



## Cambridge International AS & A Level

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**MATHEMATICS**

**9709/11**

Paper 1 Pure Mathematics 1

**May/June 2022**

**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.

- 1 (a) Express  $x^2 - 8x + 11$  in the form  $(x + p)^2 + q$  where  $p$  and  $q$  are constants. [2]

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- (b) Hence find the exact solutions of the equation  $x^2 - 8x + 11 = 1$ . [2]

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## 3

2 The thirteenth term of an arithmetic progression is 12 and the sum of the first 30 terms is  $-15$ .

Find the sum of the first 50 terms of the progression.

[5]

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- 3 The coefficient of  $x^4$  in the expansion of  $\left(2x^2 + \frac{k^2}{x}\right)^5$  is  $a$ . The coefficient of  $x^2$  in the expansion of  $(2kx - 1)^4$  is  $b$ .

(a) Find  $a$  and  $b$  in terms of the constant  $k$ .

[3]

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4 (a) Prove the identity  $\frac{\sin^3 \theta}{\sin \theta - 1} - \frac{\sin^2 \theta}{1 + \sin \theta} \equiv -\tan^2 \theta(1 + \sin^2 \theta)$ . [4]

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(b) Hence solve the equation

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

for  $0 < \theta < 2\pi$ .

[2]

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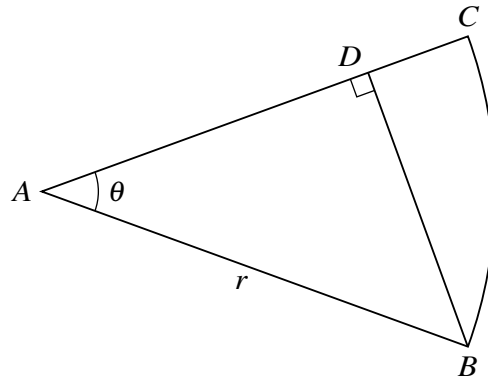
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The diagram shows a sector  $ABC$  of a circle with centre  $A$  and radius  $r$ . The line  $BD$  is perpendicular to  $AC$ . Angle  $CAB$  is  $\theta$  radians.

(a) Given that  $\theta = \frac{1}{6}\pi$ , find the exact area of  $BCD$  in terms of  $r$ . [3]

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- (b) Given instead that the length of  $BD$  is  $\frac{\sqrt{3}}{2}r$ , find the exact perimeter of  $BCD$  in terms of  $r$ . [4]

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- (b) Show that  $1 - \frac{8}{x^2 + 4}$  can be expressed as  $\frac{x^2 - 4}{x^2 + 4}$  and hence state the range of  $f$ . [4]

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- (c) Explain why the composite function  $ff$  cannot be formed. [1]

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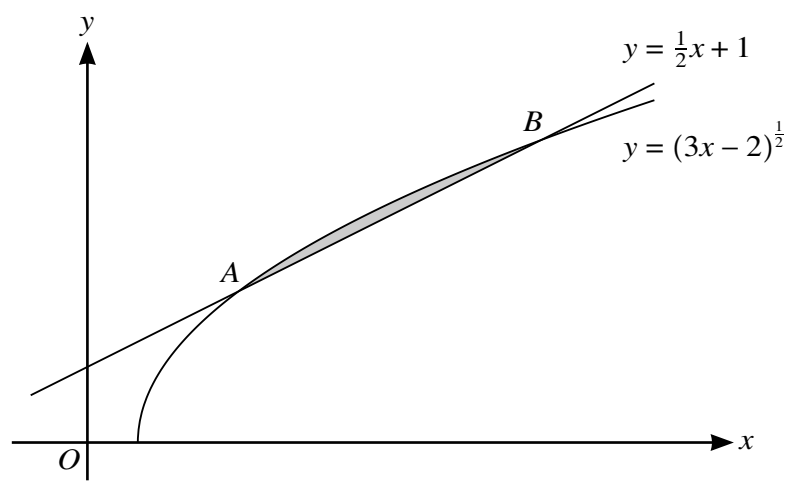
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The diagram shows the curve with equation  $y = (3x - 2)^{\frac{1}{2}}$  and the line  $y = \frac{1}{2}x + 1$ . The curve and the line intersect at points  $A$  and  $B$ .

(a) Find the coordinates of  $A$  and  $B$ . [4]

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- (b) Find the set of values of the constant  $k$  for which the line with equation  $y = kx - 5$  intersects the circle at two distinct points. [6]

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**10** The equation of a curve is such that  $\frac{d^2y}{dx^2} = 6x^2 - \frac{4}{x^3}$ . The curve has a stationary point at  $(-1, \frac{9}{2})$ .

**(a)** Determine the nature of the stationary point at  $(-1, \frac{9}{2})$ . [1]

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**(b)** Find the equation of the curve. [5]

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(c) Show that the curve has no other stationary points. [3]

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(d) A point  $A$  is moving along the curve and the  $y$ -coordinate of  $A$  is increasing at a rate of 5 units per second.

Find the rate of increase of the  $x$ -coordinate of  $A$  at the point where  $x = 1$ . [3]

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**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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