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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

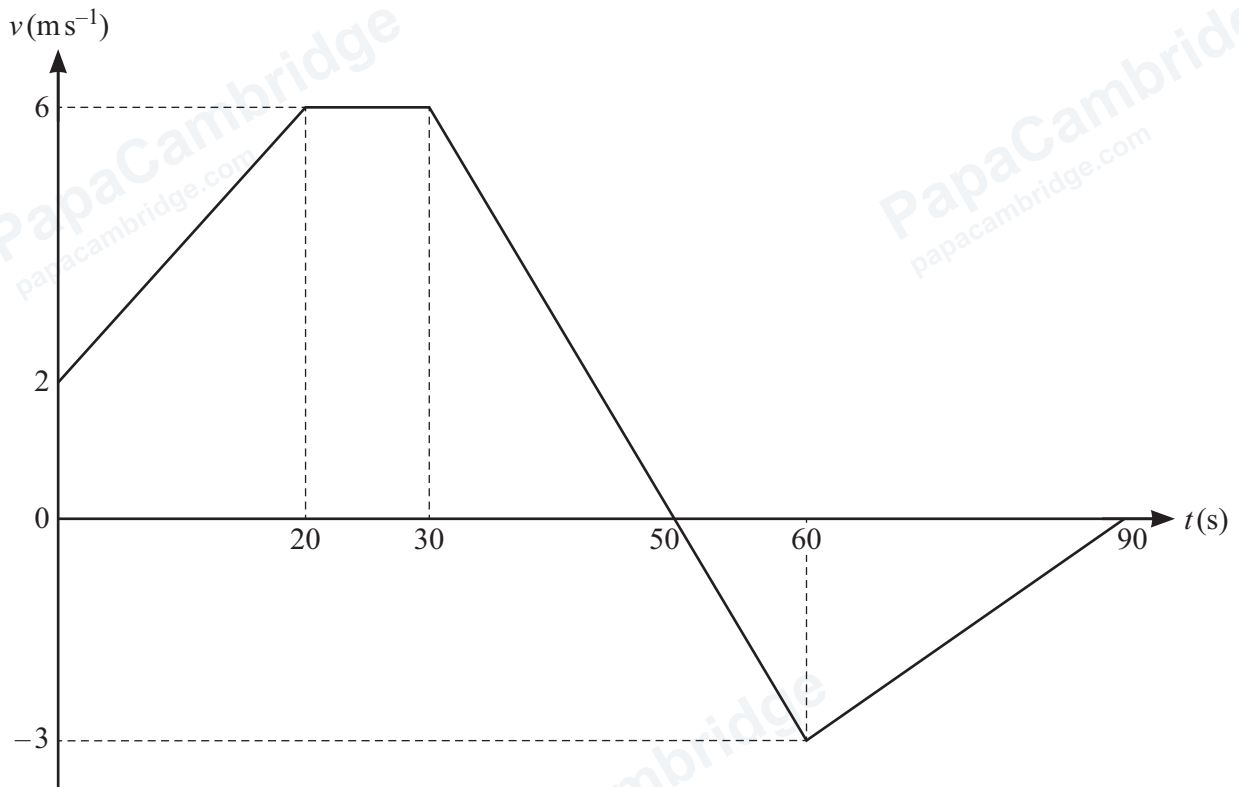
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do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

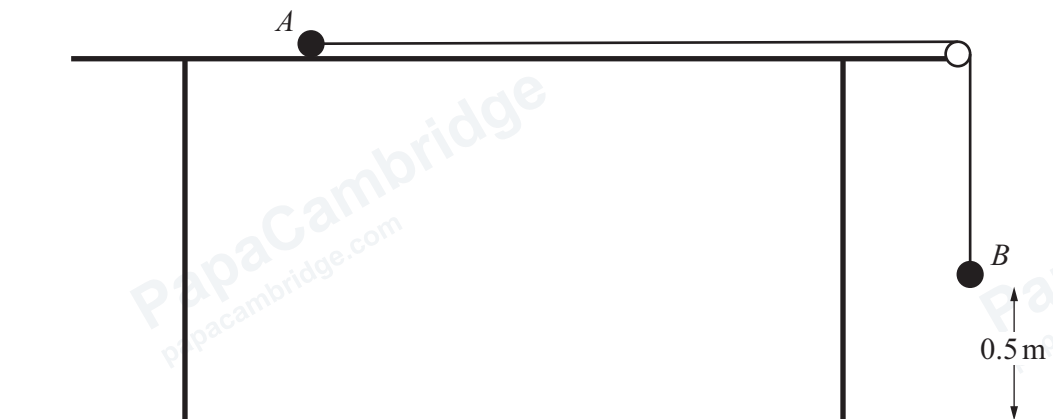
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A particle A of mass 0.6 kg rests on a smooth horizontal table and is attached to one end of a light inextensible string. The string passes over a small smooth pulley fixed at the edge of the table. The other end of the string is attached to a particle 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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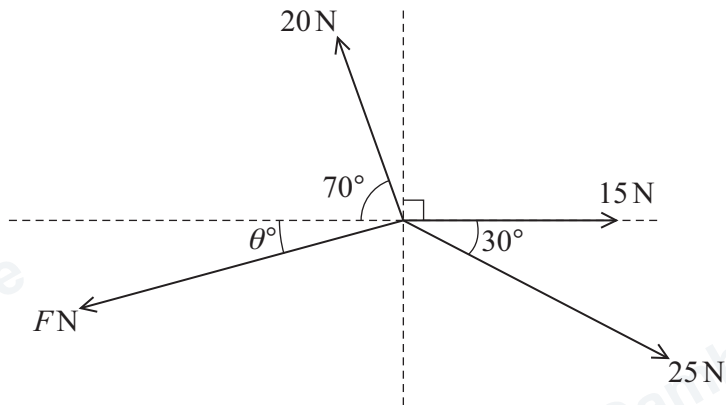
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Four coplanar forces of magnitudes 20 N, 15 N, 25 N and F N act at a point in the directions shown in the diagram.

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

This image shows a full page of blank handwriting practice paper. It features multiple sets of horizontal lines. Each set consists of a solid top line, a dashed midline, and a solid bottom line, providing a guide for letter height and placement. The paper is white with light gray or blue lines. There are faint, diagonal watermarks across the page that read "PapaCambridge.com".



5

- (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.

[3]

Handwriting practice lines with a dashed midline and dotted baseline. The page contains two sets of these lines, each with a faint 'Cambridge' watermark.

- 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]

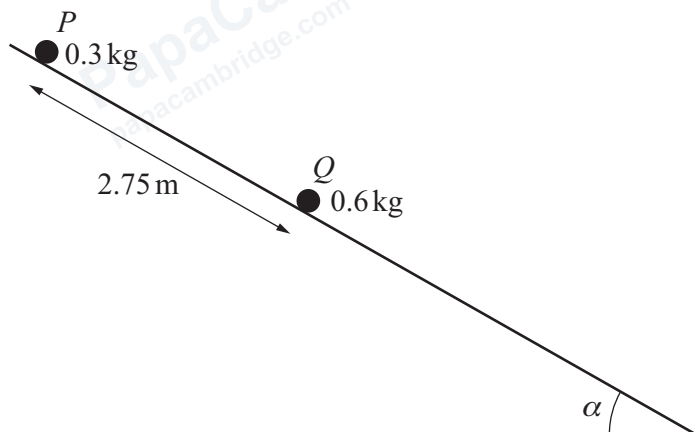


[6]

[Turn over



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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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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