

Write your name here

Surname

Other names

**Pearson Edexcel**  
**Level 3 GCE**

Centre Number

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Candidate Number

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# Further Mathematics

**Advanced Subsidiary**  
**Further Mathematics options**  
**21: Further Pure Mathematics 1**  
**(Part of options A, B, C and D)**

Thursday 17 May 2018 – Afternoon

Paper Reference

**8FM0/21**

**You must have:**

Mathematical Formulae and Statistical Tables, calculator

Total Marks

**Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. 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.
- 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.

Turn over ►

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**Pearson**

Answer ALL questions. Write your answers in the spaces provided.

1. (a) Use the substitution  $t = \tan\left(\frac{x}{2}\right)$  to show that the equation

$$5 \sin x + 12 \cos x = 2$$

can be written in the form

$$7t^2 - 5t - 5 = 0 \tag{3}$$

- (b) Hence solve, for  $-180^\circ < x < 180^\circ$ , the equation

$$5 \sin x + 12 \cos x = 2$$

giving your answers to one decimal place. (4)

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**Question 1 continued**

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**(Total for Question 1 is 7 marks)**

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2. The temperature,  $\theta^\circ\text{C}$ , of coffee in a cup,  $t$  minutes after the cup of coffee is put in a room, is modelled by the differential equation

$$\frac{d\theta}{dt} = -k(\theta - 20)$$

where  $k$  is a constant.

The coffee has an initial temperature of  $80^\circ\text{C}$

Using  $k = 0.1$

- (a) use two iterations of the approximation formula  $\left(\frac{dy}{dx}\right)_0 = \frac{y_1 - y_0}{h}$  to estimate the temperature of the coffee 3 minutes after it was put in the room.

(6)

The coffee in a different cup, which also had an initial temperature of  $80^\circ\text{C}$  when it was put in the room, cools more slowly.

- (b) Use this information to suggest how the value of  $k$  would need to be changed in the model.

(1)

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**Question 2 continued**

A large rectangular area with horizontal ruling lines for writing answers.

(Total for Question 2 is 7 marks)











**Question 4 continued**

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**Question 4 continued**

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5. The rectangular hyperbola  $H$  has equation  $xy = c^2$ , where  $c$  is a non-zero constant.

The point  $P\left(cp, \frac{c}{p}\right)$ , where  $p \neq 0$ , lies on  $H$ .

(a) Use calculus to show that an equation of the normal to  $H$  at  $P$  is

$$p^3x - py + c(1 - p^4) = 0 \tag{4}$$

The normal to  $H$  at the point  $P$  meets  $H$  again at the point  $Q$ .

(b) Find the coordinates of the midpoint of  $PQ$  in terms of  $c$  and  $p$ , simplifying your answer where possible.

(6)

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**Question 5 continued**

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Question 5 continued

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