

Write your name here	
Surname	Other names
<b>Pearson Edexcel</b>	Centre Number
<b>Level 3 GCE</b>	Candidate Number
<h1 style="margin: 0;">Further Mathematics</h1> <p style="margin: 0;"><b>Advanced Subsidiary</b>  <b>Further Mathematics options</b>  <b>21: Further Pure Mathematics 1</b>  <b>(Part of options A, B, C and D)</b></p>	
<b>Practice Paper 1</b>	Paper Reference <b>8FM0/21</b>
<b>You must have:</b> 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.
- 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.

**Answer ALL questions.**

1. Use algebra to find the set of values of  $x$  for which

$$\frac{1}{x+1} < \frac{x}{x+3}$$

**(Total for Question 1 is 6 marks)**

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

$$2 \sin x - 5 \cos x = 2 \quad [1]$$

can be written as  $3t^2 + 4t - 7 = 0$ .

**(3)**

- (b) Hence find all the solutions to equation [1] in the interval  $0 < x < 2\pi$ .  
Give your answers correct to 2 decimal places where appropriate.

**(3)**

**(Total for Question 2 is 6 marks)**

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3. The variable  $y$  satisfies the differential equation

$$\frac{d^2y}{dx^2} = e^{xy} - \frac{dy}{dx}$$

when  $x = 0, y = 1$  and  $\frac{dy}{dx} = 2$ .

Use the approximations

$$\left(\frac{d^2y}{dx^2}\right)_0 \approx \frac{y_1 - 2y_0 + y_{-1}}{h^2} \quad \text{and} \quad \left(\frac{dy}{dx}\right)_0 \approx \frac{y_1 - y_{-1}}{2h}$$

with  $h = 0.1$  to estimate the value of  $y$  when  $x = 0.1$ .

**(Total for Question 3 is 6 marks)**

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4.

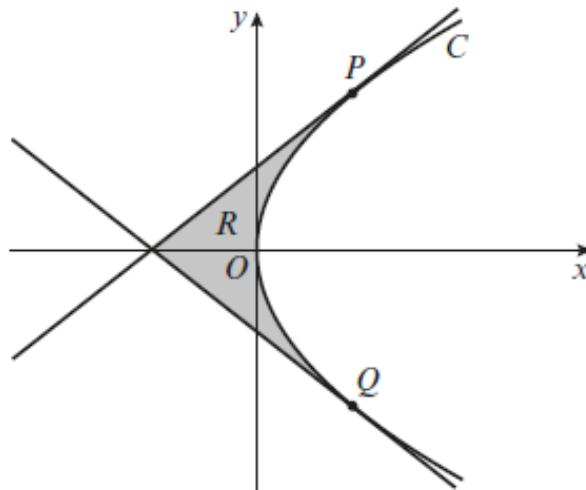


Figure 1

[You may quote without proof that for the general parabola  $y^2 = 4ax$ ,  $\frac{dy}{dx} = \frac{2a}{y}$ ]

Figure 1 shows the graph of the parabola  $C$  with equation  $y^2 = 40x$ .

The line  $x = k$  intersects the parabola at the points  $P$  and  $Q$ .

The tangent to the curve at  $P$  intersects the  $y$ -axis at  $(0, 2\sqrt{10})$ .

(a) Find the value of  $k$ . (4)

(b) Write down the  $x$ -coordinate of the point of intersection of the two tangents. (1)

The finite region  $R$ , shown shaded in the diagram, is bounded by the tangents to the curve at  $P$  and  $Q$  and by the parabola  $C$ .

(c) Find, correct to three significant figures, the area of  $R$ . (7)

**(Total for Question 4 is 12 marks)**

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5. Figure 2 shows a model for a new kind of solid tetrahedral dice.

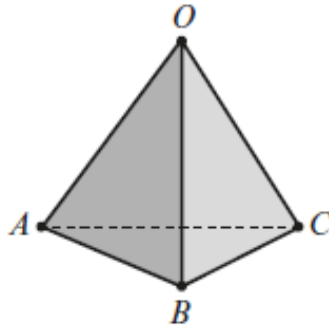


Figure 2

Points  $A$ ,  $B$  and  $C$  have position vectors  $6\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$ ,  $-2\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$  and  $-\mathbf{i} + 4\mathbf{j} - \mathbf{k}$  respectively and  $O$  is the origin.

(a) Find  $\overrightarrow{OB} \times \overrightarrow{OC}$ . (3)

(b) Find the area of the face  $OBC$  correct to three significant figures. (2)

The dice is to be 3D printed using a scale of 1 cm per unit and a plastic filament of density  $1.35 \text{ g/cm}^3$ .

Given that the manufacturer has 1 kg of plastic filament,

(c) work out the number of dice that can be made. (4)

(d) Give a reason why your answer to part (c) might be an over-estimate. (1)

(Total for Question 5 is 10 marks)

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**TOTAL FOR FURTHER PURE MATHEMATICS 1 IS 40 MARKS**