

Cambridge International AS & A Level

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MATHEMATICS

9709/11

Paper 1 Pure Mathematics 1

October/November 2021

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)** Expand $\left(1 - \frac{1}{2x}\right)^2$. [1]

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- (b)** Find the first four terms in the expansion, in ascending powers of x , of $(1 + 2x)^6$. [2]

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- (c)** Hence find the coefficient of x in the expansion of $\left(1 - \frac{1}{2x}\right)^2 (1 + 2x)^6$. [2]

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- 2** A curve has equation $y = kx^2 + 2x - k$ and a line has equation $y = kx - 2$, where k is a constant.

Find the set of values of k for which the curve and line do not intersect.

[5]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the entire width of the page. There are no margins, text, or other markings present.

3 Solve, by factorising, the equation

$$6 \cos \theta \tan \theta - 3 \cos \theta + 4 \tan \theta - 2 = 0,$$

for $0^\circ \leq \theta \leq 180^\circ$.

[4]

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- 4 The first term of an arithmetic progression is a and the common difference is -4 . The first term of a geometric progression is $5a$ and the common ratio is $-\frac{1}{4}$. The sum to infinity of the geometric progression is equal to the sum of the first eight terms of the arithmetic progression.

(a) Find the value of a .

[4]

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The k th term of the arithmetic progression is zero.

(b) Find the value of k .

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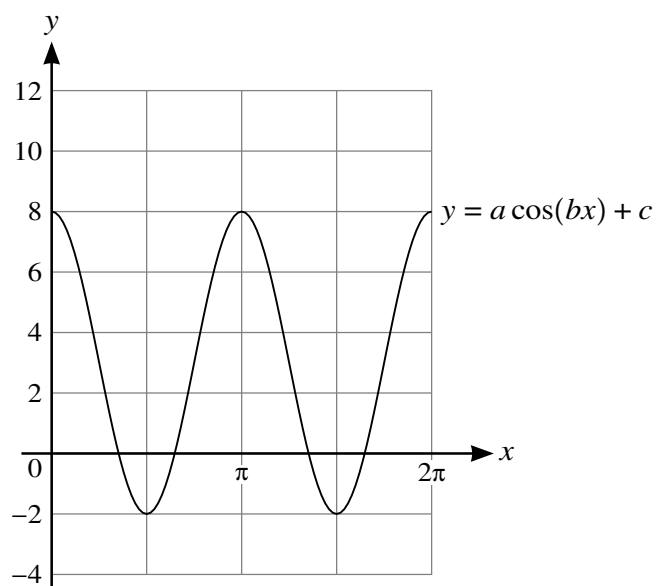
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The diagram shows part of the graph of $y = a \cos(bx) + c$.

- (a) Find the values of the positive integers a , b and c . [3]

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- (b) For these values of a , b and c , use the given diagram to determine the number of solutions in the interval $0 \leq x \leq 2\pi$ for each of the following equations.

(i) $a \cos(bx) + c = \frac{6}{\pi}x$ [1]

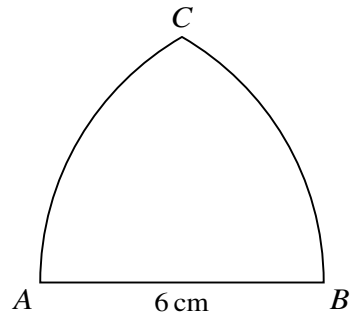
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(ii) $a \cos(bx) + c = 6 - \frac{6}{\pi}x$ [1]

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The diagram shows a metal plate ABC in which the sides are the straight line AB and the arcs AC and BC . The line AB has length 6 cm. The arc AC is part of a circle with centre B and radius 6 cm, and the arc BC is part of a circle with centre A and radius 6 cm.

- (a) Find the perimeter of the plate, giving your answer in terms of π . [3]

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[Turn over

7 A circle with centre $(5, 2)$ passes through the point $(7, 5)$.

(a) Find an equation of the circle. [2]

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The line $y = 5x - 10$ intersects the circle at A and B .

(b) Find the exact length of the chord AB . [7]

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- 8 (a) Express $-3x^2 + 12x + 2$ in the form $-3(x - a)^2 + b$, where a and b are constants. [2]

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The one-one function f is defined by $f : x \mapsto -3x^2 + 12x + 2$ for $x \leq k$.

- (b) State the largest possible value of the constant k . [1]

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It is now given that $k = -1$.

- (c) State the range of f . [1]

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- (d) Find an expression for $f^{-1}(x)$. [3]

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The result of translating the graph of $y = f(x)$ by $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$ is the graph of $y = g(x)$.

- (e) Express $g(x)$ in the form $px^2 + qx + r$, where p , q and r are constants. [3]

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- 9 A curve has equation $y = f(x)$, and it is given that $f'(x) = 2x^2 - 7 - \frac{4}{x^2}$.

- (a) Given that $f(1) = -\frac{1}{3}$, find $f(x)$. [4]

[illegible]

- (b) Find the coordinates of the stationary points on the curve. [5]

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- (c) Find $f''(x)$. [1]

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- (d) Hence, or otherwise, determine the nature of each of the stationary points. [2]

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10 (a) Find $\int_1^{\infty} \frac{1}{(3x-2)^{\frac{3}{2}}} dx$.

[4]

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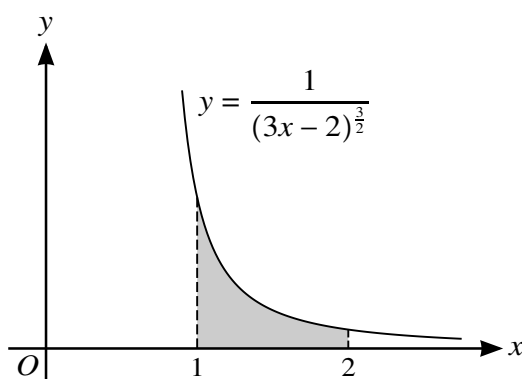
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The diagram shows the curve with equation $y = \frac{1}{(3x-2)^{\frac{3}{2}}}$. The shaded region is bounded by the curve, the x -axis and the lines $x = 1$ and $x = 2$. The shaded region is rotated through 360° about the x -axis.

(b) Find the volume of revolution.

[4]

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The normal to the curve at the point $(1, 1)$ crosses the y -axis at the point A .

(c) Find the y -coordinate of A .

[4]

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