Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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2515174191

MATHEMATICS **9709/41**

Paper 4 Mechanics 1 **(M1)** **October/November 2018**

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 **12** printed pages.

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1 A particle of mass 0.2 kg moving in a straight line experiences a constant resistance force of 1.5 N. When the particle is moving at speed $2.5\,\text{m s}^{-1}$, a constant force of magnitude F N is applied to it in the direction in which it is moving. Given that the speed of the particle 5 seconds later is $4.5\,\text{m s}^{-1}$, find the value of F. [4]

2 A high-speed train of mass 490 000 kg is moving along a straight horizontal track at a constant speed of $85\ \text{m s}^{-1}$. The engines are supplying 4080 kW of power.

(i) Show that the resistance force is 48 000 N. [1]

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(ii) The train comes to a hill inclined at an angle $\theta°$ above the horizontal, where $\sin\theta° = \frac{1}{200}$. Given that the resistance force is unchanged, find the power required for the train to keep moving at the same constant speed of $85\ \text{m s}^{-1}$. [3]

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3 A van of mass 2500 kg descends a hill of length 0.4 km inclined at 4° to the horizontal. There is a constant resistance to motion of 600 N and the speed of the van increases from $20\,\text{m}\,\text{s}^{-1}$ to $30\,\text{m}\,\text{s}^{-1}$ as it descends the hill. Find the work done by the van's engine as it descends the hill. [5]

4 Two particles A and B, of masses m kg and 0.3 kg respectively, are attached to the ends of a light inextensible string. The string passes over a fixed smooth pulley and the particles hang freely below it. The system is released from rest, with both particles 0.8 m above horizontal ground. Particle A reaches the ground with a speed of $0.6\,\text{m}\,\text{s}^{-1}$.

(i) Find the tension in the string during the motion before A reaches the ground. [4]

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(ii) Find the value of m. [2]

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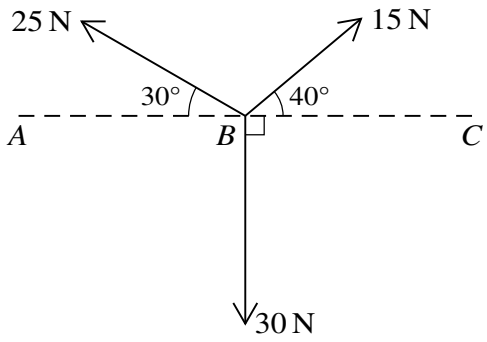

Coplanar forces, of magnitudes 15 N, 25 N and 30 N, act at a point B on the line ABC in the directions shown in the diagram.

(i) Find the magnitude and direction of the resultant force. [6]

(ii) The force of magnitude 15 N is now replaced by a force of magnitude F N acting in the same direction. The new resultant force has zero component in the direction BC. Find the value of F, and find also the magnitude and direction of the new resultant force. [3]

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6 A particle is projected from a point P with initial speed $u\,\text{m s}^{-1}$ up a line of greatest slope PQR of a rough inclined plane. The distances PQ and QR are both equal to 0.8 m. The particle takes 0.6 s to travel from P to Q and 1 s to travel from Q to R.

(i) Show that the deceleration of the particle is $\frac{2}{3}\,\text{m s}^{-2}$ and hence find u, giving your answer as an exact fraction. [6]

(ii) Given that the plane is inclined at 3° to the horizontal, find the value of the coefficient of friction between the particle and the plane. [4]

7 A particle moves in a straight line starting from rest from a point O. The acceleration of the particle at time t s after leaving O is a m s^{-2}, where

$$a = 5.4 - 1.62t.$$

(i) Find the positive value of t at which the velocity of the particle is zero, giving your answer as an exact fraction. [4]

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(ii) Find the velocity of the particle at $t = 10$ and sketch the velocity-time graph for the first ten seconds of the motion. [3]

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(iii) Find the total distance travelled during the first ten seconds of the motion. [5]

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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