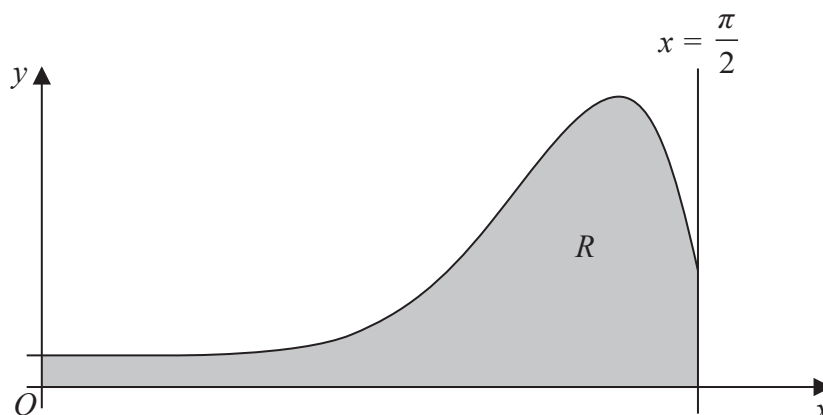


Figure 1

Figure 1 shows the vertical cross-section of a proposed flood defence system. The cross-section of the flood defence system is modelled by the curve with equation

$$y = 1.2x^6 \cos x + 0.2 \quad 0 \leq x \leq \frac{\pi}{2}$$

where  $x$  and  $y$  are measured in metres.

The area  $R$ , shown shaded in Figure 1, is bounded by the curve, the  $y$ -axis, the  $x$ -axis and the line with equation  $x = \frac{\pi}{2}$

The flood defence system will come in hollow sections that will be filled with water once they are in place. Each section will have a length of 10 metres.

(b) Use the model and the answer to part (a), to estimate the volume of water needed to fill each section. (6)

Each section can be filled with water at a maximum rate of 175 litres per minute and is required to be filled with water within 1 hour of being put in place.

(c) Use the model to decide whether this requirement can be met, showing all your reasoning. (2)

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**Question 5 continued**

Handwritten response area with horizontal lines.

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Question 5 continued

Lined writing area for the answer to Question 5.

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Question 5 continued

Lined writing area for the answer to Question 5.

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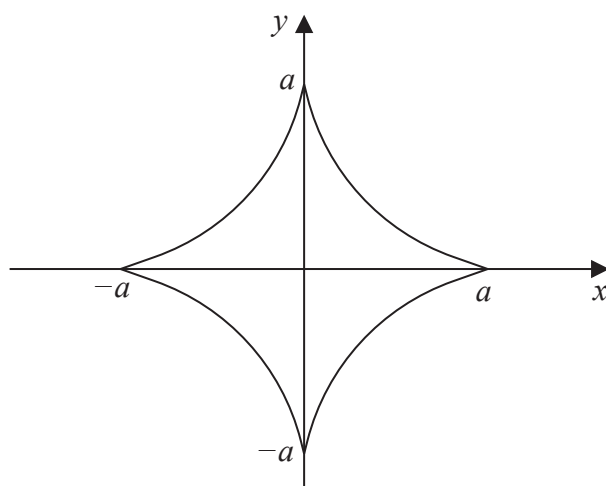


Figure 2

Figure 2 shows the curve with parametric equations

$$x = a \cos^3 \theta \quad y = a \sin^3 \theta \quad 0 \leq \theta < 2\pi$$

where  $a > 0$

(a) Find the total length of this curve in terms of  $a$ .

(7)

The curve is used to model the design for a new sweet. The curve is rotated through  $\pi$  radians about the  $x$ -axis to create the shape of a sweet. The sweet is to be covered in chocolate.

Given that the total length of the curve is 5 cm,

(b) estimate the surface area of the sweet that is to be covered in chocolate.

(6)

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Question 6 continued

Lined writing area for the answer.

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Question 6 continued

Lined writing area for Question 6 continued, containing 30 horizontal lines.

(Total for Question 6 is 13 marks)







Question 7 continued

Handwriting practice area with 25 horizontal lines.

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Question 7 continued

Lined writing area for the answer to Question 7.

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**Question 7 continued**

Lined area for student answers.

**(Total for Question 7 is 13 marks)**

**TOTAL FOR PAPER IS 75 MARKS**

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