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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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- 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 . [2]

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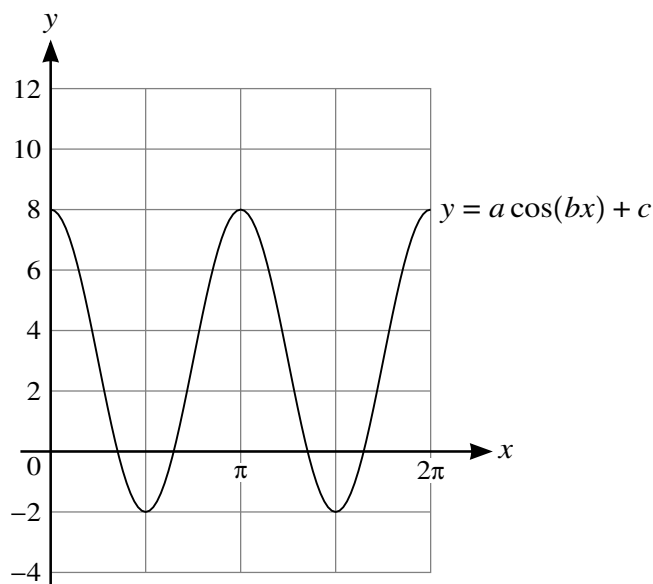
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The diagram shows part of the graph of $y = a \cos(bx) + c$.

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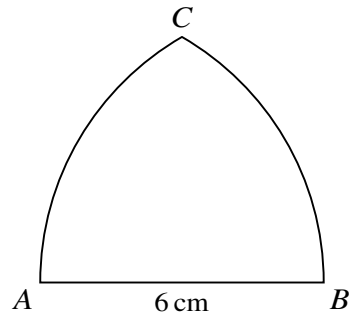
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(ii) $a \cos(bx) + c = 6 - \frac{6}{\pi}x$ [1]

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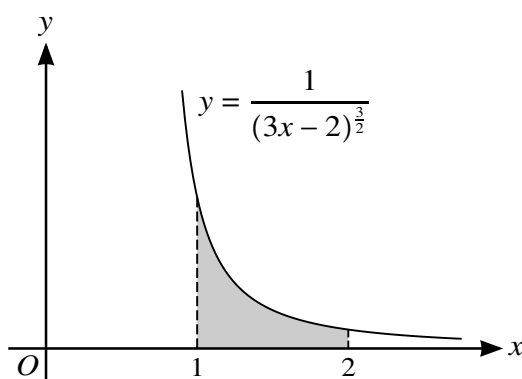
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The diagram shows the curve with equation $y = \frac{1}{(3x-2)^{\frac{3}{2}}}$. The shaded region is bounded by the curve, the x -axis and the lines $x = 1$ and $x = 2$. The shaded region is rotated through 360° about the x -axis.

(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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