TAYLOR'S
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CAMBRIDGE 'A' LEVEL PROGRAMME
SEMESTER ONE EXAMINATION JUNE 2007
(March 2007 Intake)

Friday   15 June 2007   8.15 am – 10.15 am

FURTHER MATHEMATICS   **9231**

2 hours

Additional materials: Answer Booklet/Paper
List of formulae (MF 10)

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.
The use of a calculator is expected, where appropriate.
Results obtained solely from a graphic calculator, without supporting working or reasoning, will not receive credit.
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.
At the end of the examination, fasten all your work securely together.

This document consists of **3** printed pages.

[Turn over

1. Find the sum $8^2 + 13^2 + 18^2 + \cdots + (5n+3)^2$ [10]

2. Prove that $17^n + 3^{2n-1}$ is divisible by 4 for every positive integer n.   [10]

3. If the equation $2x^4 - 3x^3 + 5x^2 - 9x + 7 = 0$ has roots α, β, γ, and δ find the equation having roots $\alpha^2 + 2, \beta^2 + 2, \gamma^2 + 2$ and $\delta^2 + 2$.   [15]

4. Sketch the graph $y = \dfrac{5x+3}{2x-4}$.   [15]

5. A ball P of mass m kg is dropped from a point A, which is 2 m vertically above a point B on a horizontal floor. After P hits the floor at B, it rebounds and hits another ball Q, of the same mass, which has also been dropped from A. The impact between the two balls is direct and takes place at the mid-point of AB. The coefficient of restitution in each impact is $\dfrac{5}{7}$. Neglecting air resistance, find the speed of P

     i) immediately after it hits the floor,   [4]

     ii) immediately after it collides with Q.   [7]

6. A body is formed from a solid hemisphere of radius a and a solid right-circular cone of height b and base radius a, the hemisphere and cone having the same density and being joined with their plane faces completely in contact.

     a) Find the center of mass of the body from the vertex of the cone.   [6]

     b) Show that the body can always rest in equilibrium with the cone in contact with a horizontal plane.   [6]

7. Two small discs can move without resistance along a straight line which is perpendicular to a vertical wall. The discs have mass 30 grams and 70 grams with the 70 grams disc between the 30 grams disc and the wall. Initially the 70 grams disc is at rest, and the 30 grams disc is moving towards it at a speed of 12 ms^{-1}.

The coefficient of restitution between the two discs is $\frac{2}{3}$ and the coefficient of restitution between the 70 grams disc and the wall is $\frac{5}{6}$.

      a) Find the speeds at which the discs are moving after all possible collision have occurred.   [10]

      b) Calculate, in joules, the total amount of energy lost as a result of the collisions.   [3]

8. A particle P is projected from a point O with the speed of 35 ms^{-1}, at 60° to the horizontal.

      a) Calculate the greatest height on the trajectory.   [3]

      b) 3 seconds after projection,
          i) find the speed of the particle,   [5]
          ii) find the horizontal and vertical displacement,   [4]
          iii) find the distance of P from O.   [2]