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Centre No.					Pape	er Refer	ence			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 24 June 2013 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination	Items included with question paper
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 or symbolic differentiation/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 for 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

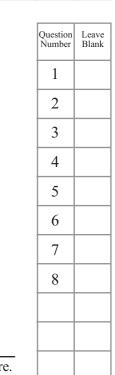
You must ensure that your answers to parts of questions are clearly labelled. You should show sufficient working to make your methods clear to the Examiner. Answers without working may not gain full credit.

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Team Leader's use only

Turn over

Total



A hyperbola H has equation

$$\frac{x^2}{a^2} - \frac{y^2}{25} = 1$$
, where a is a positive constant.

The foci of H are at the points with coordinates (13, 0) and (-13, 0).

Find

(a) the value of the constant a,

(3)

(b) the equations of the directrices of H.

(3)

2. (a) Find

$$\int \frac{1}{\sqrt{(4x^2+9)}} \, \mathrm{d}x$$

(2)

(b) Use your answer to part (a) to find the exact value of

$$\int_{-3}^{3} \frac{1}{\sqrt{4x^2 + 9}} \, \mathrm{d}x$$

giving your answer in the form $k \ln(a + b\sqrt{5})$, where a and b are integers and k is a constant.

(3)

3. '	The curve	e with	parametric	equations
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$$x = \cosh 2\theta$$
, $y = 4 \sinh \theta$, $0 \le \theta \le 1$

is rotated through 2π radians about the *x*-axis.

Show that the area of the surface generated is $\lambda(\cosh^3 \alpha - 1)$, where $\alpha = 1$ and λ is a constant to be found.

(7)

4.

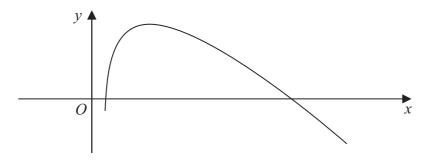


Figure 1

Figure 1 shows part of the curve with equation

$$y = 40 \operatorname{arcosh} x - 9x, \qquad x \geqslant 1$$

Use calculus to find the exact coordinates of the turning point of the curve, giving your answer in the form $\left(\frac{p}{q}, r \ln 3 + s\right)$, where p, q, r and s are integers. (7)

Question 4 continued		bl
		Q4
	(Total 7 marks)	7



5. The matrix \mathbf{M} is given by

$$\mathbf{M} = \begin{pmatrix} 1 & 1 & a \\ 2 & b & c \\ -1 & 0 & 1 \end{pmatrix}, \text{ where } a, b \text{ and } c \text{ are constants.}$$

(a) Given that $\mathbf{j} + \mathbf{k}$ and $\mathbf{i} - \mathbf{k}$ are two of the eigenvectors of \mathbf{M} ,

find

- (i) the values of a, b and c,
- (ii) the eigenvalues which correspond to the two given eigenvectors.

(8)

(b) The matrix **P** is given by

$$\mathbf{P} = \begin{pmatrix} 1 & 1 & 0 \\ 2 & 1 & d \\ -1 & 0 & 1 \end{pmatrix}, \text{ where } d \text{ is constant, } d \neq -1$$

Find

- (i) the determinant of \mathbf{P} in terms of d,
- (ii) the matrix P^{-1} in terms of d.

(5)

Question 5 continued	



6. Given that

$$I_n = \int_0^4 x^n \sqrt{(16 - x^2)} dx, \quad n \geqslant 0,$$

(a) prove that, for $n \ge 2$,

$$(n+2)I_n = 16(n-1)I_{n-2}$$

(6)

(b) Hence, showing each step of your working, find the exact value of A

(5)

stion 6 continued		



7. The ellipse E has equation

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

The line *l* is a normal to *E* at a point $P(a\cos\theta, b\sin\theta)$, $0 < \theta < \frac{\pi}{2}$

(a) Using calculus, show that an equation for l is

$$ax\sin\theta - by\cos\theta = (a^2 - b^2)\sin\theta\cos\theta$$
 (5)

The line l meets the x-axis at A and the y-axis at B.

(b) Show that the area of the triangle OAB, where O is the origin, may be written as $k\sin 2\theta$, giving the value of the constant k in terms of a and b.

(4)

(c) Find, in terms of a and b, the exact coordinates of the point P, for which the area of the triangle OAB is a maximum.

(3)

uestion 7 continued	



8. The plane Π_1 has vector equation

$$\mathbf{r}.(3\mathbf{i} - 4\mathbf{j} + 2\mathbf{k}) = 5$$

(a) Find the perpendicular distance from the point (6, 2, 12) to the plane Π_1

(3)

The plane Π_2 has vector equation

$$\mathbf{r} = \lambda(2\mathbf{i} + \mathbf{j} + 5\mathbf{k}) + \mu(\mathbf{i} - \mathbf{j} - 2\mathbf{k})$$
, where λ and μ are scalar parameters.

(b) Find the acute angle between Π_1 and Π_2 giving your answer to the nearest degree.

(5)

(c) Find an equation of the line of intersection of the two planes in the form $\mathbf{r} \times \mathbf{a} = \mathbf{b}$, where \mathbf{a} and \mathbf{b} are constant vectors.

(6)

(Total 14 marks) TOTAL FOR PAPER: 75 MARKS
(Total 14 marks)
Question 8 continued