

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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Paper
reference

8FM0/21

Further Mathematics

Advanced Subsidiary

Further Mathematics options

21: Further Pure Mathematics 1

(Part of options A, B, C and D)

You must have:

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

**Candidates may use any calculator allowed 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.
- The total mark for this part of the examination is 40. There are 5 questions.
- 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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1. Use algebra to determine the values of x for which

$$x(x-1) > \frac{x-1}{x}$$

giving your answer in set notation.

(6)



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Question 1 continued

Lined area for writing answers.

(Total for Question 1 is 6 marks)



2. The variables x and y satisfy the differential equation

$$\frac{d^2y}{dx^2} + 15\frac{dy}{dx} - 3y^2 = 2x$$

where $y = 1$ at $x = 0$ and where $y = 2$ at $x = 0.1$

Use the approximations

$$\left(\frac{d^2y}{dx^2}\right)_n \approx \frac{(y_{n+1} - 2y_n + y_{n-1}))}{h^2} \text{ and } \left(\frac{dy}{dx}\right)_n \approx \frac{(y_{n+1} - y_{n-1}))}{2h}$$

with $h = 0.1$ to find an estimate for the value of y when $x = 0.3$

(6)



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Question 2 continued

Lined area for writing the answer to Question 2.



Question 2 continued

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Question 2 continued

Lined area for writing answers.

(Total for Question 2 is 6 marks)



3. On a particular day, the depth of water in a river estuary at a specific location is modelled by the equation

$$D = 2 \sin\left(\frac{x}{3}\right) + 3 \cos\left(\frac{x}{3}\right) + 6 \quad 0 \leq x \leq 7\pi \quad (\text{I})$$

where the depth of water is D metres at time x hours after midnight on that day.

- (a) Write down the depth of water at midnight, according to the model.

(1)

Using the substitution $t = \tan\left(\frac{x}{6}\right)$

- (b) show that equation (I) can be re-written as

$$D = \frac{3t^2 + 4t + 9}{1 + t^2} \quad (3)$$

- (c) Hence determine, according to the model, the time after midnight when the depth of water is 5 metres for the first time. Give your answer to the nearest minute.

(5)



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Question 3 continued

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Question 3 continued

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Question 3 continued

Lined area for writing answers.

(Total for Question 3 is 9 marks)



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Question 4 continued

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Question 4 continued

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Question 4 continued

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(Total for Question 4 is 9 marks)



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5. The point $P(ap^2, 2ap)$, where a is a positive constant, lies on the parabola with equation

$$y^2 = 4ax$$

The normal to the parabola at P meets the parabola again at the point Q ($aq^2, 2aq$)

- (a) Show that

$$q = \frac{-p^2 - 2}{p} \quad (5)$$

- (b) Hence show that

$$PQ^2 = \frac{ka^2}{p^4}(p^2 + 1)^n$$

where k and n are integers to be determined. (5)



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Question 5 continued

Lined area for writing the answer to Question 5.



Question 5 continued

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Question 5 continued

Lined area for writing the answer to Question 5.



Question 5 continued

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(Total for Question 5 is 10 marks)

TOTAL FOR FURTHER PURE MATHEMATICS 1 IS 40 MARKS

