

Cambridge International AS & A Level

CANDIDATE
NAME

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MATHEMATICS

9709/41

Paper 4 Mechanics

May/June 2020

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

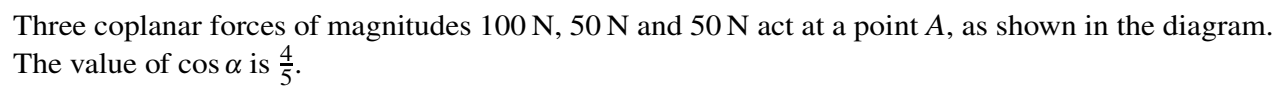
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction 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 **16** pages. Blank pages are indicated.

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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, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, which is otherwise blank white space.

- 2** A car of mass 1800 kg is towing a trailer of mass 400 kg along a straight horizontal road. The car and trailer are connected by a light rigid tow-bar. The car is accelerating at 1.5 m s^{-2} . There are constant resistance forces of 250 N on the car and 100 N on the trailer.

(a) Find the tension in the tow-bar.

[2]

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(b) Find the power of the engine of the car at the instant when the speed is 20 m s^{-1} .

[3]

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- 3 A particle P is projected vertically upwards with speed 5 m s^{-1} from a point A which is 2.8 m above horizontal ground.

(a) Find the greatest height above the ground reached by P . [3]

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(b) Find the length of time for which P is at a height of more than 3.6 m above the ground. [4]

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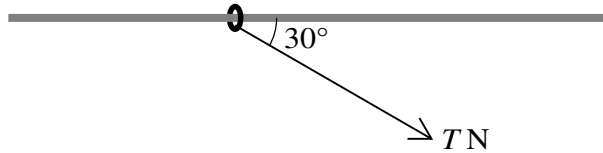
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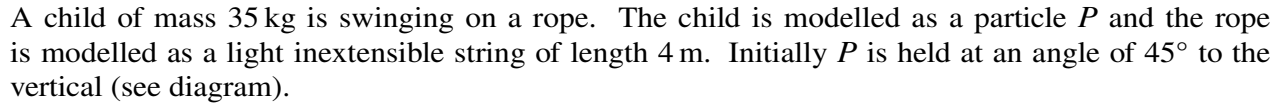


The diagram shows a ring of mass 0.1 kg threaded on a fixed horizontal rod. The rod is rough and the coefficient of friction between the ring and the rod is 0.8 . A force of magnitude $T\text{ N}$ acts on the ring in a direction at 30° to the rod, downwards in the vertical plane containing the rod. Initially the ring is at rest.

- (a) Find the greatest value of T for which the ring remains at rest. [4]

[illegible]

This image shows a full page of white paper with horizontal dashed 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.



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

[3]

[illegible]

- 6** A particle moves in a straight line AB . The velocity $v \text{ m s}^{-1}$ of the particle $t \text{ s}$ after leaving A is given by $v = k(t^2 - 10t + 21)$, where k is a constant. The displacement of the particle from A , in the direction towards B , is 2.85 m when $t = 3$ and is 2.4 m when $t = 6$.
- (a) Find the value of k . Hence find an expression, in terms of t , for the displacement of the particle from A . [7]

[illegible]

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- (b) Find the displacement of the particle from A when its velocity is a minimum. [4]

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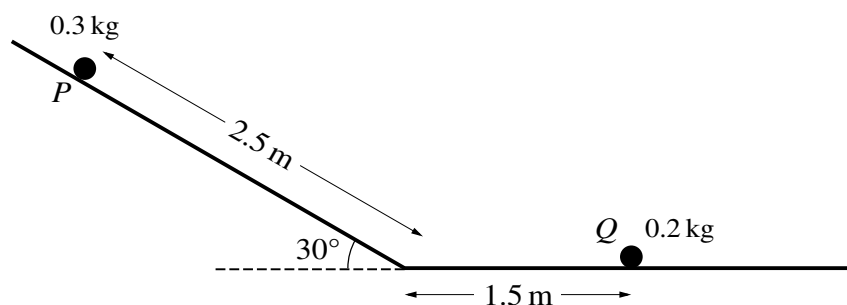
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A particle P of mass 0.3 kg , lying on a smooth plane inclined at 30° to the horizontal, is released from rest. P slides down the plane for a distance of 2.5 m and then reaches a horizontal plane. There is no change in speed when P reaches the horizontal plane. A particle Q of mass 0.2 kg lies at rest on the horizontal plane 1.5 m from the end of the inclined plane (see diagram). P collides directly with Q .

- (a) It is given that the horizontal plane is smooth and that, after the collision, P continues moving in the same direction, with speed 2 m s^{-1} .

Find the speed of Q after the collision.

[5]

[illegible]

- (b)** It is given instead that the horizontal plane is rough and that when P and Q collide, they coalesce and move with speed 1.2 m s^{-1} .

Find the coefficient of friction between P and the horizontal plane. [5]

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[illegible]

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