

Paper Reference(s)

6669/01

Edexcel GCE

Further Pure Mathematics FP3

Advanced Level

Monday 22 June 2015 – Morning

Time: 1 hour 30 minutes

Materials required for examination

Mathematical Formulae (Pink)

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

Write the name of the examining body (Edexcel), your centre number, candidate number, the unit title (Core Mathematics FP3), the paper reference (6669), your surname, initials and signature.

Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
There are 8 questions in this question paper. The total mark for this paper is 75.

Advice to Candidates

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

1. Solve the equation

$$2 \cosh^2 x - 3 \sinh x = 1,$$

giving your answers in terms of natural logarithms.

(6)

2. A curve has equation

$$y = \cosh x, \quad 1 \leq x \leq \ln 5.$$

Find the exact length of this curve. Give your answer in terms of e.

(5)

- 3.

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

(a) Find the eigenvalues of \mathbf{A} .

(5)

(b) Find a normalised eigenvector for each of the eigenvalues of \mathbf{A} .

(5)

(c) Write down a matrix \mathbf{P} and a diagonal matrix \mathbf{D} such that $\mathbf{P}^T \mathbf{A} \mathbf{P} = \mathbf{D}$.

(2)

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 2π 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)

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 Π contains the points A , B and C .

(c) Find a vector equation of Π in the form $\mathbf{r} \cdot \mathbf{n} = p$. (4)

(d) Find the perpendicular distance from the origin to Π . (2)

6. The hyperbola H is given by the equation $x^2 - y^2 = 1$

(a) Write down the equations of the two asymptotes of H . (1)

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

$$y \sinh t = x \cosh t - 1. \quad (3)$$

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)

7.
$$I_n = \int \sin^n x \, dx, \quad n \geq 0.$$

(a) Prove that for $n \geq 2$,

$$I_n = \frac{1}{n} (-\sin^{n-1} x \cos x + (n-1)I_{n-2}). \quad (4)$$

Given that n is an odd number, $n \geq 3$,

(b) show that

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

(c) Hence find $\int_0^{\frac{\pi}{2}} \sin^5 x \cos^2 x \, dx$. (3)

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

$$|PF_1| + |PF_2| = 4. \quad (4)$$

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)

TOTAL FOR PAPER: 75 MARKS

END