



Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
NUMBER

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MATHEMATICS

9709/32

Paper 3 Pure Mathematics 3

February/March 2020

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. Blank pages are indicated.



- 1 (a) Sketch the graph of $y = |x - 2|$.

[1]

- (b) Solve the inequality $|x - 2| < 3x - 4$.

[3]

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- 2** Solve the equation $\ln 3 + \ln(2x + 5) = 2 \ln(x + 2)$. Give your answer in a simplified exact form. [4]

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- 3 (a) By sketching a suitable pair of graphs, show that the equation $\sec x = 2 - \frac{1}{2}x$ has exactly one root in the interval $0 \leq x < \frac{1}{2}\pi$. [2]

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- (b) Verify by calculation that this root lies between 0.8 and 1. [2]

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- (c) Use the iterative formula $x_{n+1} = \cos^{-1}\left(\frac{2}{4-x_n}\right)$ to determine the root correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

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- 4 Find $\int_{\frac{1}{6}\pi}^{\frac{1}{3}\pi} x \sec^2 x \, dx$. Give your answer in a simplified exact form. [7]

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5 (a) Show that $\frac{\cos 3x}{\sin x} + \frac{\sin 3x}{\cos x} = 2 \cot 2x$.

[4]

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6 The variables x and y satisfy the differential equation

$$\frac{dy}{dx} = \frac{1 + 4y^2}{e^x}.$$

It is given that $y = 0$ when $x = 1$.

(a) Solve the differential equation, obtaining an expression for y in terms of x .

[7]

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- (b) State what happens to the value of y as x tends to infinity.

[1]

7 The equation of a curve is $x^3 + 3xy^2 - y^3 = 5$.

(a) Show that $\frac{dy}{dx} = \frac{x^2 + y^2}{y^2 - 2xy}$. [4]

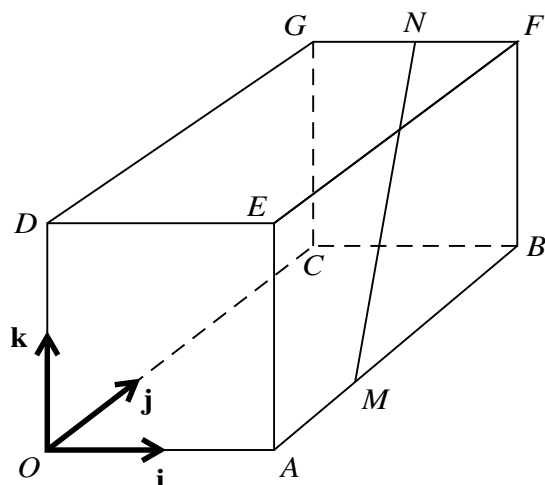
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- (b)** Find the coordinates of the points on the curve where the tangent is parallel to the y-axis. [5]

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In the diagram, $OABCDEFG$ is a cuboid in which $OA = 2$ units, $OC = 3$ units and $OD = 2$ units. Unit vectors $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$ are parallel to OA , OC and OD respectively. The point M on AB is such that $MB = 2AM$. The midpoint of FG is N .

- (a) Express the vectors $\overrightarrow{OM}$ and $\overrightarrow{MN}$ in terms of $\mathbf{i}$, $\mathbf{j}$ and $\mathbf{k}$. [3]

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- (b) Find a vector equation for the line through M and N . [2]

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- (c) Find the position vector of P , the foot of the perpendicular from D to the line through M and N . [4]

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9 Let $f(x) = \frac{2 + 11x - 10x^2}{(1 + 2x)(1 - 2x)(2 + x)}$.

(a) Express $f(x)$ in partial fractions.

[5]

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- (b)** Hence obtain the expansion of $f(x)$ in ascending powers of x , up to and including the term in x^2 . [5]

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- 10 (a)** The complex numbers v and w satisfy the equations

$$v + iw = 5 \quad \text{and} \quad (1 + 2i)v - w = 3i.$$

Solve the equations for v and w , giving your answers in the form $x + iy$, where x and y are real.

[6]

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- (b) (i) On an Argand diagram, sketch the locus of points representing complex numbers z satisfying $|z - 2 - 3i| = 1$. [2]

- (ii) Calculate the least value of $\arg z$ for points on this locus. [2]

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