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Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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2665635565

MATHEMATICS **9709/42**

Paper 4 Mechanics 1 **(M1)** **May/June 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 **13** printed pages and **3** blank pages.

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1 A man has mass 80 kg. He runs along a horizontal road against a constant resistance force of magnitude P N. The total work done by the man in increasing his speed from $4\,\text{m s}^{-1}$ to $5.5\,\text{m s}^{-1}$ while running a distance of 60 metres is 1200 J. Find the value of P. [4]

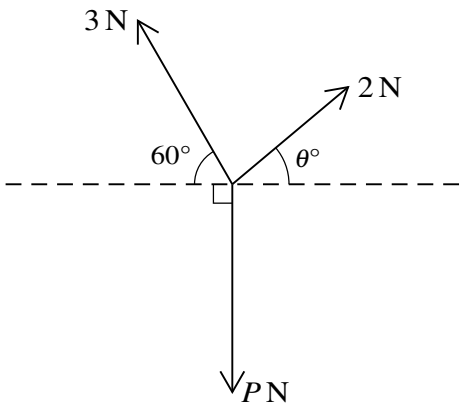
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2 A train of mass 240 000 kg travels up a slope inclined at an angle of 4° to the horizontal. There is a constant resistance of magnitude 18 000 N acting on the train. At an instant when the speed of the train is 15 m s^{-1} its deceleration is 0.2 m s^{-2}. Find the power of the engine of the train. [4]

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The three coplanar forces shown in the diagram have magnitudes 3 N, 2 N and P N. Given that the three forces are in equilibrium, find the values of θ and P. [4]

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4 A particle P moves in a straight line $ABCD$ with constant acceleration. The distances AB and BC are 100 m and 148 m respectively. The particle takes 4 s to travel from A to B and also takes 4 s to travel from B to C.

(i) Show that the acceleration of P is $3\,\text{m s}^{-2}$ and find the speed of P at A. [6]

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(ii) P reaches D with a speed of $61\ \text{m s}^{-1}$. Find the distance CD. [3]

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5 A particle of mass 20 kg is on a rough plane inclined at an angle of 60° to the horizontal. Equilibrium is maintained by a force of magnitude P N acting on the particle, in a direction parallel to a line of greatest slope of the plane. The greatest possible value of P is twice the least possible value of P. Find the value of the coefficient of friction between the particle and the plane. [7]

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6 A particle P moves in a straight line passing through a point O. At time t s, the acceleration, a m s^{-2}, of P is given by $a = 6 - 0.24t$. The particle comes to instantaneous rest at time $t = 20$.

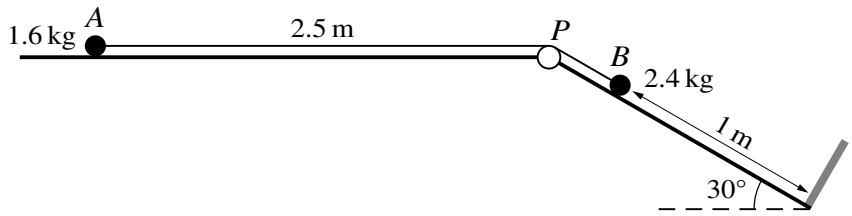
(i) Find the value of t at which the particle is again at instantaneous rest. [5]

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(ii) Find the distance the particle travels between the times of instantaneous rest. [3]

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7



As shown in the diagram, a particle A of mass 1.6 kg lies on a horizontal plane and a particle B of mass 2.4 kg lies on a plane inclined at an angle of 30° to the horizontal. The particles are connected by a light inextensible string which passes over a small smooth pulley P fixed at the top of the inclined plane. The distance AP is 2.5 m and the distance of B from the bottom of the inclined plane is 1 m. There is a barrier at the bottom of the inclined plane preventing any further motion of B. The part BP of the string is parallel to a line of greatest slope of the inclined plane. The particles are released from rest with both parts of the string taut.

(i) Given that both planes are smooth, find the acceleration of A and the tension in the string. [5]

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(ii) It is given instead that the horizontal plane is rough and that the coefficient of friction between A and the horizontal plane is 0.2. The inclined plane is smooth. Find the total distance travelled by A. [9]

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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