



# 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)

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### 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 [ ].

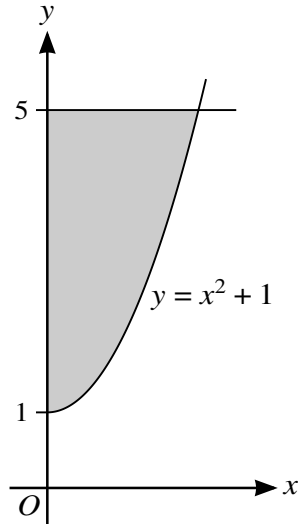
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The diagram shows part of the curve with equation  $y = x^2 + 1$ . The shaded region enclosed by the curve, the  $y$ -axis and the line  $y = 5$  is rotated through  $360^\circ$  about the  $y$ -axis.

Find the volume obtained.

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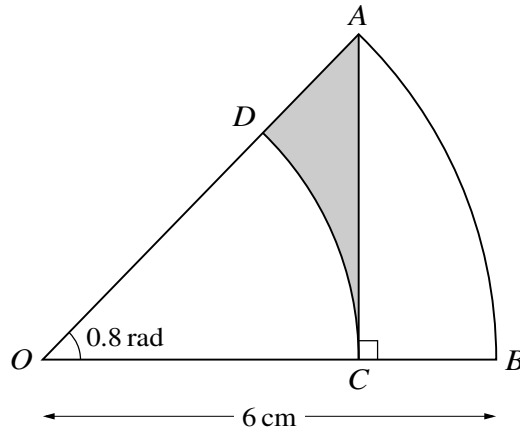
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The diagram shows a sector  $AOB$  which is part of a circle with centre  $O$  and radius  $6\text{ cm}$  and with angle  $AOB = 0.8$  radians. The point  $C$  on  $OB$  is such that  $AC$  is perpendicular to  $OB$ . The arc  $CD$  is part of a circle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

Find the area of the shaded region.

[6]

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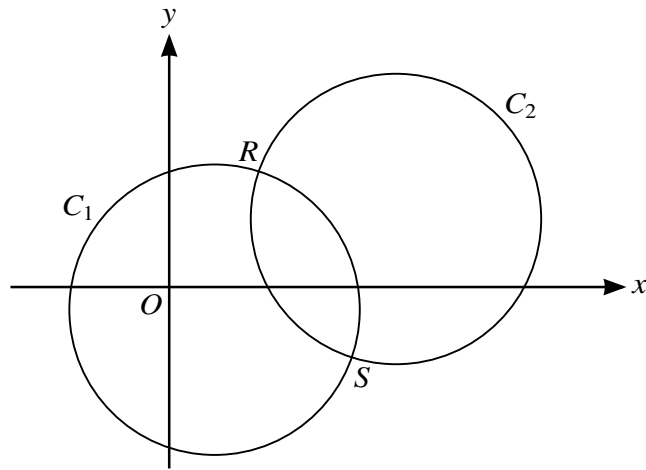
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The circle  $C_1$  is translated by  $\begin{pmatrix} 8 \\ 4 \end{pmatrix}$  to give circle  $C_2$ , as shown in the diagram.

(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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