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Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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1330165820

MATHEMATICS **9709/42**

Paper 4 Mechanics 1 **(M1)** **May/June 2019**

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 in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.
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 **13** printed pages and **3** blank pages.

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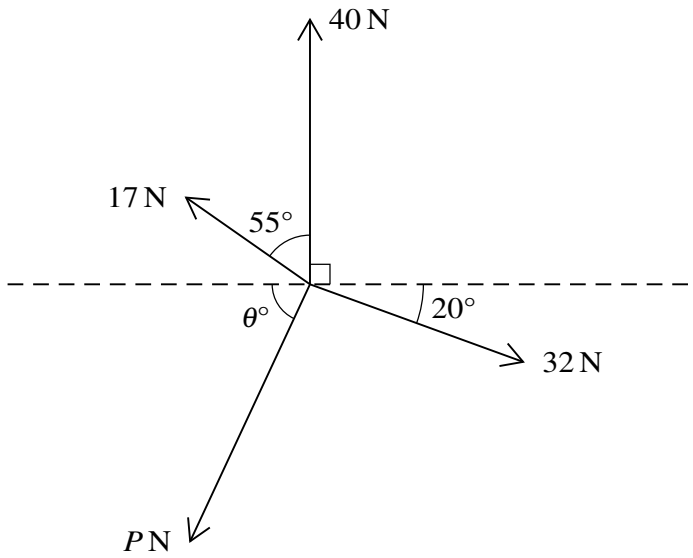
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1



Coplanar forces of magnitudes 40 N, 32 N, P N and 17 N act at a point in the directions shown in the diagram. The system is in equilibrium. Find the values of P and θ. [6]

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2 A car moves in a straight line with initial speed $u\,\text{m s}^{-1}$ and constant acceleration $a\,\text{m s}^{-2}$. The car takes 5 s to travel the first 80 m and it takes 8 s to travel the first 160 m. Find a and u. [6]

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3 A particle of mass 13 kg is on a rough plane inclined at an angle of θ to the horizontal, where $\tan\theta = \frac{5}{12}$. The coefficient of friction between the particle and the plane is 0.3. A force of magnitude T N, acting parallel to a line of greatest slope, moves the particle a distance of 2.5 m up the plane at a constant speed. Find the work done by this force. [5]

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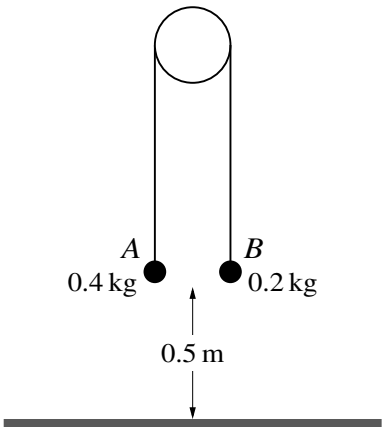
4 A constant resistance to motion of magnitude 350 N acts on a car of mass 1250 kg. The engine of the car exerts a constant driving force of 1200 N. The car travels along a road inclined at an angle of θ to the horizontal, where $\sin\theta = 0.05$. Find the speed of the car when it has moved 100 m from rest in each of the following cases.

- The car is moving up the hill.
- The car is moving down the hill. [7]

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Two particles A and B, of masses 0.4 kg and 0.2 kg respectively, are connected by a light inextensible string which passes over a fixed smooth pulley. Both A and B are 0.5 m above the ground. The particles hang vertically (see diagram). The particles are released from rest. In the subsequent motion B does not reach the pulley and A remains at rest after reaching the ground.

(i) For the motion before A reaches the ground, show that the magnitude of the acceleration of each particle is $\frac{10}{3}\,\text{m s}^{-2}$ and find the tension in the string. [4]

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(ii) Find the maximum height of B above the ground. [4]

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6 A car has mass 1000 kg. When the car is travelling at a steady speed of $v\,\text{m s}^{-1}$, where $v > 2$, the resistance to motion of the car is $(Av + B)$ N, where A and B are constants. The car can travel along a horizontal road at a steady speed of $18\,\text{m s}^{-1}$ when its engine is working at 36 kW. The car can travel up a hill inclined at an angle of θ to the horizontal, where $\sin\theta = 0.05$, at a steady speed of $12\,\text{m s}^{-1}$ when its engine is working at 21 kW. Find A and B. [7]

7 Particles P and Q leave a fixed point A at the same time and travel in the same straight line. The velocity of P after t seconds is $6t(t-3)\,\text{m s}^{-1}$ and the velocity of Q after t seconds is $(10-2t)\,\text{m s}^{-1}$.

(i) Sketch, on the same axes, velocity-time graphs for P and Q for $0 \leqslant t \leqslant 5$. [3]

(ii) Verify that P and Q meet after 5 seconds. [4]

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(iii) Find the greatest distance between P and Q for $0 \leqslant t \leqslant 5$. [4]

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Additional Page

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

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