TAYLOR'S UNIVERSITY COLLEGE
Wisdom · Integrity · Excellence

CAMBRIDGE 'A' LEVEL PROGRAMME

A2 TRIAL EXAMINATION AUGUST/SEPTEMBER 2007

(June 2006 Intake)

Wednesday **29 August 2007** **8.30 am – 9.45 am**

MATHEMATICS 9709/4

PAPER 4 Mechanics 1 (M1) 1 hour 15 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.
Where a numerical value for the acceleration due to gravity is needed, use 10 ms^{-2}.
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 50.
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 3 printed pages.

[Turn over

1. A particle moves on the x-axis. At time t seconds the displacement of the particle from the origin is x metres and the velocity of the particle is v m s^{-1}. When t = 0, x = 0 and v = 3. Given that the acceleration of the particle is $-\frac{3}{8}(t-2)^2$, show that v = 1 when t = 4. [4]

2. A particle A, of mass 4kg, rests on a smooth plane inclined at an angle 30° to the horizontal. It is connected, by a light inextensible string passing over a smooth pulley fixed at the top of the plane, to a particle B of mass 3 kg which hangs freely. The part of the string between A and the pulley is parallel to a line of greatest slope of the inclined plane. The system is released from rest with both parts of the string taut. Find the speed of the system when B has fallen a distance of 1.4 m. [6]

3. A block of weight 2W rests upon a horizontal plane and is about to move when a force W is applied to it at an angle $\sin^{-1}(\frac{3}{5})$ with the plane. Find the coefficient of friction if the force is acting
(i) upward, and [4]
(ii) downward along the given line of action. [3]

4. A car is traveling on a straight road with constant acceleration a m s^{-2}. At a point A, where the speed of the car is u m s^{-1}, the driver sees an obstruction ahead. The car continues to accelerate for T s (the driver's reaction time) and then moves with constant retardation $3a$ m s^{-2} until it comes to rest at B.
(i) Sketch the velocity-time graph. [3]

(ii) Show that the distance d m between A and B is given by
$$6ad = u^2 + 8uaT + 4a^2T^2.$$ [4]

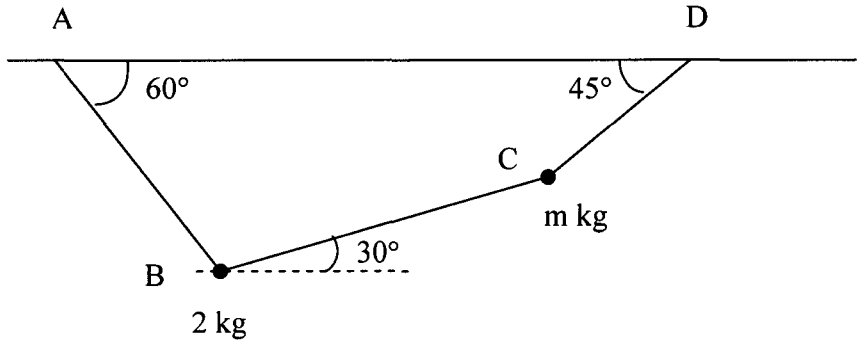
5. The top of a chute whose length is 12 m is 3 m vertically above its lowest point. A parcel of mass 1.6 kg slides from rest from the top of the chute and reaches the lowest point with a speed of 5 m s^{-1}. Calculate, for the parcel,
(i) the gain in kinetic energy, [2]

(ii) the loss in potential energy, [2]

(iii)the work done in overcoming the frictional resistance, [1]

(iv)the average value of this resistance. [2]

6. AB, BC and CD are three light inextensible strings. The ends A and D are fastened to fixed points on a horizontal wire. Particles of mass 2 kg and m kg are attached at B and C respectively as shown in the diagram below. The strings AB, BC and CD are inclined to the horizontal at 60°, 30° and 45° respectively as indicated in the diagram.



(i) By considering the forces acting on the particle of mass 2 kg, show that the tension in BC is 10 N and find the tension in the string AB.

[4]

(ii) By considering the forces acting on the particle of mass m kg, find the tension in the string CD and determine the value of m, giving your answer correct to 3 significant figures. [4]

7 (i) A car weighing 1000 kg climbs a hill of inclination $\sin^{-1}(\frac{1}{10})$ to the horizontal at a steady speed of 50 km h^{-1} against a constant resistance of 200 N. Find the power at which the engine is working. [4]

(ii) The power of the engine is suddenly increased by 5 %. Find the immediate acceleration of the car, assuming that the constant resistance remains the same. [4]

(iii) If this acceleration is maintained, find the power of the engine after 10 seconds. [3]