Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

4809945275

MATHEMATICS **9709/41**

Paper 4 Mechanics 1 **(M1)** **May/June 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

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.

This document consists of **11** printed pages and **1** blank page.

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1 A particle of mass 0.6 kg is dropped from a height of 8 m above the ground. The speed of the particle at the instant before hitting the ground is $10\,\mathrm{m\,s^{-1}}$. Find the work done against air resistance. [3]

2 A particle of mass 0.8 kg is projected with a speed of $12\,\mathrm{m\,s^{-1}}$ up a line of greatest slope of a rough plane inclined at an angle of 10° to the horizontal. The coefficient of friction between the particle and the plane is 0.4.

(i) Find the acceleration of the particle. [4]

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(ii) Find the distance the particle moves up the plane before coming to rest. [2]

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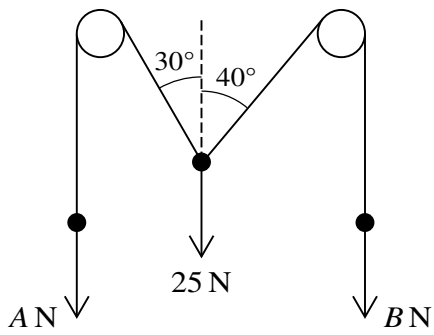

Two light inextensible strings are attached to a particle of weight 25 N. The strings pass over two smooth fixed pulleys and have particles of weights A N and B N hanging vertically at their ends. The sloping parts of the strings make angles of 30° and 40° respectively with the vertical (see diagram). The system is in equilibrium. Find the values of A and B. [6]

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4 A car of mass 800 kg is moving up a hill inclined at $\theta°$ to the horizontal, where $\sin\theta = 0.15$. The initial speed of the car is $8\,\mathrm{m\,s^{-1}}$. Twelve seconds later the car has travelled 120 m up the hill and has speed $14\,\mathrm{m\,s^{-1}}$.

(i) Find the change in the kinetic energy and the change in gravitational potential energy of the car. [3]

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(ii) The engine of the car is working at a constant rate of 32 kW. Find the total work done against the resistive forces during the twelve seconds. [3]

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5 A particle P moves in a straight line $ABCD$ with constant deceleration. The velocities of P at A, B and C are $20\,\mathrm{m\,s^{-1}}$, $12\,\mathrm{m\,s^{-1}}$ and $6\,\mathrm{m\,s^{-1}}$ respectively.

(i) Find the ratio of distances $AB : BC$. [4]

(ii) The particle comes to rest at D. Given that the distance AD is 80 m, find the distance BC. [3]

6 A particle P moves in a straight line passing through a point O. At time t s, the velocity of P, $v\ \mathrm{m\,s^{-1}}$, is given by $v = qt + rt^2$, where q and r are constants. The particle has velocity $4\ \mathrm{m\,s^{-1}}$ when $t = 1$ and when $t = 2$.

(i) Show that, when $t = 0.5$, the acceleration of P is $4\ \mathrm{m\,s^{-2}}$. [4]

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(ii) Find the values of t when P is at instantaneous rest. [2]

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(iii) The particle is at O when $t = 3$. Find the distance of P from O when $t = 0$. [4]

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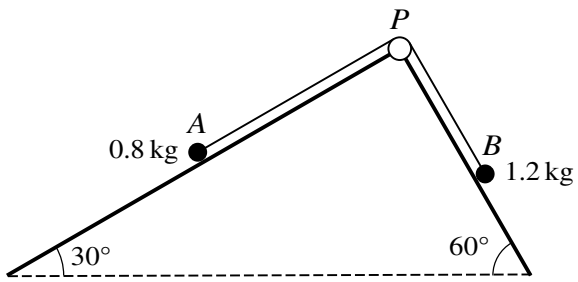

As shown in the diagram, a particle A of mass 0.8 kg lies on a plane inclined at an angle of 30° to the horizontal and a particle B of mass 1.2 kg lies on a plane inclined at an angle of 60° to the horizontal. The particles are connected by a light inextensible string which passes over a small smooth pulley P fixed at the top of the planes. The parts AP and BP of the string are parallel to lines of greatest slope of the respective planes. The particles are released from rest with both parts of the string taut.

(i) Given that both planes are smooth, find the acceleration of A and the tension in the string. [6]

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(ii) It is given instead that both planes are rough, with the same coefficient of friction, μ, for both particles. Find the value of μ for which the system is in limiting equilibrium. [6]

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