



Cambridge International AS & A Level

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FURTHER MATHEMATICS

9231/33

Paper 3 Further Mechanics

May/June 2025

1 hour 30 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.



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- Given that $\tan \theta = \frac{4}{3}$, find ω in terms of a and g . [3]

This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dotted 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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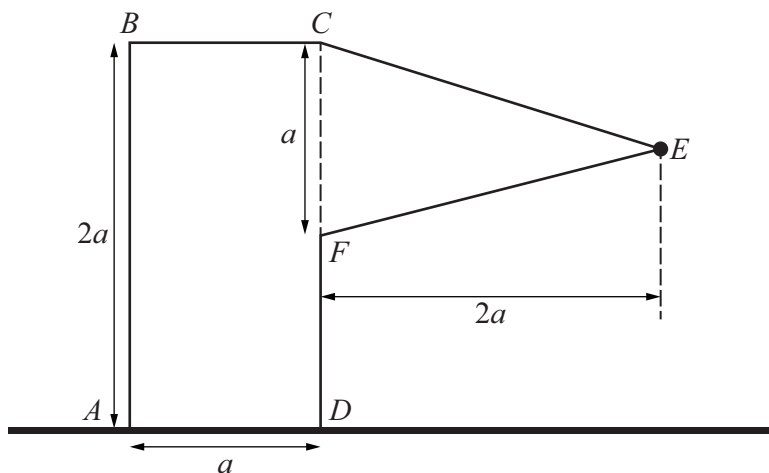
- (a) Show that the distance travelled by the ball when it is moving upwards is $x = \frac{1}{2k} \ln \left(\frac{g + kU^2}{g + kv^2} \right)$. [4]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.



- [4]

[illegible]

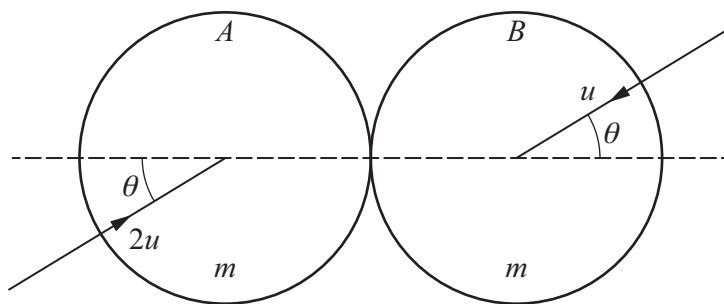


Given that the object is on the point of toppling in its vertical plane about the vertex D , find the value of k . [4]

This image shows a full page of white paper with horizontal dashed lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

[illegible]

6



Two identical uniform smooth spheres A and B , each with mass m , are moving on a horizontal surface with speeds $2u$ and u respectively when they collide. Immediately before the collision, the spheres are moving parallel to each other in opposite directions such that their directions of motion each make an angle θ with the line of centres (see diagram). As a result of the collision, B moves in a direction which is perpendicular to its initial direction of motion. The coefficient of restitution between the spheres is e .

- (a) Find an expression for $\tan \theta$ in terms of e . [6]

[illegible]



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As a result of the collision, A moves in a direction which is perpendicular to the line of centres.

(b) Find the value of θ . [2]

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At time T , the particle strikes a smooth horizontal plane at a point which is a horizontal distance D from O and a vertical distance H below O .

- (c) Find the ratio $H : D$. [4]

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After striking the horizontal plane, P rebounds with speed w . The coefficient of restitution between P and the plane is $\frac{2}{3}$.

- (d) Find w in terms of U . [3]

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This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three 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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