Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Practice Paper 2

(Time: 1 hour 30 minutes) | Paper Reference **9FM0/3A**

Further Mathematics
Advanced
Paper 3A: Further Pure Mathematics 1

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.
- 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 75. There are 7 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. The points A, B and C lie on the plane Π and, relative to a fixed origin O, they have position vectors

$$\mathbf{a} = 3\mathbf{i} - \mathbf{j} + 4\mathbf{k}, \quad \mathbf{b} = -\mathbf{i} + 2\mathbf{j}, \quad \mathbf{c} = 5\mathbf{i} - 3\mathbf{j} + 7\mathbf{k}$$

respectively.

(*a*) Find $\overrightarrow{AB} \times \overrightarrow{AC}$.

(4)

(*b*) Find an equation of Π in the form $\mathbf{r.n} = p$.

(2)

The point D has position vector $5\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$.

(*c*) Calculate the volume of the tetrahedron $ABCD$.

(4)

(Total for Question 1 is 10 marks)

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2. Find the set of values for which

$$|x - 1| > 6x - 1.$$

(Total for Question 2 is 5 marks)

3.

$$y = \sec^2 x$$

(*a*) Show that $\dfrac{\mathrm{d}^2 y}{\mathrm{d}x^2} = 6\sec^4 x - 4\sec^2 x$.

(4)

(*b*) Find a Taylor series expansion of $\sec^2 x$ in ascending powers of $\left(x - \dfrac{\pi}{4}\right)$, up to and including the term in $\left(x - \dfrac{\pi}{4}\right)^3$.

(6)

(Total for Question 3 is 10 marks)

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4. $$\frac{dy}{dx} = x^2 - y^2, \quad y = 1 \text{ at } x = 0. \quad \text{(I)}$$

(*a*) Use the approximation $\left(\frac{dy}{dx}\right)_0 \approx \frac{y_1 - y_0}{h}$ with a step length of 0.05 to estimate the values of y at $x = 0.05$ and $x = 0.1$.

(6)

(*b*) By differentiating (I) twice with respect to x, show that

$$\frac{d^3y}{dx^3} + 2y\frac{d^2y}{dx^2} + 2\left(\frac{dy}{dx}\right)^2 - 2 = 0.$$

(4)

(*c*) Hence, for (I), find the series solution for y in ascending powers of x up to and including the term in x^3.

(4)

(Total for Question 4 is 14 marks)

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5. The point $P\left(2p, \frac{2}{p}\right)$ and the point $Q\left(2q, \frac{2}{q}\right)$, where $p \neq -q$, lie on the rectangular hyperbola with equation $xy = 4$.

The tangents to the curve at the points P and Q meet at the point R.

(*a*) Show that at the point R,

$$x = \frac{4pq}{p+q} \text{ and } y = \frac{4}{p+q}.$$

(8)

As p and q vary, the locus of R has equation $xy = 3$.

(*b*) Find the relationship between p and q in the form $q = \mathrm{f}(p)$.

(5)

(Total for Question 5 is 13 marks)

6.

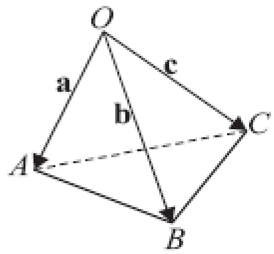

Figure 1

The points A, B and C have position vectors $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$ respectively, relative to a fixed origin O, as shown in Figure 1.

It is given that

$$\mathbf{a} = \mathbf{i} + \mathbf{j}, \quad \mathbf{b} = 3\mathbf{i} - \mathbf{j} + \mathbf{k} \quad \text{and} \quad \mathbf{c} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}\,.$$

Calculate

(*a*) $\mathbf{b} \times \mathbf{c}$,

(3)

(*b*) $\mathbf{a} \,.\, (\mathbf{b} \times \mathbf{c})$,

(2)

(*c*) the area of triangle OBC,

(2)

(*d*) the volume of the tetrahedron $OABC$.

(1)

(Total for Question 6 is 8 marks)

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7. $$\frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 6x = 2e^{-t}.$$

Given that $x = 0$ and $\frac{dx}{dt} = 2$ at $t = 0$,

(*a*) find x in terms of t.

(8)

The solution to part (*a*) is used to represent the motion of a particle P on the x-axis. At time t seconds, where $t > 0$, P is x metres from the origin O.

(*b*) Show that the maximum distance between O and P is $\frac{2\sqrt{3}}{9}$ m and justify that this distance is a maximum.

(7)

(Total for Question 7 is 15 marks)

TOTAL FOR FURTHER PURE MATHEMATICS 1 IS 75 MARKS

Origin of questions:

1. **P6 June 2004, Qn 3**
2. **P4 January 2002, Qn 2**
3. **FP2 June 2009, Qn 5**
4. **P6 June 2003, Qn 8**
5. **P5 June 2002, Qn 7**
6. **FP3 June 2009, Qn 2**
7. **FP2 June 2009, Qn 8**