



Cambridge International AS & A Level

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MATHEMATICS

9709/45

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

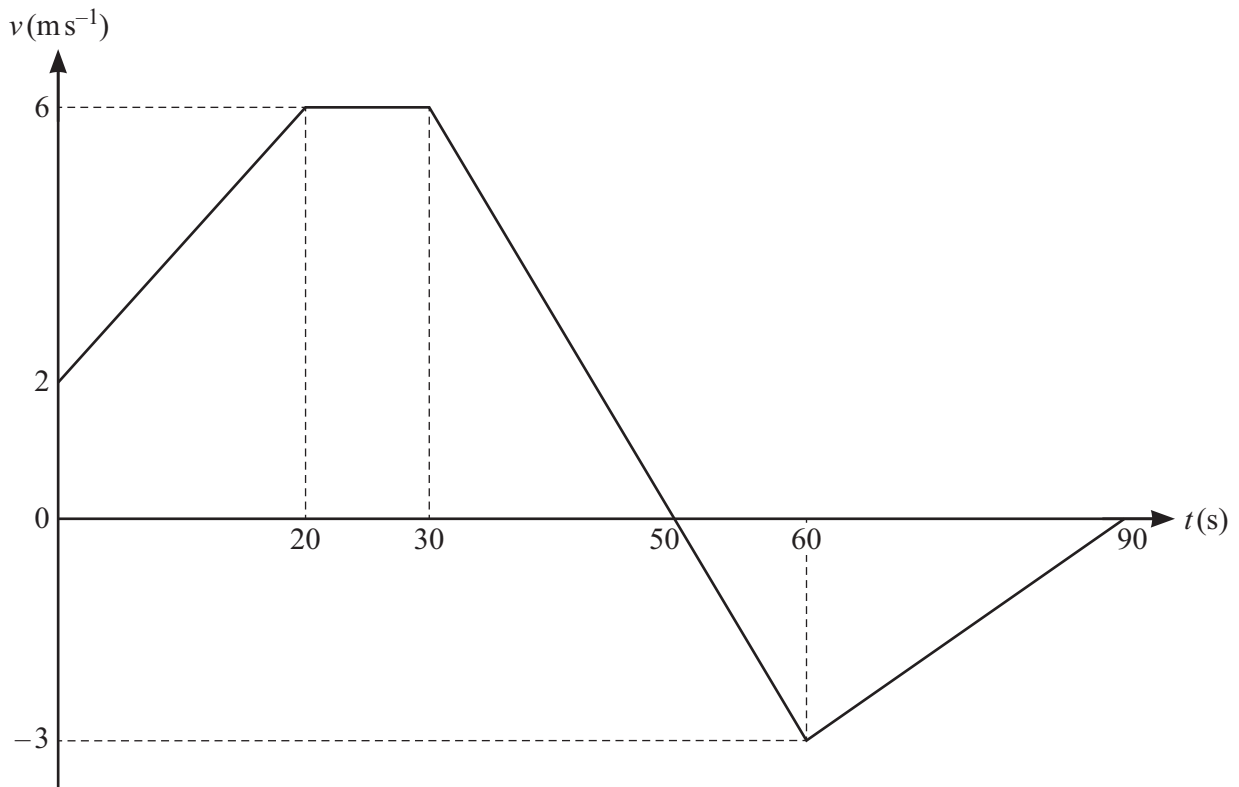
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **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 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



The diagram shows the velocity-time graph of the motion of an athlete who is running in a straight line. The athlete's velocity t seconds after passing a fixed point O is $v \text{ m s}^{-1}$. The graph consists of 4 straight line segments. The athlete is at point P at time $t = 90$.

- (a) Find the distance OP . [2]

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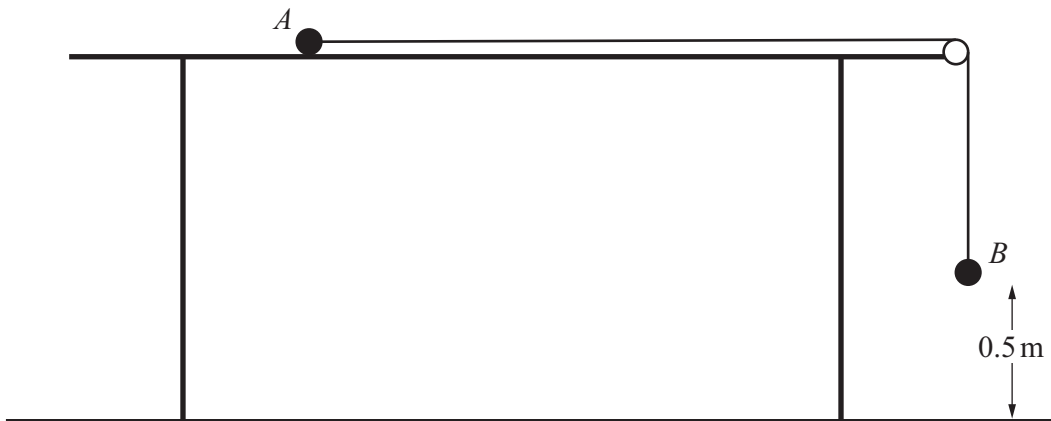
- (b) Find the total distance which the athlete runs in the 90s after passing O . [1]

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A particle A of mass 0.6 kg rests on a smooth horizontal table and is attached to one end of a light inextensible string. The string passes over a small smooth pulley fixed at the edge of the table. The other end of the string is attached to a particle B of mass 0.4 kg which hangs freely below the pulley. The system is released from rest with the string taut and with B at a height of 0.5 m above horizontal ground (see diagram).

- (a) Find the tension in the string and the magnitude of the acceleration of B . [4]

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- (b) Find the time that it takes for B to reach the ground after the system is released. You should assume that A does not reach the pulley before B reaches the ground. [2]

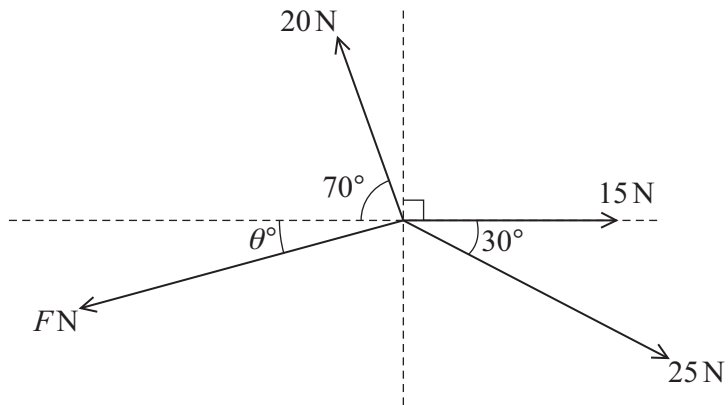
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Four coplanar forces of magnitudes 20 N, 15 N, 25 N and F N act at a point in the directions shown in the diagram.

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

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4 A car of mass 1200 kg is travelling along a straight horizontal road. There is a constant resistance force of magnitude R N acting on the car. Points A , B and C are on the road in that order.

- (a) The car takes 70 s to travel from A to B at constant speed. The distance AB is 1400 m. The power produced by the car's engine is 15 kW.

Find the value of R . [3]

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- (b) At B , the power produced by the car's engine is increased to 25 kW. The car travels a distance of 500 m from B to C . The speed of the car at C is 40 ms^{-1} and the value of R is unchanged.

Find the time that the car takes to travel from B to C . [4]

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- 5 A particle moves in a straight line through two points O and A . The particle starts from A and initially moves away from O . The velocity of the particle t seconds after leaving A is $v \text{ m s}^{-1}$, where $v = 6t - t^{\frac{3}{2}}$.

(a) Given that the particle is 700 m from O when $t = 25$, find the distance OA .

[4]

[illegible]

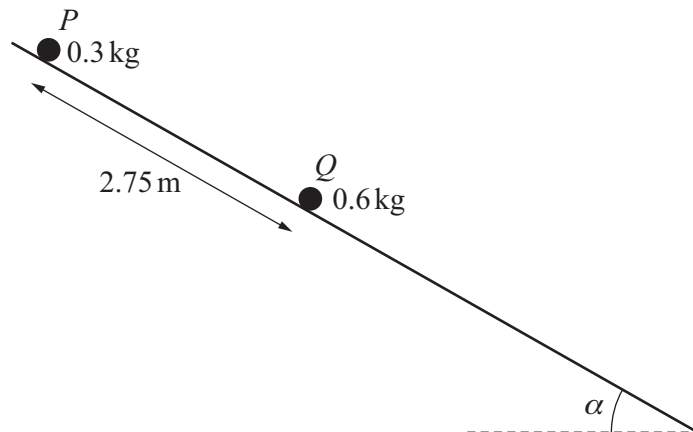


- (b)** Given that $t > 0$, find the distance travelled by the particle between the time at which its acceleration is zero and the time at which its velocity is zero.

[6]

[illegible]

6



Particles P and Q have masses 0.3 kg and 0.6 kg respectively. The particles are held at rest at a distance of 2.75 m apart on a line of greatest slope of a rough plane inclined at angle α to the horizontal, where $\sin \alpha = 0.28$ (see diagram). The coefficient of friction between each particle and the plane is 0.5 .

Particles P and Q are then released.

(a) Show that neither particle moves.

[3]

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Particle P is now projected directly towards Q with speed 6 m s^{-1} .

(b) Find the speed of P immediately before it collides with Q .

[4]

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- (c)** Immediately after the collision, P begins to move with speed 1 m s^{-1} up the plane.

Find the distance between the two particles when they both come to rest after the collision. [5]



- 7 A cyclist travels along a straight horizontal road with constant acceleration $a \text{ ms}^{-2}$. She passes through points A , B , C and D . The distances AB and CD are 50 m and 100 m respectively. The times that she takes to travel from A to B , from B to C and from C to D are all 10 s.

Find, in either order, the value of a and the increase in the speed of the cyclist between A and D . [6]

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DO NOT WRITE IN THIS MARGIN



Handwriting practice lines consisting of 20 horizontal dotted lines.

Additional page

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

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