

Cambridge International AS & A Level

CANDIDATE
NAME

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CENTRE
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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

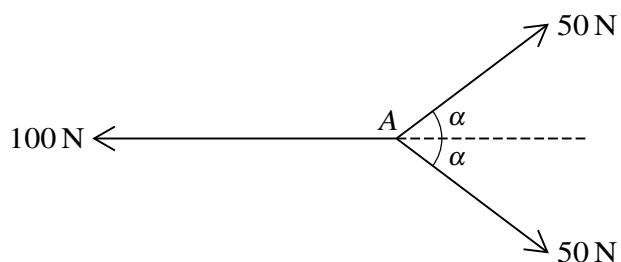
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction 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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Three coplanar forces of magnitudes 100 N, 50 N and 50 N act at a point A, as shown in the diagram. The value of $\cos \alpha$ is $\frac{4}{5}$.

Find the magnitude of the resultant of the three forces and state its direction. [3]

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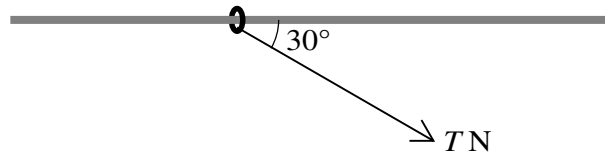
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The diagram shows a ring of mass 0.1 kg threaded on a fixed horizontal rod. The rod is rough and the coefficient of friction between the ring and the rod is 0.8 . A force of magnitude $T\text{ N}$ acts on the ring in a direction at 30° to the rod,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

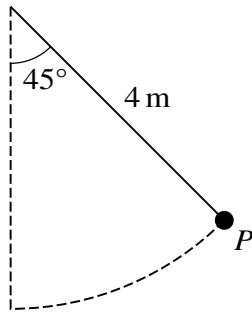
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[3]

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A child of mass 35 kg is swinging on a rope. The child is modelled as a particle P and the rope is modelled as a light inextensible string of length 4 m. Initially P is held at an angle of 45° to the vertical (see diagram).

- (a) Given that there is no resistance force, find the speed of P when it has travelled half way along the circular arc from its initial position to its lowest point. [4]

the circular arc from its initial position to its lowest point.

[4]

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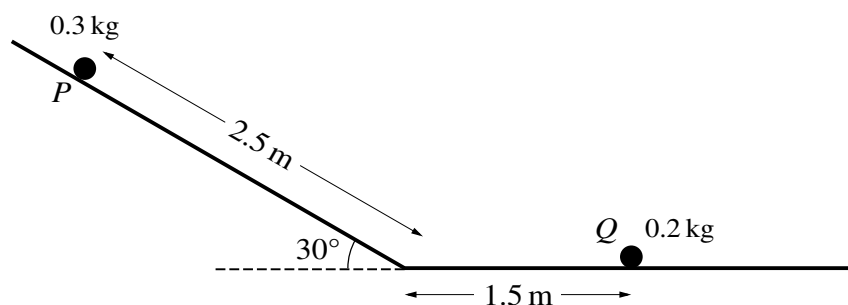
[3]

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



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]

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