TAYLOR'S UNIVERSITY COLLEGE

Wisdom · Integrity · Excellence

CAMBRIDGE 'A' LEVEL PROGRAMME

AS TRIAL EXAMINATION AUGUST/SEPTEMBER 2007

(January 2007 & March 2007 Intake)

Tuesday **4 September 2007** **1.30 pm – 3.15 pm**

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 5 printed pages.

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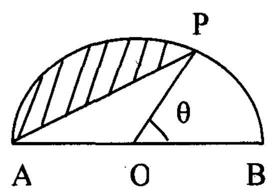
1. (i) Expand $(a + 2b)^4$ fully, simplify the coefficients. [2]

(ii) Find the term independent of x in the expansion of $\left(x^2 + \frac{2}{x}\right)^6$. [3]

2.



The diagram shows a semicircle APB on AB as diameter. The midpoint of AB is O. The point P on the semicircle is such that the area of the sector POB is equal to twice the area of the shaded segment. Given that angle POB is θ radians, show that $3\theta = 2(\pi - \sin\theta)$. [5]

3. Find the range of the values of k for which $y = 2x + k$ meets $2x^2 + y^2 = 3$ in two distinct points. [6]

4. (i) The curve with equation $y = 2 + k\sin x$ passes through the point with coordinates $\left(\frac{\pi}{2}, -2\right)$. Find

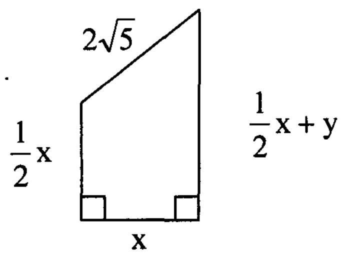
(a) the value of k, [2]

(b) the values of x in the interval $0 \le x \le 2\pi$ for which $y = 2 + 2\sqrt{2}$. [3]

(ii) Write down the maximum and minimum values of the expression $4 - 2\sin 3x$ as x varies.

[2]

5. The diagram below represents (in meter) the dimensions of a small garden.



(i) Show that $y = \sqrt{20 - x^2}$. [2]

(ii) Write an expression, in terms of x, for the perimeter, P (in meters) of the garden and find a value of x for which $\frac{dP}{dx} = 0$. [5]

6. The straight line L_1 has equation $2y - x + 7 = 0$. The straight line L_2 passes through the point P(-1,6) and is perpendicular to L_1.

(i) Find the equation of L_2, giving your answer in the form of $ax + by + c = 0$. [3]

(ii) Find the coordinates of the point of intersection of L_1 and L_2. [3]

(iii) Show that the perpendicular distance from P to L_1 is $4\sqrt{5}$. [2]

7. Two small insects A and B are crawling on the walls of a room, with A starting from ceiling. The floor is horizontal and forms the x-y plane, and the z-axis is vertically upwards. Relative to the origin, the position vector of the insects at time t seconds $(0 \le t \le 10)$ are

$$\overrightarrow{OA} = \mathbf{i} + 3\mathbf{j} + (4 - \frac{1}{10}t)\mathbf{k}$$

$$\overrightarrow{OB} = (\frac{1}{5}t + 1)\mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$$

where the unit of distance is the meter and **i**, **j** ,**k** are the unit vectors along the x, y and z axis respectively.

(i) Write down the height of the room. [1]

(ii) Show that the insect move in such a way that angle BOA=90°. [3]

(iii) Write down the expression of the vector $\overrightarrow{AB}$, hence find the distance between the two insects in terms of t. [4]

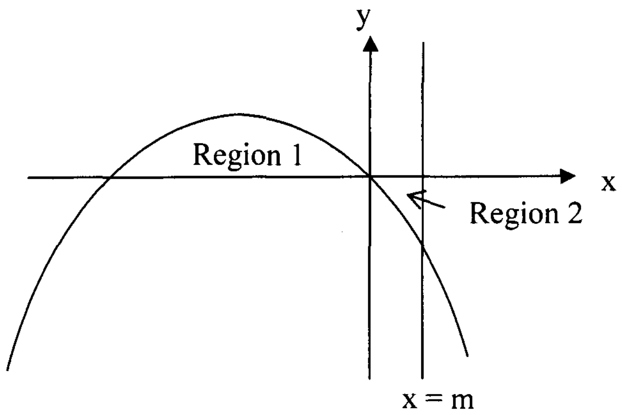
[Turn over

8. The function f and g are defined by

$$f : x \rightarrow 1 + \sqrt{x}, \quad x \geq 0$$
$$g : x \rightarrow x^2 \quad , \; x \in R$$

(i) Find the domain of the inverse function of f. [1]
(ii) Find the expression for f^{-1}. [3]
(iii) Find an expression for fg(x) for the case $x \geq 0$. [2]
(iv) Obtain the value of fg(2). [1]
(v) Sketch the graph of y = fg(x) and its inverse function $y = (fg)^{-1}(x)$. [2]

9. The graph of $y = -x^2 - 4x$ and $x = m$ where $m > 0$ are shown below:



Region 1 is above the x-axis and is enclosed by the graph of $y = -x^2 - 4x$ and the x-axis. Region 2 is below the x-axis and is enclosed by the graph of $y = -x^2 - 4x$, the x-axis and the line $x = m$.

(i) Find the area of the region 1. [4]

(ii) If $\int_{-4}^{m}(-x^2 - 4x)dx = 0$, state the area of Region 2. [1]

(iii) Find the equation of the tangent to $y = -x^2 - 4x$ at $x = 1$. [5]

10. (i) A building society offers 6% interest per annum on investments. Someone deposits £ 4000 in an account and leaves the interest to accumulate.

(a) Find the total value of the investment (to the nearest pound) after 6 years. [2]

(b) Find how many years have elapsed before the investment has at least doubled its value. [3]

(ii) The first term of an arithmetic progression is 3 and the sum of the first 6 terms is 4 times the sum of the first 3 terms. Find the common difference. [5]