



Cambridge International AS & A Level

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FURTHER MATHEMATICS

9231/31

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 . [5]

[illegible]

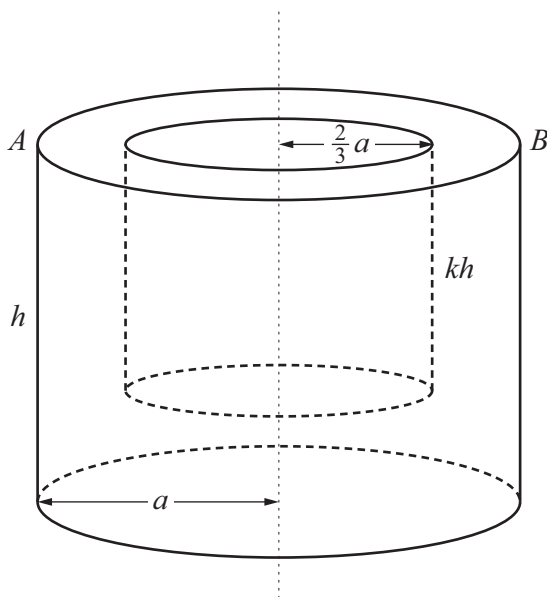
- (a)** Given that the particle just reaches O in the subsequent motion, find the value of d . [6]

[illegible]



[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]

This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page, typical of notebook or legal stationery. There are no margins, text, or other markings on the page.

[illegible]



5 A particle P of mass 2 kg moving on a horizontal straight line has displacement $x\text{ m}$ from a fixed point O on the line and velocity $v\text{ m s}^{-1}$ at time $t\text{ s}$. The only horizontal force acting on P is a variable force $F\text{ N}$ which can be expressed as a function of t . It is given that

$$\frac{v}{x} = \frac{3-t}{1+t}$$

and when $t = 0, x = 5$.

- (a) Find an expression for x in terms of t .

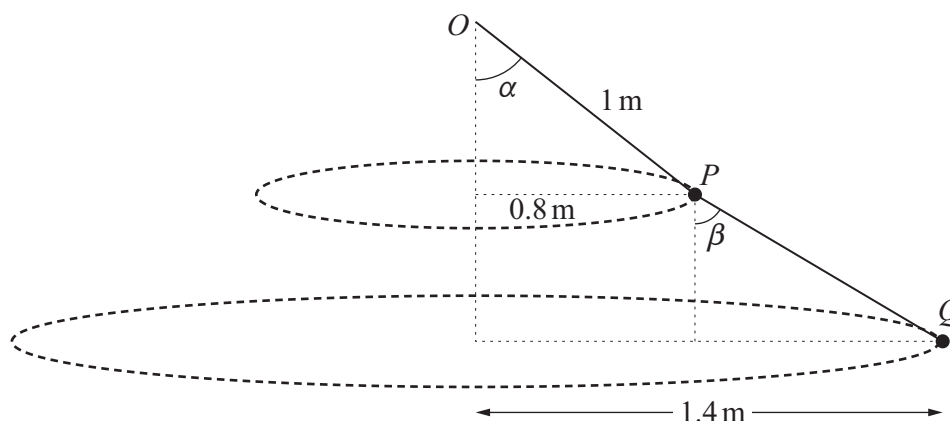
[4]

[illegible]



[3]

This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing 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.



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]

This image shows a blank sheet 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 paper.



(b) Find the value of ω .

[3]

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(c) Find the value of β .

[2]

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[6]

[illegible]

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

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