Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	6	7	5	/	0	1	Signature	

Paper Reference(s)

6675/01

Edexcel GCE

Further Pure Mathematics FP2

Advanced/Advanced Subsidiary

Friday 19 June 2009 – 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
Mathematical Formulae (Green)

Items included with question papers
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 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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1. $$y = (\operatorname{arsinh} 2x)^2$$

Find the exact value of $\frac{dy}{dx}$ at $x = \frac{1}{2}$, giving your answer in the form $a \ln b$, where a and b are real numbers.

(5)

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Question 1 continued

Q1

(Total 5 marks)

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2. The ellipse E has equation $\frac{x^2}{a^2}+\frac{y^2}{8}=1$, where $a > 2\sqrt{2}$.

The eccentricity of E is $\frac{1}{\sqrt{2}}$.

(a) Calculate the value of a.

(2)

The ellipse E cuts the y-axis at the points D and D'. The foci of E are S and S'.

(b) Calculate the area of the quadrilateral $SDS'D'$.

(3)

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Question 2 continued

(Total 5 marks)

Q2

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3. $$I_n = \int_0^1 (1-x)^n \cosh x \, dx, \ n \geqslant 0.$$

(a) Prove that, for $n \geqslant 2$, $I_n = n(n-1)\, I_{n-2} - n$.

(5)

(b) Find an exact expression for I_4, giving your answer in terms of e.

(4)

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Question 3 continued

Q3

(Total 9 marks)

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4. $$f(x) = 15\sinh x - 17\cosh x + 6x$$

The curve with equation $y = f(x)$ has a stationary point P.

(a) Find the exact x-coordinate of P, giving your answer in terms of ln 2.

(6)

(b) Determine the nature of the stationary point.

(3)

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Question 4 continued

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Question 4 continued

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Question 4 continued

Q4

(Total 9 marks)

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5. A curve has parametric equations

$$x = 2t^3,\ y = 3t^2,\ 0 \leqslant t \leqslant 1.$$

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

Prove that the area of the curved surface generated is $\frac{24\pi}{5}\left(\sqrt{2}+1\right)$.

(9)

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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. Using the substitution $u = \cosh\theta$, find the value of

$$\int_{\ln 2}^{\ln 4} \frac{\cosh\theta + 1}{\sinh\theta\left(\cosh\theta - 1\right)^2}\,\mathrm{d}\theta,$$

giving your answer as an exact fraction.

(10)

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Question 6 continued

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Question 6 continued

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Question 6 continued

(Total 10 marks)

Q6

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7. The curve C has cartesian equation

$$y = \ln(\sin x), \quad 0 < x < \pi.$$

The intrinsic equation of C is $s = \mathrm{f}(\psi)$, where s increases as ψ decreases.

(a) Show that $\psi = \frac{\pi}{2} - x$. **(3)**

The point with intrinsic coordinates $\left(0, \frac{\pi}{4}\right)$ lies on C.

(b) Show that $s = \ln\left(\frac{\sqrt{2}+1}{\sec\psi + \tan\psi}\right)$. **(6)**

(c) Find the radius of curvature of C at the point where $\psi = \frac{\pi}{6}$. **(3)**

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Question 7 continued

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Question 7 continued

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Question 7 continued

(Total 12 marks)

Q7

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8. The parabola C has equation $y^2 = 4ax$, where a is a positive constant. The point P on C has coordinates $(ap^2, 2ap)$.

(a) Show that an equation of the normal to C at P is $y + px = 2ap + ap^3$.

(4)

The normal to C at P meets the curve again at Q.

(b) Show that the y-coordinate of Q is $-2a\left(\frac{2+p^2}{p}\right)$.

(5)

(c) Show that, as p varies, the least distance from P to Q is $6\sqrt{3}a$.

(7)

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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 16 marks)

TOTAL FOR PAPER: 75 MARKS

END

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