



Cambridge International AS & A Level

CANDIDATE
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MATHEMATICS

9709/41

Paper 4 Mechanics

May/June 2023

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. Any blank pages are indicated.



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- 1 Two particles P and Q , of masses m kg and 0.3 kg respectively, are at rest on a smooth horizontal plane. P is projected at a speed of 5 m s^{-1} directly towards Q . After P and Q collide, P moves with a speed of 2 m s^{-1} in the same direction as it was originally moving.

- (a) Find, in terms of m , the speed of Q after the collision. [2]

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After this collision, Q moves directly towards a third particle R , of mass 0.6 kg, which is at rest on the plane. Q is brought to rest in the collision with R , and R begins to move with a speed of 1.5 m s^{-1} .

- (b) Find the value of m . [2]

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2 A particle P of mass 0.4 kg is projected vertically upwards from horizontal ground with speed 10 m s^{-1} .

(a) Find the greatest height above the ground reached by P . [2]

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When P reaches the ground again, it bounces vertically upwards. At the first instant that it hits the ground, P loses 7.2 J of energy.

(b) Find the time between the first and second instants at which P hits the ground. [4]

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- (b) Given that $T = 12$, find the minimum velocity of the particle. [2]

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- (c) Given instead that the greatest speed of the particle is 3 m s^{-1} , find the value of T and hence find the average speed of the particle for the whole of the motion. [4]

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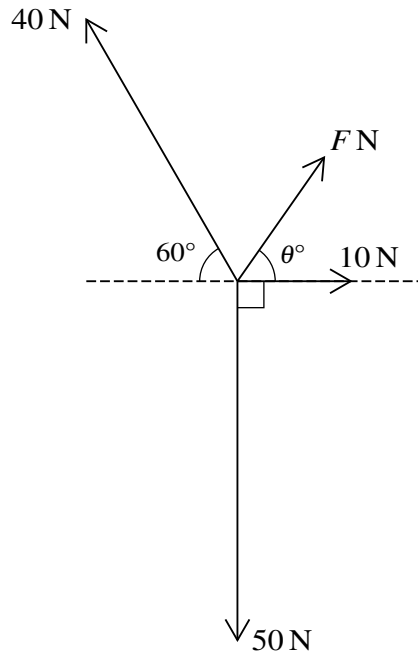
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Four coplanar forces act at a point. The magnitudes of the forces are F N, 10 N, 50 N and 40 N. The directions of the forces are as shown in the diagram.

(a) Given that the forces are in equilibrium, find the value of F and the value of θ . [6]

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- (b) Given instead that $F = 10\sqrt{2}$ and $\theta = 45$, find the direction and the exact magnitude the resultant force. [3]

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12

7 A car of mass 1200 kg is travelling along a straight horizontal road. The power of the car's engine is constant and is equal to 16 kW. There is a constant resistance to motion of magnitude 500 N.

(a) Find the acceleration of the car at an instant when its speed is 20 m s^{-1} . [3]

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(b) Assuming that the power and the resistance forces remain unchanged, find the steady speed at which the car can travel. [2]

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