



## Cambridge International AS & A Level

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**MATHEMATICS**

**9709/11**

Paper 1 Pure Mathematics 1

**October/November 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** Find the set of values of  $m$  for which the line with equation  $y = mx - 3$  and the curve with equation  $y = 2x^2 + 5$  do not meet. [3]

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- 2 The equation of a curve is such that  $\frac{dy}{dx} = \frac{1}{(x-3)^2} + x$ . It is given that the curve passes through the point (2, 7).

Find the equation of the curve.

[4]

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3 Air is being pumped into a balloon in the shape of a sphere so that its volume is increasing at a constant rate of  $50 \text{ cm}^3 \text{ s}^{-1}$ .

Find the rate at which the radius of the balloon is increasing when the radius is 10 cm. [3]

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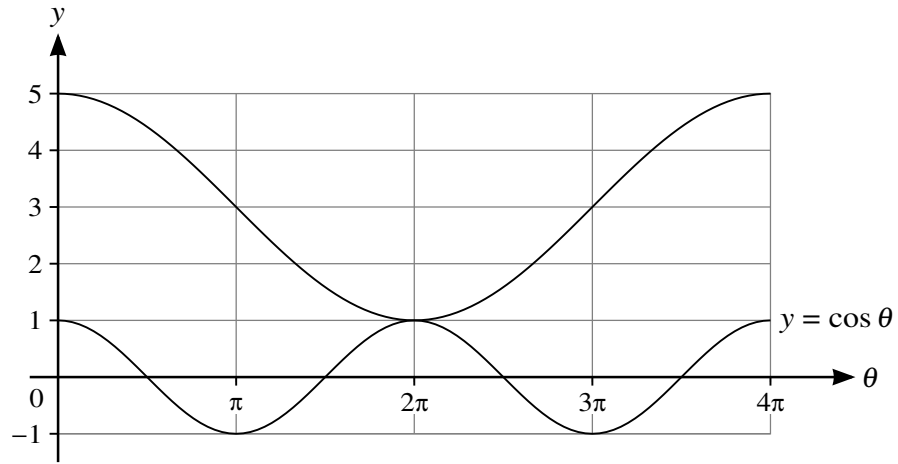
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In the diagram, the lower curve has equation  $y = \cos \theta$ . The upper curve shows the result of applying a combination of transformations to  $y = \cos \theta$ .

Find, in terms of a cosine function, the equation of the upper curve. [3]

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5 In the expansion of  $\left(2x^2 + \frac{a}{x}\right)^6$ , the coefficients of  $x^6$  and  $x^3$  are equal.

(a) Find the value of the non-zero constant  $a$ .

[4]

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(b) Find the coefficient of  $x^6$  in the expansion of  $(1 - x^3)\left(2x^2 + \frac{a}{x}\right)^6$ .

[1]

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6 The equation of a curve is  $y = 2 + \sqrt{25 - x^2}$ .

Find the coordinates of the point on the curve at which the gradient is  $\frac{4}{3}$ . [5]

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7 (a) Show that  $\frac{\sin \theta}{1 - \sin \theta} - \frac{\sin \theta}{1 + \sin \theta} \equiv 2 \tan^2 \theta.$  [3]

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(b) Hence solve the equation  $\frac{\sin \theta}{1 - \sin \theta} - \frac{\sin \theta}{1 + \sin \theta} = 8$ , for  $0^\circ < \theta < 180^\circ$ . [3]

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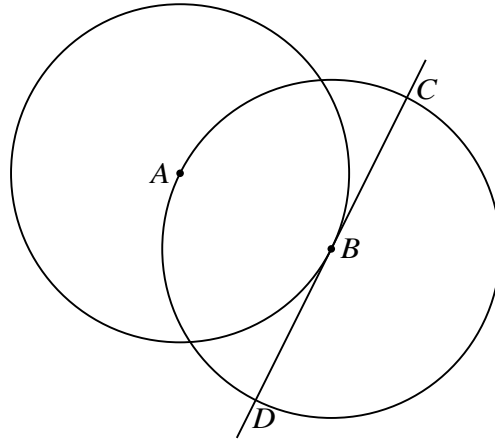
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It is now given that the 3rd term of the first progression is equal to the 2nd term of the second progression.

(b) Express  $S$  in terms of  $a$ . [4]

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The diagram shows a circle with centre  $A$  passing through the point  $B$ . A second circle has centre  $B$  and passes through  $A$ . The tangent at  $B$  to the first circle intersects the second circle at  $C$  and  $D$ .

The coordinates of  $A$  are  $(-1, 4)$  and the coordinates of  $B$  are  $(3, 2)$ .

(a) Find the equation of the tangent  $CBD$ . [2]

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(b) Find an equation of the circle with centre  $B$ . [3]

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

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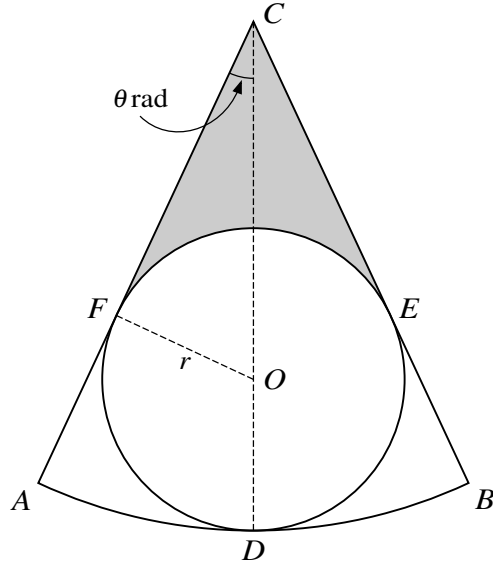
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The diagram shows a sector  $CAB$  which is part of a circle with centre  $C$ . A circle with centre  $O$  and radius  $r$  lies within the sector and touches it at  $D$ ,  $E$  and  $F$ , where  $COD$  is a straight line and angle  $ACD$  is  $\theta$  radians.

(a) Find  $CD$  in terms of  $r$  and  $\sin \theta$ .

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It is now given that  $r = 4$  and  $\theta = \frac{1}{6}\pi$ .

(b) Find the perimeter of sector  $CAB$  in terms of  $\pi$ . [3]

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(c) Find the area of the shaded region in terms of  $\pi$  and  $\sqrt{3}$ . [4]

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11 The functions  $f$  and  $g$  are defined by

$$f(x) = x^2 + 3 \quad \text{for } x > 0,$$
$$g(x) = 2x + 1 \quad \text{for } x > -\frac{1}{2}.$$

(a) Find an expression for  $fg(x)$ . [1]

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(b) Find an expression for  $(fg)^{-1}(x)$  and state the domain of  $(fg)^{-1}$ . [4]

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(c) Solve the equation  $fg(x) - 3 = gf(x)$ .

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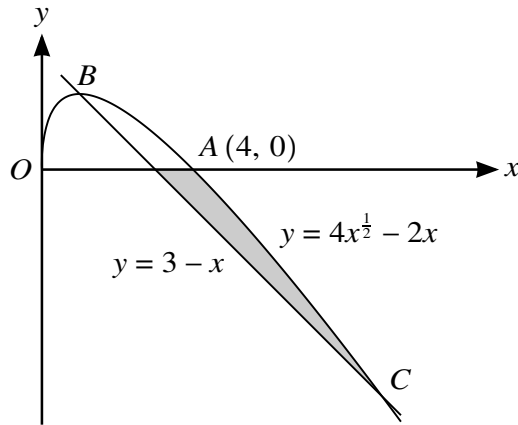
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The diagram shows a curve with equation  $y = 4x^{\frac{1}{2}} - 2x$  for  $x \geq 0$ , and a straight line with equation  $y = 3 - x$ . The curve crosses the  $x$ -axis at  $A(4, 0)$  and crosses the straight line at  $B$  and  $C$ .

- (a) Find, by calculation, the  $x$ -coordinates of  $B$  and  $C$ . [4]

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- (b) Show that  $B$  is a stationary point on the curve. [2]

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(c) Find the area of the shaded region.

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