



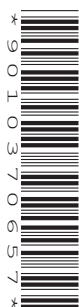
Cambridge International AS & A Level

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**MATHEMATICS****9709/43**

Paper 4 Mechanics

May/June 2024**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 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 **12** pages.



- 1 Two particles P and Q of masses 0.2 kg and 0.5 kg respectively are at rest on a smooth horizontal plane. Particle P is projected with a speed 6 m s^{-1} directly towards Q . After P and Q collide, P moves with a speed of 1 m s^{-1} .

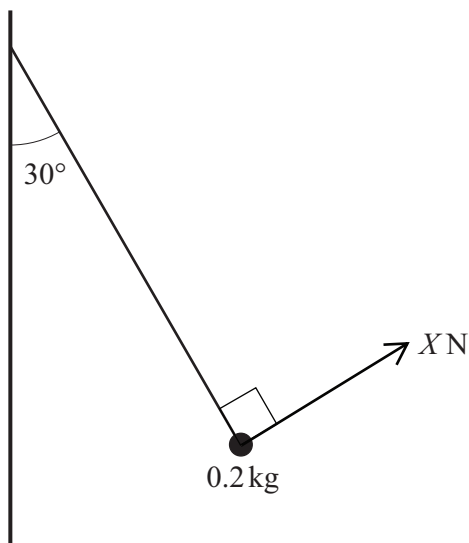
Find the two possible speeds of Q after the collision.

[3]

[illegible]



2



A particle of mass 0.2 kg is attached to one end of a light inextensible string. The other end of the string is attached to a fixed point on a vertical wall. The particle is held in equilibrium by a force of magnitude $X\text{ N}$, perpendicular to the string, with the string taut and making an angle of 30° with the wall (see diagram).

Find the tension in the string and the value of X .

[3]

[illegible]



3 A car travels along a straight road with constant acceleration $a \text{ ms}^{-2}$, where $a > 0$. The car passes through points A , B and C in that order. The speed of the car at A is $u \text{ ms}^{-1}$ in the direction AB . The distance BC is twice the distance AB . The car takes 8 seconds to travel from A to B and 10 seconds to travel from B to C .

(a) Find u in terms of a .

[4]

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

(b) Find the speed of the car at C in terms of a .

[2]

This image shows a single sheet of white paper with ten horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and extend across the width of the page. There is no text or other markings on the paper.



- 4 A particle travels in a straight line. The velocity of the particle at time t s after leaving a point O is v m s⁻¹, where

$$v = kt^2 - 4t + 3.$$

The distance travelled by the particle in the first 2 s of its motion is 6 m. You may assume that $v > 0$ in the first 2 s of its motion.

- (a) Find the value of k . [4]

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- (b) Find the value of the minimum velocity of the particle. You do **not** need to show that this velocity is a minimum. [3]

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- Find the acceleration of the trailer and the driving force of the van's engine. [4]

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(b) (i) Find the acceleration of the van and the tension in the tow-bar. [5]

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.

(ii) Find the speed of the van when it has travelled a distance of 375 m up the hill. [2]

[illegible]



- 6 A cyclist is travelling along a straight horizontal road. The total mass of the cyclist and her bicycle is 80 kg. There is a constant resistance force of magnitude 32 N to the cyclist's motion. At an instant when she is travelling at 7 m s^{-1} , her acceleration is 0.1 m s^{-2} .

(a) Find the power output of the cyclist. [3]

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(b) Find the steady speed that the cyclist can maintain if her power output and the resistance force are both unchanged. [2]

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(c) Given that the speed of the cyclist at the top of the hill is 7.5 m s^{-1} , find her speed at the bottom of the hill. [6]

This image shows a full page of primary-ruled paper. It features multiple sets of horizontal dashed lines spaced evenly down the page, providing a guide for handwriting practice. The lines are thin and light gray, set against a plain white background. There are no margins, text, or other markings on the page.



7



The diagram shows a track $ABCD$ which lies in a vertical plane. The section AB is a straight line inclined at an angle of 30° to the horizontal and is smooth. The section BC is a horizontal straight line and is rough. The section CD is a straight line inclined at an angle of 30° to the horizontal and is rough. The lengths AB , BC and CD are each 2 m.

A particle is released from rest at A . The coefficient of friction between the particle and both BC and CD is μ . There is no change in the speed of the particle when it passes through either of the points B or C .

- (a)** It is given that $\mu = 0.1$.

Find the distance which the particle has moved up the section CD when its speed is 1 m s^{-1} . [5]

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- 5

[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.

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

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