

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education  
Advanced Subsidiary Level and Advanced Level

**MATHEMATICS**

**9709/01**

Paper 1 Pure Mathematics 1 **(P1)**

May/June 2006

**1 hour 45 minutes**

Additional Materials: Answer Booklet/Paper  
Graph paper  
List of Formulae (MF9)

**READ THESE INSTRUCTIONS FIRST**

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.  
Write your Centre number, candidate number and name on all the work you hand in.  
Write in dark blue or black pen on both sides of the paper.  
You may use a soft pencil for any diagrams or graphs.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

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.

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

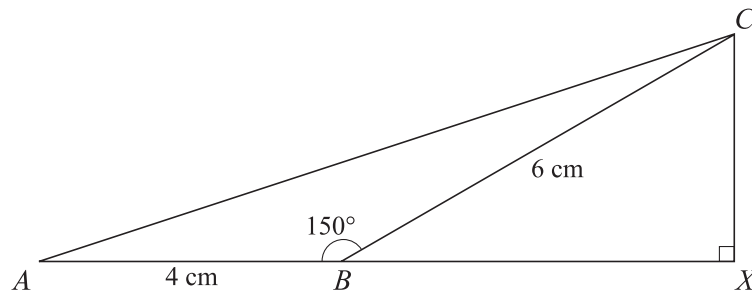
This document consists of **4** printed pages.



- 1 A curve has equation  $y = \frac{k}{x}$ . Given that the gradient of the curve is  $-3$  when  $x = 2$ , find the value of the constant  $k$ . [3]
- 2 Solve the equation  

$$\sin 2x + 3 \cos 2x = 0,$$
for  $0^\circ \leq x \leq 180^\circ$ . [4]
- 3 Each year a company gives a grant to a charity. The amount given each year increases by 5% of its value in the preceding year. The grant in 2001 was \$5000. Find  
 (i) the grant given in 2011, [3]  
 (ii) the total amount of money given to the charity during the years 2001 to 2011 inclusive. [2]
- 4 The first three terms in the expansion of  $(2 + ax)^n$ , in ascending powers of  $x$ , are  $32 - 40x + bx^2$ . Find the values of the constants  $n$ ,  $a$  and  $b$ . [5]
- 5 The curve  $y^2 = 12x$  intersects the line  $3y = 4x + 6$  at two points. Find the distance between the two points. [6]

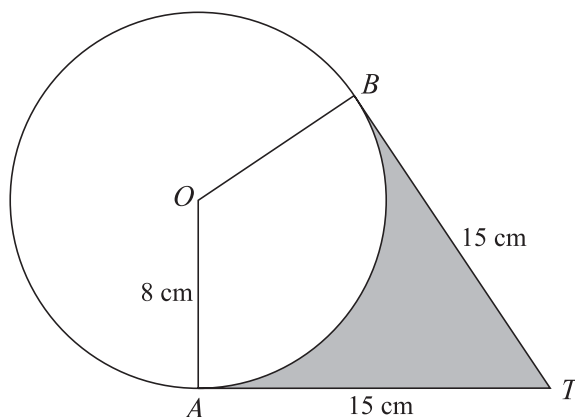
6



In the diagram,  $ABC$  is a triangle in which  $AB = 4$  cm,  $BC = 6$  cm and angle  $ABC = 150^\circ$ . The line  $CX$  is perpendicular to the line  $ABX$ .

- (i) Find the exact length of  $BX$  and show that angle  $CAB = \tan^{-1}\left(\frac{3}{4 + 3\sqrt{3}}\right)$ . [4]
- (ii) Show that the exact length of  $AC$  is  $\sqrt{(52 + 24\sqrt{3})}$  cm. [2]

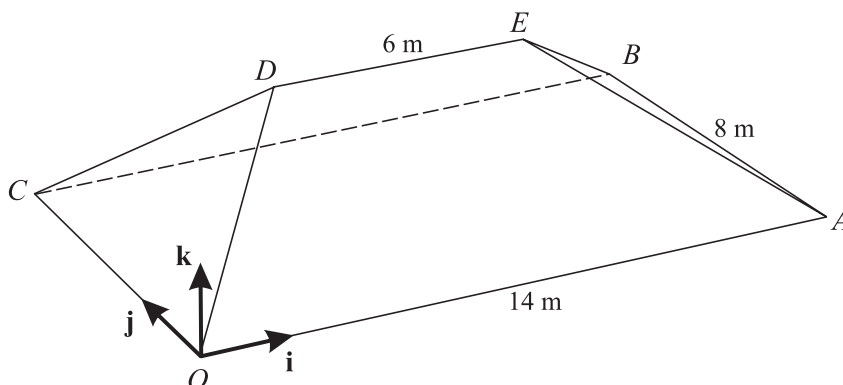
7



The diagram shows a circle with centre  $O$  and radius 8 cm. Points  $A$  and  $B$  lie on the circle. The tangents at  $A$  and  $B$  meet at the point  $T$ , and  $AT = BT = 15$  cm.

- (i) Show that angle  $AOB$  is 2.16 radians, correct to 3 significant figures. [3]
- (ii) Find the perimeter of the shaded region. [2]
- (iii) Find the area of the shaded region. [3]

8



The diagram shows the roof of a house. The base of the roof,  $OABC$ , is rectangular and horizontal with  $OA = CB = 14$  m and  $OC = AB = 8$  m. The top of the roof  $DE$  is 5 m above the base and  $DE = 6$  m. The sloping edges  $OD$ ,  $CD$ ,  $AE$  and  $BE$  are all equal in length.

Unit vectors  $\mathbf{i}$  and  $\mathbf{j}$  are parallel to  $OA$  and  $OC$  respectively and the unit vector  $\mathbf{k}$  is vertically upwards.

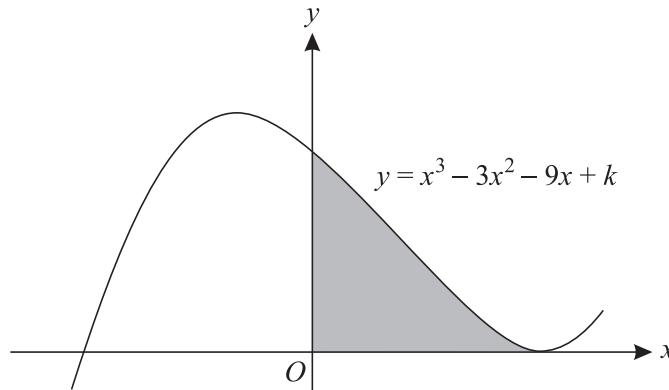
- (i) Express the vector  $\overrightarrow{OD}$  in terms of  $\mathbf{i}$ ,  $\mathbf{j}$  and  $\mathbf{k}$ , and find its magnitude. [4]
- (ii) Use a scalar product to find angle  $DOB$ . [4]

9 A curve is such that  $\frac{dy}{dx} = \frac{4}{\sqrt{6-2x}}$ , and  $P(1, 8)$  is a point on the curve.

(i) The normal to the curve at the point  $P$  meets the coordinate axes at  $Q$  and at  $R$ . Find the coordinates of the mid-point of  $QR$ . [5]

(ii) Find the equation of the curve. [4]

10



The diagram shows the curve  $y = x^3 - 3x^2 - 9x + k$ , where  $k$  is a constant. The curve has a minimum point on the  $x$ -axis.

(i) Find the value of  $k$ . [4]

(ii) Find the coordinates of the maximum point of the curve. [1]

(iii) State the set of values of  $x$  for which  $x^3 - 3x^2 - 9x + k$  is a decreasing function of  $x$ . [1]

(iv) Find the area of the shaded region. [4]

11 Functions  $f$  and  $g$  are defined by

$$\begin{aligned} f : x &\mapsto k - x && \text{for } x \in \mathbb{R}, \text{ where } k \text{ is a constant,} \\ g : x &\mapsto \frac{9}{x+2} && \text{for } x \in \mathbb{R}, x \neq -2. \end{aligned}$$

(i) Find the values of  $k$  for which the equation  $f(x) = g(x)$  has two equal roots and solve the equation  $f(x) = g(x)$  in these cases. [6]

(ii) Solve the equation  $fg(x) = 5$  when  $k = 6$ . [3]

(iii) Express  $g^{-1}(x)$  in terms of  $x$ . [2]