

Monday 14 January 2013 – Morning

A2 GCE MATHEMATICS

4726/01 Further Pure Mathematics 2

QUESTION PAPER

Candidates answer on the Printed Answer Book.

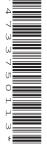
OCR supplied materials:

- Printed Answer Book 4726/01
- List of Formulae (MF1)

Other materials required:

Scientific or graphical calculator

Duration: 1 hour 30 minutes



INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- Write your answer to each question in the space provided in the Printed Answer Book. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer all the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Do not write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Give non-exact numerical answers correct to 3 significant figures unless a different degree of accuracy is specified in the question or is clearly appropriate.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets [] at the end of each question or part question on the Question Paper.
- You are reminded of the need for clear presentation in your answers.
- The total number of marks for this paper is 72.
- The Printed Answer Book consists of 16 pages. The Question Paper consists of 4 pages.
 Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

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- 1 Express $\frac{5x}{(x-1)(x^2+4)}$ in partial fractions. [5]
- 2 The equation of a curve is $y = \frac{x^2 3}{x 1}$.
 - (i) Find the equations of the asymptotes of the curve. [3]
 - (ii) Write down the coordinates of the points where the curve cuts the axes. [1]
 - (iii) Show that the curve has no stationary points. [3]
 - (iv) Sketch the curve and the asymptotes. [3]
- 3 By first expressing $\cosh x$ and $\sinh x$ in terms of exponentials, solve the equation

$$3\cosh x - 4\sinh x = 7$$
,

giving your answer in an exact logarithmic form. [6]

4 You are given that $I_n = \int_0^1 x^n e^{2x} dx$ for $n \ge 0$.

(i) Show that
$$I_n = \frac{1}{2}e^2 - \frac{1}{2}nI_{n-1}$$
 for $n \ge 1$.

- (ii) Find I_3 in terms of e. [4]
- 5 You are given that $f(x) = e^{-x} \sin x$.
 - (i) Find f(0) and f'(0).
 - (ii) Show that f''(x) = -2f'(x) 2f(x) and hence, or otherwise, find f''(0). [4]
 - (iii) Find a similar expression for f'''(x) and hence, or otherwise, find f'''(0). [2]
 - (iv) Find the Maclaurin series for f(x) up to and including the term in x^3 . [2]

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- 6 By first completing the square, find $\int_0^1 \frac{1}{\sqrt{x^2 + 4x + 8}} dx$, giving your answer in an exact logarithmic form. [6]
- 7 A curve has polar equation $r = 5 \sin 2\theta$ for $0 \le \theta \le \frac{1}{2}\pi$.
 - (i) Sketch the curve, indicating the line of symmetry and stating the polar coordinates of the point *P* on the curve which is furthest away from the pole. [4]
 - (ii) Calculate the area enclosed by the curve. [3]
 - (iii) Find the cartesian equation of the tangent to the curve at P. [3]
 - (iv) Show that a cartesian equation of the curve is $(x^2 + y^2)^3 = (10xy)^2$. [3]
- 8 It is required to solve the equation ln(x-1) x + 3 = 0.

You are given that there are two roots, α and β , where $1.1 < \alpha < 1.2$ and $4.1 < \beta < 4.2$.

(i) The root β can be found using the iterative formula

$$x_{n+1} = \ln(x_n - 1) + 3.$$

- (a) Using this iterative formula with $x_1 = 4.15$, find β correct to 3 decimal places. Show all your working.
- (b) Explain with the aid of a sketch why this iterative formula will not converge to α whatever initial value is taken. [3]
- (ii) (a) Show that the Newton-Raphson iterative formula for this equation can be written in the form

$$x_{n+1} = \frac{3 - 2x_n - (x_n - 1)\ln(x_n - 1)}{2 - x_n}.$$
 [5]

(b) Use this formula with $x_1 = 1.2$ to find α correct to 3 decimal places. [3]

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