

CANDIDATE
NAME

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MATHEMATICS

9709/41

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 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 **11** printed pages and **1** blank page.



- 1 A particle of mass 0.6 kg is dropped from a height of 8 m above the ground. The speed of the particle at the instant before hitting the ground is 10 m s^{-1} . Find the work done against air resistance. [3]

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- 2 A particle of mass 0.8 kg is projected with a speed of 12 m s^{-1} up a line of greatest slope of a rough plane inclined at an angle of 10° to the horizontal. The coefficient of friction between the particle and the plane is 0.4 .

(i) Find the acceleration of the particle.

[4]

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(ii) Find the distance the particle moves up the plane before coming to rest.

[2]

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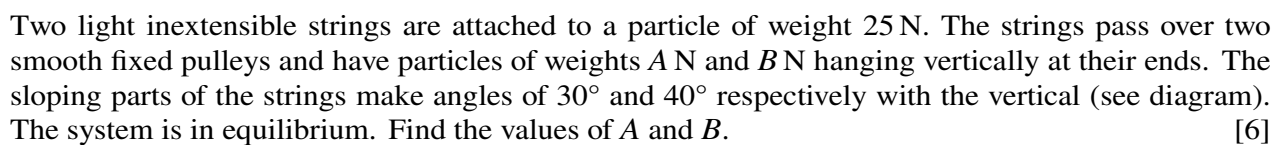
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[illegible]

- 4** A car of mass 800 kg is moving up a hill inclined at θ° to the horizontal, where $\sin \theta = 0.15$. The initial speed of the car is 8 m s^{-1} . Twelve seconds later the car has travelled 120 m up the hill and has speed 14 m s^{-1} .

(i) Find the change in the kinetic energy and the change in gravitational potential energy of the car. [3]

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(ii) The engine of the car is working at a constant rate of 32 kW. Find the total work done against the resistive forces during the twelve seconds. [3]

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- 5** A particle P moves in a straight line $ABCD$ with constant deceleration. The velocities of P at A , B and C are 20 m s^{-1} , 12 m s^{-1} and 6 m s^{-1} respectively.

(i) Find the ratio of distances $AB : BC$.

[4]

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- (ii) The particle comes to rest at D . Given that the distance AD is 80 m, find the distance BC . [3]

[illegible]

- 6** A particle P moves in a straight line passing through a point O . At time t s, the velocity of P , v m s⁻¹, is given by $v = qt + rt^2$, where q and r are constants. The particle has velocity 4 m s⁻¹ when $t = 1$ and when $t = 2$.

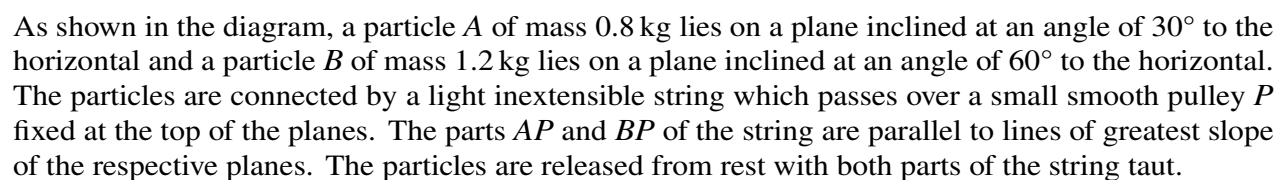
(i) Show that, when $t = 0.5$, the acceleration of P is 4 m s^{-2} . [4]

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(ii) Find the values of t when P is at instantaneous rest. [2]

[illegible]

[Turn over



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- This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- (ii)** It is given instead that both planes are rough, with the same coefficient of friction, μ , for both particles. Find the value of μ for which the system is in limiting equilibrium. [6]

[illegible]

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