

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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**Thursday 16 May 2019**

Afternoon

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.
- 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**

1. (a) Write down the  $t$ -formula for  $\sin x$ .

(1)

- (b) Use the answer to part (a)

- (i) to find the exact value of  $\sin x$  when

$$\tan\left(\frac{x}{2}\right) = \sqrt{2}$$

- (ii) to show that

$$\cos x = \frac{1 - t^2}{1 + t^2}$$

(4)

- (c) Use the  $t$ -formulae to solve for  $0 < \theta \leqslant 360^\circ$

$$7 \sin \theta + 9 \cos \theta + 3 = 0$$

giving your answers to one decimal place.

(4)



**Question 1 continued**

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(Total for Question 1 is 9 marks)



2. A student was set the following problem.

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

$$\frac{x}{x - 24} > \frac{1}{x + 11}$$

The student's attempt at a solution is written below.

$$x(x - 24)(x + 11)^2 > (x + 11)(x - 24)^2$$

$$x(x - 24)(x + 11)^2 - (x + 11)(x - 24)^2 > 0$$

$$(x - 24)(x + 11)[x(x + 11) - x - 24] > 0$$

Line 3

$$(x - 24)(x + 11)[x^2 + 10x - 24] > 0$$

$$(x - 24)(x + 11)(x + 12)(x - 2) > 0$$

$$x = 24, x = -11, x = -12, x = 2$$

$$\{x \in \mathbb{R} : -12 < x < -11\} \cup \{x \in \mathbb{R} : 2 < x < 24\}$$

Line 7

There are errors in the student's solution.

- (a) Identify the error made

(i) in line 3

(ii) in line 7

(2)

- (b) Find a correct solution to this problem.

(4)



**Question 2 continued**

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(Total for Question 2 is 6 marks)



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3. Julie decides to start a business breeding rabbits to sell as pets.

Initially she buys 20 rabbits. After  $t$  years the number of rabbits,  $R$ , is modelled by the differential equation

$$\frac{dR}{dt} = 2R + 4 \sin t \quad t > 0$$

Julie needs to have at least 40 rabbits before she can start to sell them.

Use two iterations of the approximation formula

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

to find out if, according to the model, Julie will be able to start selling rabbits after 4 months.

(7)



**Question 3 continued**

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(Total for Question 3 is 7 marks)



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4.

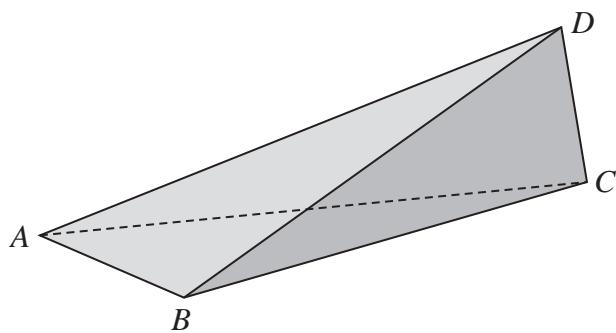
**Figure 1**

Figure 1 shows a sketch of a solid doorstop made of wood. The doorstop is modelled as a tetrahedron.

Relative to a fixed origin  $O$ , the vertices of the tetrahedron are  $A(2, 1, 4)$ ,  $B(6, 1, 2)$ ,  $C(4, 10, 3)$  and  $D(5, 8, d)$ , where  $d$  is a positive constant and the units are in centimetres.

- (a) Find the area of the triangle  $ABC$ .

(4)

Given that the volume of the doorstop is  $21 \text{ cm}^3$

- (b) find the value of the constant  $d$ .

(4)



## **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 8 marks)



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5.

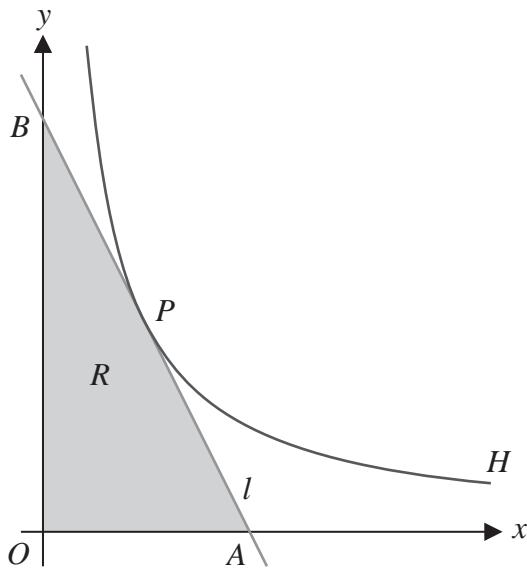
**Figure 2**

Figure 2 shows a sketch of part of the rectangular hyperbola  $H$  with equation

$$xy = c^2 \quad x > 0$$

where  $c$  is a positive constant.

The point  $P\left(ct, \frac{c}{t}\right)$  lies on  $H$ .

The line  $l$  is the tangent to  $H$  at the point  $P$ .

The line  $l$  crosses the  $x$ -axis at the point  $A$  and crosses the  $y$ -axis at the point  $B$ .

The region  $R$ , shown shaded in Figure 2, is bounded by the  $x$ -axis, the  $y$ -axis and the line  $l$ .

Given that the length  $OB$  is twice the length of  $OA$ , where  $O$  is the origin, and that the area of  $R$  is 32, find the exact coordinates of the point  $P$ .

(10)



**Question 5 continued**

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### **Question 5 continued**

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### **Question 5 continued**

**(Total for Question 5 is 10 marks)**

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

