

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
NUMBER

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MATHEMATICS

9709/12

Paper 1 Pure Mathematics 1

October/November 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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- 1** The coefficient of x^3 in the expansion of $(1 + kx)(1 - 2x)^5$ is 20.

Find the value of the constant k .

[4]

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- 2** The first, second and third terms of a geometric progression are $2p + 6$, $-2p$ and $p + 2$ respectively, where p is positive.

Find the sum to infinity of the progression.

[5]

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- 3** The equation of a curve is $y = 2x^2 + m(2x + 1)$, where m is a constant, and the equation of a line is $y = 6x + 4$.

Show that, for all values of m , the line intersects the curve at two distinct points.

[5]

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- 4** The sum, S_n , of the first n terms of an arithmetic progression is given by

$$S_n = n^2 + 4n.$$

The k th term in the progression is greater than 200.

Find the smallest possible value of k .

[5]

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5 Functions f and g are defined by

$$f(x) = 4x - 2, \quad \text{for } x \in \mathbb{R},$$

$$g(x) = \frac{4}{x+1}, \quad \text{for } x \in \mathbb{R}, x \neq -1.$$

(a) Find the value of $fg(7)$.

[1]

[illegible]

(b) Find the values of x for which $f^{-1}(x) = g^{-1}(x)$.

[5]

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- 6 (a) Prove the identity $\left(\frac{1}{\cos x} - \tan x\right)\left(\frac{1}{\sin x} + 1\right) \equiv \frac{1}{\tan x}$. [4]

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- (b) Hence solve the equation $\left(\frac{1}{\cos x} - \tan x\right)\left(\frac{1}{\sin x} + 1\right) = 2 \tan^2 x$ for $0^\circ \leq x \leq 180^\circ$. [2]

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7 The point (4, 7) lies on the curve $y = f(x)$ and it is given that $f'(x) = 6x^{-\frac{1}{2}} - 4x^{-\frac{3}{2}}$.

- (a) A point moves along the curve in such a way that the x -coordinate is increasing at a constant rate of 0.12 units per second.

Find the rate of increase of the y -coordinate when $x = 4$.

[3]

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- (b) Find the equation of the curve.

[4]

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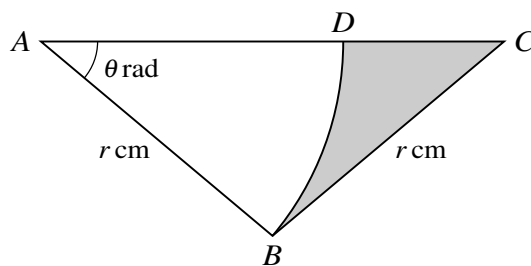
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(a) Express the area of the shaded region in terms of r and θ . [3]

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[4]

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- 9 A circle has centre at the point $B(5, 1)$. The point $A(-1, -2)$ lies on the circle.

(a) Find the equation of the circle.

[3]

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Point C is such that AC is a diameter of the circle. Point D has coordinates $(5, 16)$.

(b) Show that DC is a tangent to the circle.

[4]

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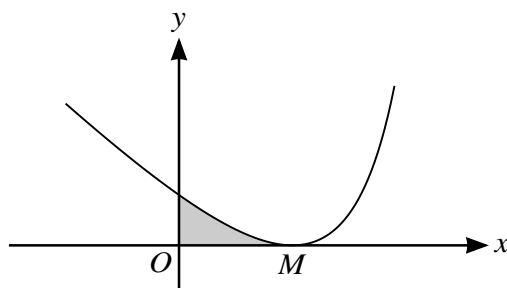
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[2]

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(a) Find expressions for $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ and $\int y \, dx$. [6]

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- (b) Find, by calculation, the x -coordinate of M . [2]

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- (c) Find the area of the shaded region bounded by the curve and the coordinate axes. [2]

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11 A curve has equation $y = 3 \cos 2x + 2$ for $0 \leq x \leq \pi$.

- (a)** State the greatest and least values of y . [2]

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- (b)** Sketch the graph of $y = 3 \cos 2x + 2$ for $0 \leq x \leq \pi$. [2]

- (c)** By considering the straight line $y = kx$, where k is a constant, state the number of solutions of the equation $3 \cos 2x + 2 = kx$ for $0 \leq x \leq \pi$ in each of the following cases.

- (i)** $k = -3$ [1]

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- (ii)** $k = 1$ [1]

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- (iii)** $k = 3$ [1]

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Functions f , g and h are defined for $x \in \mathbb{R}$ by

$$f(x) = 3 \cos 2x + 2,$$

$$g(x) = f(2x) + 4,$$

$$h(x) = 2f\left(x + \frac{1}{2}\pi\right).$$

- (d) Describe fully a sequence of transformations that maps the graph of $y = f(x)$ on to $y = g(x)$. [2]

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- (e) Describe fully a sequence of transformations that maps the graph of $y = f(x)$ on to $y = h(x)$. [2]

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