

# Cambridge International AS & A Level

CANDIDATE  
NAME

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NUMBER

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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.

- 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.

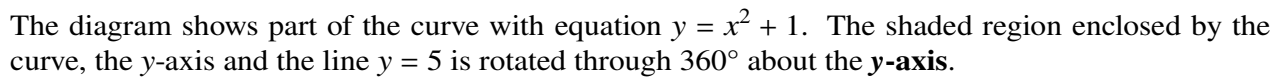
[3]

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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

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

[illegible]



[4]

[illegible]

- 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]

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**5** Solve the equation

$$\frac{\tan \theta + 3 \sin \theta + 2}{\tan \theta - 3 \sin \theta + 1} = 2$$

for  $0^\circ \leq \theta \leq 90^\circ$ .

[5]

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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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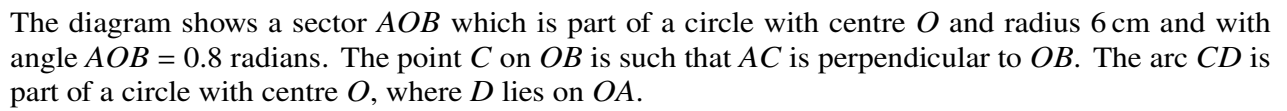
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[6]

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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]

[illegible]

- 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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(c) Find the equation of the curve.

[4]

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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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- (c) For the equation  $3 \tan^2 x - 5 \tan x + k = 0$ , state the value of  $k$  for which there are three solutions in the interval  $0^\circ \leq x \leq 180^\circ$ , and find these solutions. [3]

[illegible]

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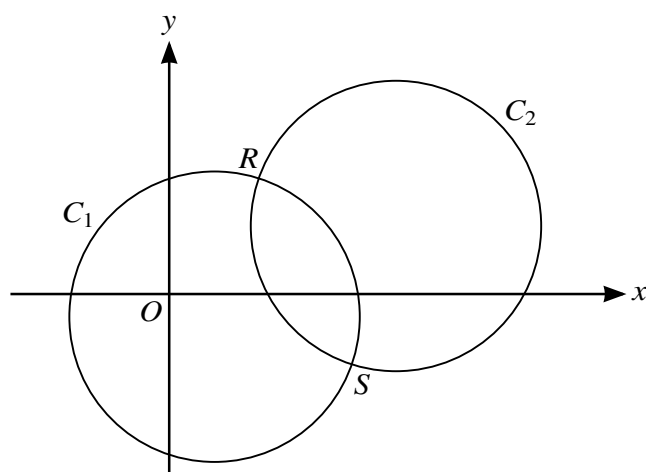
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The circle  $C_1$  is translated by  $\begin{pmatrix} 8 \\ 4 \end{pmatrix}$  to give circle  $C_2$ , as shown in the diagram.

**(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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This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.



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