Centre No.					
Candidate No.					

Paper Reference

6 6 6 7 / 0 1

Surname | Initial(s)

Signature

Paper Reference(s)

6667/01

Edexcel GCE

Further Pure Mathematics FP1

Advanced/Advanced Subsidiary

Monday 28 January 2013 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
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7	
8	
9	
Total	

Materials required for examination	Items included with question papers
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 to 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 9 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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Turn over

PEARSON

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1. Show, using the formulae for $\sum_{r=1}^{n} r$ and $\sum_{r=1}^{n} r^2$, that

$$\sum_{r=1}^{n} 3(2r-1)^2 = n(2n+1)(2n-1), \text{ for all positive integers } n.$$

(5)

Leave blank

2.

$$z = \frac{50}{3+4\mathrm{i}}$$

Find, in the form $a + \mathrm{i}\,b$ where $a, b \in \mathbb{R}$,

(a) z,

(2)

(b) z^2.

(2)

Find

(c) $|z|$,

(2)

(d) $\arg z^2$, giving your answer in degrees to 1 decimal place.

(2)

Leave blank

3.

$$f(x) = 2x^{\frac{1}{2}} + x^{-\frac{1}{2}} - 5, \qquad x > 0$$

(a) Find $f'(x)$.

(2)

The equation $f(x) = 0$ has a root α in the interval [4.5, 5.5].

(b) Using $x_0 = 5$ as a first approximation to α, apply the Newton-Raphson procedure once to $f(x)$ to find a second approximation to α, giving your answer to 3 significant figures.

(4)

Leave blank

4. The transformation U, represented by the 2×2 matrix $\mathbf{P}$, is a rotation through $90°$ anticlockwise about the origin.

(a) Write down the matrix $\mathbf{P}$.

(1)

The transformation V, represented by the 2×2 matrix $\mathbf{Q}$, is a reflection in the line $y=-x$.

(b) Write down the matrix $\mathbf{Q}$.

(1)

Given that U followed by V is transformation T, which is represented by the matrix $\mathbf{R}$,

(c) express $\mathbf{R}$ in terms of $\mathbf{P}$ and $\mathbf{Q}$,

(1)

(d) find the matrix $\mathbf{R}$,

(2)

(e) give a full geometrical description of T as a single transformation.

(2)

Leave blank

5.

$$f(x) = (4x^2 + 9)(x^2 - 6x + 34)$$

(a) Find the four roots of $f(x) = 0$

Give your answers in the form $x = p + iq$, where p and q are real.

(5)

(b) Show these four roots on a single Argand diagram.

(2)

Leave blank

6. $$\mathbf{X} = \begin{pmatrix} 1 & a \\ 3 & 2 \end{pmatrix}, \text{ where } a \text{ is a constant.}$$

(a) Find the value of a for which the matrix **X** is singular.

(2)

$$\mathbf{Y} = \begin{pmatrix} 1 & -1 \\ 3 & 2 \end{pmatrix}$$

(b) Find $\mathbf{Y}^{-1}$.

(2)

The transformation represented by **Y** maps the point A onto the point B.

Given that B has coordinates $(1 - \lambda, 7\lambda - 2)$, where λ is a constant,

(c) find, in terms of λ, the coordinates of point A.

(4)

Leave blank

7. The rectangular hyperbola, H, has cartesian equation $xy = 25$

The point $P\left(5p, \frac{5}{p}\right)$, and the point $Q\left(5q, \frac{5}{q}\right)$, where $p, q \neq 0, p \neq q$, are points on the rectangular hyperbola H.

(a) Show that the equation of the tangent at point P is

$$p^2y + x = 10p$$

(4)

(b) Write down the equation of the tangent at point Q.

(1)

The tangents at P and Q meet at the point N.

Given $p + q \neq 0$,

(c) show that point N has coordinates $\left(\frac{10pq}{p+q}, \frac{10}{p+q}\right)$.

(4)

The line joining N to the origin is perpendicular to the line PQ.

(d) Find the value of p^2q^2.

(5)

Leave blank

8. (a) Prove by induction that, for $n \in \mathbb{Z}^+$,

$$\sum_{r=1}^{n} r(r+3) = \tfrac{1}{3}n(n+1)(n+5)$$

(6)

(b) A sequence of positive integers is defined by

$$u_1 = 1,$$
$$u_{n+1} = u_n + n(3n+1), \qquad n \in \mathbb{Z}^+$$

Prove by induction that

$$u_n = n^2(n-1) + 1, \qquad n \in \mathbb{Z}^+$$

(5)

Leave blank

9.

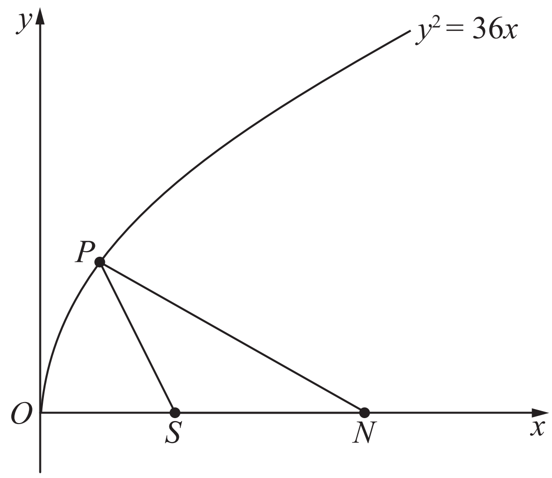

Figure 1

Figure 1 shows a sketch of part of the parabola with equation $y^2 = 36x$.

The point P (4, 12) lies on the parabola.

(a) Find an equation for the normal to the parabola at P.

(5)

This normal meets the x-axis at the point N and S is the focus of the parabola, as shown in Figure 1.

(b) Find the area of triangle PSN.

(4)