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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

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MATHEMATICS **9709/41**

Paper 4 Mechanics **October/November 2025**

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 $10\,\text{m}\,\text{s}^{-2}$.

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.

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1 A car of mass 900 kg is moving along a straight horizontal road against a constant resistance to motion of 350 N. At an instant when the car is moving at $15\,\text{m}\,\text{s}^{-1}$ its acceleration is $0.25\,\text{m}\,\text{s}^{-2}$.

(a) Find the driving force of the car's engine at this instant. [2]

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(b) Find the power of the car's engine at this instant. [2]

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2 Two particles, P and Q, of masses 3 kg and 5 kg respectively, are at rest on a smooth horizontal plane. P is projected at a speed of $4\,\text{m s}^{-1}$ directly towards Q. After P and Q collide, P has speed $1\,\text{m s}^{-1}$.

(a) Find the two possible speeds of Q after the collision. [3]

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It is given that λ J of kinetic energy, where $\lambda > 0$, is lost during the collision.

(b) Find the value of λ. [2]

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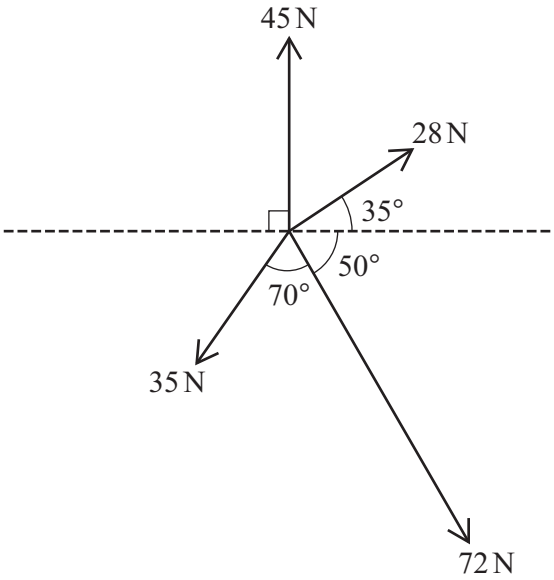
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Coplanar forces of magnitudes 45 N, 28 N, 72 N and 35 N act at a point in the directions shown in the diagram.

Find, in either order, the magnitude and direction of the resultant force. [6]

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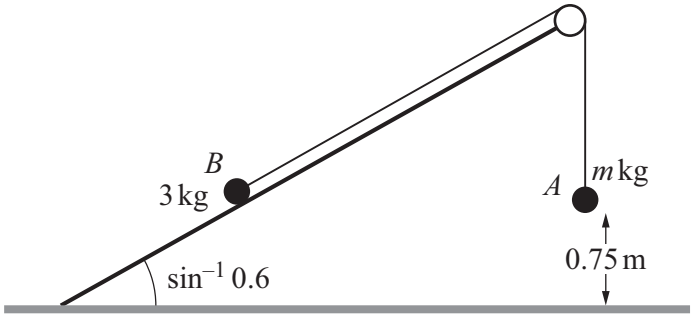
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Two particles, A and B, of masses m kg and 3 kg respectively, are connected by a light inextensible string. Particle B is on a fixed plane which is at an angle of $\sin^{-1} 0.6$ to the horizontal ground. The string passes over a fixed smooth pulley at the top of the plane. Particle A hangs vertically below the pulley and is 0.75 m above the ground (see diagram).

The system is released from rest. In the subsequent motion B moves up a line of greatest slope of the plane and does not reach the pulley. As B moves up the plane there is a constant resistance to its motion of magnitude $\frac{10}{3}$ N. The speed of A immediately before it hits the ground is $2\,\text{m}\,\text{s}^{-1}$.

Use an energy method to find the value of m. [6]

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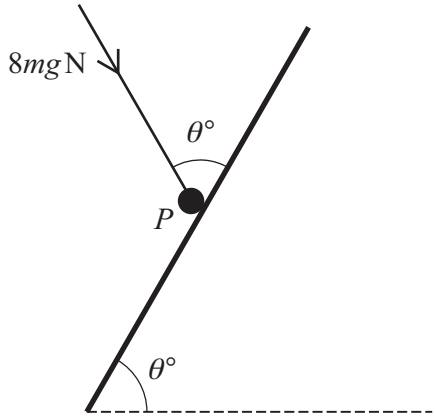
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A particle P of mass m kg is in equilibrium on a rough plane inclined at an angle $\theta°$ to the horizontal. The equilibrium of P is maintained by a force of magnitude $8mg$ N making an angle $\theta°$ with a line of greatest slope (see diagram). The coefficient of friction between P and the plane is 0.5 and P is on the point of slipping down the plane.

Find the value of θ. [6]

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6 A particle A of mass 2.5 kg is released from rest from the top of a smooth plane, which makes an angle of $\sin^{-1} 0.2$ with the horizontal. The particle A collides 2 seconds later with a particle B, of mass 3 kg, which is moving up a line of greatest slope of the plane. The speed of B immediately before the collision is $3.5\,\text{m}\,\text{s}^{-1}$. Immediately after the collision, B has a velocity of $0.5\,\text{m}\,\text{s}^{-1}$ down the plane.

Find the distance A moves up the plane after the collision. [6]

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7 A particle P starts from a point O and moves in a straight line. The velocity $v\,\text{m}\,\text{s}^{-1}$ of P, at time t s after leaving O, is given by $v = \frac{1}{3}(2t-3)(t-4)$.

(a) Find the acceleration of P when $t = 2$. [2]

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(b) Find the total distance travelled by P in the first 3 seconds of its motion. [5]

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(c) Determine whether P returns to O. [2]

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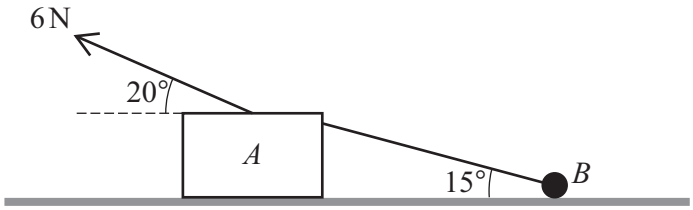
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A block A of mass 2 kg and a particle B of mass 0.5 kg are connected by a light inextensible string inclined at 15° to the horizontal. They are pulled across a horizontal surface with acceleration $1.2\,\text{m}\,\text{s}^{-2}$ by a force of magnitude 6 N, applied to A, acting at 20° above the horizontal as shown in the diagram. The string and the force applied to A are in the same vertical plane.

The contact between B and the surface is smooth and the contact between A and the surface is rough.

(a) Find the tension in the string. [2]

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(b) Find the coefficient of friction between A and the surface. [6]

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Additional page

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