

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
NUMBER

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MATHEMATICS

9709/42

Paper 4 Mechanics

May/June 2022

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 **16** pages. Any blank pages are indicated.

- 1** Small smooth spheres A and B , of equal radii and of masses 5 kg and 3 kg respectively, lie on a smooth horizontal plane. Initially B is at rest and A is moving towards B with speed 8.5 m s^{-1} . The spheres collide and after the collision A continues to move in the same direction but with a quarter of the speed of B .

(a) Find the speed of B after the collision. [3]

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(b) Find the loss of kinetic energy of the system due to the collision. [2]

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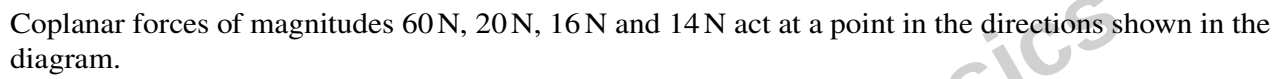
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[6]

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- (b) Find the greatest height of B above the plane.

[3]

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- (b) Find the values of t when the particles are the same distance from O . [3]

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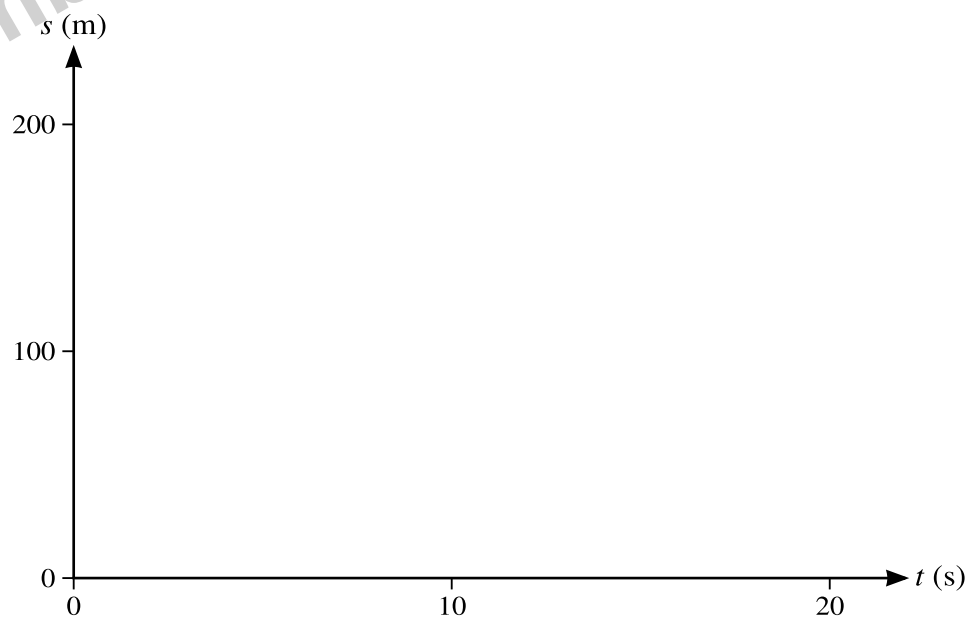
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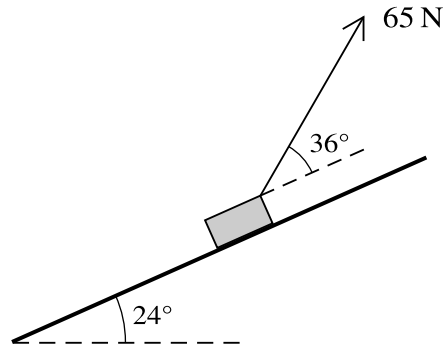
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- (c) On the given axes, sketch the displacement-time graphs for both particles, for values of t from 0 to 20. [3]





A block of mass 12 kg is placed on a plane which is inclined at an angle of 24° to the horizontal. A light string, making an angle of 36° above a line of greatest slope, is attached to the block. The tension in the string is 65 N (see diagram). The coefficient of friction between the block and plane is μ . The block is in limiting equilibrium and is on the point of sliding up the plane.

Find μ .

[6]

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- (a) Find the work done against the resistive forces during the 12 s. [5]

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[3]

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- 7** A particle P moves in a straight line. The velocity $v \text{ m s}^{-1}$ at time t seconds is given by

$$\begin{aligned} v &= 0.5t && \text{for } 0 \leq t \leq 10, \\ v &= 0.25t^2 - 8t + 60 && \text{for } 10 \leq t \leq 20. \end{aligned}$$

- (a) Show that there is an instantaneous change in the acceleration of the particle at $t = 10$. [3]

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