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Newlighthouse Mock AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

MATHEMATICS **9709/32**

Paper 3 Pure Mathematics 3 **May/June 2026**

1 hour 50 minutes

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 [ ].

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

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1 **(a)** Find the exact real roots of the equation $|x^2 - 4| = 3x$. [3]

(b) Hence, without further calculation, solve the equation $|(x-1)^2 - 4| = 3(x-1)$. [2]

2 The polynomial $P(x)$ is denoted by $2x^3 + ax^2 + bx + 12$, where a and b are constants. The curve C has equation $y = P(x)$. It is given that the x-axis is a tangent to the curve C at the point where $x = 2$.

(a) Find the values of a and b. [4]

(b) Hence, find the x-coordinate of the other point where C intersects the x-axis. [2]

3 **(a)** Express $4\sin\theta + 3\cos\theta$ in the form $R\sin(\theta + \alpha)$, where $R > 0$ and $0° < \alpha < 90°$. State the exact value of R and give α correct to 2 decimal places. [3]

(b) The curve with equation $y = 4\sin x + 3\cos x$ is translated by the vector $\begin{pmatrix} 0 \\ k \end{pmatrix}$, where k is a positive constant. Find the exact value of k such that the translated curve touches the x-axis. [2]

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4 Let $f(x) = \dfrac{3-x}{\sqrt{4+2x}}$.

(a) Expand $(4+2x)^{-\frac{1}{2}}$ in ascending powers of x, up to and including the term in x^2, simplifying the coefficients. [3]

(b) Hence obtain the expansion of $f(x)$ in ascending powers of x, up to and including the term in x^2. [2]

(c) State the set of values of x for which the expansion of $f(x)$ is valid. [1]

5 The equation of a curve is $x^3 + y^3 - 3xy = 3$.

Find the exact coordinates of the points on the curve where the tangent is parallel to the x-axis. [6]

6 **(a)** Find the complex number u which satisfies the equation

$$uu^* + 4\mathrm{i}u - 5 + 12\mathrm{i} = 0.$$

Give your answer in the form $x + \mathrm{i}y$, where x and y are real. [4]

(b) On an Argand diagram, sketch the region representing complex numbers w satisfying both the inequalities $|w - u| \leqslant 2$ and $\mathrm{Im}(w) \geqslant 2$. [3]

(c) The complex number z is given by $z = w + 1$. Find the exact maximum value of $|z|$ given that w lies in the region found in part **(b)** [2]

7 Let $f(x) = \dfrac{4a^2}{x^2 - a^2}$, where a is a positive constant.

(a) Express $f(x)$ in partial fractions. [2]

(b) Find the value of $\int_{2a}^{3a} f(x)\,\mathrm{d}x$, giving your answer in the form $a\ln k$. [3]

(c) Hence, find an expression for $\int_{2a}^{N} f(x)\,\mathrm{d}x$ in terms of a and N, and deduce the exact value of $\int_{2a}^{\infty} f(x)\,\mathrm{d}x$. [3]

8 The line l has equation $\mathbf{r} = \mathbf{i} + 2\mathbf{j} + \mathbf{k} + \lambda(2\mathbf{i} - \mathbf{j} + \mathbf{k})$. The point P has position vector $3\mathbf{j} + \mathbf{k}$.

(a) Find the position vector of P', the reflection of P in the line l. [4]

(b) The point Q lies on l such that the area of triangle PQP' is $\sqrt{3}$. Find the position vectors of the two possible positions of Q. [4]

9 A chemical substance is dissolving in a liquid. At time t minutes, the mass of the un-dissolved substance is x grams. The rate of decrease of x is proportional to $x^2\sqrt{t}$.

When $t = 1$, the mass is 2 grams and it is decreasing at a rate of 0.5 grams per minute.

(a) Show that x and t satisfy the differential equation $\frac{dx}{dt} = -0.125x^2\sqrt{t}$. [2]

(b) Solve the differential equation, obtaining an expression for x in terms of t. [5]

(c) State what happens to the mass of the un-dissolved substance as t becomes very large. [1]

10 **(a)** By using the substitution $u = x^2$, or otherwise, find $\int x e^{x^2} \, dx$. [2]

(b) Using integration by parts and your result from part **(a)**, find the exact value of $\int_0^1 x^3 e^{x^2} \, dx$. [4]

11 The equation of a curve is $y = x^2 \cos 2x$.

(a) Show that the x-coordinate of the stationary point in the interval $0 < x < \frac{1}{4}\pi$ satisfies the equation

$$x = \frac{1}{2}\tan^{-1}\left(\frac{1}{x}\right).$$

[3]

(b) Use the equation in part **(a)** to show by calculation that this root lies between 0.5 and 0.6. [2]

(c) Use the iterative formula $x_{n+1} = \frac{1}{2}\tan^{-1}\left(\frac{1}{x_n}\right)$ with initial value $x_1 = 0.5$ to find the root correct to 3 decimal places. Give the result of each iteration to 5 decimal places. [3]

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