



# Cambridge International AS & A Level

CANDIDATE  
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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  $10 \text{ m s}^{-2}$ .

## 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  $8.5 \text{ m s}^{-1}$ . 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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**(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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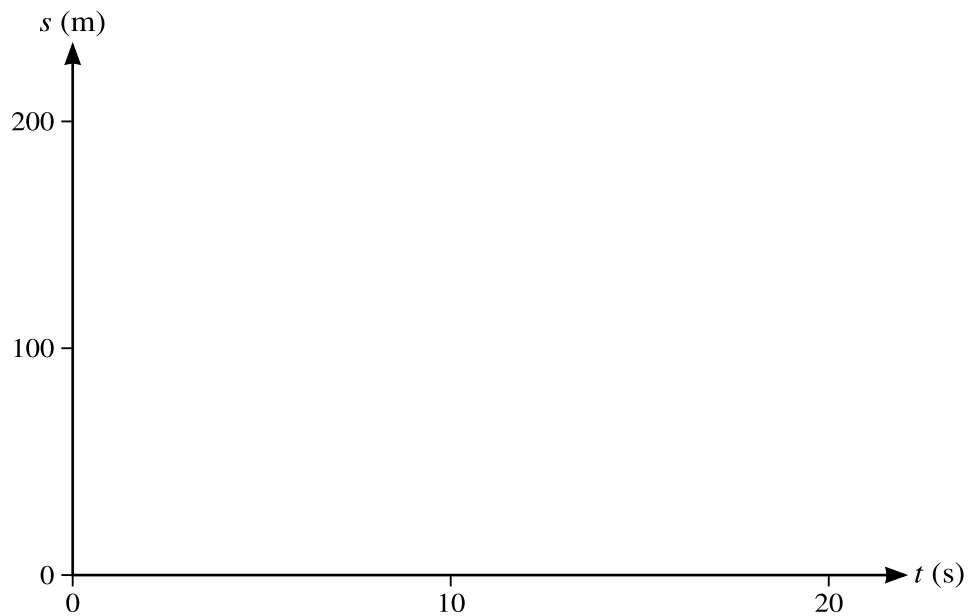
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(c) On the given axes, sketch the displacement-time graphs for both particles, for values of  $t$  from 0 to 20. [3]







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The car then travels along a straight horizontal road. There is a resistance to the motion of the car of  $(1520 + 4v)$  N when the speed of the car is  $v \text{ m s}^{-1}$ . The car travels at a constant speed with the engine working at a constant rate of 32 kW.

(b) Find this speed. [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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**(b)** Find the total distance covered by  $P$  in the interval  $0 \leq t \leq 20$ .

[6]

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**Additional Page**

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