TAYLOR'S COLLEGE

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CAMBRIDGE 'A' LEVEL PROGRAMME

AS TRIAL EXAMINATION AUGUST/SEPTEMBER 2004

(Jan 2004 Intake)

Monday **30 August 2004** **8.30 am – 10.15 am**

MATHEMATICS 9709/1

PAPER 1 Pure Mathematics 1 (P1) 1 hour 45 minutes

Additional materials: Answer Booklet/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 name and class 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.
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 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.

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

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[Turn over

1. A and B are two points on the circumference of a circle, centre O and radius r, and AOB = θ radians.

   (i) State the perimeter of the sector OAB. [1]

   (ii) Given that the square of the perimeter is 16 times the area of the sector OAB, find the value of θ. [3]

2. Solve the simultaneous equations $y = 1 - x$ and $x(4 - y) = 1$. [4]

3. Sketch the curve $y = -x^2 - x$ showing the turning points and the intercepts on the x and y axes.

   Determine the greatest and least values of y for $-1 \leq x \leq 1$. [5]

4. Find the area bounded by the curves $y = 2x^2 - 2$ and $y = x^2 + x$. [5]

5. The position vectors of A and B relative to the origin O are $\mathbf{i} + \mathbf{j} + 3\mathbf{k}$ and $2\mathbf{i} + 2\mathbf{j}$ respectively.

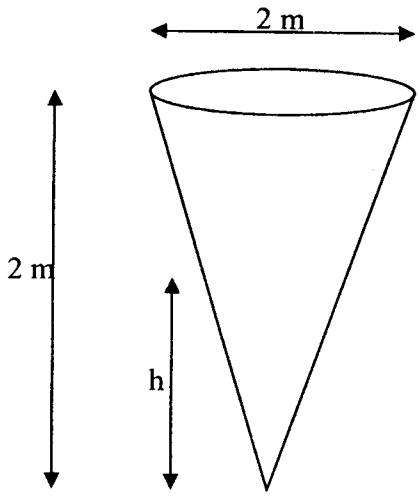
   (i) Given that C lies between A and B such that AC = 2CB, find the position vector of C. [3]

   (ii) Calculate the angle AOC to the nearest degree. [2]

6. Given that $f(x) = 3x^2 - 4$, $x > 0$ and $g(x) = x + 4$, $x \in \Re$,

   find (i) $f^{-1}(x)$, $x > -4$ (ii) $fg(x)$, $x > -4$. [6]

7.



A container is in the shape of a right circular cone with both height and diameter 2 metres (as shown).

It is being filled with water at a rate of π m^3 per minute. Find the rate of change of height h of water when the container is one - eighth full (by volume).

(Volume of a right circular cone of radius r and height h is $\frac{1}{3} \pi r^2 h$). [7]

8. (a) If α is a root of the equation $x^2 + 4x + 1 = 0$, show that $\alpha^2 = -4\alpha - 1$ and $\alpha^3 = -4\alpha^2 - \alpha$. Deduce that $\alpha^3 = 15\alpha + 4$.

[4]

(b) Find the range of values of the constant p for which the function $y = px^2 + 4x + p + 3$ is positive for all real values of x. [4]

9. (a) If $\sin^{-1}x = \frac{\pi}{5}$, find the value of $\cos^{-1}x$. [2]

(b) A line goes through (a,b) and makes an angle of θ with the x-axis. Show that the equation of the line can be written as $y \cos\theta - x \sin\theta = b \cos\theta - a \sin\theta$. [3]

(c) Solve the equation $2\tan\theta - \frac{4}{\tan\theta} = \frac{1}{\sin\theta}$, giving your answers in radians in the range $-\pi < \theta < \pi$, correct to 2 significant figures. [4]

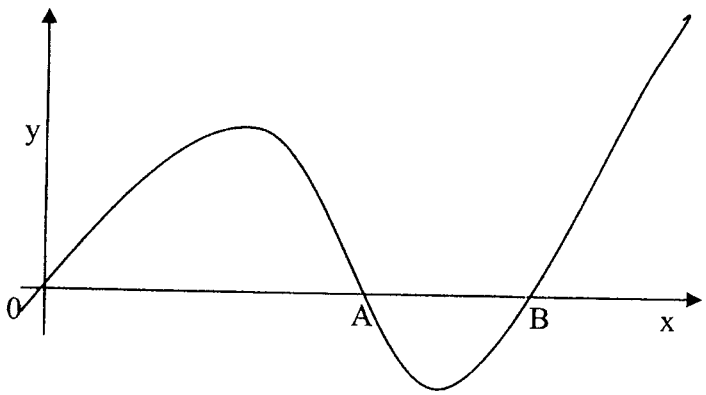
10. (a) A geometric progression has first term $\frac{1}{4}$ and common ratio $\frac{1}{\sqrt{2}}$.

Find the sum to infinity of the progression, correct to 3 decimal places. [4]

(b) The sum S_n of the first n terms of an arithmetic progression is given by $S_n = an + bn^2$. Given that $S_8 = 20$ and $S_{10} = 27$, find the values of a and b. Hence, or otherwise, find the nth term of this arithmetic progression. [6]

[Turn over

11. The figure below shows a sketch of part of the curve C with equation $2y = 3x^3 - 7x^2 + 4x$ which meets the x-axis at the origin O, point A(1,0) and point B.



(a) Find the coordinates of B. [4]

The normals to the curve C at the points O and A meet at the point N.

(b) Find the coordinates of N. [6]

(c) Calculate the area of triangle OAN. [2]