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Surname	Other names
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**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

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Candidate Number

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# Further Pure Mathematics F2

## Advanced/Advanced Subsidiary

Wednesday 6 June 2018 – Morning  
**Time: 1 hour 30 minutes**

Paper Reference  
**WFM02/01**

**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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2. (a) Find the general solution of the differential equation

$$(x^2 + 1)\frac{dy}{dx} + xy - x = 0$$

giving your answer in the form  $y = f(x)$ .

**(6)**

(b) Find the particular solution for which  $y = 2$  when  $x = 3$

**(2)**

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Question 2 continued

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3.

$$2 \frac{d^2y}{dx^2} + \frac{dy}{dx} - xy = 1$$

(a) Show that

$$\frac{d^4y}{dx^4} = \frac{1}{2} \left( a \frac{dy}{dx} + bx \frac{d^2y}{dx^2} + c \frac{d^3y}{dx^3} \right)$$

where  $a, b$  and  $c$  are constants to be found.

(4)

Given that  $y = 1$  and  $\frac{dy}{dx} = 1$  when  $x = 2$

(b) find a series solution for  $y$  in ascending powers of  $(x - 2)$ , up to and including the term in  $(x - 2)^4$ . Write each term in its simplest form.

(4)

(c) Use the solution to part (b) to find an approximate value for  $y$  when  $x = 2.1$ , giving your answer to 3 decimal places.

(2)

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Question 3 continued

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**Question 3 continued**

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**Q3**

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**(Total 10 marks)**



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4. A complex number  $z$  is represented by the point  $P$  in an Argand diagram. Given that

$$|z + i| = 1$$

- (a) sketch the locus of  $P$ . (2)

The transformation  $T$  from the  $z$ -plane to the  $w$ -plane is given by

$$w = \frac{3iz - 2}{z + i}, \quad z \neq -i$$

- (b) Given that  $T$  maps  $|z + i| = 1$  to a circle  $C$  in the  $w$ -plane, find a cartesian equation of  $C$ . (7)

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Question 4 continued

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(Total 9 marks)

Q4



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5. (a) Express  $\frac{4r + 2}{r(r + 1)(r + 2)}$  in partial fractions. (3)

(b) Hence, using the method of differences, prove that

$$\sum_{r=1}^n \frac{4r + 2}{r(r + 1)(r + 2)} = \frac{n(an + b)}{2(n + 1)(n + 2)}$$

where  $a$  and  $b$  are constants to be found. (5)

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**Question 5 continued**

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Question 5 continued

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Q5

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(Total 8 marks)



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6. (a) Show that the transformation  $x = e^t$  transforms the differential equation

$$x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 3y = x^2 \quad x > 0 \quad (I)$$

into the differential equation

$$\frac{d^2y}{dt^2} - 4 \frac{dy}{dt} + 3y = e^{2t} \quad (II) \quad (6)$$

- (b) Find the general solution of the differential equation (II), expressing  $y$  as a function of  $t$ . (6)

- (c) Hence find the general solution of the differential equation (I). (1)

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### Question 6 continued

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Q6

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**(Total 13 marks)**

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7. (a) Use de Moivre's theorem to show that

cos 7θ ≡ 64 cos<sup>7</sup>θ - 112 cos<sup>5</sup>θ + 56 cos<sup>3</sup>θ - 7 cos θ (6)

(b) Hence find the four distinct roots of the equation

64x<sup>7</sup> - 112x<sup>5</sup> + 56x<sup>3</sup> - 7x + 1 = 0

giving your answers to 3 decimal places where necessary. (5)

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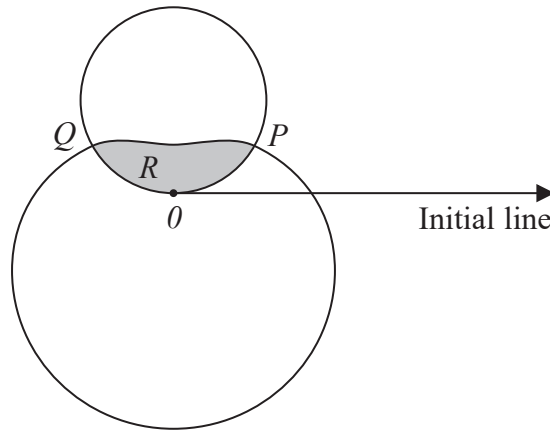


Figure 1

Figure 1 shows a sketch of the curves with polar equations

$$r = 2 \sin \theta \quad 0 \leq \theta \leq \pi$$

$$r = 1.5 - \sin \theta \quad 0 \leq \theta \leq 2\pi$$

The curves intersect at the points  $P$  and  $Q$ .

- (a) Find the polar coordinates of the point  $P$  and the polar coordinates of the point  $Q$ . (3)

The region  $R$ , shown shaded in Figure 1, is enclosed by the two curves.

- (b) Find the exact area of  $R$ , giving your answer in the form  $p\pi + q\sqrt{3}$ , where  $p$  and  $q$  are rational numbers to be found. (8)

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Question 8 continued

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