CAMBRIDGE INTERNATIONAL EXAMINATIONS

General Certificate of Education Advanced Subsidiary Level
General Certificate of Education Advanced Level

MATHEMATICS 9709/4

PAPER 4 Mechanics 1 **(M1)**

MAY/JUNE SESSION 2002

1 hour 15 minutes

Additional materials:
Answer paper
Graph paper
List of Formulae (MF9)

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

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 $10\,\text{m}\,\text{s}^{-2}$.

INFORMATION FOR CANDIDATES

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.

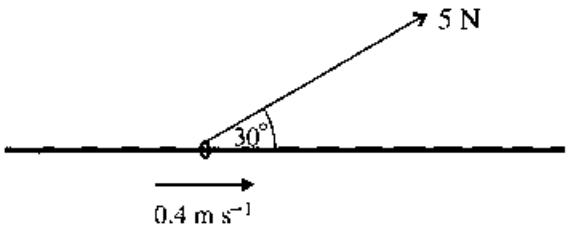
The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

This question paper consists of 3 printed pages and 1 blank page.

[Turn over

1



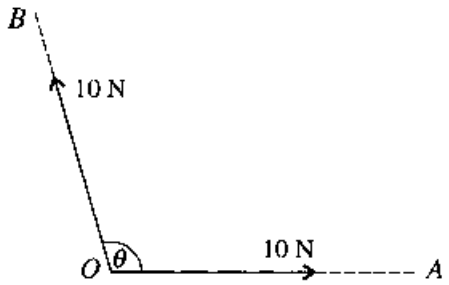
One end of a light inextensible string is attached to a ring which is threaded on a fixed horizontal bar. The string is used to pull the ring along the bar at a constant speed of 0.4 m s^{-1}. The string makes a constant angle of 30° with the bar and the tension in the string is 5 N (see diagram). Find the work done by the tension in 10 s. [3]

2 A basket of mass 5 kg slides down a slope inclined at 12° to the horizontal. The coefficient of friction between the basket and the slope is 0.2.

(i) Find the frictional force acting on the basket. [2]

(ii) Determine whether the speed of the basket is increasing or decreasing. [3]

3



Two forces, each of magnitude 10 N, act at a point O in the directions of OA and OB, as shown in the diagram. The angle between the forces is θ. The resultant of these two forces has magnitude 12 N.

(i) Find θ. [3]

(ii) Find the component of the resultant force in the direction of OA. [2]

4 A box of mass 4.5 kg is pulled at a constant speed of 2 m s^{-1} along a rough horizontal floor by a horizontal force of magnitude 15 N.

(i) Find the coefficient of friction between the box and the floor. [3]

The horizontal pulling force is now removed. Find

(ii) the deceleration of the box in the subsequent motion, [2]

(iii) the distance travelled by the box from the instant the horizontal force is removed until the box comes to rest. [2]

5 **(i)** A cyclist travels in a straight line from A to B with constant acceleration $0.06\,\mathrm{m\,s^{-2}}$. His speed at A is $3\,\mathrm{m\,s^{-1}}$ and his speed at B is $6\,\mathrm{m\,s^{-1}}$. Find

(a) the time taken by the cyclist to travel from A to B, [2]

(b) the distance AB. [2]

(ii) A car leaves A at the same instant as the cyclist. The car starts from rest and travels in a straight line to B. The car reaches B at the same instant as the cyclist. At time t s after leaving A the speed of the car is $kt^2\,\mathrm{m\,s^{-1}}$, where k is a constant. Find

(a) the value of k, [4]

(b) the speed of the car at B. [1]

6 **(i)** A lorry P of mass 15 000 kg climbs a straight hill of length 800 m at a steady speed. The hill is inclined at 2° to the horizontal. For P's journey from the bottom of the hill to the top, find

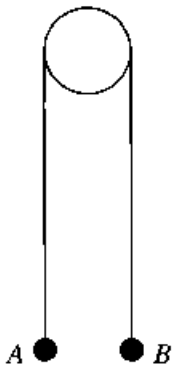
(a) the gain in gravitational potential energy, [2]

(b) the work done by the driving force, which has magnitude 7000 N, [1]

(c) the work done against the force resisting the motion. [2]

(ii) A second lorry, Q, also has mass 15 000 kg and climbs the same hill as P. The motion of Q is subject to a constant resisting force of magnitude 900 N, and Q's speed falls from $20\,\mathrm{m\,s^{-1}}$ at the bottom of the hill to $10\,\mathrm{m\,s^{-1}}$ at the top. Find the work done by the driving force as Q climbs from the bottom of the hill to the top. [5]

7



Particles A and B, of masses 0.15 kg and 0.25 kg respectively, are attached to the ends of a light inextensible string which passes over a smooth fixed pulley. The system is held at rest with the string taut and with A and B at the same horizontal level, as shown in the diagram. The system is then released.

(i) Find the downward acceleration of B. [4]

After 2 s B hits the floor and comes to rest without rebounding. The string becomes slack and A moves freely under gravity.

(ii) Find the time that elapses until the string becomes taut again. [4]

(iii) Sketch on a single diagram the velocity-time graphs for both particles, for the period from their release until the instant that B starts to move upwards. [3]

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