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**MATHEMATICS**

**9709/12**

Paper 1 Pure Mathematics 1 (P1)

**May/June 2019**

**1 hour 45 minutes**

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

**READ THESE INSTRUCTIONS FIRST**

Write your centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 75.

This document consists of **18** printed pages and **2** blank pages.



2 Two points *A* and *B* have coordinates  $(1, 3)$  and  $(9, -1)$  respectively. The perpendicular bisector of *AB* intersects the *y*-axis at the point *C*. Find the coordinates of *C*. [5]

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3 A curve is such that  $\frac{dy}{dx} = x^3 - \frac{4}{x^2}$ . The point  $P(2, 9)$  lies on the curve.

- (i) A point moves on the curve in such a way that the  $x$ -coordinate is decreasing at a constant rate of 0.05 units per second. Find the rate of change of the  $y$ -coordinate when the point is at  $P$ . [2]

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- (ii) Find the equation of the curve. [3]

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4 Angle  $x$  is such that  $\sin x = a + b$  and  $\cos x = a - b$ , where  $a$  and  $b$  are constants.

(i) Show that  $a^2 + b^2$  has a constant value for all values of  $x$ . [3]

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(ii) In the case where  $\tan x = 2$ , express  $a$  in terms of  $b$ . [2]

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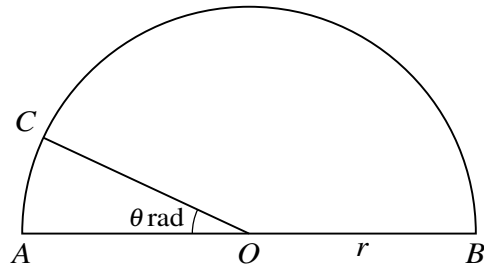
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The diagram shows a semicircle with diameter  $AB$ , centre  $O$  and radius  $r$ . The point  $C$  lies on the circumference and angle  $AOC = \theta$  radians. The perimeter of sector  $BOC$  is twice the perimeter of sector  $AOC$ . Find the value of  $\theta$  correct to 2 significant figures. [5]

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6 The equation of a curve is  $y = 3 \cos 2x$  and the equation of a line is  $2y + \frac{3x}{\pi} = 5$ .

(i) State the smallest and largest values of  $y$  for both the curve and the line for  $0 \leq x \leq 2\pi$ . [3]

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(ii) Sketch, on the same diagram, the graphs of  $y = 3 \cos 2x$  and  $2y + \frac{3x}{\pi} = 5$  for  $0 \leq x \leq 2\pi$ . [3]

(iii) State the number of solutions of the equation  $6 \cos 2x = 5 - \frac{3x}{\pi}$  for  $0 \leq x \leq 2\pi$ . [1]

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8 The position vectors of points  $A$  and  $B$ , relative to an origin  $O$ , are given by

$$\vec{OA} = \begin{pmatrix} 6 \\ -2 \\ -6 \end{pmatrix} \quad \text{and} \quad \vec{OB} = \begin{pmatrix} 3 \\ k \\ -3 \end{pmatrix},$$

where  $k$  is a constant.

(i) Find the value of  $k$  for which angle  $AOB$  is  $90^\circ$ . [2]

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(ii) Find the values of  $k$  for which the lengths of  $OA$  and  $OB$  are equal. [2]

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The point  $C$  is such that  $\vec{AC} = 2\vec{CB}$ .

(iii) In the case where  $k = 4$ , find the unit vector in the direction of  $\vec{OC}$ . [4]

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- 9 The curve  $C_1$  has equation  $y = x^2 - 4x + 7$ . The curve  $C_2$  has equation  $y^2 = 4x + k$ , where  $k$  is a constant. The tangent to  $C_1$  at the point where  $x = 3$  is also the tangent to  $C_2$  at the point  $P$ . Find the value of  $k$  and the coordinates of  $P$ . [8]

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10 (a) In an arithmetic progression, the sum of the first ten terms is equal to the sum of the next five terms. The first term is  $a$ .

(i) Show that the common difference of the progression is  $\frac{1}{3}a$ . [4]

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(ii) Given that the tenth term is 36 more than the fourth term, find the value of  $a$ . [2]

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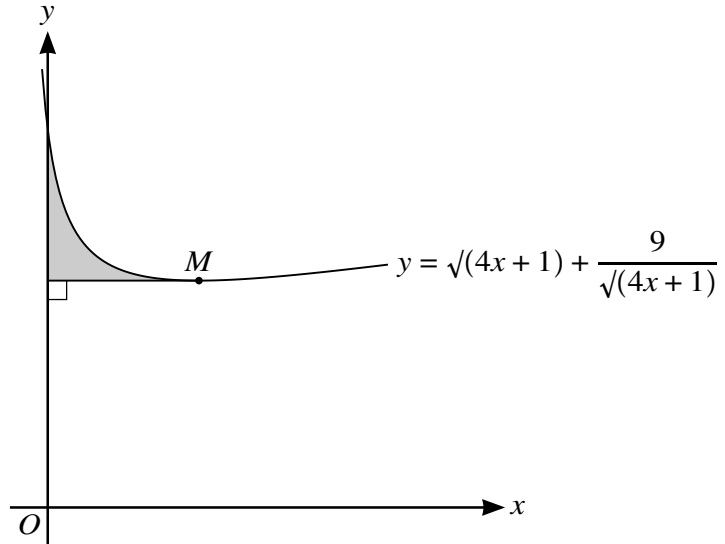
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The diagram shows part of the curve  $y = \sqrt{4x+1} + \frac{9}{\sqrt{4x+1}}$  and the minimum point  $M$ .

- (i) Find expressions for  $\frac{dy}{dx}$  and  $\int y \, dx$ .

[6]

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(ii) Find the coordinates of  $M$ .

[3]

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The shaded region is bounded by the curve, the  $y$ -axis and the line through  $M$  parallel to the  $x$ -axis.

(iii) Find, showing all necessary working, the area of the shaded region.

[3]

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**Additional Page**

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