TAYLOR'S UNIVERSITY COLLEGE
Wisdom · Integrity · Excellence

CAMBRIDGE A LEVEL PROGRAMME

A2 TRIAL EXAMINATION MARCH/APRIL 2008

(Jan & March 2007 Intake)

Wednesday **26 March 2008** **1.30 pm – 2.45 pm**

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.

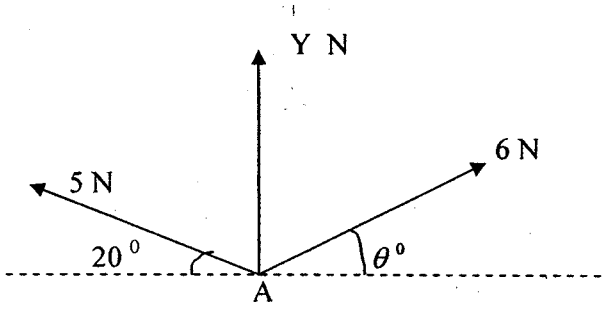
Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
Where a numerical value for the acceleration due to gravity is needed, use 10 ms^{-2}.
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.

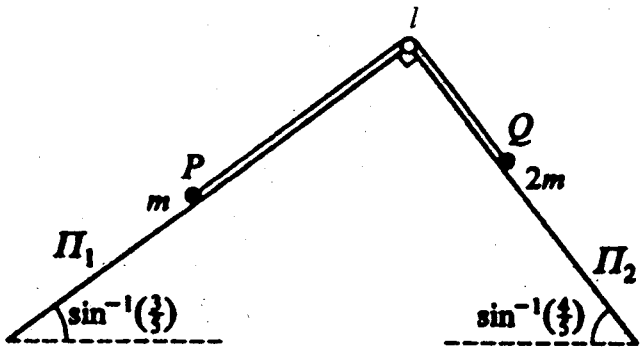
[Turn over

1. Three forces with magnitudes and directions as shown in the diagram, act in a horizontal plane at the point A. The resultant of the three forces has magnitude 10 Newtons and acts in the direction of the force of the magnitude Y Newtons. Find θ and Y.



[5]

2.



Two fixed smooth planes Π_1 and Π_2 are at right angles to each other. Their line of intersection l is horizontal, and the angles of inclination to the horizontal of Π_1 and Π_2 are $\sin^{-1}\left(\frac{3}{5}\right)$ and $\sin^{-1}\left(\frac{4}{5}\right)$ respectively. Particles P and Q, of masses m and $2m$ respectively, are attached to the ends of a light inextensible string, which passes over a small smooth pulley, fixed on l. The particles P and Q lie on Π_1 and Π_2 respectively, and are released from rest with the string taut and lying in a vertical plane perpendicular to l, as shown in the diagram. In the first 0.3 seconds of motion, neither particle strikes the pulley. Find the distance moved by Q in this time.

[6]

3. The angle of inclination of a plane to the horizontal is denoted by α ,where $\tan \alpha = \frac{3}{4}$. A particle of mass m is free to move on the plane. Air resistance may be ignored. The coefficient of friction between the particle and the plane is μ. The particle slides down a line of greatest slope of the plane at a constant speed. Find μ. [2]

The angle of inclination of the plane to the horizontal is now increased to 2α, and the particle is released from rest on the plane. Find the acceleration of the particle . [4]

4. A particle P of mass 0.2 kg is moving on the positive x-axis. At time t s its velocity is $(6t - 3t^2)\text{ms}^{-1}$. There are two points, A and B, on the x-axis at which the particle is instantaneously at rest. Find the distance AB. [3]

Find the magnitude and direction of the force acting on P when $t = 2$. [3]

5. Two vehicles, moving in the same direction, pass the point O on a straight road at time $t = 0$. Vehicle A is moving at constant speed 11 ms^{-1}. Vehicle B has constant acceleration 2 ms^{-2}, and it has speed 3 ms^{-1} as it passes O. Find

(i) the distance from O at which B has speed 21 ms^{-1}. [2]

(ii) the time, t seconds, when B overtakes A, [2]

(iii) the maximum distance by which A is ahead B. [3]

6. A body of mass 2 kg is projected up a rough inclined plane with an initial speed of 5 ms^{-1}. It travels up the slope for some distance and then stops and starts to slide down. The angle of inclination is 10^0 to the horizontal and the coefficient of friction between the plane and the body is 0.1.

Calculate

(i) the work done in bringing the body to rest [2]

(ii) the distance travelled up the slope [4]

(iii) the speed of the body when it returns to the starting point [4]

7. The resistance to motion of a car, of mass 1500 kg, has magnitude ($Av + Bv^2$) Newtons, where A and B are constants and v is the speed in ms^{-1}. The maximum power of the car engine is 30 KW. The maximum speed on a horizontal road is 50 ms^{-1}.

(i) Show that A + 50B = 12 [4]

When travelling uphill on a road inclined at an angle α to the horizontal, where $\sin \alpha = \frac{1}{20}$, the maximum speed is 30 ms^{-1}.

(ii) Show that $A + 30B = \frac{25}{3}$ [3]

(iii) Find the values of A and B and hence show that at 45 ms^{-1} the resistance is 499 Newtons, correct to three significant figures. [3]