MATHEMATICS **9709/01**

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

October/November 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.
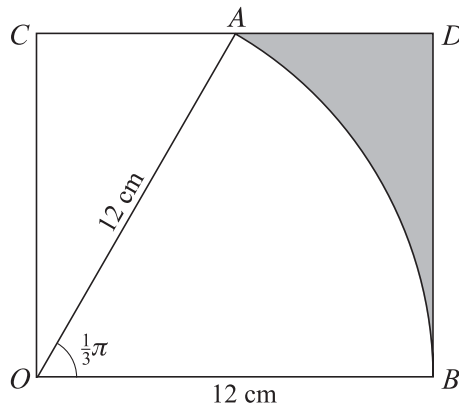
[Turn over

1 Find the coefficient of x^2 in the expansion of $\left(x + \dfrac{2}{x}\right)^6$. [3]

2 Given that $x = \sin^{-1}\left(\frac{2}{5}\right)$, find the exact value of

   **(i)** $\cos^2 x$, [2]

   (ii) $\tan^2 x$. [2]

3

In the diagram, AOB is a sector of a circle with centre O and radius 12 cm. The point A lies on the side CD of the rectangle $OCDB$. Angle $AOB = \frac{1}{3}\pi$ radians. Express the area of the shaded region in the form $a(\sqrt{3}) - b\pi$, stating the values of the integers a and b. [6]

4 The position vectors of points A and B are $\begin{pmatrix} -3 \\ 6 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} -1 \\ 2 \\ 4 \end{pmatrix}$ respectively, relative to an origin O.

   (i) Calculate angle AOB. [3]

   (ii) The point C is such that $\overrightarrow{AC} = 3\overrightarrow{AB}$. Find the unit vector in the direction of $\overrightarrow{OC}$. [4]

5
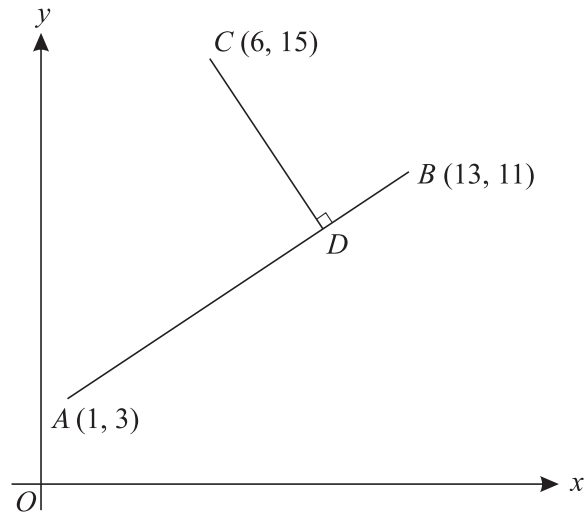
The three points A (1, 3), B (13, 11) and C (6, 15) are shown in the diagram. The perpendicular from C to AB meets AB at the point D. Find

  (i) the equation of CD,   [3]

  (ii) the coordinates of D.   [4]
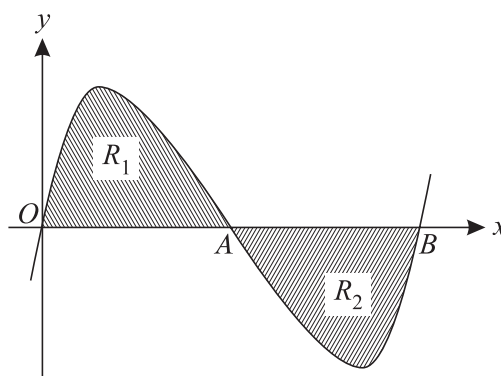
6   **(a)** Find the sum of all the integers between 100 and 400 that are divisible by 7.   [4]

    (b) The first three terms in a geometric progression are 144, x and 64 respectively, where x is positive. Find

       (i) the value of x,

      (ii) the sum to infinity of the progression.

                                                                           [5]

7

The diagram shows the curve $y = x(x - 1)(x - 2)$, which crosses the x-axis at the points O (0, 0), A (1, 0) and B (2, 0).

 **(i)** The tangents to the curve at the points A and B meet at the point C. Find the x-coordinate of C.
                                                                           [5]

  (ii) Show by integration that the area of the shaded region R_1 is the same as the area of the shaded region R_2.   [4]

8 The equation of a curve is $y = \dfrac{6}{5 - 2x}$.

    (i) Calculate the gradient of the curve at the point where $x = 1$. [3]

    (ii) A point with coordinates (x, y) moves along the curve in such a way that the rate of increase of y has a constant value of 0.02 units per second. Find the rate of increase of x when $x = 1$. [2]

    (iii) The region between the curve, the x-axis and the lines $x = 0$ and $x = 1$ is rotated through $360°$ about the x-axis. Show that the volume obtained is $\frac{12}{5}\pi$. [5]

9
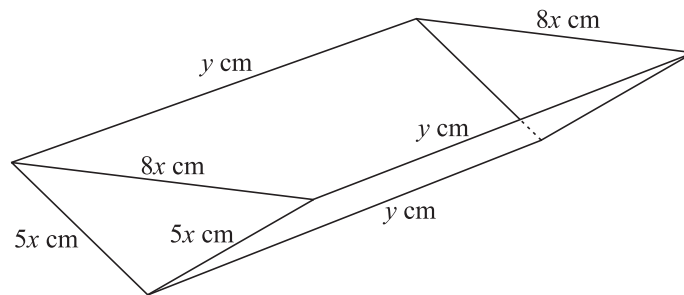
The diagram shows an open container constructed out of $200\,\text{cm}^2$ of cardboard. The two vertical end pieces are isosceles triangles with sides $5x\,\text{cm}$, $5x\,\text{cm}$ and $8x\,\text{cm}$, and the two side pieces are rectangles of length $y\,\text{cm}$ and width $5x\,\text{cm}$, as shown. The open top is a horizontal rectangle.

    (i) Show that $y = \dfrac{200 - 24x^2}{10x}$. [3]

    (ii) Show that the volume, $V\,\text{cm}^3$, of the container is given by $V = 240x - 28.8x^3$. [2]

Given that x can vary,

    (iii) find the value of x for which V has a stationary value, [3]

    (iv) determine whether it is a maximum or a minimum stationary value. [2]

10 The function f is defined by $\text{f} : x \mapsto x^2 - 3x$ for $x \in \mathbb{R}$.

    (i) Find the set of values of x for which $\text{f}(x) > 4$. [3]

    (ii) Express $\text{f}(x)$ in the form $(x - a)^2 - b$, stating the values of a and b. [2]

    (iii) Write down the range of f. [1]

    (iv) State, with a reason, whether f has an inverse. [1]

The function g is defined by $\text{g} : x \mapsto x - 3\sqrt{x}$ for $x \geqslant 0$.

    (v) Solve the equation $\text{g}(x) = 10$. [3]

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