

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**  
**General Certificate of Education Advanced Subsidiary Level**

**MATHEMATICS**

**8709/1**

**PAPER 1 Pure Mathematics 1 (P1)**

**OCTOBER/NOVEMBER SESSION 2001**

**1 hour 45 minutes**

Additional materials:  
Answer paper  
Graph paper  
List of Formulae (MF9)

**TIME** 1 hour 45 minutes

**INSTRUCTIONS TO CANDIDATES**

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

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.

**INFORMATION FOR CANDIDATES**

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.

Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.

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

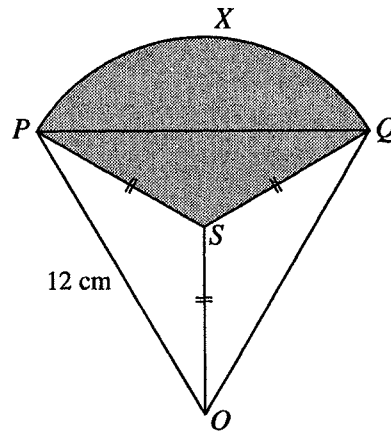
You are reminded of the need for clear presentation in your answers.

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**This question paper consists of 4 printed pages.**

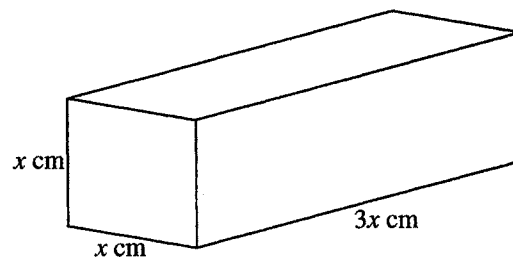
- 1 Find the value of the constant  $k$  for which the line  $y + 2x = k$  is a tangent to the curve  $y = x^2 - 6x + 14$ . [4]
- 2 (i) Express  $2x^2 - 12x + 11$  in the form  $a(x + b)^2 + c$ . [3]
- (ii) Given that  $f : x \mapsto 2x^2 - 12x + 11$ , for the domain  $x \geq 0$ , find the range of  $f$ . [2]
- 3 (i) Sketch and label, on the same diagram, the graphs of  $y = \cos x$  and  $y = \cos 3x$  for the interval  $0 \leq x \leq 2\pi$ . [3]
- (ii) Given that  $f : x \mapsto \cos x$ , for the domain  $0 \leq x \leq k$ , find the largest value of  $k$  for which  $f$  has an inverse. [2]

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The diagram shows an equilateral triangle  $OPQ$ , of side 12 cm, and the point  $S$  such that  $OS = PS = QS$ . The arc  $PXQ$  has centre  $O$  and radius 12 cm. Find the perimeter of the shaded region, giving your answer in terms of  $\pi$  and  $\sqrt{3}$ . [6]

5

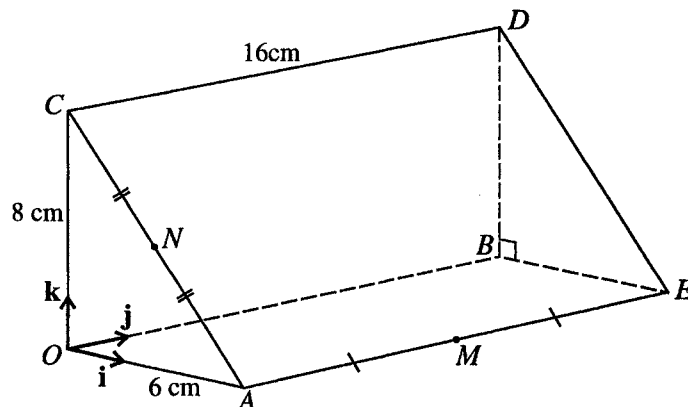


The diagram shows a rectangular block of ice,  $x$  cm by  $x$  cm by  $3x$  cm.

- (i) Obtain an expression, in terms of  $x$ , for the total surface area,  $A$  cm<sup>2</sup>, of the block and write down an expression for  $\frac{dA}{dx}$ . [3]
- (ii) Given that the ice is melting in such a way that  $A$  is decreasing at a constant rate of  $0.14$  cm<sup>2</sup> s<sup>-1</sup>, calculate the rate of decrease of  $x$  at the instant when  $x = 2$ . [3]

- 6 Three points have coordinates  $A(2, 5)$ ,  $B(10, 9)$  and  $C(6, 2)$ . Line  $L_1$  passes through  $A$  and  $B$ . Line  $L_2$  passes through  $C$  and is perpendicular to  $L_1$ . Find the coordinates of the point of intersection of  $L_1$  and  $L_2$ . [7]
- 7 It is given that  $a = 2 \sin \theta + \cos \theta$  and  $b = 2 \cos \theta - \sin \theta$ , where  $0^\circ \leq \theta \leq 360^\circ$ .
- (i) Show that  $a^2 + b^2$  is constant for all values of  $\theta$ . [3]
- (ii) Given that  $2a = 3b$ , show that  $\tan \theta = \frac{4}{7}$  and find the corresponding values of  $\theta$ . [4]
- 8 A precious metal is extracted from a mine. In the first year of operation, 2000 kg of the metal was extracted. In each succeeding year, the amount extracted was 90% of the previous year's amount. Find
- (i) the amount of metal extracted in the 10th year of operation, [2]
- (ii) the total amount of metal extracted in the first 20 years of operation, [2]
- (iii) the total amount of metal that would be extracted over a very long period of time. [3]
- 9 A curve is such that  $\frac{dy}{dx} = \frac{24}{x^3} - 3$ .
- (i) Given that the curve passes through the point  $(1, 16)$ , find the equation of the curve. [4]
- (ii) Find the coordinates of the stationary point on the curve. [4]

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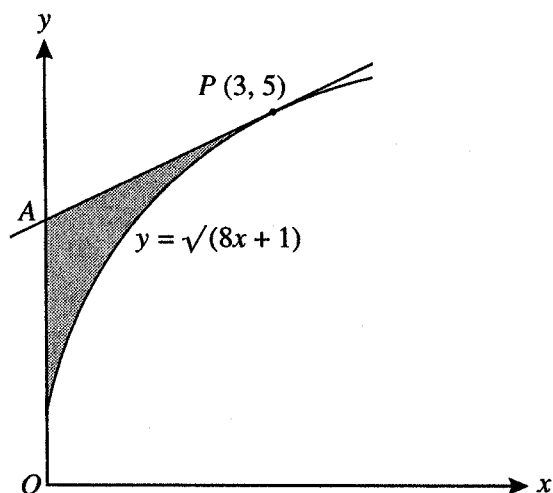


The diagram shows a prism with cross-section in the shape of a right-angled triangle  $OAC$  where  $OA = 6$  cm and  $OC = 8$  cm. The cross-section through  $E$  is the triangle  $BED$ . The length of the prism is 16 cm.  $M$  is the mid-point of  $AE$  and  $N$  is the mid-point of  $AC$ .

Unit vectors  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$  are parallel to  $OA$ ,  $OB$  and  $OC$  respectively as shown.

- (i) Express each of the vectors  $\overrightarrow{MN}$  and  $\overrightarrow{MD}$  in terms of  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$ . [4]
- (ii) Evaluate  $\overrightarrow{MN} \cdot \overrightarrow{MD}$  and hence find the value of angle  $NMD$ , giving your answer to the nearest degree. [5]

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The diagram shows the curve  $y = \sqrt{8x+1}$  and the tangent at the point  $P(3, 5)$  on the curve. This tangent meets the y-axis at A. Find

- (i) the equation of the tangent at P, [4]
- (ii) the coordinates of A, [1]
- (iii) the area of the shaded region. [6]