Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 6 6 9 / 0 1	Signature	

Paper Reference(s)

6669/01

Edexcel GCE

Further Pure Mathematics FP3

Advanced/Advanced Subsidiary

Monday 28 June 2010 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
Total	

Materials required for examination	Items included with question papers
Mathematical Formulae (Pink)	Nil

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 to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions.
You must write your answer to each question in the space following the question.
When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 8 questions in this question paper. The total mark for this paper is 75.
There are 28 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You should show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.

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1. The line $x = 8$ is a directrix of the ellipse with equation

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, \quad a > 0,\ b > 0,$$

and the point (2, 0) is the corresponding focus.

Find the value of a and the value of b.

(5)

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Question 1 continued

Q1

(Total 5 marks)

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2. Use calculus to find the exact value of $\displaystyle\int_{-2}^{1} \frac{1}{x^2 + 4x + 13}\,\mathrm{d}x$.

(5)

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Question 2 continued

Q2

(Total 5 marks)

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3. (a) Starting from the definitions of $\sinh x$ and $\cosh x$ in terms of exponentials, prove that

$$\cosh 2x = 1 + 2\sinh^2 x$$

(3)

(b) Solve the equation

$$\cosh 2x - 3\sinh x = 15,$$

giving your answers as exact logarithms.

(5)

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Question 3 continued

Q3

(Total 8 marks)

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4. $I_n = \int_0^a (a-x)^n \cos x \, dx, \quad a > 0, \quad n \geqslant 0$

(a) Show that, for $n \geqslant 2$,

$$I_n = na^{n-1} - n(n-1)I_{n-2}$$

(5)

(b) Hence evaluate $\int_0^{\frac{\pi}{2}} \left(\frac{\pi}{2} - x\right)^2 \cos x \, dx$.

(3)

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Question 4 continued

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Question 4 continued

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Question 4 continued

Q4

(Total 8 marks)

5. Given that $y = (\text{arcosh } 3x)^2$, where $3x > 1$, show that

(a) $(9x^2 - 1)\left(\dfrac{dy}{dx}\right)^2 = 36y$,

(5)

(b) $(9x^2 - 1)\dfrac{d^2y}{dx^2} + 9x\dfrac{dy}{dx} = 18$.

(4)

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Question 5 continued

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Question 5 continued

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Question 5 continued

Q5

(Total 9 marks)

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6. $$\mathbf{M} = \begin{pmatrix} 1 & 0 & 3 \\ 0 & -2 & 1 \\ k & 0 & 1 \end{pmatrix}, \text{ where } k \text{ is a constant.}$$

Given that $\begin{pmatrix} 6 \\ 1 \\ 6 \end{pmatrix}$ is an eigenvector of **M**,

(a) find the eigenvalue of **M** corresponding to $\begin{pmatrix} 6 \\ 1 \\ 6 \end{pmatrix}$, **(2)**

(b) show that $k = 3$, **(2)**

(c) show that **M** has exactly two eigenvalues. **(4)**

A transformation $T : \mathbb{R}^3 \to \mathbb{R}^3$ is represented by **M**.

The transformation T maps the line l_1, with cartesian equations $\frac{x-2}{1} = \frac{y}{-3} = \frac{z+1}{4}$, onto the line l_2.

(d) Taking $k = 3$, find cartesian equations of l_2. **(5)**

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Question 6 continued

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Question 6 continued

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Question 6 continued

(Total 13 marks)

Q6

N 3 5 3 8 9 R A 0 1 9 2 8

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7. The plane Π has vector equation

$$\mathbf{r} = 3\mathbf{i} + \mathbf{k} + \lambda(-4\mathbf{i} + \mathbf{j}) + \mu(6\mathbf{i} - 2\mathbf{j} + \mathbf{k})$$

(a) Find an equation of Π in the form $\mathbf{r.n} = p$, where $\mathbf{n}$ is a vector perpendicular to Π and p is a constant.
(5)

The point P has coordinates $(6, 13, 5)$. The line l passes through P and is perpendicular to Π. The line l intersects Π at the point N.

(b) Show that the coordinates of N are $(3, 1, -1)$.
(4)

The point R lies on Π and has coordinates $(1, 0, 2)$.

(c) Find the perpendicular distance from N to the line PR. Give your answer to 3 significant figures.
(5)

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Question 7 continued

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Question 7 continued

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Question 7 continued

(Total 14 marks)

Q7

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8. The hyperbola H has equation $\dfrac{x^2}{16} - \dfrac{y^2}{4} = 1$.

The line l_1 is the tangent to H at the point $P(4\sec t,\ 2\tan t)$.

(a) Use calculus to show that an equation of l_1 is

$$2y\sin t = x - 4\cos t$$

(5)

The line l_2 passes through the origin and is perpendicular to l_1.

The lines l_1 and l_2 intersect at the point Q.

(b) Show that, as t varies, an equation of the locus of Q is

$$\left(x^2 + y^2\right)^2 = 16x^2 - 4y^2$$

(8)

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Question 8 continued

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Question 8 continued

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Question 8 continued

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Question 8 continued

Q8

(Total 13 marks)

TOTAL FOR PAPER: 75 MARKS

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