

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
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MATHEMATICS

9709/42

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

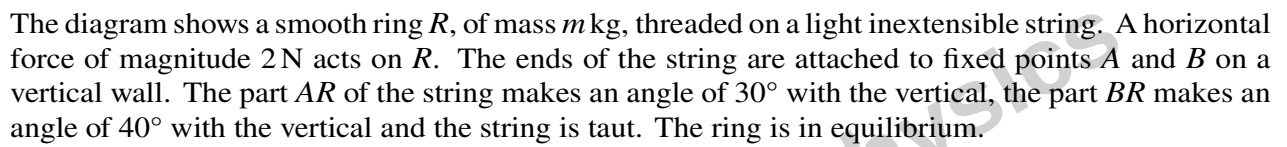
- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages.

[4]

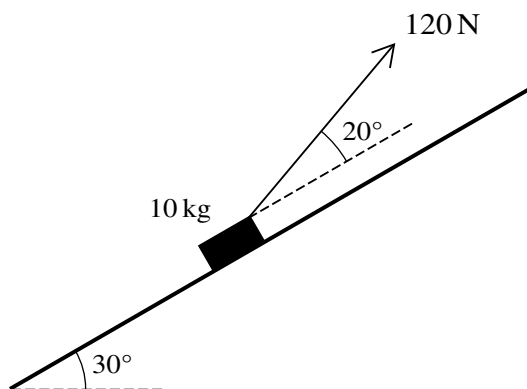
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[5]

This image shows a blank sheet of white paper designed for handwriting practice. It features multiple sets of horizontal lines. Each set consists of a solid top line, a dashed middle line, and a solid bottom line, providing a guide for letter height and placement. The lines are evenly spaced across the entire page. A large, light gray watermark is oriented diagonally from the top-left towards the center-right. The watermark contains the text "Kambridge Math" in a bold, sans-serif font, followed by the website address "kambridgemp.com" in a smaller, regular font below it.



A block of mass 10 kg is at rest on a rough plane inclined at an angle of 30° to the horizontal. A force of 120 N is applied to the block at an angle of 20° above a line of greatest slope (see diagram). There is a force resisting the motion of the block and 200 J of work is done against this force when the block has moved a distance of 5 m up the plane from rest.

Find the speed of the block when it has moved a distance of 5 m up the plane from rest. [5]

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- 4 A particle P of mass 0.2 kg lies at rest on a rough horizontal plane. A horizontal force of 1.2 N is applied to P .

- (a) Given that P is in limiting equilibrium, find the coefficient of friction between P and the plane. [3]

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- (b) Given instead that the coefficient of friction between P and the plane is 0.3 , find the distance travelled by P in the third second of its motion. [4]

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5 A particle A of mass 0.5 kg is projected vertically upwards from horizontal ground with speed 25 m s^{-1} .

(a) Find the speed of A when it reaches a height of 20 m above the ground. [2]

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When A reaches a height of 20 m , it collides with a particle B of mass 0.3 kg which is moving downwards in the same vertical line as A with speed 32.5 m s^{-1} . In the collision between the two particles, B is brought to instantaneous rest.

(b) Show that the velocity of A immediately after the collision is 4.5 m s^{-1} downwards. [2]

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- (a)** Find the acceleration of the engine and find the tension in the coupling. [5]

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- 7 A particle X travels in a straight line. The velocity of X at time t s after leaving a fixed point O is denoted by $v \text{ m s}^{-1}$, where

$$v = -0.1t^3 + 1.8t^2 - 6t + 5.6.$$

The acceleration of X is zero at $t = p$ and $t = q$, where $p < q$.

- (a) Find the value of p and the value of q . [4]

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It is given that the velocity of X is zero at $t = 14$.

- (b) Find the velocities of X at $t = p$ and at $t = q$, and hence sketch the velocity-time graph for the motion of X for $0 \leq t \leq 15$. [3]

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[5]

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