



Cambridge International AS & A Level

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MATHEMATICS

9709/12

Paper 1 Pure Mathematics 1

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.

2

- 1 The function f is defined by $f(x) = \frac{1}{3x+2} + x^2$ for $x < -1$.

Determine whether f is an increasing function, a decreasing function or neither.

[3]

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2 The graph of $y = f(x)$ is transformed to the graph of $y = 1 + f\left(\frac{1}{2}x\right)$.

Describe fully the two single transformations which have been combined to give the resulting transformation. [4]

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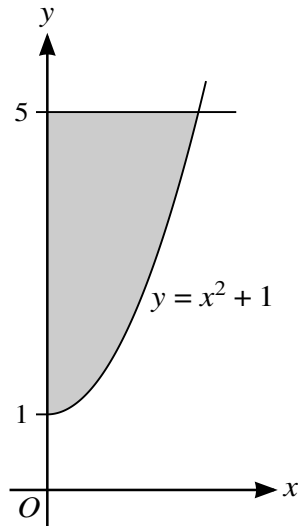
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The diagram shows part of the curve with equation $y = x^2 + 1$. The shaded region enclosed by the curve, the y -axis and the line $y = 5$ is rotated through 360° about the y -axis.

Find the volume obtained.

[4]

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- 4 A curve has equation $y = x^2 - 2x - 3$. A point is moving along the curve in such a way that at P the y -coordinate is increasing at 4 units per second and the x -coordinate is increasing at 6 units per second.

Find the x -coordinate of P .

[4]

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6 The coefficient of $\frac{1}{x}$ in the expansion of $\left(2x + \frac{a}{x^2}\right)^5$ is 720.

(a) Find the possible values of the constant a . [3]

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(b) Hence find the coefficient of $\frac{1}{x^7}$ in the expansion. [2]

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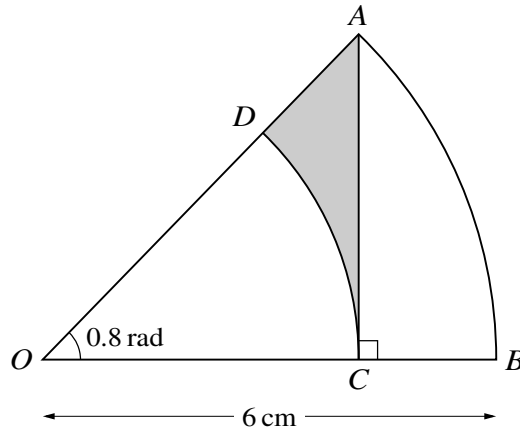
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The diagram shows a sector AOB which is part of a circle with centre O and radius 6 cm and with angle $AOB = 0.8$ radians. The point C on OB is such that AC is perpendicular to OB . The arc CD is part of a circle with centre O , where D lies on OA .

Find the area of the shaded region. [6]

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8 A woman's basic salary for her first year with a particular company is \$30 000 and at the end of the year she also gets a bonus of \$600.

(a) For her first year, express her bonus as a percentage of her basic salary. [1]

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At the end of each complete year, the woman's basic salary will increase by 3% and her bonus will increase by \$100.

(b) Express the bonus she will be paid at the end of her 24th year as a percentage of the basic salary paid during that year. [5]

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- 9 (a) Express $2x^2 + 12x + 11$ in the form $2(x + a)^2 + b$, where a and b are constants. [2]

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The function f is defined by $f(x) = 2x^2 + 12x + 11$ for $x \leq -4$.

- (b) Find an expression for $f^{-1}(x)$ and state the domain of f^{-1} . [3]

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The function g is defined by $g(x) = 2x - 3$ for $x \leq k$.

(c) For the case where $k = -1$, solve the equation $fg(x) = 193$. [2]

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(d) State the largest value of k possible for the composition fg to be defined. [1]

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12

- 10 The gradient of a curve at the point (x, y) is given by $\frac{dy}{dx} = 2(x + 3)^{\frac{1}{2}} - x$. The curve has a stationary point at $(a, 14)$, where a is a positive constant.

(a) Find the value of a . [3]

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(b) Determine the nature of the stationary point. [3]

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11 (a) Solve the equation $3 \tan^2 x - 5 \tan x - 2 = 0$ for $0^\circ \leq x \leq 180^\circ$. [4]

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(b) Find the set of values of k for which the equation $3 \tan^2 x - 5 \tan x + k = 0$ has no solutions. [2]

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12 A diameter of a circle C_1 has end-points at $(-3, -5)$ and $(7, 3)$.

(a) Find an equation of the circle C_1 . [3]

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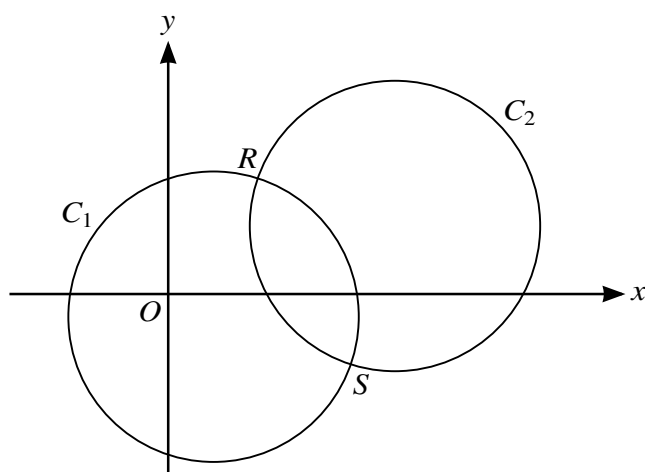
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The circle C_1 is translated by $\begin{pmatrix} 8 \\ 4 \end{pmatrix}$ to give circle C_2 , as shown in the diagram.

(b) Find an equation of the circle C_2 . [2]

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The two circles intersect at points R and S .

- (c) Show that the equation of the line RS is $y = -2x + 13$. [4]

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- (d) Hence show that the x -coordinates of R and S satisfy the equation $5x^2 - 60x + 159 = 0$. [2]

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