

Write your name here

Surname

Other names

**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

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Candidate Number

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# Further Pure Mathematics F1

**Advanced/Advanced Subsidiary**

Monday 14 May 2018 – Afternoon

**Time: 1 hour 30 minutes**

Paper Reference

**WFM01/01**

**You must have:**

Mathematical Formulae and Statistical Tables (Blue)

Total Marks

**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

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

## Information

- The total mark for this paper is 75.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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1. Use the standard results for  $\sum_{r=1}^n r$  and for  $\sum_{r=1}^n r^2$  to show that, for all positive integers  $n$ ,

$$\sum_{r=1}^n r(r+3) = \frac{n}{a}(n+1)(n+b)$$

where  $a$  and  $b$  are integers to be found.

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Question 1 continued

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(Total 4 marks)

Q1



- (1)

(2)

(4)

### Question 2 continued

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Question 2 continued

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Q2

(Total 7 marks)



Figure 1 shows the parabola  $C$  which has cartesian equation  $y^2 = 6x$ . The point  $S$  is the focus of  $C$ .

- The point  $P$  lies on the parabola  $C$ , and the point  $Q$  lies on the directrix of  $C$ .  $PQ$  is parallel to the  $x$ -axis with distance  $PQ = 14$

- Given that the point  $P$  is above the  $x$ -axis,

- (c) find the exact coordinates of  $P$ .
- (3)**



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Question 3 continued

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Q3



$$\mathbf{A} = \begin{pmatrix} 2p & 3q \\ 3p & 5q \end{pmatrix}$$

(a) Find  $\mathbf{A}^{-1}$  in terms of  $p$  and  $q$ .

(3)

$$\mathbf{B} = \begin{pmatrix} p & q \\ 6p & 11q \\ 5p & 8q \end{pmatrix}$$

(b) find the matrix  $\mathbf{X}$ , giving your answer in its simplest form.

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**Question 4 continued**

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**Question 4 continued**

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Question 4 continued

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(Total 7 marks)

Q4



**5.** Given that

$$z^4 - 6z^3 + 34z^2 - 54z + 225 \equiv (z^2 + 9)(z^2 + az + b)$$

where  $a$  and  $b$  are real numbers,

- (a) find the value of  $a$  and the value of  $b$ .

(2)

- (b) Hence find the exact roots of the equation

$$z^4 - 6z^3 + 34z^2 - 54z + 225 = 0$$

(4)

- (c) Show your roots on a single Argand diagram.

(2)

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Question 5 continued

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Question 5 continued

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Question 5 continued

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Q5



$$f(x) = \frac{2(x^3 + 3)}{\sqrt{x}} - 9, \quad x > 0$$

(a) Taking 0.45 as a first approximation to  $\alpha$ , apply the Newton-Raphson procedure once to  $f(x)$  to find a second approximation to  $\alpha$ , giving your answer to 3 decimal places.

(5)

(b) Use linear interpolation once on the interval  $[1.2, 1.3]$  to find an approximation to  $\beta$ , giving your answer to 3 decimal places.

(4)

Question 6 continued

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**Question 6 continued**



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Question 6 continued

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Q6





Question 7 continued

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(Total 9 marks)

Q7



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

$$\begin{pmatrix} a & 0 \\ 1 & b \end{pmatrix}^n = \begin{pmatrix} a^n & 0 \\ \frac{a^n - b^n}{a - b} & b^n \end{pmatrix}$$

where  $a$  and  $b$  are constants and  $a \neq b$ .

(5)

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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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(Total 5 marks)

Q8



$$\frac{z - ki}{z + 3i} = i, \text{ where } k \text{ is a positive real constant}$$

(b) Using the printed answer in part (a),

(ii) find the argument of  $z$  when  $k = 1$ . Give your answer in radians to 3 decimal places, where  $-\pi < \arg z < \pi$

(4)

**Question 9 continued**

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### Question 9 continued

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Question 9 continued

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Q9



- (a) Show, by using calculus, that the normal to  $H$  at the point  $P$  has equation

Given that the normal through  $P$  crosses the positive  $x$ -axis at the point  $Q$  and the negative  $y$ -axis at the point  $R$ ,

- (c) Given also that the area of triangle  $OQR$  is 512, find the possible values of  $p$ . (5)



**Question 10 continued**

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Question 10 continued

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**Question 10 continued**

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Question 10 continued

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Q10

Mark allocation box for Q10.

(Total 13 marks)

TOTAL FOR PAPER: 75 MARKS

END

