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 22 June 2015 – Morning

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**

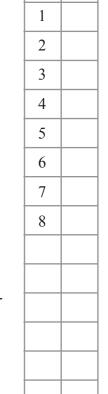
You must ensure that your answers to parts of questions are clearly labelled. You should show sufficient working to make your methods clear to the Examiner. Answers without working may not gain full credit.

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Examiner's use only

Team Leader's use only

Turn over

Total



	I
1. Solve the equation	
$2\cosh^2 x - 3\sinh x = 1$	
giving your answers in terms of natural logarithms.	
giving your unswers in terms of natural logarithms.	(6)

	Lea blar
2. A curve has equation	
$y = \cosh x, \qquad 1 \leqslant x \leqslant \ln 5$	
Find the exact length of this curve. Give your answer in terms of e.	
	(5)

Leave	
blank	

3.

$$\mathbf{A} = \begin{pmatrix} 2 & 1 & 0 \\ 1 & 2 & 1 \\ 0 & 1 & 2 \end{pmatrix}$$

(a) Find the eigenvalues of A.

**(5)** 

(b) Find a normalised eigenvector for each of the eigenvalues of A.

**(5)** 

(c) Write down a matrix P and a diagonal matrix D such that  $P^TAP = D$ .

**(2)** 



Qu	nestion 3 continued	Leave blank
		1



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

$$y = \frac{1}{\sqrt{x^2 + 2x - 3}}, \quad x > 1$$

(a) Find  $\int y \, dx$ 

**(3)** 

The region R is bounded by the curve C, the x-axis and the lines with equations x = 2 and x = 3. The region R is rotated through  $2\pi$  radians about the x-axis.

(b) Find the volume of the solid generated. Give your answer in the form  $p\pi \ln q$ , where p and q are rational numbers to be found.

(4)

10



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- **5.** The points A, B and C have position vectors  $\begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix}$ ,  $\begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}$  and  $\begin{pmatrix} 2 \\ 1 \\ 0 \end{pmatrix}$  respectively.
  - (a) Find a vector equation of the straight line AB.

**(2)** 

(b) Find a cartesian form of the equation of the straight line AB.

**(2)** 

The plane  $\Pi$  contains the points A, B and C.

(c) Find a vector equation of  $\Pi$  in the form  $\mathbf{r} \cdot \mathbf{n} = p$ .

**(4)** 

(d) Find the perpendicular distance from the origin to  $\Pi$ .

**(2)** 

Question 5 continued	Leave blank



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6.	The hyperbola <i>H</i> is given by the equation $x^2 - y^2 = 1$
	(a) Write down the equations of the two asymptotes of <i>H</i> .

(1)

(b) Show that an equation of the tangent to H at the point  $P(\cosh t, \sinh t)$  is

$$y \sinh t = x \cosh t - 1$$

**(3)** 

The tangent at P meets the asymptotes of H at the points Q and R.

(c) Show that P is the midpoint of QR.

**(3)** 

(d) Show that the area of the triangle OQR, where O is the origin, is independent of t.

(3)
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Question 6 continued	Leave blank



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7.

$$I_n = \int \sin^n x \, \mathrm{d}x, \ n \geqslant 0$$

(a) Prove that for  $n \ge 2$ 

$$I_n = \frac{1}{n} \left( -\sin^{n-1} x \cos x + (n-1)I_{n-2} \right)$$

Given that *n* is an odd number,  $n \ge 3$ 

(b) show that

$$\int_0^{\frac{\pi}{2}} \sin^n x \, dx = \frac{(n-1)(n-3)...6.4.2}{n(n-2)(n-4)...7.5.3}$$
 (4)

(c) Hence find  $\int_0^{\frac{\pi}{2}} \sin^5 x \cos^2 x \, dx$ 

**(3)** 

**(4)** 



Question 7 continued	Leave blank



L	eave	
hl	ank	

- **8.** The ellipse E has equation  $x^2 + 4y^2 = 4$ 
  - (a) (i) Find the coordinates of the foci,  $F_1$  and  $F_2$ , of E.
    - (ii) Write down the equations of the directrices of E.

(4)

(b) Given that the point P lies on the ellipse, show that

$$\left| PF_1 \right| + \left| PF_2 \right| = 4$$

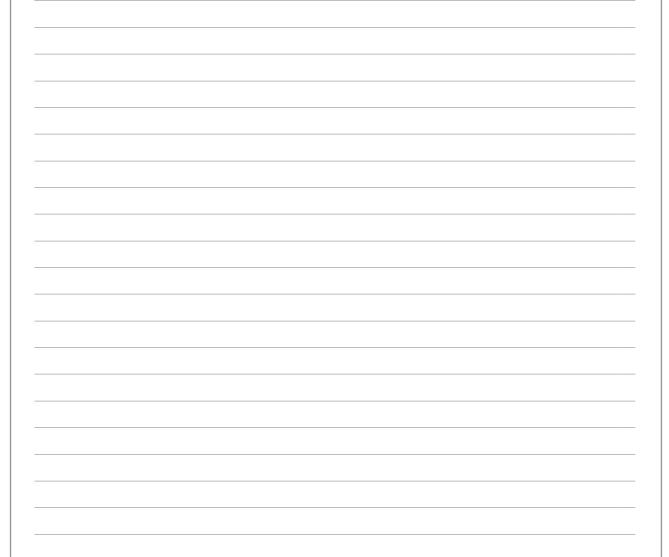
**(4)** 

A chord of an ellipse is a line segment joining two points on the ellipse.

The set of midpoints of the parallel chords of E with gradient m, where m is a constant, lie on a straight line l.

(c) Find an equation of l.

**(6)** 





Question 8 continued	Leave blank
Question o continued	

