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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2601216071

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.

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[Turn over

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]

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 $0 \leqslant x < \frac{1}{2}\pi$. [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 $\int_{\frac{1}{6}\pi}^{\frac{1}{3}\pi} x \sec^2 x \, \mathrm{d}x$. 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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(b) Hence solve the equation $\frac{\cos 3x}{\sin x} + \frac{\sin 3x}{\cos x} = 4$, for $0 < x < \pi$. [3]

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6 The variables x and y satisfy the differential equation

$$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1 + 4y^2}{\mathrm{e}^x}.$$

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]

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

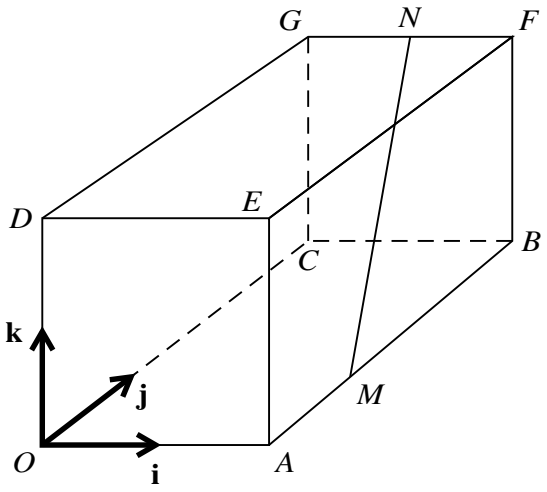
(a) Show that $\frac{dy}{dx} = \frac{x^2 + y^2}{y^2 - 2xy}$. [4]

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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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8



In the diagram, $OABCDEFG$ is a cuboid in which $OA = 2$ units, $OC = 3$ units and $OD = 2$ units. Unit vectors **i**, **j** and **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 **i**, **j** and **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]

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

(a) Express $f(x)$ in partial fractions. [5]

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

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

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

Solve the equations for v and w, giving your answers in the form $x + \mathrm{i}y$, 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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Additional Page

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