

Cambridge International AS & A Level

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

MATHEMATICS 9709/42

Paper 4 Mechanics May/June 2023

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 m s⁻².

INFORMATION

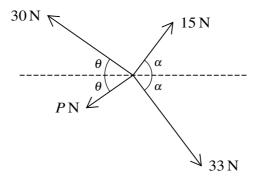
- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has 12 pages.

A particle of mass 1.6 kg is dropped from a height of 9 m above horizontal ground. The speed of the

Find the work done against air resistance.	[3

spee		
(a)	Find the value of v.	[2]
		•••••
)	Find the loss of kinetic energy of the system due to the collision.	[2]
))	Find the loss of kinetic energy of the system due to the collision.	[2]
)	Find the loss of kinetic energy of the system due to the collision.	[2]
)	Find the loss of kinetic energy of the system due to the collision.	[2]
	Find the loss of kinetic energy of the system due to the collision.	[2]
)	Find the loss of kinetic energy of the system due to the collision.	[2]
)	Find the loss of kinetic energy of the system due to the collision.	[2]
	Find the loss of kinetic energy of the system due to the collision.	[2]
•	Find the loss of kinetic energy of the system due to the collision.	[2]
)	Find the loss of kinetic energy of the system due to the collision.	[2]
	Find the loss of kinetic energy of the system due to the collision.	
•	Find the loss of kinetic energy of the system due to the collision.	

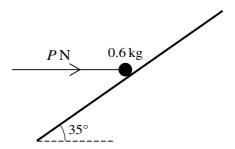


Coplanar forces of magnitudes 30 N, 15 N, 33 N and PN act at a point in the directions shown in the diagram, where $\tan \alpha = \frac{4}{3}$. The system is in equilibrium.

(a)	Show that $\left(\frac{14.4}{30 - P}\right)^2 + \left(\frac{28.8}{P + 30}\right)^2 = 1.$	[4]
		•••••
		•••••
		•••••
		•••••
		•••••
		•••••
		•••••
		•••••
		•••••

(b)	Verify that $P = 6$ satisfies this equation and find the value of θ .	[2]
		•••••
		•••••
		•••••
		•••••

An	athlete of mass 84 kg is running along a straight road.
(a)	Initially the road is horizontal and he runs at a constant speed of $3\mathrm{ms^{-1}}$. The athlete produces a constant power of $60\mathrm{W}$.
	Find the resistive force which acts on the athlete.
(b)	The athlete then runs up a 150 m section of the road which is inclined at 0.8° to the horizontal. The speed of the athlete at the start of this section of road is $3 \mathrm{ms^{-1}}$ and he now produces a constant driving force of 24 N. The total resistive force which acts on the athlete along this section of road has constant magnitude 13 N.
	Use an energy method to find the speed of the athlete at the end of the 150 m section of road. [6]

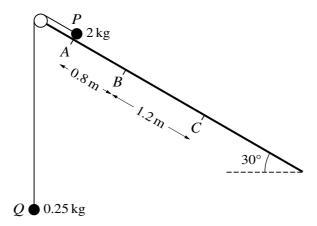


A particle of mass $0.6 \,\mathrm{kg}$ is placed on a rough plane which is inclined at an angle of 35° to the horizontal. The particle is kept in equilibrium by a horizontal force of magnitude $P\mathrm{N}$ acting in a vertical plane containing a line of greatest slope (see diagram). The coefficient of friction between the particle and plane is 0.4.

Find the least possible value of P .	[6]
	••••••
	••••••
	•••••

	ocity of P , $v \mathrm{m}\mathrm{s}^{-1}$, is given by $v = bt + ct^{\frac{3}{2}}$, where b and c are constants. P has velocity $8\mathrm{m}$ en $t = 4$ and has velocity $13.5\mathrm{m}\mathrm{s}^{-1}$ when $t = 9$.	1 s ⁻¹
(a)	Show that $b = 3$ and $c = -0.5$.	[1]
		•••••
		•••••
(b)	Find the acceleration of P when $t = 1$.	[2]
		•••••
		•••••
		•••••
		•••••
		•••••
(c)	Find the positive value of t when P is at instantaneous rest and find the distance of P from this instant.	O at [5]
		· • • • • • • • • • • • • • • • • • • •
		•••••
		•••••
		•••••
		•••••

		•••••
(d)) Find the speed of P at the instant it returns to O .	[3]



Two particles P and Q, of masses 2 kg and 0.25 kg respectively, are connected by a light inextensible string that passes over a fixed smooth pulley. Particle P is on an inclined plane at an angle of 30° to the horizontal. Particle Q hangs below the pulley. Three points A, B and C lie on a line of greatest slope of the plane with AB = 0.8 m and BC = 1.2 m (see diagram).

Particle P is released from rest at A with the string taut and slides down the plane. During the motion of P from A to C, Q does not reach the pulley. The part of the plane from A to B is rough, with coefficient of friction 0.3 between the plane and P. The part of the plane from B to C is smooth.

[4]	(a) (i) Find the acceleration of P between A and B.

	(11)	Hence, find the speed of P at C .	[5]
(L)	F:	14h - Cons Asland Con Dan Association of Association	F.4.7
(D)	FIIIC	If the time taken for P to travel from A to C .	[4]
	•••••		
	•••••		
	•••••		
	•••••		
	•••••		

Additional Page

If you use the following lined page to must be clearly shown.	o complete the answer(s) to any question(s), the	question number(s)

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.