

Cambridge International AS & A Level

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

MATHEMATICS

9709/42

Paper 4 Mechanics

May/June 2020

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. Blank pages are indicated.

- 1** A tram starts from rest and moves with uniform acceleration for 20 s. The tram then travels at a constant speed, $V \text{ m s}^{-1}$, for 170 s before being brought to rest with a uniform deceleration of magnitude twice that of the acceleration. The total distance travelled by the tram is 2.775 km.

(a) Sketch a velocity-time graph for the motion, stating the total time for which the tram is moving. [2]

.....

.....

(b) Find V . [2]

.....

.....

.....

.....

.....

.....

(c) Find the magnitude of the acceleration. [2]

.....

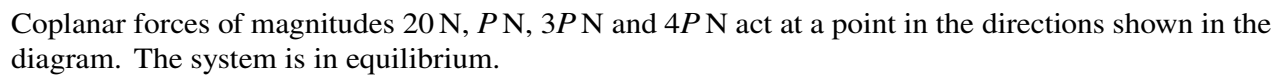
.....

.....

.....

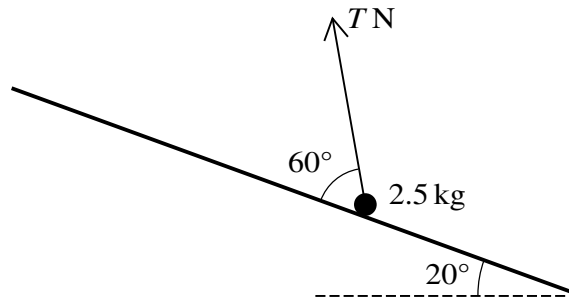
.....

.....



[6]

[illegible]



Find the greatest and least possible values of T . [8]

[illegible]

- 4** Small smooth spheres A and B , of equal radii and of masses 4 kg and 2 kg respectively, lie on a smooth horizontal plane. Initially B is at rest and A is moving towards B with speed 10 m s^{-1} . After the spheres collide A continues to move in the same direction but with half the speed of B .

(a) Find the speed of B after the collision. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

A third small smooth sphere C , of mass 1 kg and with the same radius as A and B , is at rest on the plane. B now collides directly with C . After this collision B continues to move in the same direction but with one third the speed of C .

(b) Show that there is another collision between A and B . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) A and B coalesce during this collision.

Find the total loss of kinetic energy in the system due to the three collisions. [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

5 A car of mass 1250 kg is moving on a straight road.

(a) On a horizontal section of the road, the car has a constant speed of 32 m s^{-1} and there is a constant force of 750 N resisting the motion.

(i) Calculate, in kW, the power developed by the engine of the car. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Given that this power is suddenly decreased by 8 kW, find the instantaneous deceleration of the car. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- 6 A particle P moves in a straight line. The velocity $v \text{ m s}^{-1}$ at time $t \text{ s}$ is given by

$$\begin{aligned} v &= 2t + 1 && \text{for } 0 \leq t \leq 5, \\ v &= 36 - t^2 && \text{for } 5 \leq t \leq 7, \\ v &= 2t - 27 && \text{for } 7 \leq t \leq 13.5. \end{aligned}$$

- (a) Sketch the velocity-time graph for $0 \leq t \leq 13.5$.

[3]

- (b) Find the acceleration at the instant when $t = 6$.

[2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

[5]

[illegible]

[illegible]

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