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Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4508415906

MATHEMATICS **9709/42**

Paper 4 Mechanics 1 **(M1)** **February/March 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 0.4 kg is projected with a speed of $12\,\mathrm{m\,s^{-1}}$ up a line of greatest slope of a smooth plane inclined at 30° to the horizontal.

(i) Find the initial kinetic energy of the particle. [1]

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(ii) Use an energy method to find the distance the particle moves up the plane before coming to instantaneous rest. [3]

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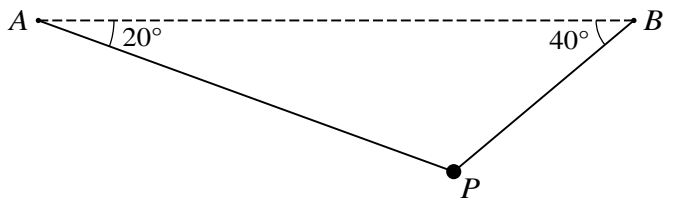

A particle P of mass 1.6 kg is suspended in equilibrium by two light inextensible strings attached to points A and B. The strings make angles of 20° and 40° respectively with the horizontal (see diagram). Find the tensions in the two strings. [6]

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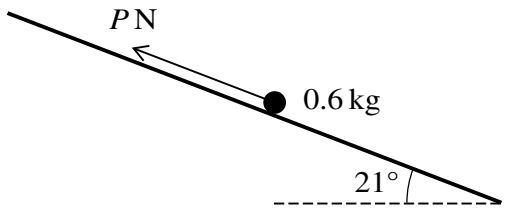

A particle of mass 0.6 kg is placed on a rough plane which is inclined at an angle of 21° to the horizontal. The particle is kept in equilibrium by a force of magnitude P N acting parallel to a line of greatest slope of the plane, as shown in the diagram. The coefficient of friction between the particle and the plane is 0.3. Show that the least possible value of P is 0.470, correct to 3 significant figures, and find the greatest possible value of P. [6]

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4 A car of mass 900 kg is moving on a straight horizontal road $ABCD$. There is a constant resistance of magnitude 800 N in the sections AB and BC, and a constant resistance of magnitude R N in the section CD. The power of the car's engine is a constant 36 kW.

(i) The car moves from A to B at a constant speed in 120 s. Find the speed of the car and the distance AB. [3]

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The car's engine is switched off at B.

(ii) The distance BC is 450 m. Find the speed of the car at C. [3]

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(iii) The car comes to rest at D. The distance AD is 6637.5 m. Find the deceleration of the car and the value of R. [4]

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5 A particle P moves in a straight line starting from a point O and comes to rest 35 s later. At time t s after leaving O, the velocity v m s^{-1} of P is given by

$$v = \tfrac{4}{5}t^2 \qquad 0 \leqslant t \leqslant 5,$$
$$v = 2t + 10 \qquad 5 \leqslant t \leqslant 15,$$
$$v = a + bt^2 \qquad 15 \leqslant t \leqslant 35,$$

where a and b are constants such that $a > 0$ and $b < 0$.

(i) Show that the values of a and b are 49 and -0.04 respectively. [3]

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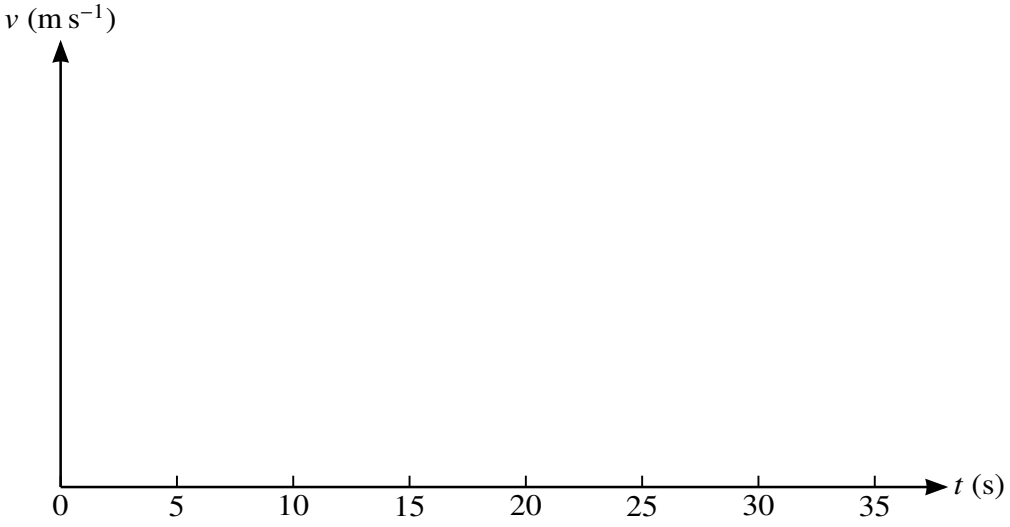
(ii) Sketch the velocity-time graph. [4]



(iii) Find the total distance travelled by P during the 35 s. [5]

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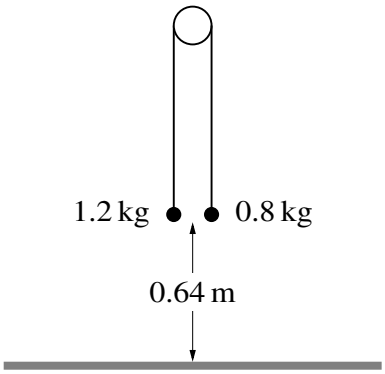

Two particles of masses 1.2 kg and 0.8 kg are connected by a light inextensible string that passes over a fixed smooth pulley. The particles hang vertically. The system is released from rest with both particles 0.64 m above the floor (see diagram). In the subsequent motion the 0.8 kg particle does not reach the pulley.

(i) Show that the acceleration of the particles is $2\,\mathrm{m\,s^{-2}}$ and find the tension in the string. [4]

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(ii) Find the total distance travelled by the 0.8 kg particle during the first second after the particles are released. [8]

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