



Cambridge International AS & A Level

CANDIDATE
NAME
CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

FURTHER MATHEMATICS

9231/33

Paper 3 Further Mechanics

October/November 2024

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 ms^{-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 T in terms of m and g .

[illegible]

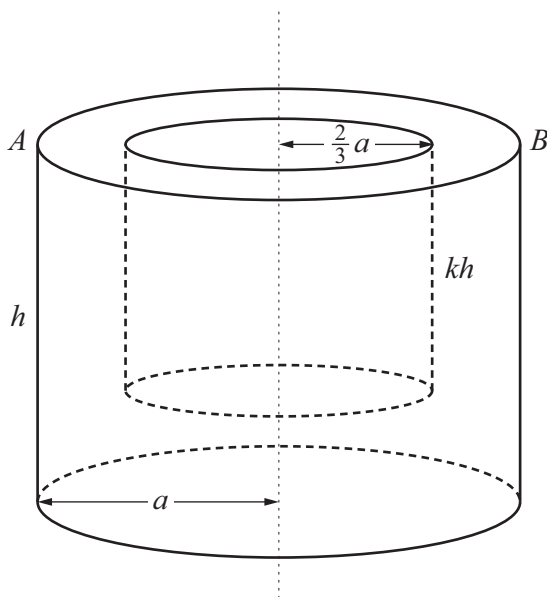
- (a)** Given that the particle just reaches O in the subsequent motion, find the value of d . [6]

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.



[2]

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



An object is formed by removing a cylinder of radius $\frac{2}{3}a$ and height kh ($k < 1$) from a uniform solid cylinder of radius a and height h . The vertical axes of symmetry of the two cylinders coincide. The upper faces of the two cylinders are in the same plane as each other. The points A and B are the opposite ends of a diameter of the upper face of the object (see diagram).

- (a) Find, in terms of h and k , the distance of the centre of mass of the object from AB . [4]

[illegible]

[illegible]

- DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

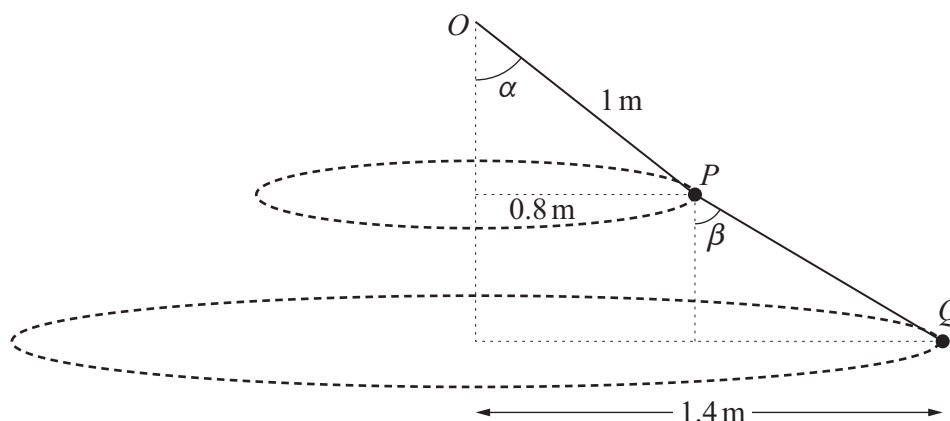
DO NOT WRITE IN THIS MARGIN

- DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

[3]

[illegible]



A particle P of mass 0.05 kg is attached to one end of a light inextensible string of length 1 m . The other end of the string is attached to a fixed point O . A particle Q of mass 0.04 kg is attached to one end of a second light inextensible string. The other end of this string is attached to P .

The particle P moves in a horizontal circle of radius 0.8 m with angular speed $\omega\text{ rad s}^{-1}$. The particle Q moves in a horizontal circle of radius 1.4 m also with angular speed $\omega\text{ rad s}^{-1}$. The centres of the circles are vertically below O , and O , P and Q are always in the same vertical plane. The strings OP and PQ remain at constant angles α and β respectively to the vertical (see diagram).

- (a) Find the tension in the string OP .

[3]

[illegible]



(b) Find the value of ω .

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) Find the value of β .

[2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





[6]

[illegible]

If you use the following page to complete the answer to any question, the question number must be clearly shown.

[illegible]



DO NOT WRITE IN THIS MARGIN





BLANK PAGE

DO NOT WRITE IN THIS MARGIN

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.



DO NOT WRITE IN THIS MARGIN