



# **Cambridge International AS & A Level**

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## **MATHEMATICS**

**9709/01**

Paper 1 Pure Mathematics 1

**For examination from 2020**

SPECIMEN PAPER

**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 [ ].

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This document has **22** pages. Blank pages are indicated.

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- 1** The following points

$$A(0, 1), \quad B(1, 6), \quad C(1.5, 7.75), \quad D(1.9, 8.79) \quad \text{and} \quad E(2, 9)$$

lie on the curve  $y = f(x)$ . The table below shows the gradients of the chords  $AE$  and  $BE$ .

Chord	$AE$	$BE$	$CE$	$DE$
Gradient of chord	4	3		

- (a)** Complete the table to show the gradients of  $CE$  and  $DE$ .

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- (b)** State what the values in the table indicate about the value of  $f'(2)$ .

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- 2** Functions  $f$  and  $g$  are defined by

$$f: x \mapsto 3x + 2, \quad x \in \mathbb{R},$$

$$g : x \mapsto 4x - 12, \quad x \in \mathbb{R}.$$

Solve the equation  $f^{-1}(x) = gf(x)$ .

[4]

- 3 An arithmetic progression has first term 7. The  $n$ th term is 84 and the  $(3n)$ th term is 245.

Find the value of  $n$ .

[4]

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- 4 A curve has equation  $y = f(x)$ . It is given that  $f'(x) = \frac{1}{\sqrt{x+6}} + \frac{6}{x^2}$  and that  $f(3) = 1$ .  
 Find  $f(x)$ . [5]

- 5 (a) The curve  $y = x^2 + 3x + 4$  is translated by  $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$ .

Find and simplify the equation of the translated curve.

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- (b) The graph of  $y = f(x)$  is transformed to the graph of  $y = 3f(-x)$ .

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

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- 6 (a) Find the coefficients of  $x^2$  and  $x^3$  in the expansion of  $(2 - x)^6$ . [3]

- (b) Hence find the coefficient of  $x^3$  in the expansion of  $(3x + 1)(2 - x)^6$ . [2]

- 7 (a) Show that the equation  $1 + \sin x \tan x = 5 \cos x$  can be expressed as

$$6\cos^2 x - \cos x - 1 = 0.$$

[3]

- (b) Hence solve the equation  $1 + \sin x \tan x = 5 \cos x$  for  $0^\circ \leq x \leq 180^\circ$ . [3]

- 8** A curve has equation  $y = \frac{12}{3-2x}$ .

(a) Find  $\frac{dy}{dx}$ .

[2]

A point moves along this curve. As the point passes through  $A$ , the  $x$ -coordinate is increasing at a rate of 0.15 units per second and the  $y$ -coordinate is increasing at a rate of 0.4 units per second.

(b) Find the possible  $x$ -coordinates of  $A$ .

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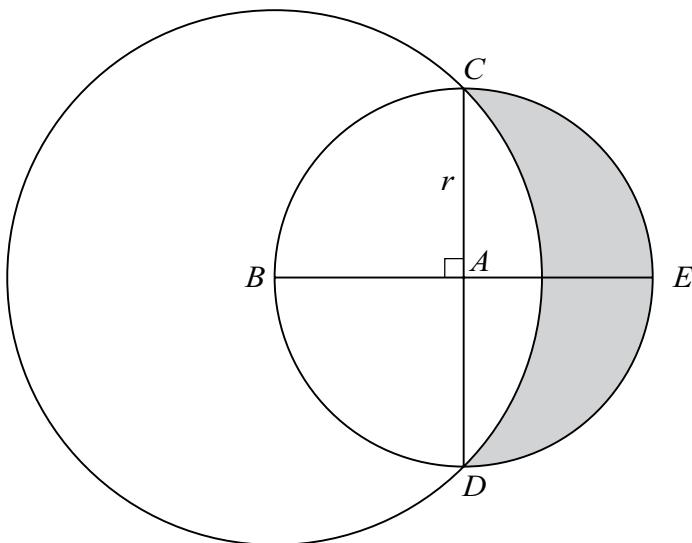
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The diagram shows a circle with centre  $A$  and radius  $r$ . Diameters  $CAD$  and  $BAE$  are perpendicular to each other. A larger circle has centre  $B$  and passes through  $C$  and  $D$ .

- (a) Show that the radius of the larger circle is  $r\sqrt{2}$ .

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- (b) Find the area of the shaded region in terms of  $r$ .

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- 10** The circle  $x^2 + y^2 + 4x - 2y - 20 = 0$  has centre  $C$  and passes through points  $A$  and  $B$ .

- (a) State the coordinates of C.

[1]

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It is given that the midpoint,  $D$ , of  $AB$  has coordinates  $(1\frac{1}{2}, 1\frac{1}{2})$ .

- (b)** Find the equation of  $AB$ , giving your answer in the form  $y = mx + c$ .

[4]

- (c) Find, by calculation, the  $x$ -coordinates of  $A$  and  $B$ . [3]

- 11 The function  $f$  is defined, for  $x \in \mathbb{R}$ , by  $f : x \mapsto x^2 + ax + b$ , where  $a$  and  $b$  are constants.

- (a) It is given that  $a = 6$  and  $b = -8$ .

Find the range of  $f$ .

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- (b) It is given instead that  $a = 5$  and that the roots of the equation  $f(x) = 0$  are  $k$  and  $-2k$ , where  $k$  is a constant.

Find the values of  $b$  and  $k$ .

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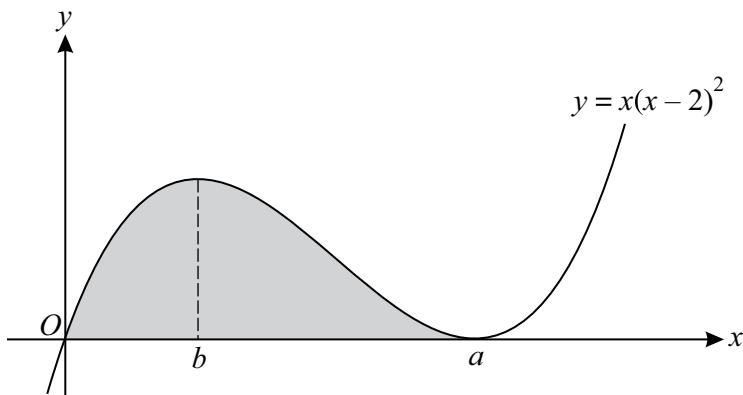
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- (c) Show that if the equation  $f(x + a) = a$  has no real roots then  $a^2 < 4(b - a)$ . [3]

12



The diagram shows the curve with equation  $y = x(x - 2)^2$ . The minimum point on the curve has coordinates  $(a, 0)$  and the  $x$ -coordinate of the maximum point is  $b$ , where  $a$  and  $b$  are constants.

- (a) State the value of  $a$ .

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- (b) Calculate the value of  $b$ .

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- (c) Find the area of the shaded region.

[4]

- (d) The gradient,  $\frac{dy}{dx}$ , of the curve has a minimum value  $m$ .

Calculate the value of  $m$ .

[4]

## **Additional page**

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

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