TAYLOR'S UNIVERSITY COLLEGE
Wisdom · Integrity · Excellence

CAMBRIDGE A LEVEL PROGRAMME

SEMESTER ONE EXAMINATION JUNE 2009

(March 2009 Intake)

Friday **12 June 2009** **8.15 am – 10.15 am**

FURTHER MATHEMATICS 9231

2 hours

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

READ THESE INSTRUCTIONS FIRST

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.
Where a numerical value is necessary, take the acceleration due to gravity to be 10 ms^{-2}.
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.
The total marks for this paper is **100.**
At the end of the examination, fasten all your work securely together.

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

[Turn over

Section A: Pure Mathematics (50%)

1. Find the sum $9^3 + 16^3 + 23^3 + \ldots + (7n + 2)^3$.

[11]

2. Prove that $6^{2n} + 34^{2n-1}$ is divisible by 35 for every positive integer n.

[11]

3. If the equation $9x^4 - 4x^3 + 8x^2 + 3x - 2 = 0$ has roots $\alpha, \beta, \gamma, \delta$, find the equation having roots $\alpha^2 + 3, \beta^2 + 3, \gamma^2 + 3, \delta^2 + 3$.

[12]

4. Sketch the curve $y = \dfrac{3x+8}{4x+9}$.

[16]

Students are required to answer questions in Section B using a fresh sheet of answer paper. Answers for Section A and Section B are to be fastened and handed in separately.

Section B: Applied Mathematics (50%)

1. A particle of mass 2 kg moving in a straight line with speed 5 ms^{-1} receives an impulse of magnitude 12 Ns in the direction of its motion. The impulse acts for 0.2 seconds.

   (i) Find the magnitude of the constant force acting on the particle. [2]

   (ii) Find the increase in kinetic energy of the particle. [5]

2. Two particles A and B have mass m kg, and $2m$ kg respectively. They lie in a straight line. The coefficient of restitution between these particles is $\frac{5}{8}$. A is projected towards B with speed u ms^{-1}. After collision A rebounds from B with speed 0.5 ms^{-1}.

   (i) Find the value of u. [4]

   (ii) Find the speed of B after the collision. [2]

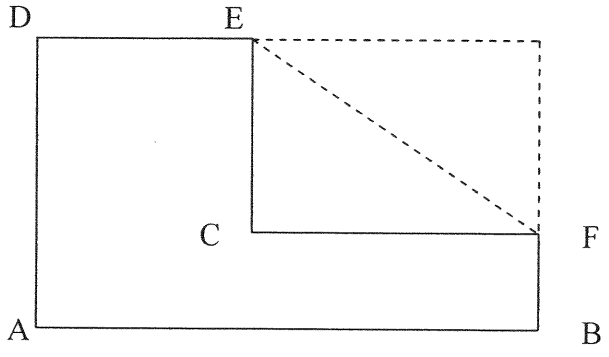
   (iii) Find the loss in kinetic energy due to the collision. [3]

3. A particle P of mass m, moving with speed u on a smooth horizontal table, strikes a fixed smooth vertical barrier. Just before the impact the direction of motion of P makes an angle of 60° with the barrier. As a result of the impact the direction of motion of P is turned through a right angle.

(i) Find the value of e, the coefficient of restitution between P and the barrier. [5]

(ii) Find in terms of m and u, the magnitude of the impulse which the barrier exerts on the sphere. [4]

4. A uniform lamina ABCD has a corner CEF folded as shown below:

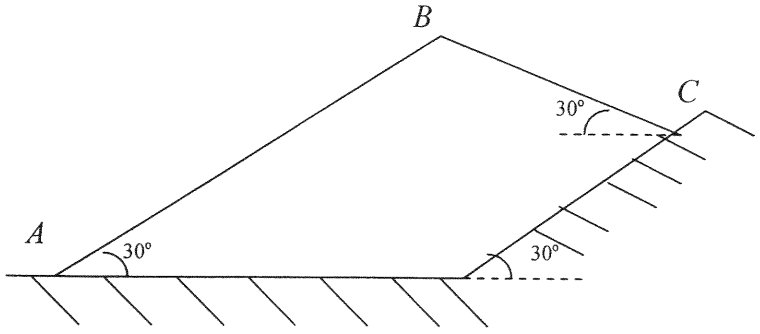


Given that the rectangular lamina is of length 9 cm and width 8 cm, while EC=CF=6 cm, find the centre of mass of the folded lamina, stating its position from AD and AB. [8]

Given that the lamina is attached to a light inextensible string at point A and suspended, find the angle that AB would make with the vertical. [3]

[Turn over

5.



A uniform rod AB, of length $2a$ and weight $6W$, is smoothly hinged at B to a uniform rod BC, of length $2b$ and weight W. The rods rest in equilibrium in a vertical plane with the end A of the rod AB resting on a rough horizontal plane, and the end C of the rod BC resting on a rough plane which is inclined at 30° to the horizontal. Both rods are inclined at 30° to the horizontal and AB is parallel to a line of greatest slope of the inclined plane (see diagram).

(i) Given that the coefficient of friction at C is $\frac{1}{4}\sqrt{3}$ and that C is about to slip up the plane, show that the magnitude of the normal component of the force of the inclined plane on BC is $(2\sqrt{3})\ W$. [4]

(ii) Show that the magnitude of the frictional force at A is $(\frac{7}{4}\sqrt{3})\ W$ and find the magnitude of the normal component of the force of the horizontal plane on AB. [8]

(iii) The coefficient of friction at A is μ. Find the range of possible values of μ. [2]