

**Paper Reference 8FM0/21**  
**Pearson Edexcel**  
**Level 3 GCE**

**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**

**YOU WILL BE GIVEN**  
**Answer Booklet**  
**Diagram Booklet**

**Q68617A**

**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**

**In the boxes on the Answer Booklet and on the Diagram Booklet, write 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 Answer Booklet or on the separate diagrams – there may be more space than you need.**

**Do NOT write on the Question Paper.**

**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.**

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

$$x \geq \frac{2x + 15}{2x + 3}$$

(Total for Question 1 is 6 marks)

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2. A population of deer was introduced onto an island.

The number of deer,  $P$ , on the island at time  $t$  years following their introduction is modelled by the differential equation

$$\frac{dP}{dt} = \frac{P}{5000} \left( 1000 - \frac{P(t+1)}{6t+5} \right) \quad t > 0$$

It was estimated that there were **540** deer on the island six months after they were introduced.

Use **TWO** applications of the approximation formula

$$\left( \frac{dy}{dx} \right)_n \approx \frac{y_{n+1} - y_n}{h}$$

to estimate the number of deer on the island **10** months after they were introduced.

(Total for Question 2 is 7 marks)

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3. (a) Use  $t = \tan \frac{\theta}{2}$  to show that, where both sides are defined

$$\frac{29 - 21 \sec \theta}{20 - 21 \tan \theta} \equiv \frac{5t + 2}{2t + 5}$$

(4 marks)

- (b) Hence, again using  $t = \tan \frac{\theta}{2}$ , prove that, where both sides are defined

$$\frac{20 + 21 \tan \theta}{29 + 21 \sec \theta} \equiv \frac{29 - 21 \sec \theta}{20 - 21 \tan \theta}$$

(3 marks)

(Total for Question 3 is 7 marks)

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4. The parabola **C** has equation  $y^2 = 10x$

The point **F** is the focus of **C**

- (a) Write down the coordinates of **F**  
(1 mark)

The point **P** on **C** has **y** coordinate **q**,  
where  $q > 0$

- (b) Show that an equation for the tangent to **C** at **P**  
is given by

$$10x - 2qy + q^2 = 0$$

(3 marks)

(continued on the next page)

4. continued.

The tangent to **C** at **P** intersects the directrix of **C** at the point **A**

The point **B** lies on the directrix such that **PB** is parallel to the **x**-axis.

(c) Show that the point of intersection of the diagonals of quadrilateral **PBAF** always lies on the **y**-axis.

(5 marks)

(Total for Question 4 is 9 marks)

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5. Refer to the diagram for Question 5 in the Diagram Booklet.

The diagram shows the points  $A(3, 2, -4)$ ,  $B(9, -4, 2)$ ,  $C(-6, -10, 8)$  and  $D(-4, -5, 10)$  are the vertices of a tetrahedron.

The plane with equation  $z = 0$  cuts the tetrahedron into two pieces, one on each side of the plane.

The edges  $AB$ ,  $AC$  and  $AD$  of the tetrahedron intersect the plane at the points  $M$ ,  $N$  and  $P$  respectively, as shown in the diagram.

(continued on the next page)

**5. continued.**

**Determine**

**(a) the coordinates of the points M, N and P,  
(3 marks)**

**(b) the area of triangle MNP,  
(2 marks)**

**(c) the exact volume of the solid BCDPNM  
(6 marks)**

**(Total for Question 5 is 11 marks)**

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**TOTAL FOR FURTHER PURE MATHEMATICS 1**

**IS 40 MARKS**

**END OF PAPER**

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