



Cambridge International AS & A Level

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

460356208

MATHEMATICS 9709/43

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

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.



Two particles P and Q, of masses 0.1 kg and 0.3 kg respectively, are at rest on a smooth horizontal plane. P is projected directly towards Q with speed $4u \, \mathrm{m \, s}^{-1}$. At the same instant, Q is projected directly towards P with speed $u \,\mathrm{m\,s}^{-1}$. After \widetilde{P} and Q collide, P moves with speed $2 \,\mathrm{m\,s}^{-1}$ and Q moves with speed $4 \,\mathrm{m\,s}^{-1}$.

(a)	Find the two possible values of u .	[3]
(b)	Find the largest possible loss of kinetic energy in the collision.	[2]
		•••••
		••••••



A van of mass $4500 \,\mathrm{kg}$ is towing a trailer of mass $350 \,\mathrm{kg}$ along a straight horizontal road. The van and trailer are connected by a light rigid tow-bar which is parallel to the road. There are resistance forces of XN on the van and $120 \,\mathrm{N}$ on the trailer. The driving force produced by the van's engine is $2500 \,\mathrm{N}$. The tension in the tow-bar is TN, and the acceleration of the van is $0.4 \,\mathrm{m\,s}^{-2}$.

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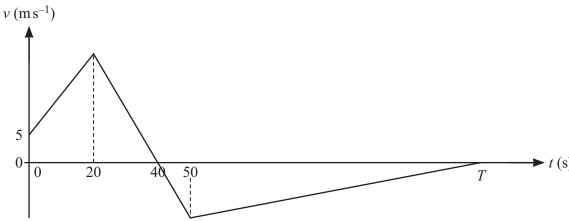
Find the value of X and the value of T .	[4]
	•••••

[5]



(a) Find the value of T.

3



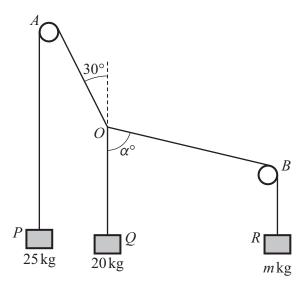
The diagram shows a velocity-time graph which models the motion of a particle. The graph consists of 3 straight line segments. The velocity of the particle at time ts after passing a fixed point O is v m s⁻¹. The particle leaves O with a velocity of 5 m s⁻¹ and accelerates at 0.75 m s⁻² for 20 s. The particle then decelerates for the next 30 s. At t = 40, the velocity of the particle is zero. After t = 40, the particle starts to travel back to O, coming to rest at O at time Ts.

(b)	Find the acceleration of the particle from $t = 50$ to $t = T$. [2]	



Find the value of m and the value of α .

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Three blocks P, Q and R, of masses 25 kg, 20 kg and m kg respectively, are held in equilibrium by three light inextensible strings OP, OQ and OR. The strings OP and OR both pass over small fixed smooth pulleys A and B respectively, with P and R hanging vertically below the pulleys. The block Q hangs vertically below the point O. The angle between OA and the vertical is 30° and the angle $BOQ = \alpha^\circ$ (see diagram).

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[6]

A van of mass 2500 kg travelling at speed $v \,\mathrm{m\,s}^{-1}$ experiences a resistance force of $kv^2 \,\mathrm{N}$. The constant power of the van's engine is 62.5 kW.

The steady speed that the van could maintain when moving along a straight horizontal road

norizontal road.			van when its s	_	[4
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The van begins to ascend a hill inclined at an angle θ° to the horizontal. The van travels along a line of greatest slope of the hill. The speed of the van at the start of the hill is $20 \,\mathrm{m\,s^{-1}}$, and its acceleration is $5 \,\mathrm{g\,m\,s^{-2}}$. Later, on the same hill, the speed of the van is $30 \,\mathrm{m\,s^{-1}}$, and its acceleration is $6 \,\mathrm{m\,s^{-2}}$. The

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of greatest slope of the hill. The speed of the van at the start of the hill is 20 m s ⁻¹ , and its acceleration
is $5a \mathrm{ms^{-2}}$. Later, on the same hill, the speed of the van is $30 \mathrm{ms^{-1}}$, and its acceleration is $a \mathrm{ms^{-2}}$. The
power of the van's engine remains at $62.5 \mathrm{kW}$, and the resistance force remains at $0.5 \mathrm{v}^2 \mathrm{N}$.
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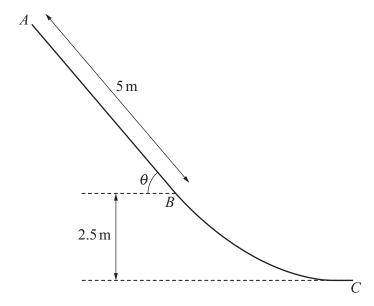
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[5]



(a) Find the speed of the man at B.

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The diagram shows the vertical cross-section ABC of a rough waterslide. The section AB is a straight line of length 5 m inclined at an angle of θ to the horizontal, where $\sin \theta = 0.8$. The point B is 2.5 m above the level of C. A man of mass 80 kg, modelled as a particle, slides down the waterslide, starting from rest at A. The coefficient of friction between the man and the straight section of the waterslide is 0.1.

* (9
It is C is	given that there is no change in the speed of the man when passing through B and that his speed at $11 \mathrm{ms}^{-1}$.
(b)	Find the work done against the resistance force as the man moves from B to C . [4]
	Many



A particle X moves in a straight line.	The displacement	of X from 6	O at time t s	s after leaving () is <i>s</i> m
where $s = 0.3t^2 + 0.6t$ for $0 \le t \le 4$.					

(a)	Fin	and the velocity of X at $t = 4$.				
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For char	t >	4, the acceleration of X at time ts after leaving O is $a \mathrm{ms}^{-2}$, where $a = 0.3t^{\frac{1}{2}}$. There in the velocity of X at $t = 4$. The velocity of X at $t = T$ is $14.2 \mathrm{ms}^{-1}$.	e is no			
(b)	(i)	Find the value of <i>T</i> .	[4]			
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(11)	Find the total distance travelled by X between $t = 0$ and $t = T$.	
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Additional page

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