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

HIGHER MATHEMATICS **8719/05**

MATHEMATICS **9709/05**

Paper 5 Mechanics 2 **(M2)**

October/November 2004

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 $10\,\mathrm{m\,s^{-2}}$.
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 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.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

UNIVERSITY of CAMBRIDGE
International Examinations

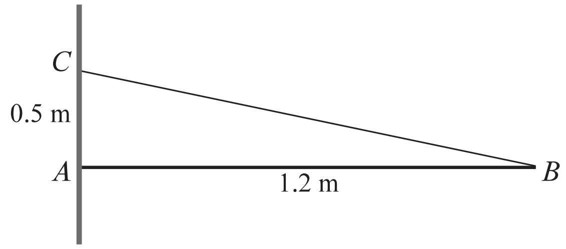
1 A light elastic string has natural length 1.5 m and modulus of elasticity 60 N. The string is stretched between two fixed points A and B, which are at the same horizontal level and 2 m apart.

(i) Find the tension in the string. [2]

A particle of weight W N is now attached to the mid-point of the string and the particle is in equilibrium at a point 0.75 m vertically below the mid-point of AB.

(ii) Find the value of W. [4]

2



A uniform rod AB of length 1.2 m and weight 30 N is in equilibrium with the end A in contact with a vertical wall. AB is held at right angles to the wall by a light inextensible string. The string has one end attached to the rod at B and the other end attached to a point C of the wall. The point C is 0.5 m vertically above A (see diagram). Find

(i) the tension in the string, [3]

(ii) the horizontal and vertical components of the force exerted on the rod by the wall at A. [3]

3 A car of mass 1000 kg is moving on a straight horizontal road. The driving force of the car is $\frac{28\,000}{v}$ N and the resistance to motion is $4v$ N, where v m s^{-1} is the speed of the car t seconds after it passes a fixed point on the road.

(i) Show that $\frac{\mathrm{d}v}{\mathrm{d}t} = \frac{7000 - v^2}{250v}$. [2]

The car passes points A and B with speeds 10 m s^{-1} and 40 m s^{-1} respectively.

(ii) Find the time taken for the car to travel from A to B. [4]

4 A particle is projected from a point O on horizontal ground with speed 50 m s^{-1} at an angle θ to the horizontal. Given that the speed of the particle when it is at its highest point is 40 m s^{-1},

(i) show that $\cos\theta = 0.8$, [2]

(ii) find, in either order,

(a) the greatest height reached by the particle,

(b) the distance from O at which the particle hits the ground.

[5]

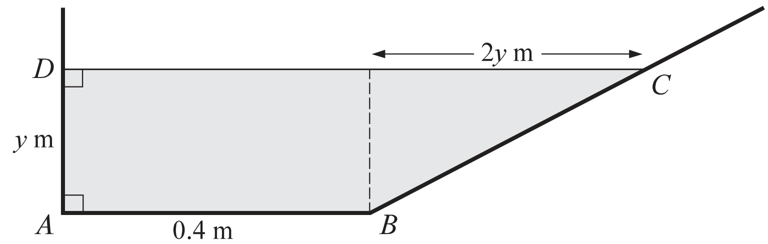
5 One end of a light elastic string of natural length 0.4 m and modulus of elasticity 16 N is attached to a fixed point O of a horizontal table. A particle P of mass 0.8 kg is attached to the other end of the string. The particle P is released from rest on the table, at a point which is 0.5 m from O. The coefficient of friction between the particle and the table is 0.2. By considering work and energy, find the speed of P at the instant the string becomes slack. [7]

6 A horizontal turntable rotates with constant angular speed ω rad s^{-1} about its centre O. A particle P of mass 0.08 kg is placed on the turntable. The particle moves with the turntable and no sliding takes place.

(i) It is given that $\omega = 3$ and that the particle is about to slide on the turntable when $OP = 0.5$ m. Find the coefficient of friction between the particle and the turntable. [3]

(ii) Given instead that the particle is about to slide when its speed is 1.2 m s^{-1}, find ω. [5]

7



A light container has a vertical cross-section in the form of a trapezium. The container rests on a horizontal surface. Grain is poured into the container to a depth of y m. As shown in the diagram, the cross-section $ABCD$ of the grain is such that $AB = 0.4$ m and $DC = (0.4 + 2y)$ m.

(i) When $y = 0.3$, find the vertical height of the centre of mass of the grain above the base of the container. [5]

(ii) Find the value of y for which the container is about to topple. [5]

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