

CANDIDATE
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MATHEMATICS

9709/42

Paper 4 Mechanics 1 **(M1)**

October/November 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 0.2 kg is resting in equilibrium on a rough plane inclined at 20° to the horizontal.
- (i)** Show that the friction force acting on the particle is 0.684 N, correct to 3 significant figures. [1]

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The coefficient of friction between the particle and the plane is 0.6. A force of magnitude 0.9 N is applied to the particle down a line of greatest slope of the plane. The particle accelerates down the plane.

- (ii)** Find this acceleration. [4]

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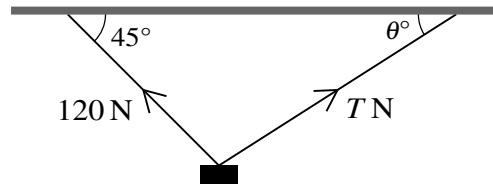
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A block of mass 15 kg hangs in equilibrium below a horizontal ceiling attached to two strings as shown in the diagram. One of the strings is inclined at 45° to the horizontal and the tension in this string is 120 N. The other string is inclined at θ° to the horizontal and the tension in this string is T N. Find the values of T and θ . [6]

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- 3** A car travels along a straight road with constant acceleration. It passes through points A , B and C . The car passes point A with velocity 14 m s^{-1} . The two sections AB and BC are of equal length. The times taken to travel along AB and BC are 5 s and 3 s respectively.

- (i) Write down an expression for the distance AB in terms of the acceleration of the car. Write down a similar expression for the distance AC . Hence show that the acceleration of the car is 4 m s^{-2} . [4]

[illegible]

- (ii) Find the speed of the car as it passes point C . [2]

- 4 A particle P is projected vertically upwards from horizontal ground with speed 12 m s^{-1} .

(i) Find the time taken for P to return to the ground. [2]

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The time in seconds after P is projected is denoted by t . When $t = 1$, a second particle Q is projected vertically upwards with speed 10 m s^{-1} from a point which is 5 m above the ground. Particles P and Q move in different vertical lines.

(ii) Find the set of values of t for which the two particles are moving in the same direction. [4]

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- 5 A cyclist is riding up a straight hill inclined at an angle α to the horizontal, where $\sin \alpha = 0.04$. The total mass of the bicycle and rider is 80 kg. The cyclist is riding at a constant speed of 4 m s^{-1} . There is a force resisting the motion. The work done by the cyclist against this resistance force over a distance of 25 m is 600 J.

(i) Find the power output of the cyclist.

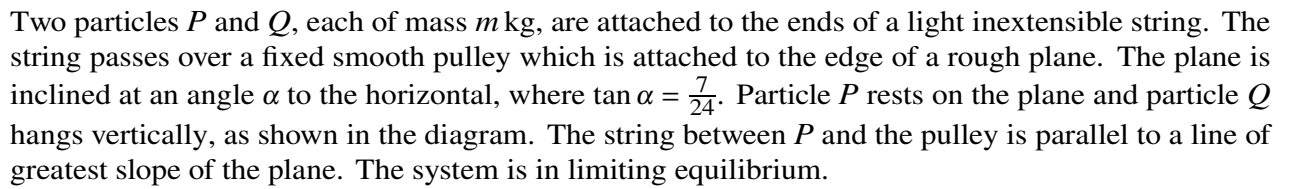
[4]

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The cyclist reaches the top of the hill, where the road becomes horizontal, with speed 4 m s^{-1} . The cyclist continues to work at the same rate on the horizontal part of the road.

- (ii) Find the speed of the cyclist 10 seconds after reaching the top of the hill, given that the work done by the cyclist during this period against the resistance force is 1200 J. [4]

[illegible]



- [illegible]

A force of magnitude 10 N is applied to P , acting up a line of greatest slope of the plane, and P accelerates at 2.5 m s^{-2} .

(ii) Find the value of m .

[5]

This image shows a blank sheet 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 paper.

- 7 A particle starts from rest and moves in a straight line. The velocity of the particle at time t s after the start is v m s⁻¹, where

$$v = -0.01t^3 + 0.22t^2 - 0.4t.$$

- (i) Find the two positive values of t for which the particle is instantaneously at rest. [2]

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- (ii) Find the time at which the acceleration of the particle is greatest. [3]

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