TAYLOR'S UNIVERSITY COLLEGE
Wisdom · Integrity · Excellence

CAMBRIDGE A LEVEL PROGRAMME

A2 TRIAL EXAMINATION AUGUST/SEPTEMBER 2008

(July 2007 Intake)

Wednesday **27 August 2008** **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 **4** printed pages.

[Turn over

1. A car of mass 650 kg is travelling on a straight road which is inclined to the horizontal at 5^0. At a certain point P on the road the car's speed is 15 ms^{-1}. The point Q is 400m down the hill from P, and at Q the car's speed is 35 ms^{-1}. For the motion from P to Q, calculate the
   (i) increase in kinetic energy of the car, [3]
   (ii) decrease in gravitational potential energy of the car. [2]

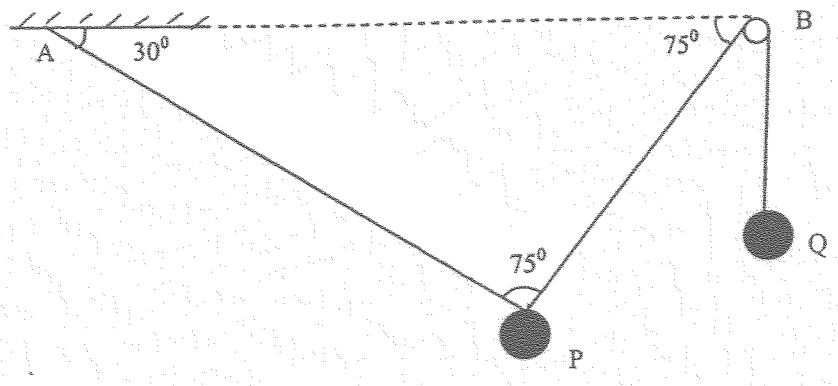
2. A particle of mass 7 kg is placed on a plane inclined at an angle of 30^0 to the horizontal. The coefficient of friction between the particle and the plane is 0.6.
   (i) Show the particle does not slide down the plane. [4]
   (ii) Find the magnitude of the least force, parallel to the plane, which will cause the particle to move down the plane. [2]

   [Take g to be $10ms^{-2}$.]

3. (a) The engine of a car has a maximum rate of working 30 kW, and the total mass of the car and its driver is 800 kg. Given that the air resistance when the car is moving at v ms^{-1} is 0.04v Newtons per kilogram mass, find the maximum constant velocity that the car can maintain on a horizontal road. Give your answers to the 3 significant figures. [3]
   (b) Also find the greatest possible acceleration when the car is moving horizontally with velocity 15 ms^{-1}. [3]

4 A particle moves in a straight line in such a way that its acceleration is $(2-2t)$ ms^{-2}, where t is the time in seconds. The velocity is 3 ms^{-1} when $t=0$.
   (i) Show that the particle comes instantaneously to rest when $t=3$. [4]
   (ii) Find the distance moved between $t=0$ and $t=3$. [2]

5.



The diagram shows a particle P, of mass m, which hangs in equilibrium supported by two light inextensible strings. One string is attached to a fixed point A, and this string is inclined at 30^0 to the horizontal. The other string passes over a small smooth peg B, which is fixed at the same horizontal level as A, and supports a particle Q, of mass M, which hangs freely. The lengths of AP and AB are equal, so that angles APB and ABP are each 75^0.

(i) Find the value of $\frac{M}{m}$, giving your answer correct to 3 significant figures. [5]

(ii) Express the tension in the string AP in the form kmg, giving the value of k correct to 3 significant figures. [2]

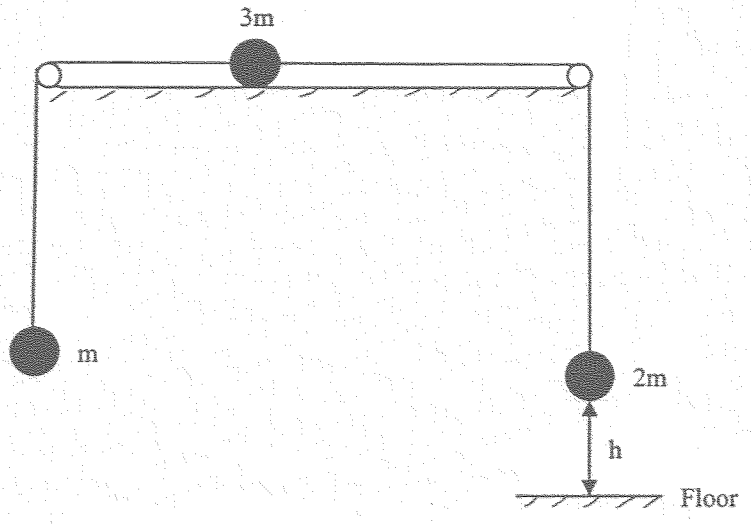
6. A car is traveling on a straight road with constant acceleration a ms^{-2}. At a point A, where the speed of the car is u ms^{-1}, the driver sees an obstruction ahead. The car continues to accelerate for T s (the driver's reaction time) and then moves with a constant retardation 3a ms^{-2} until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

(i) Sketch the velocity –time graph. [2]

(ii) Show that the distance d m between A and B is given by

$$6ad = u^2 + 8uaT + 4a^2T^2$$ [5]

7.



A particle of mass 3m rests on a smooth horizontal table and is attached to particles of masses m and 2m by the two light inextensible strings that pass over smooth pulleys at opposite edge of the table, as shown in the diagram. The three particles lie in a vertical plane.

(i) The system is released from rest. Find the magnitude of the acceleration of the three particles and the tensions in the two strings. [6]

(ii) After falling a distance h, the particle of mass 2m strikes the floor without rebounding. Show that the particles of masses m and 3m will travel a further distance $\frac{2}{3}$h before coming instantaneously to rest. [7]