UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

MATHEMATICS **9709/04**

Paper 4 Mechanics 1 **(M1)**

May/June 2006

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph 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 Centre number, candidate number and name 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 $10\,\text{m}\,\text{s}^{-2}$.
The use of an electronic calculator is expected, where appropriate.
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 number of 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.
At the end of the examination, fasten all your work securely together.

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

UNIVERSITY of CAMBRIDGE International Examinations

[Turn over

1 A car of mass 1200 kg travels on a horizontal straight road with constant acceleration a m s^{-2}.

(i) Given that the car's speed increases from 10 m s^{-1} to 25 m s^{-1} while travelling a distance of 525 m, find the value of a. [2]

The car's engine exerts a constant driving force of 900 N. The resistance to motion of the car is constant and equal to R N.

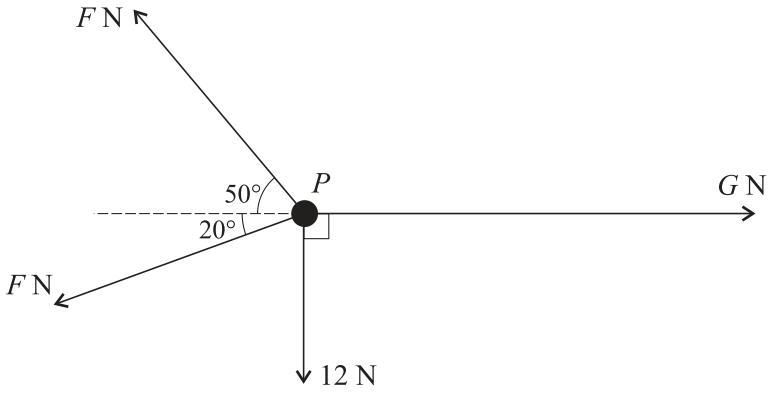
(ii) Find R. [2]

2 A motorcyclist starts from rest at A and travels in a straight line until he comes to rest again at B. The velocity of the motorcyclist t seconds after leaving A is v m s^{-1}, where $v = t - 0.01t^2$. Find

(i) the time taken for the motorcyclist to travel from A to B, [2]

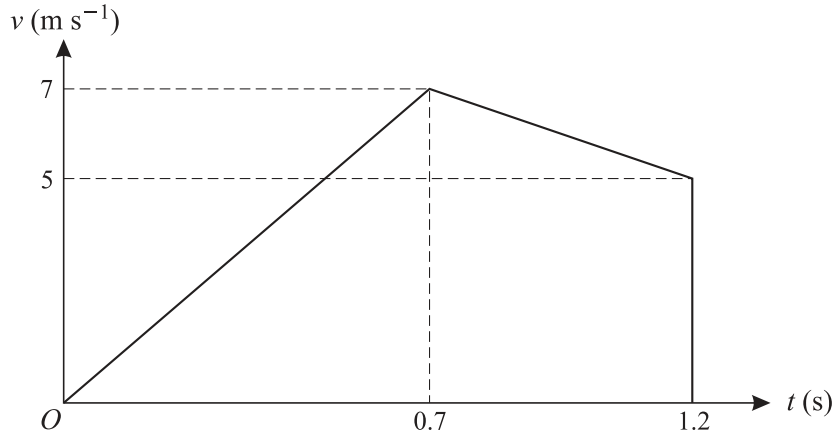
(ii) the distance AB. [3]

3



A particle P is in equilibrium on a smooth horizontal table under the action of horizontal forces of magnitudes F N, F N, G N and 12 N acting in the directions shown. Find the values of F and G. [6]

4



The diagram shows the velocity-time graph for the motion of a small stone which falls vertically from rest at a point A above the surface of liquid in a container. The downward velocity of the stone t s after leaving A is v m s^{-1}. The stone hits the surface of the liquid with velocity 7 m s^{-1} when $t = 0.7$. It reaches the bottom of the container with velocity 5 m s^{-1} when $t = 1.2$.

(i) Find

(a) the height of A above the surface of the liquid,

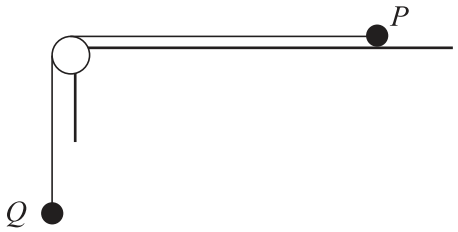
(b) the depth of liquid in the container.

[3]

(ii) Find the deceleration of the stone while it is moving in the liquid. [2]

(iii) Given that the resistance to motion of the stone while it is moving in the liquid has magnitude 0.7 N, find the mass of the stone. [3]

5



Particles P and Q are attached to opposite ends of a light inextensible string. P is at rest on a rough horizontal table. The string passes over a small smooth pulley which is fixed at the edge of the table. Q hangs vertically below the pulley (see diagram). The force exerted on the string by the pulley has magnitude $4\sqrt{2}$ N. The coefficient of friction between P and the table is 0.8.

(i) Show that the tension in the string is 4 N and state the mass of Q. [2]

(ii) Given that P is on the point of slipping, find its mass. [2]

A particle of mass 0.1 kg is now attached to Q and the system starts to move.

(iii) Find the tension in the string while the particles are in motion. [4]

[Turn over

6 A block of mass 50 kg is pulled up a straight hill and passes through points A and B with speeds $7\,\text{m s}^{-1}$ and $3\,\text{m s}^{-1}$ respectively. The distance AB is 200 m and B is 15 m higher than A. For the motion of the block from A to B, find

(i) the loss in kinetic energy of the block, [2]

(ii) the gain in potential energy of the block. [2]

The resistance to motion of the block has magnitude 7.5 N.

(iii) Find the work done by the pulling force acting on the block. [2]

The pulling force acting on the block has constant magnitude 45 N and acts at an angle α° upwards from the hill.

(iv) Find the value of α. [3]

7 Two particles P and Q move on a line of greatest slope of a smooth inclined plane. The particles start at the same instant and from the same point, each with speed $1.3\,\text{m s}^{-1}$. Initially P moves down the plane and Q moves up the plane. The distance between the particles t seconds after they start to move is d m.

(i) Show that $d = 2.6t$. [4]

When $t = 2.5$ the difference in the vertical height of the particles is 1.6 m. Find

(ii) the acceleration of the particles down the plane, [3]

(iii) the distance travelled by P when Q is at its highest point. [3]