TAYLOR'S UNIVERSITY COLLEGE
Wisdom · Integrity · Excellence

CAMBRIDGE 'A' LEVEL PROGRAMME

A2 TRIAL EXAMINATION MARCH/APRIL 2007

(January/March 2006 Intake)

Friday **6 April 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.
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.

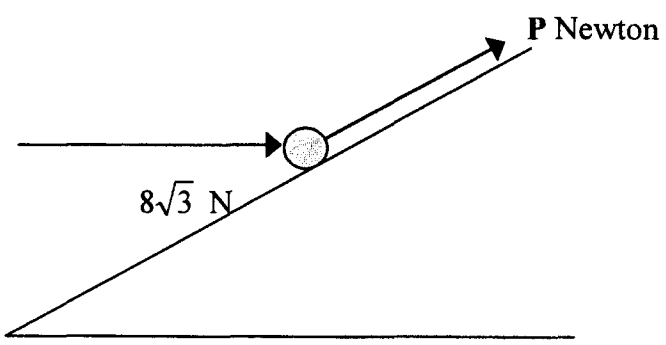
[Turn over

1. A particle of mass 2 kg is released from rest and slides down a smooth plane inclined at $\sin^{-1}\left(\frac{3}{5}\right)$ to the horizontal. Find the distance travelled while the particle increases its velocity to $5ms^{-1}$. [2]

2. A truck of mass 10 000kg is moving in a straight line on a level road. The resistance to motion is a force of magnitude 64v Newton, where v m/s is the speed of the truck. The engine of the truck is working at a rate of 40 kW.
   Find the maximum speed of the truck on level road. [3]

3. At the same time 2 boys, who are standing 40 metres apart, begin to run towards each other. Tan starts from rest and runs with a constant acceleration of $2ms^{-2}$ while Joseph runs with a constant velocity of $3ms^{-1}$. Find
   (i) how long it is before they meet.
   (ii) how far Joseph has travelled when they meet. [4]

4. A particle of mass 4 kg rests on a smooth plane which is inclined at an angle of 30° to the horizontal. When a force **P** acting up the inclined plane and a horizontal force of $8\sqrt{3}$ N are applied to the particle, it rests in equilibrium.
   Calculate, in exact terms, the value of **P** and the normal contact force between the particle and the plane. [6]



5. A tractor of mass M is pulling a trailer of mass M_1. The tractor exerts a steady driving force D.

Construct a mathematical model stating two assumptions made and hence find, in terms of M, M_1 and D, [4]

(i) the acceleration of the trailer [2]

(ii) the tension in the tow rope. [2]

6. (a) A particle of mass m is placed on a rough plane inclined at an angle $\tan^{-1}\left(\frac{5}{12}\right)$ to the horizontal. The coefficient of friction between the plane and the particle is $\frac{1}{2}$.

Prove that the particle will remain stationary. [4]

(b) A particle of weight 8 Newtons is resting in rough contact with a plane inclined at an angle α to the horizontal where $\tan\alpha = \frac{3}{4}$.

The coefficient of friction between the particle and the plane is μ.

A horizontal force P Newtons is applied, such that when $P = 16$, the particle is on the point of slipping up the plane.

(i) Find μ. [5]

(ii) Find the value of P such that the particle is just prevented from slipping down the plane. [4]

7. Cyclist A travels at a constant speed of $10ms^{-1}$ along a straight road. At time t = 0 cyclist A passes cyclist B who is stationary. Thirty seconds later cyclist B sets off in pursuit of cyclist A. Cyclist B accelerates uniformly at $2ms^{-2}$ until she reaches a speed of $15ms^{-1}$, and catches up with cyclist A when t = T.
Sketch a velocity time graph for the above information and hence find T. [6]

Cyclist A immediately applies her brakes when cyclist B catches up to her. Her acceleration, $a\,ms^{-2}$, during this braking period is given by $a = \frac{-t}{2}$, where t is the time in seconds after she first applies her brakes.
Find, in exact terms, how long it takes cyclist A to brake from $10ms^{-1}$ to rest and find, correct to 4 significant figures, the total distance she has travelled from t = 0 up to the moment she comes to rest. [8]