

CANDIDATE  
NAME

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CENTRE  
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**MATHEMATICS**

**9709/11**

Paper 1 Pure Mathematics 1 (P1)

**May/June 2017**

**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.

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 **19** printed pages and **1** blank page.





2 Relative to an origin  $O$ , the position vectors of points  $A$  and  $B$  are given by

$$\overrightarrow{OA} = \begin{pmatrix} 3 \\ -6 \\ p \end{pmatrix} \quad \text{and} \quad \overrightarrow{OB} = \begin{pmatrix} 2 \\ -6 \\ -7 \end{pmatrix},$$

and angle  $AOB = 90^\circ$ .

(i) Find the value of  $p$ .

[2]

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The point  $C$  is such that  $\overrightarrow{OC} = \frac{2}{3}\overrightarrow{OA}$ .

(ii) Find the unit vector in the direction of  $\overrightarrow{BC}$ .

[4]

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5 The equation of a curve is  $y = 2 \cos x$ .

- (i) Sketch the graph of  $y = 2 \cos x$  for  $-\pi \leq x \leq \pi$ , stating the coordinates of the point of intersection with the  $y$ -axis. [2]

Points  $P$  and  $Q$  lie on the curve and have  $x$ -coordinates of  $\frac{1}{3}\pi$  and  $\pi$  respectively.

- (ii) Find the length of  $PQ$  correct to 1 decimal place. [2]

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The line through  $P$  and  $Q$  meets the  $x$ -axis at  $H(h, 0)$  and the  $y$ -axis at  $K(0, k)$ .

(iii) Show that  $h = \frac{5}{9}\pi$  and find the value of  $k$ .

[3]

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6 The horizontal base of a solid prism is an equilateral triangle of side  $x$  cm. The sides of the prism are vertical. The height of the prism is  $h$  cm and the volume of the prism is  $2000\text{ cm}^3$ .

(i) Express  $h$  in terms of  $x$  and show that the total surface area of the prism,  $A\text{ cm}^2$ , is given by

$$A = \frac{\sqrt{3}}{2}x^2 + \frac{24000}{\sqrt{3}}x^{-1}. \quad [3]$$

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- (ii) Given that  $x$  can vary, find the value of  $x$  for which  $A$  has a stationary value. [3]

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- (iii) Determine, showing all necessary working, the nature of this stationary value. [2]

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7 A curve for which  $\frac{dy}{dx} = 7 - x^2 - 6x$  passes through the point  $(3, -10)$ .

(i) Find the equation of the curve.

[3]

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(ii) Express  $7 - x^2 - 6x$  in the form  $a - (x + b)^2$ , where  $a$  and  $b$  are constants. [2]

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(iii) Find the set of values of  $x$  for which the gradient of the curve is positive. [3]

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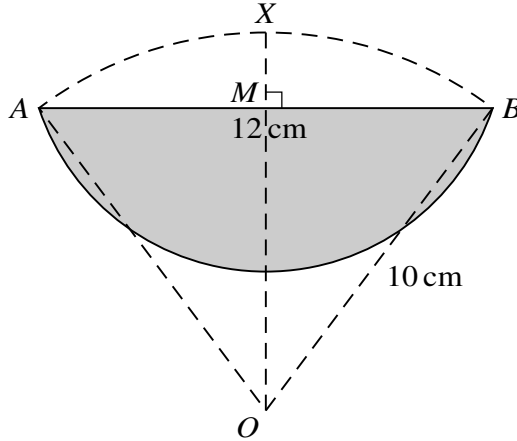
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In the diagram,  $OAXB$  is a sector of a circle with centre  $O$  and radius 10 cm. The length of the chord  $AB$  is 12 cm. The line  $OX$  passes through  $M$ , the mid-point of  $AB$ , and  $OX$  is perpendicular to  $AB$ . The shaded region is bounded by the chord  $AB$  and by the arc of a circle with centre  $X$  and radius  $XA$ .

- (i) Show that angle  $AXB$  is 2.498 radians, correct to 3 decimal places. [3]

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- (ii) Find the perimeter of the shaded region. [3]

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(iii) Find the area of the shaded region.

[3]

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The function  $g$  is defined by  $g : x \mapsto 4x + a$  for  $x \in \mathbb{R}$ , where  $a$  is a constant.

(ii) Find the value of  $a$  for which  $gf(-1) = 3$ . [3]

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(iii) Find the possible values of  $a$  given that the equation  $f^{-1}(x) = g^{-1}(x)$  has two equal roots. [4]

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