Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
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**Pearson Edexcel International Advanced Level**

Centre Number | Candidate Number

**Time** 1 hour 30 minutes

**Paper reference** **WFM02/01**

# Mathematics

## International Advanced Subsidiary/Advanced Level
## Further Pure Mathematics F2

**You must have:**
Mathematical Formulae and Statistical Tables (Yellow), calculator

Total Marks

**Candidates may use any calculator allowed by Pearson regulations. 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).
- **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.
- Inexact answers should be given to three significant figures unless otherwise stated.

## Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 8 questions in this question paper. 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.
- Good luck with your examination.

*Turn over*


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**1.** (a) Express $\dfrac{2}{r(r^2-1)}$ in partial fractions.

**(3)**

(b) Hence find, in terms of $n$,

$$\sum_{r=2}^{n} \frac{1}{r(r^2-1)}$$

Give your answer in the form

$$\frac{n^2 + An + B}{Cn(n+1)}$$

where $A$, $B$ and $C$ are constants to be found.

**(5)**

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**Question 1 continued**

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**Question 1 continued**

**Q1**

**(Total 8 marks)**

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**2.** The transformation $T$ from the $z$-plane, where $z = x + \mathrm{i}y$, to the $w$-plane, where $w = u + \mathrm{i}v$, is given by

$$w = \frac{z + 2}{z - \mathrm{i}} \qquad z \neq \mathrm{i}$$

The transformation $T$ maps the circle $|z| = 2$ in the $z$-plane onto a circle $C$ in the $w$-plane.

Find (i) the centre of $C$,

(ii) the radius of $C$.

**(8)**

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**Question 2 continued**

**Q2**

**(Total 8 marks)**

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**3.** The curve $C$, with pole $O$, has polar equation

$$r = 1 + \cos\theta, \quad 0 \leqslant \theta \leqslant \frac{\pi}{2}$$

At the point $A$ on $C$, the tangent to $C$ is parallel to the initial line.

(a) Find the polar coordinates of $A$.

**(4)**

(b) Find the finite area enclosed by the initial line, the line $OA$ and the curve $C$, giving your answer in the form $a\pi + b\sqrt{3}$, where $a$ and $b$ are rational constants to be found.

**(6)**

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**Question 3 continued**

**(Total 10 marks)**

Q3

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**4.** Given that

$$y\frac{d^2y}{dx^2} - 4\left(\frac{dy}{dx}\right)^2 + 3y = 0$$

(a) show that

$$\frac{d^3y}{dx^3} = \frac{28}{y^2}\left(\frac{dy}{dx}\right)^3 - \frac{24}{y}\left(\frac{dy}{dx}\right)$$

**(5)**

Given also that $y = 8$ and $\frac{dy}{dx} = 1$ at $x = 0$

(b) find a series solution for $y$ in ascending powers of $x$, up to and including the term in $x^3$, simplifying the coefficients where possible.

**(4)**

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**Question 4 continued**

**(Total 9 marks)**

**Q4**

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**5.** Use algebra to find the set of values of $x$ for which

$$\left|2x^2 + x - 3\right| > 3(1 - x)$$

**(7)**

[*Solutions based entirely on graphical or numerical methods are not acceptable.*]

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**Question 5 continued**

**(Total 7 marks)**

Q5

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

$$\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 8y = 2x^2 + x$$

**(8)**

(b) Find the particular solution of this differential equation for which $y = 1$ and $\frac{dy}{dx} = 0$ when $x = 0$

**(5)**

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**Question 6 continued**

**(Total 13 marks)**

**Q6**

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

$$\tan 4\theta \equiv \frac{4\tan\theta - 4\tan^3\theta}{1 - 6\tan^2\theta + \tan^4\theta}$$

**(6)**

(b) Use the identity given in part (a) to find the 2 positive roots of

$$x^4 + 2x^3 - 6x^2 - 2x + 1 = 0$$

giving your answers to 3 significant figures.

**(3)**

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**Question 7 continued**

Q7

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**8.** (a) Show that the substitution $v = y^{-2}$ transforms the differential equation

$$\frac{dy}{dx} + 6xy = 3xe^{x^2}y^3 \qquad x > 0 \qquad \text{(I)}$$

into the differential equation

$$\frac{dv}{dx} - 12vx = -6xe^{x^2} \qquad x > 0 \qquad \text{(II)}$$

**(5)**

(b) Hence find the general solution of the differential equation (I), giving your answer in the form $y^2 = f(x)$.

**(6)**

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**Question 8 continued**

**Q8**

**(Total 11 marks)**

**TOTAL FOR PAPER: 75 MARKS**

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