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

MATHEMATICS **9709/43**

Paper 4 Mechanics 1 **(M1)** **October/November 2012**

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)

* 2 4 0 6 8 3 4 2 6 6 *

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.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

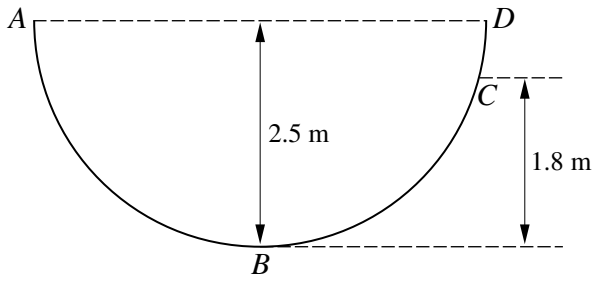
Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
Where a numerical value for the acceleration due to gravity is needed, use $10\,\text{m}\,\text{s}^{-2}$.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

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 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.

This document consists of **3** printed pages and **1** blank page.

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1



ABCD is a semi-circular cross-section, in a vertical plane, of the inner surface of half a hollow cylinder of radius 2.5 m which is fixed with its axis horizontal. *AD* is horizontal, *B* is the lowest point of the cross-section and *C* is at a height of 1.8 m above the level of *B* (see diagram). A particle *P* of mass 0.8 kg is released from rest at *A* and comes to instantaneous rest at *C*.

(i) Find the work done on *P* by the resistance to motion while *P* travels from *A* to *C*. [2]

The work done on *P* by the resistance to motion while *P* travels from *A* to *B* is 0.6 times the work done while *P* travels from *A* to *C*.

(ii) Find the speed of *P* when it passes through *B*. [3]

2 A particle moves in a straight line. Its velocity t seconds after leaving a fixed point *O* on the line is v m s^{-1}, where $v = 0.2t + 0.006t^2$. For the instant when the acceleration of the particle is 2.5 times its initial acceleration,

(i) show that $t = 25$, [3]

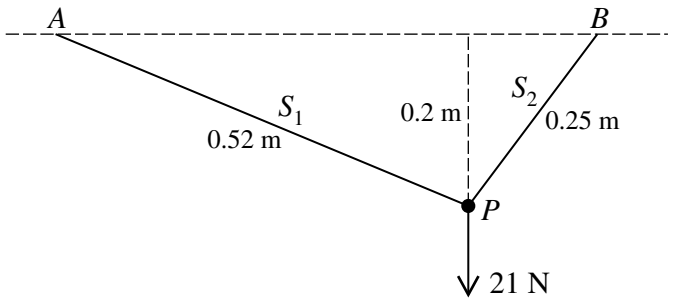
(ii) find the displacement of the particle from *O*. [3]

3 A particle *P* is projected vertically upwards, from a point *O*, with a velocity of 8 m s^{-1}. The point *A* is the highest point reached by *P*. Find

(i) the speed of *P* when it is at the mid-point of *OA*, [4]

(ii) the time taken for *P* to reach the mid-point of *OA* while moving upwards. [2]

4



A particle *P* of weight 21 N is attached to one end of each of two light inextensible strings, S_1 and S_2, of lengths 0.52 m and 0.25 m respectively. The other end of S_1 is attached to a fixed point *A*, and the other end of S_2 is attached to a fixed point *B* at the same horizontal level as *A*. The particle *P* hangs in equilibrium at a point 0.2 m below the level of *AB* with both strings taut (see diagram). Find the tension in S_1 and the tension in S_2. [6]

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5 An object of mass 12 kg slides down a line of greatest slope of a smooth plane inclined at 10° to the horizontal. The object passes through points A and B with speeds $3\,\text{m s}^{-1}$ and $7\,\text{m s}^{-1}$ respectively.

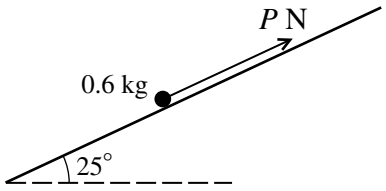
(i) Find the increase in kinetic energy of the object as it moves from A to B. [2]

(ii) Hence find the distance AB, assuming there is no resisting force acting on the object. [3]

The object is now pushed up the plane from B to A, with constant speed, by a horizontal force.

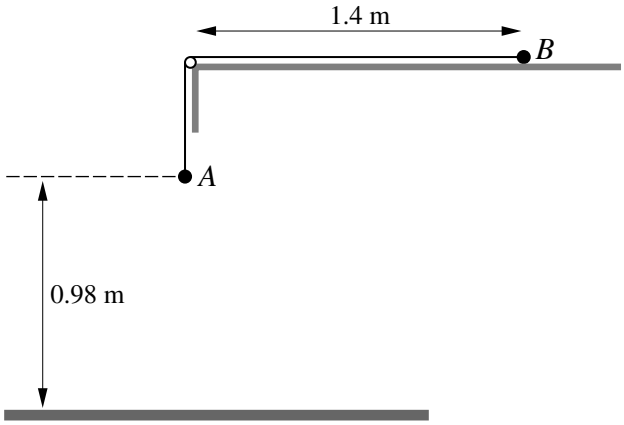
(iii) Find the magnitude of this force. [3]

6



The diagram shows a particle of mass 0.6 kg on a plane inclined at 25° to the horizontal. The particle is acted on by a force of magnitude P N directed up the plane parallel to a line of greatest slope. The coefficient of friction between the particle and the plane is 0.36. Given that the particle is in equilibrium, find the set of possible values of P. [9]

7



Particles A and B have masses 0.32 kg and 0.48 kg respectively. The particles are attached to the ends of a light inextensible string which passes over a small smooth pulley fixed at the edge of a smooth horizontal table. Particle B is held at rest on the table at a distance of 1.4 m from the pulley. A hangs vertically below the pulley at a height of 0.98 m above the floor (see diagram). A, B, the string and the pulley are all in the same vertical plane. B is released and A moves downwards.

(i) Find the acceleration of A and the tension in the string. [5]

A hits the floor and B continues to move towards the pulley. Find the time taken, from the instant that B is released, for

(ii) A to reach the floor, [2]

(iii) B to reach the pulley. [3]

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