

Cambridge International AS & A Level

CANDIDATE
NAME

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MATHEMATICS

9709/42

Paper 4 Mechanics

October/November 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 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 **12** pages.

- 1** A cyclist is riding a bicycle along a straight horizontal road AB of length 50 m. The cyclist starts from rest at A and reaches a speed of 6 ms^{-1} at B . The cyclist produces a constant driving force of magnitude 100 N. There is a resistance force, and the work done against the resistance force from A to B is 3560 J.

Find the total mass of the cyclist and bicycle.

[3]

[illegible]

2 A particle P of mass 0.4 kg is in limiting equilibrium on a plane inclined at 30° to the horizontal.

(a) Show that the coefficient of friction between the particle and the plane is $\frac{1}{3}\sqrt{3}$. [3]

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A force of magnitude 7.2 N is now applied to P directly up a line of greatest slope of the plane.

(b) Given that P starts from rest, find the time that it takes for P to move 1 m up the plane. [4]

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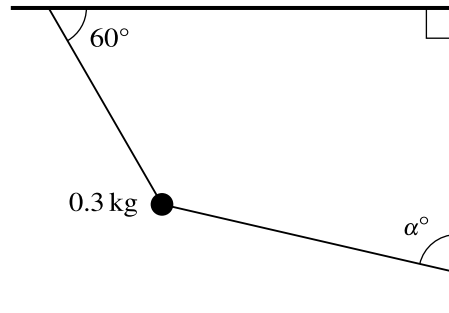
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A particle of mass 0.3 kg is held at rest by two light inextensible strings. One string is attached at an angle of 60° to a horizontal ceiling. The other string is attached at an angle α° to a vertical wall (see diagram). The tension in the string attached to the ceiling is 4 N .

Find the tension in the string which is attached to the wall and find the value of α . [6]

This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook 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.

- 4** A car of mass 1200 kg is travelling along a straight horizontal road AB . There is a constant resistance force of magnitude 500 N. When the car passes point A , it has a speed of 15 m s^{-1} and an acceleration of 0.8 m s^{-2} .

(a) Find the power of the car's engine at the point A . [3]

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The car continues to work with this power as it travels from A to B . The car takes 53 seconds to travel from A to B and the speed of the car at B is 32 m s^{-1} .

(b) Show that the distance AB is 1362.6 m. [3]

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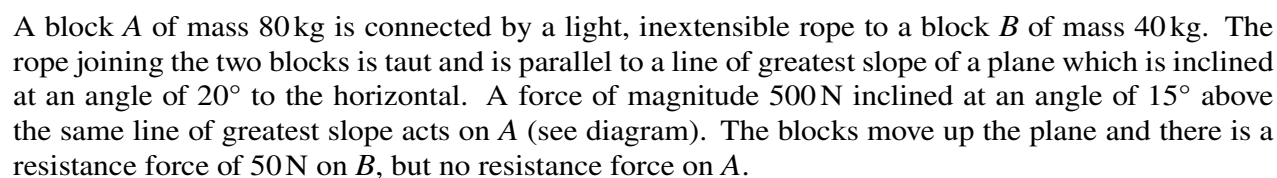
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- [illegible]

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- (b) Find the time that it takes for the blocks to reach a speed of 1.2 m s^{-1} from rest. [2]

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- (a)** Show that the speed of B after the collision is 1.05 m s^{-1} . [2]

(b) Find m . [2]

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- (c) Find the time that it takes, from the instant when B and C collide, until A collides with the combined particle. [5]

This image shows a full page of primary-ruled paper. It features approximately 20 horizontal dotted lines spaced evenly down the page, providing a guide for handwriting practice. The paper is otherwise blank, with no margins, text, or other markings.

- 7** A particle P travels in a straight line, starting at rest from a point O . The acceleration of P at time t s after leaving O is denoted by $a \text{ m s}^{-2}$, where

$$\begin{aligned} a &= 0.3t^{\frac{1}{2}} && \text{for } 0 \leq t \leq 4, \\ a &= -kt^{-\frac{3}{2}} && \text{for } 4 < t \leq T, \end{aligned}$$

where k and T are constants.

- (a) Find the velocity of P at $t = 4$. [2]

[illegible]

- (b)** It is given that there is no change in the velocity of P at $t = 4$ and that the velocity of P at $t = 16$ is 0.3 m s^{-1} .

Show that $k = 2.6$ and find an expression, in terms of t , for the velocity of P for $4 \leq t \leq T$. [4]

[illegible]

[illegible]

(d) Find the total distance travelled between $t = 0$ and $t = T$. [4]

[illegible]

[illegible]

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