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Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

MATHEMATICS **9709/43**

Paper 4 Mechanics 1 **(M1)** **May/June 2015**

1 hour 15 minutes

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

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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 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.
Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.

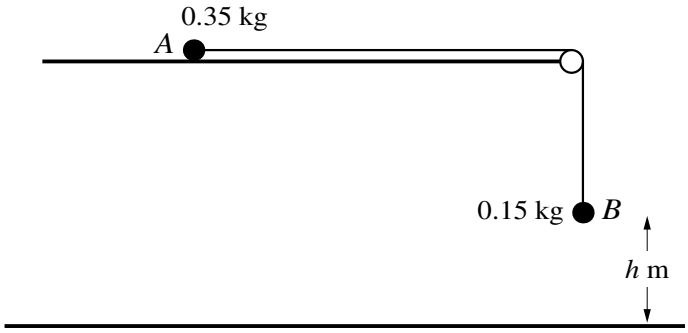
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1 A block is pulled along a horizontal floor by a horizontal rope. The tension in the rope is 500 N and the block moves at a constant speed of 2.75 m s^{-1}. Find the work done by the tension in 40 s and find the power applied by the tension. [4]

2



Particles A and B, of masses 0.35 kg and 0.15 kg respectively, are attached to the ends of a light inextensible string. A is held at rest on a smooth horizontal surface with the string passing over a small smooth pulley fixed at the edge of the surface. B hangs vertically below the pulley at a distance h m above the floor (see diagram). A is released and the particles move. B reaches the floor and A subsequently reaches the pulley with a speed of 3 m s^{-1}.

(i) Explain briefly why the speed with which B reaches the floor is 3 m s^{-1}. [1]

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

3 A car of mass 860 kg travels along a straight horizontal road. The power provided by the car's engine is P W and the resistance to the car's motion is R N. The car passes through one point with speed 4.5 m s^{-1} and acceleration 4 m s^{-2}. The car passes through another point with speed 22.5 m s^{-1} and acceleration 0.3 m s^{-2}. Find the values of P and R. [6]

4 A lorry of mass 12 000 kg moves up a straight hill of length 500 m, starting at the bottom with a speed of 24 m s^{-1} and reaching the top with a speed of 16 m s^{-1}. The top of the hill is 25 m above the level of the bottom of the hill. The resistance to motion of the lorry is 7500 N. Find the driving force of the lorry. [6]

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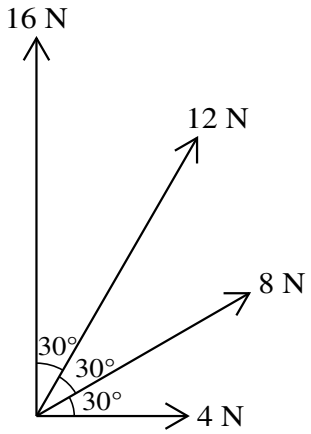


Fig. 1

Four coplanar forces of magnitudes 4 N, 8 N, 12 N and 16 N act at a point. The directions in which the forces act are shown in Fig. 1.

(i) Find the magnitude and direction of the resultant of the four forces. [5]

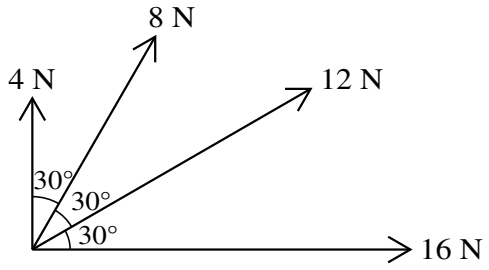


Fig. 2

The forces of magnitudes 4 N and 16 N exchange their directions and the forces of magnitudes 8 N and 12 N also exchange their directions (see Fig. 2).

(ii) State the magnitude and direction of the resultant of the four forces in Fig. 2. [2]

6 A small box of mass 5 kg is pulled at a constant speed of $2.5\,\mathrm{m\,s^{-1}}$ down a line of greatest slope of a rough plane inclined at 10° to the horizontal. The pulling force has magnitude 20 N and acts downwards parallel to a line of greatest slope of the plane.

(i) Find the coefficient of friction between the box and the plane. [5]

The pulling force is removed while the box is moving at $2.5\,\mathrm{m\,s^{-1}}$.

(ii) Find the distance moved by the box after the instant at which the pulling force is removed. [4]

[Question 7 is printed on the next page.]

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7 A particle P moves on a straight line. It starts at a point O on the line and returns to O 100 s later. The velocity of P is v m s^{-1} at time t s after leaving O, where

$$v = 0.0001t^3 - 0.015t^2 + 0.5t.$$

(i) Show that P is instantaneously at rest when $t = 0$, $t = 50$ and $t = 100$. [2]

(ii) Find the values of v at the times for which the acceleration of P is zero, and sketch the velocity-time graph for P's motion for $0 \leqslant t \leqslant 100$. [7]

(iii) Find the greatest distance of P from O for $0 \leqslant t \leqslant 100$. [4]

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