



Cambridge International AS & A Level

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MATHEMATICS

9709/42

Paper 4 Mechanics

February/March 2026

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. Do **not** use correction fluid or tape.
- 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 block of mass 200 kg is pulled along rough horizontal ground at a constant speed of $v \text{ m s}^{-1}$ by a horizontal rope attached to a winch. The coefficient of friction between the block and the ground is 0.8. The winch is working at a constant rate of 4000 W.

Find the value of v .

[4]

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- 2 A cyclist starts from rest and moves in a straight line with acceleration 0.5 m s^{-2} for 10 s. They then accelerate at 1.5 m s^{-2} for a distance of 13 m, reaching a speed of $v \text{ m s}^{-1}$. They then travel at speed $v \text{ m s}^{-1}$ for 5 s. They then travel a distance of 28 m whilst decelerating uniformly to rest.

(a) Find the value of v .

[3]

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(b) (i) Find the total distance travelled by the cyclist.

[2]

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(ii) Find the average speed of the cyclist for the whole of their motion.

[2]

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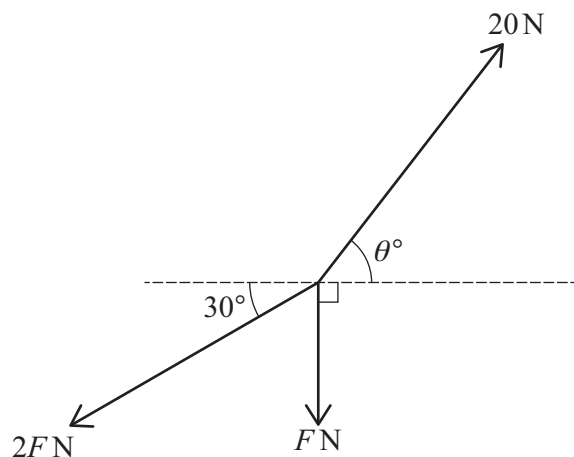
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Coplanar forces of magnitudes FN , $2FN$ and 20 N act at a point, as shown in the diagram.

Given that the forces are in equilibrium, find the value of F and the value of θ .

[6]

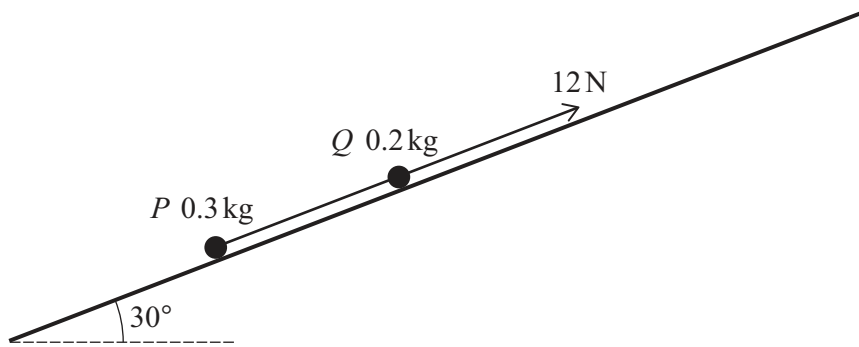
[illegible]



- 4 A car of mass 1600 kg passes through points A and B with speeds 10 m s^{-1} and 12 m s^{-1} respectively. The distance AB is 2 km. The heights of A and B above sea level are 250 m and 200 m respectively. The car's engine does no work in moving from A to B . There are two forces resisting the motion of the car, a braking force and an additional constant force of magnitude 150 N.

Use an energy method to find the work done by the braking force as the car moves from A to B . [5]

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A particle P of mass 0.3 kg is connected by a light inextensible string to a particle Q of mass 0.2 kg . The string joining the two particles is taut and is parallel to a line of greatest slope of a rough plane which is inclined at an angle of 30° to the horizontal. A constant force of magnitude 12 N acts on Q and pulls the particles up the plane. The 12 N force acts parallel to a line of greatest slope of the plane (see diagram). The coefficient of friction between each of the particles and the plane is 0.4 .

- (a) Find the magnitude of the acceleration of the particles and the tension in the string. [6]

[illegible]



(b) At the instant when the speed of the particles is 2 m s^{-1} , the string breaks.

Find the time it takes from the instant the string breaks until P comes to instantaneous rest. [3]





- 6 Two particles P and Q of masses $4m$ kg and $3m$ kg respectively are at rest on smooth horizontal ground. P is projected directly towards Q with speed 6.5 m s^{-1} . After the particles collide, they move in the same direction and the speeds of P and Q are 2 m s^{-1} and $v \text{ m s}^{-1}$ respectively.

(a) (i) Show that $v = 6$.

[2]

[illegible]

(ii) Given that the energy lost in the collision between P and Q is 45 J, find the value of m .

[2]

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After Q has moved a distance of 9 m from the point at which P and Q first collided, it hits a vertical wall perpendicular to the direction of motion of Q and rebounds. The speed of Q after hitting the wall is 0.5 m s^{-1} .

- (b) Find the distance from the wall to the point at which the second collision between P and Q occurs.

[5]

[illegible]



7 A particle P travels in a straight line. The velocity of P at time t s is v m s⁻¹, where

$$v = t - 7t^{\frac{1}{2}} + 12.$$

- (a) Find the acceleration of P at $t = 4$.

[2]

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- (b)** Find the values of t at which P is instantaneously at rest.

[3]

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(c) Find the total distance travelled by P in the interval $0 \leq t \leq 25$.

[5]

[illegible]

[illegible]

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