

* 0000800000001 *

DFD



Newlighthouse Mock AS & A Level

CANDIDATE
NAME



CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

FURTHER MATHEMATICS

9231/11

Paper 1 Further Pure Mathematics 1

May/June 2026

2 hours

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [].

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

This document has **20** pages. Any blank pages are indicated.

DC (SL/SG) 358625/1
© NEWLH 2026

[Turn over

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

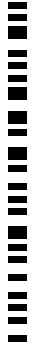
DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN





DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

BLANK PAGE

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN



1 The quartic equation $x^4 + ax^3 + bx^2 + cx + d = 0$, where a, b, c and d are constants, has roots $\alpha, \beta, \gamma, \delta$. It is given that

$$\sum \alpha = 0, \quad \sum \alpha^2 = 2, \quad \sum \alpha^3 = 3, \quad \text{and} \quad \alpha\beta\gamma\delta = 1$$

(a) State the values of a and d , and show that $b = -1$. [3]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(b) Show that $\sum \frac{1}{\alpha} = -c$. By dividing the given quartic equation by x and summing over all the roots, or otherwise, find the value of c . [3]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(c) Hence find the exact value of $\sum \frac{1}{\alpha^2}$. [3]

2 The matrix \mathbf{M} is given by $\mathbf{M} = \begin{pmatrix} a & -2 \\ 1 & b \end{pmatrix}$, where a and b are constants. It is given that the line $y = x$ is an invariant line, passing through the origin, of the transformation in the $x - y$ plane represented by \mathbf{M} .

(a) Show that $a = b + 3$. [2]

(b) A polygon S is transformed by \mathbf{M} onto polygon P . Given that the area of P is 6 times the area of S , and that $a > 0$, find the values of a and b . [3]

(c) Using your values from part (b), find the equation of the other invariant line passing through the origin. [3]

3 Let $f(r) = \frac{r}{(r+1)!}$.

(a) Show algebraically that

$$f(r) - f(r+1) \equiv \frac{r^2 + r - 1}{(r+2)!}$$

[2]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(b) Hence use the method of differences to find $\sum_{r=1}^n \frac{r^2+r-1}{(r+2)!}$ in terms of n .

[4]

(c) Deduce the exact value of $\sum_{r=1}^{\infty} \frac{r^2+r-1}{(r+2)!}$.

[2]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

4 A sequence of positive numbers is defined by $u_1 = 5$ and $u_{n+1} = \frac{5u_n - 4}{u_n}$ for all positive integers n .

(a) Prove by mathematical induction that $u_n > 4$ for all integers $n \geq 1$.

[4]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(b) Show that $u_{n+1} - u_n = \frac{-(u_n - 1)(u_n - 4)}{u_n}$ and hence deduce that the sequence is strictly decreasing.

[3]

5 The line l_1 is the line of intersection of the planes Π_1 and Π_2 , which have Cartesian equations

$$\Pi_1 : x + y - z = 2 \quad \text{and} \quad \Pi_2 : 2x - y + 3z = 1$$

The line l_2 passes through the point with coordinates $(2, 0, 1)$ and is parallel to the vector $\mathbf{i} + \mathbf{j} - 2\mathbf{k}$.

(a) Find a vector equation for the line l_1 .

[5]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(b) Find the acute angle between the lines l_1 and l_2 .

[3]

(c) Find the exact shortest distance between the lines l_1 and l_2 .

[6]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

6 The curve C has polar equation $r = \theta\sqrt{\sin\theta}$, for $0 \leq \theta \leq \pi$.

(a) Sketch C and state the polar coordinates of the pole. [2]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(b) Find the exact area of the region enclosed by C and the initial line. [6]

(c) Show that, at the point on C furthest from the initial line,

$$\tan \theta = -\frac{3}{2}\theta$$

[4]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(d) Verify that the equation in part (c) has a root between 1.9 and 2.0.

[2]

7 The curve C has equation $y = f(x)$, where $f(x) = \frac{x^2 + ax + b}{x + c}$ and a, b, c are constants. It is given that the equations of the asymptotes of C are $x = 1$ and $y = x - 2$.

(a) Deduce the values of a and c . [3]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(b) Given also that C passes through the point $(2, -1)$, show that $b = 1$. [1]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(c) Show algebraically that C has no stationary points. [3]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

(d) Sketch C , stating the coordinates of any intersections with the axes and clearly showing the asymptotes.
[3]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN



(e) Find the exact set of values of x for which $\left| \frac{x^2 - 3x + 1}{x - 1} \right| > 2$.

[5]

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN