Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2044311977

MATHEMATICS **9709/43**

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 $10\,\mathrm{m\,s^{-2}}$.
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 **12** printed pages.

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1 A man pushes a wheelbarrow of mass 25 kg along a horizontal road with a constant force of magnitude 35 N at an angle of 20° below the horizontal. There is a constant resistance to motion of 15 N. The wheelbarrow moves a distance of 12 m from rest.

(i) Find the work done by the man. [2]

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(ii) Find the speed attained by the wheelbarrow after 12 m. [3]

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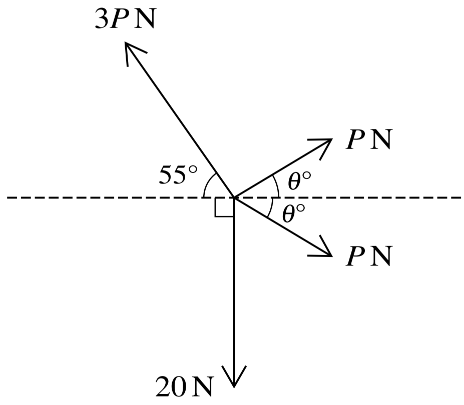

The four coplanar forces shown in the diagram are in equilibrium. Find the values of P and θ. [5]

3 A train travels between two stations, A and B. The train starts from rest at A and accelerates at a constant rate for T s until it reaches a speed of $25\,\mathrm{m\,s^{-1}}$. It then travels at this constant speed before decelerating at a constant rate, coming to rest at B. The magnitude of the train's deceleration is twice the magnitude of its acceleration. The total time taken for the journey is 180 s.

(i) Sketch the velocity-time graph for the train's journey from A to B. [1]

(ii) Find an expression, in terms of T, for the length of time for which the train is travelling with constant speed. [2]

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(iii) The distance from A to B is 3300 m. Find how far the train travels while it is decelerating. [3]

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4 A particle P moves in a straight line starting from a point O. At time t s after leaving O, the velocity, $v\,\mathrm{m\,s^{-1}}$, of P is given by $v = (2t - 5)^3$.

(i) Find the values of t when the acceleration of P is $54\,\mathrm{m\,s^{-2}}$. [3]

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(ii) Find an expression for the displacement of P from O at time t s. [3]

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5 A particle is projected vertically upwards from a point O with a speed of $12\,\mathrm{m\,s^{-1}}$. Two seconds later a second particle is projected vertically upwards from O with a speed of $20\,\mathrm{m\,s^{-1}}$. At time t s after the second particle is projected, the two particles collide.

(i) Find t. [5]

(ii) Hence find the height above O at which the particles collide. [1]

6 A car of mass 1200 kg is travelling along a horizontal road.

(i) It is given that there is a constant resistance to motion.

(a) The engine of the car is working at 16 kW while the car is travelling at a constant speed of $40\,\mathrm{m\,s^{-1}}$. Find the resistance to motion. [2]

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(b) The power is now increased to 22.5 kW. Find the acceleration of the car at the instant it is travelling at a speed of $45\,\mathrm{m\,s^{-1}}$. [3]

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(ii) It is given instead that the resistance to motion of the car is $(590 + 2v)$ N when the speed of the car is $v\,\mathrm{m\,s^{-1}}$. The car travels at a constant speed with the engine working at 16 kW. Find this speed. [3]

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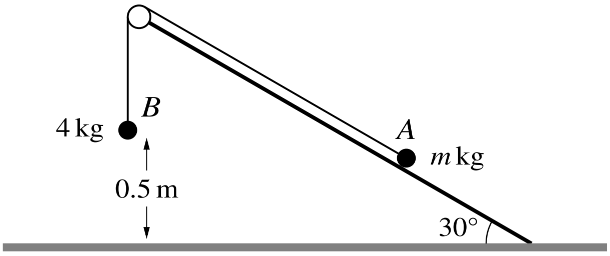

Two particles A and B of masses m kg and 4 kg respectively are connected by a light inextensible string that passes over a fixed smooth pulley. Particle A is on a rough fixed slope which is at an angle of 30° to the horizontal ground. Particle B hangs vertically below the pulley and is 0.5 m above the ground (see diagram). The coefficient of friction between the slope and particle A is 0.2.

(i) In the case where the system is in equilibrium with particle A on the point of moving directly up the slope, show that $m = 5.94$, correct to 3 significant figures. [6]

(ii) In the case where $m = 3$, the system is released from rest with the string taut. Find the total distance travelled by A before coming to instantaneous rest. You may assume that A does not reach the pulley. [8]

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