



# Cambridge International AS & A Level

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**MATHEMATICS****9709/45**

Paper 4 Mechanics

**May/June 2025****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.





- Find the work done by the pulling force.

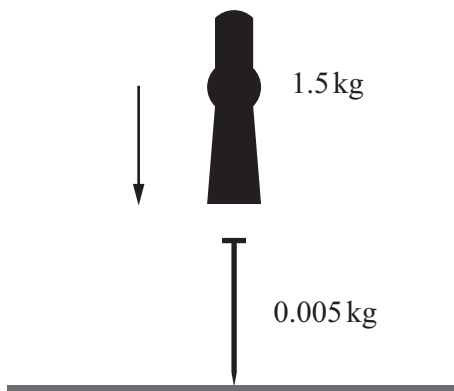
[4]

This image shows a full page of a document template. It consists of approximately 28 horizontal dotted lines spaced evenly down the page, providing a guide for handwriting practice or as a template for lined notes. The background is plain white, and there are no margins, text, or other markings present.



2

4



A machine for driving a nail into a block of wood causes a hammerhead to drop vertically onto the top of the nail. The mass of the hammerhead is 1.5 kg and the mass of the nail is 0.005 kg (see diagram). The hammerhead hits the nail with speed  $32 \text{ m s}^{-1}$  and remains in contact with the nail after the impact.

- (a) Calculate the speed with which the combined hammerhead and nail move immediately after the impact. Give your answer correct to 3 decimal places. [2]

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There is a constant force resisting the motion of magnitude 25 000 N.

- (b) Calculate the distance the nail is driven into the wood. [3]

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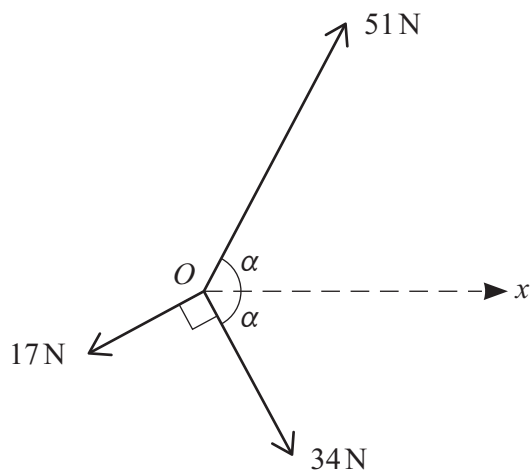
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- Find the value of  $T$  and hence find the distance moved by the train while travelling at the constant speed of  $30 \text{ ms}^{-1}$ . [5]

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Coplanar forces of magnitudes 17 N, 51 N and 34 N act at a point  $O$  in the directions shown in the diagram, where  $\tan \alpha = \frac{15}{8}$ .

- (a) Find the magnitude and direction of the resultant of the three forces. [6]

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The force of magnitude 51 N is replaced by a force of magnitude  $P$  N acting in the same direction. The resultant of the three forces now acts in the positive  $x$ -direction.

[illegible]

- (a) It is given that there is a constant resistance to motion. The engine of the car is working at 24 kW while the car is travelling at a constant speed of  $32 \text{ m s}^{-1}$ . The power is now increased to 28 kW.

Find the acceleration of the car at the instant it is travelling at a speed of  $36 \text{ ms}^{-1}$ . [4]

[illegible]



- When the engine is working at 20 kW, the car is travelling at constant speed.

Find this constant speed.

[3]

[illegible]



- 6 A particle  $P$  moves in a straight line starting from a point  $O$ . At time  $t$  s after leaving  $O$ , the velocity,  $v \text{ m s}^{-1}$ , of  $P$  is given by  $v = (15 - 2t)^2$ .

(a) Find the values of  $t$  when the velocity of  $P$  is  $100 \text{ m s}^{-1}$ . [2]

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(b) Show that there is a particular value of  $t$  for which the velocity and acceleration of the particle are both zero. [3]

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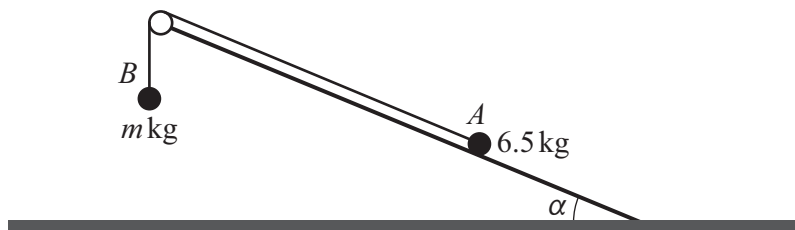
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[illegible]



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- Use an energy method to find the speed of the particles when each particle has moved 0.6 m. You may assume that this occurs before  $A$  reaches the pulley or  $B$  reaches the ground. [5]

[illegible]

This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.





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