

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
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MATHEMATICS

9709/43

Paper 4 Mechanics

October/November 2023

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- Where a numerical value for the acceleration due to gravity (g) is needed, use 10 m s^{-2} .

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

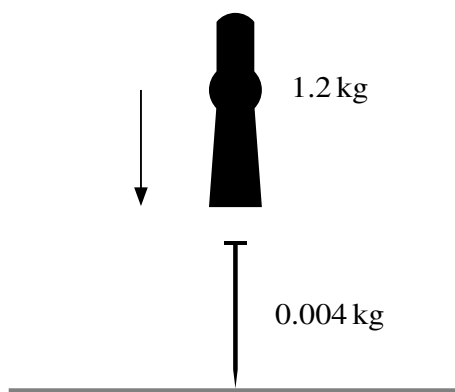
This document has **12** pages.

- 1 A particle is projected vertically upwards from horizontal ground with a speed of $u \text{ m s}^{-1}$. The particle has height $s \text{ m}$ above the ground at times 3 seconds and 4 seconds after projection.

Find the value of u and the value of s .

[3]

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A machine for driving a nail into a block of wood causes a hammerhead to drop vertically onto the top of a nail. The mass of the hammerhead is 1.2 kg and the mass of the nail is 0.004 kg (see diagram). The hammerhead hits the nail with speed $v \text{ m s}^{-1}$ and remains in contact with the nail after the impact. The combined hammerhead and nail move immediately after the impact with speed 40 m s^{-1} .

- (a) Calculate v , giving your answer as an exact fraction. [2]

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- (b) The nail is driven 4 cm into the wood.

Find the constant force resisting the motion. [3]

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- 3** A block of mass 8 kg slides down a rough plane inclined at 30° to the horizontal, starting from rest. The coefficient of friction between the block and the plane is μ . The block accelerates uniformly down the plane at 2.4 m s^{-2} .

(a) Draw a diagram showing the forces acting on the block. [1]

(b) Find the value of μ . [4]

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(c) Find the speed of the block after it has moved 3 m down the plane. [1]

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4 A car has mass 1600 kg.

- (a) The car is moving along a straight horizontal road at a constant speed of 24 m s^{-1} and is subject to a constant resistance of magnitude 480 N .

Find, in kW, the rate at which the engine of the car is working. [2]

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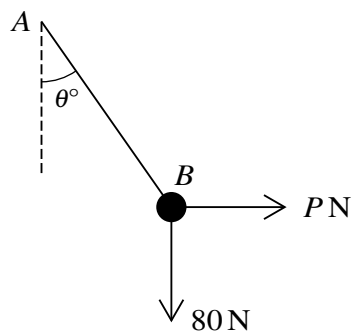
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The car now moves down a hill inclined at an angle of θ to the horizontal, where $\sin \theta = 0.09$. The engine of the car is working at a constant rate of 12 kW. The speed of the car is 24 m s^{-1} at the top of the hill. Ten seconds later the car has travelled 280 m down the hill and has speed 32 m s^{-1} .

- (b) Given that the resistance is not constant, use an energy method to find the total work done against the resistance during the ten seconds. [5]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the entire width of the page. There are no margins, text, or other markings present.



A light string AB is fixed at A and has a particle of weight 80 N attached at B . A horizontal force of magnitude $P\text{ N}$ is applied at B such that the string makes an angle θ° to the vertical (see diagram).

- (a) It is given that $P = 32$ and the system is in equilibrium.

Find the tension in the string and the value of θ .

[4]

[illegible]

- (b) It is given instead that the tension in the string is 120 N and that the particle attached at B still has weight 80 N.

Find the value of P and the value of θ .

[4]

[illegible]

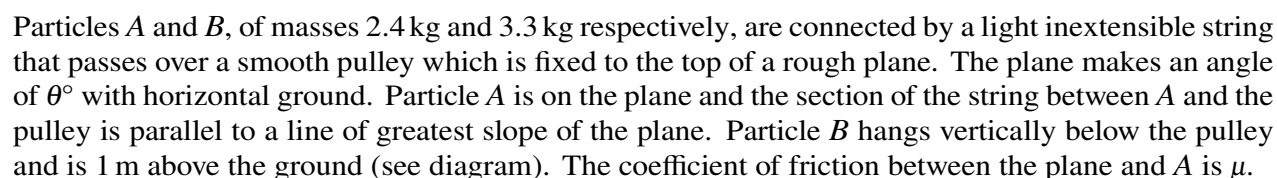
- 6** A particle moves in a straight line. At time t s, the acceleration, $a \text{ m s}^{-2}$, of the particle is given by $a = 36 - 6t$. The velocity of the particle is 27 m s^{-1} when $t = 2$.

(a) Find the values of t when the particle is at instantaneous rest. [4]

[illegible]

[4]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing 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.



- Show that $\mu = 1.01$ correct to 3 significant figures. [5]

[illegible]

[illegible]

[illegible]

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