



Cambridge International AS & A Level

CANDIDATE
NAME

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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} .

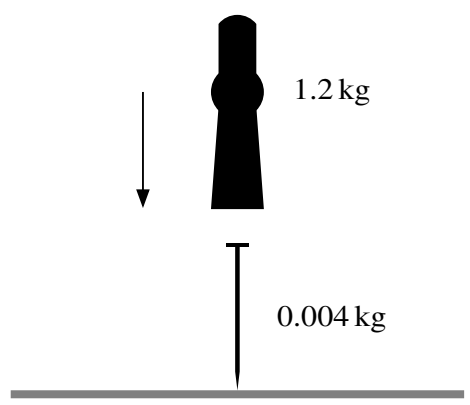
INFORMATION

- 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.

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3



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]

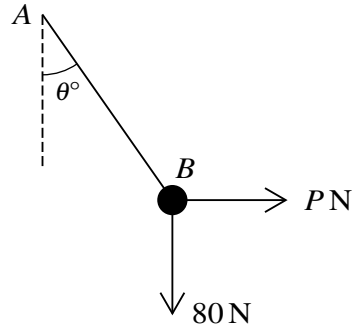
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The car now moves down a hill inclined at an angle of θ to the horizontal, where $\sin \theta = 0.09$. The engine of the car is working at a constant rate of 12 kW. The speed of the car is 24 m s^{-1} at the top of the hill. Ten seconds later the car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

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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]

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