| 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

Wednesday 18 June 2008 – Morning

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. Write your answers in the spaces provided in this question paper.
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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N 3 0 7 4 6 A 0 1 2 8

*Turn over*

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**1.** Show that

$$\frac{\mathrm{d}}{\mathrm{d}x}\left[\ln(\tanh x)\right] = 2 \operatorname{cosech} 2x, \qquad x > 0.$$

**(4)**



N 3 0 7 4 6 A 0 2 2 8

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**Question 1 continued**

**Q1**

**(Total 4 marks)**

Leave blank

**2.** Find the values of $x$ for which

$$8\cosh x - 4\sinh x = 13,$$

giving your answers as natural logarithms.

**(6)**



N 3 0 7 4 6 A 0 4 2 8

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**Question 2 continued**

**Q2**

**(Total 6 marks)**

Leave blank

**3.** Show that

$$\int_5^6 \frac{3+x}{\sqrt{(x^2-9)}}\,dx = 3\ln\left(\frac{2+\sqrt{3}}{3}\right) + 3\sqrt{3} - 4.$$

**(7)**



N 3 0 7 4 6 A 0 6 2 8

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**Question 3 continued**

**Q3**

**(Total 7 marks)**

Leave blank

**4.** The curve $C$ has equation

$$y = \text{arsinh}\,(x^3), \qquad x \geqslant 0.$$

The point $P$ on $C$ has $x$-coordinate $\sqrt{2}$.

(a) Show that an equation of the tangent to $C$ at $P$ is

$$y = 2x - 2\sqrt{2} + \ln\left(3 + 2\sqrt{2}\right).$$

**(5)**

The tangent to $C$ at the point $Q$ is parallel to the tangent to $C$ at $P$.

(b) Find the $x$-coordinate of $Q$, giving your answer to 2 decimal places.

**(5)**



N 3 0 7 4 6 A 0 8 2 8

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**Question 4 continued**

**(Total 10 marks)**

Q4

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**5.** Given that

$$I_n = \int_0^{\pi} e^x \sin^n x \, dx, \qquad n \geqslant 0,$$

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

$$I_n = \frac{n(n-1)}{n^2+1} I_{n-2}.$$

**(8)**

(b) Find the exact value of $I_4$.

**(4)**



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**Question 5 continued**

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**Question 5 continued**

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**Question 5 continued**

**(Total 12 marks)**

Q5

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**6.**

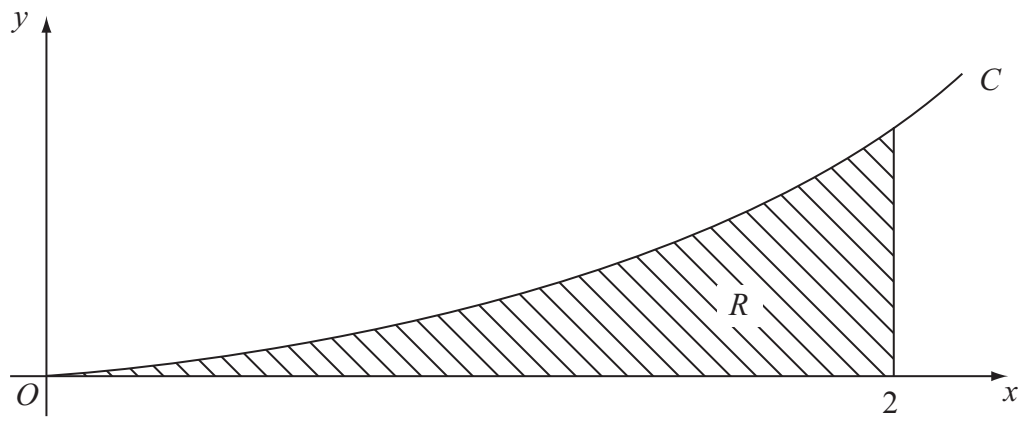


**Figure 1**

Figure 1 shows the curve $C$ with equation

$$y = \frac{1}{10}\cosh x \arctan(\sinh x), \qquad x \geqslant 0.$$

The shaded region $R$ is bounded by $C$, the $x$-axis and the line $x = 2$.

(a) Find $\int \cosh x \arctan(\sinh x)\,\mathrm{d}x$.

**(5)**

(b) Hence show that, to 2 significant figures, the area of $R$ is 0.34

**(2)**



N 3 0 7 4 6 A 0 1 4 2 8

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**Question 6 continued**

Leave blank

**Question 6 continued**

Leave blank

**Question 6 continued**

**Q6**

**(Total 7 marks)**

Leave blank

**7.** The hyperbola $H$ has equation

$$\frac{x^2}{16} - \frac{y^2}{9} = 1.$$

(a) Show that an equation for the normal to $H$ at a point $P$ $(4 \sec t, 3 \tan t)$ is

$$4x \sin t + 3y = 25 \tan t.$$

**(6)**

The point $S$, which lies on the positive $x$-axis, is a focus of $H$. Given that $PS$ is parallel to the $y$-axis and that the $y$-coordinate of $P$ is positive,

(b) find the values of the coordinates of $P$.

**(5)**

Given that the normal to $H$ at this point $P$ intersects the $x$-axis at the point $R$,

(c) find the area of triangle $PRS$.

**(3)**



N 3 0 7 4 6 A 0 1 8 2 8

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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 curve $C$ has parametric equations

$$x = 3(t + \sin t), \qquad y = 3(1 - \cos t), \qquad 0 \leqslant t < \pi.$$

(a) Show that $\dfrac{dy}{dx} = \tan\dfrac{t}{2}$. **(3)**

The arc length $s$ of $C$ is measured from the origin $O$.

(b) Show that $s = 12\sin\dfrac{t}{2}$. **(4)**

(c) Hence write down the intrinsic equation of $C$ in the form $s = f(\psi)$. **(1)**

The point $P$ lies on $C$ and the arc $OP$ of $C$ has length $L$. The arc $OP$ is rotated through $2\pi$ radians about the $x$-axis.

(d) Show that the area of the curved surface generated is given by

$$\frac{\pi L^3}{36}.$$ **(7)**



N 3 0 7 4 6 A 0 2 2 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 15 marks)**

**TOTAL FOR PAPER: 75 MARKS**

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