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CAMBRIDGE International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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MATHEMATICS **9709/41**

Paper 4 Mechanics **May/June 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 $10\,\text{m}\,\text{s}^{-2}$.

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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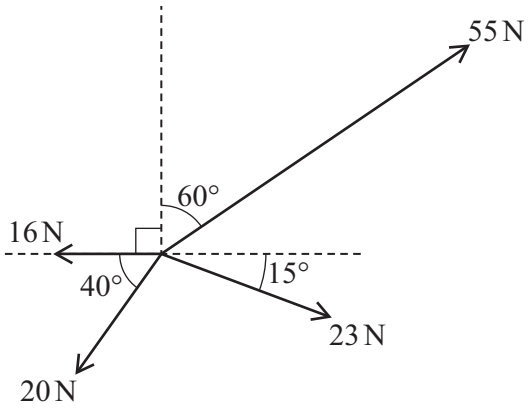
1



Coplanar forces of magnitudes 55 N, 23 N, 20 N and 16 N act at a point in the directions shown in the diagram.

Find the magnitude and direction of the resultant force. [6]

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2 A car of mass 1200 kg is moving on a straight horizontal road. The resistance to the motion of the car has a constant magnitude of 600 N and the car's engine is working at a rate of 27 kW.

(a) Find the acceleration of the car when its speed is $18\,\text{m}\,\text{s}^{-1}$. [3]

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The car now moves up a straight hill which is inclined at an angle θ to the horizontal. The resistance to the motion of the car has now changed to a constant magnitude of 650 N. The car moves up the hill at a constant speed of $12\,\text{m}\,\text{s}^{-1}$ with the car's engine working at a rate of 22 kW.

(b) Find the value of θ. [3]

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3 A particle P travels in a straight line, starting from a point O. At time t seconds the displacement of P from O is s metres, where $s = 4t^3 - 39t^2 + 120t$.

(a) Find the values of t for which P is instantaneously at rest. [3]

(b) Find the total distance travelled by P in the interval $1 \leqslant t \leqslant 4$. [2]

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(c) Find the magnitude of the acceleration of P when $t = 3$. [3]

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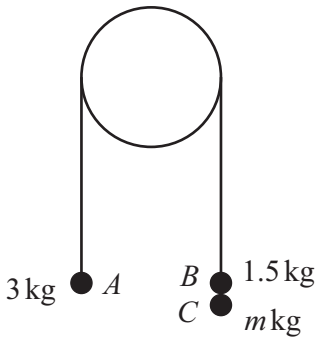

Three particles A, B and C have masses 3 kg, 1.5 kg and m kg respectively, where $m > 1.5$. Particles A and B are attached to the ends of a light inextensible string that passes over a smooth fixed pulley.

Particle C is attached to particle B. The system is held at rest with the string taut and the hanging parts of the string vertical (see diagram).

The system is released from rest and while the three particles are all attached as described, the tension in the string is 37.5 N.

(a) Find the value of m. [4]

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At the instant when A has moved a distance 0.8 m upwards from its initial position, C separates from B and falls away. In the subsequent motion, A and B continue to move and A does not reach the pulley.

(b) Find the total time from when the system is released until A first comes to instantaneous rest. [6]

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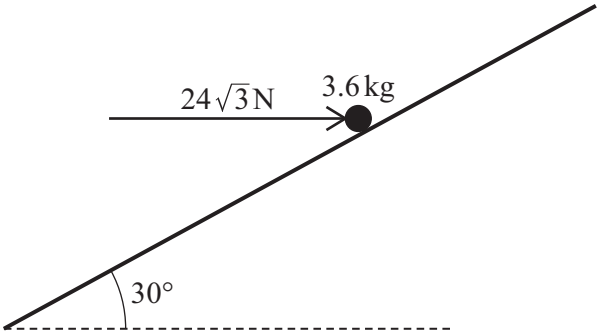

A particle of mass 3.6 kg is placed on a rough plane inclined at an angle of 30° to the horizontal. The particle is held at rest on the plane by a horizontal force of magnitude $24\sqrt{3}$ N. The force acts in a vertical plane containing a line of greatest slope of the inclined plane (see diagram). The particle is on the point of moving up the plane.

(a) Show that the coefficient of friction between the particle and the plane is $\frac{1}{5}\sqrt{3}$. [5]

The force of magnitude $24\sqrt{3}$ N is now removed, and the particle moves from rest down the plane.

(b) Find the speed of the particle after it has travelled 1.5 m down the plane. [5]

6 Three small smooth spheres A, B and C of equal radii and masses m kg, 2 kg and 4 kg respectively, lie at rest in that order in a straight line on a smooth horizontal plane. Sphere A is projected directly towards B with speed $2m\ \text{m s}^{-1}$ and B is projected directly towards A with speed $(m+2)\ \text{m s}^{-1}$. After the spheres collide, both A and B move in the same direction as A's original motion with speeds $2\ \text{m s}^{-1}$ and $3.25\ \text{m s}^{-1}$ respectively.

(a) Find the value of m. [4]

After the collision between A and B, sphere B moves directly towards C. Sphere B now collides with C. After the spheres collide, both B and C move in the same direction and the loss of kinetic energy due to the collision between B and C is 6.875 J.

(b) Determine if there is a further collision between A and B. [6]

Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

