



Cambridge International AS & A Level

CANDIDATE
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MATHEMATICS

9709/42

Paper 4 Mechanics

February/March 2021

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 **16** pages. Any blank pages are indicated.

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2 A car of mass 1400 kg is travelling at constant speed up a straight hill inclined at α to the horizontal, where $\sin \alpha = 0.1$. There is a constant resistance force of magnitude 600 N. The power of the car's engine is 22 500 W.

(a) Show that the speed of the car is 11.25 m s^{-1} . [3]

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The car, moving with speed 11.25 m s^{-1} , comes to a section of the hill which is inclined at 2° to the horizontal.

(b) Given that the power and resistance force do not change, find the initial acceleration of the car up this section of the hill. [3]

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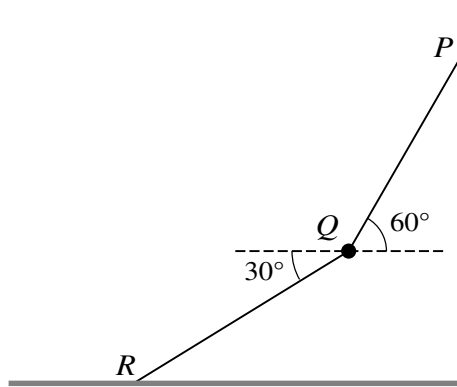
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3



A particle Q of mass 0.2 kg is held in equilibrium by two light inextensible strings PQ and QR . P is a fixed point on a vertical wall and R is a fixed point on a horizontal floor. The angles which strings PQ and QR make with the horizontal are 60° and 30° respectively (see diagram).

Find the tensions in the two strings.

[5]

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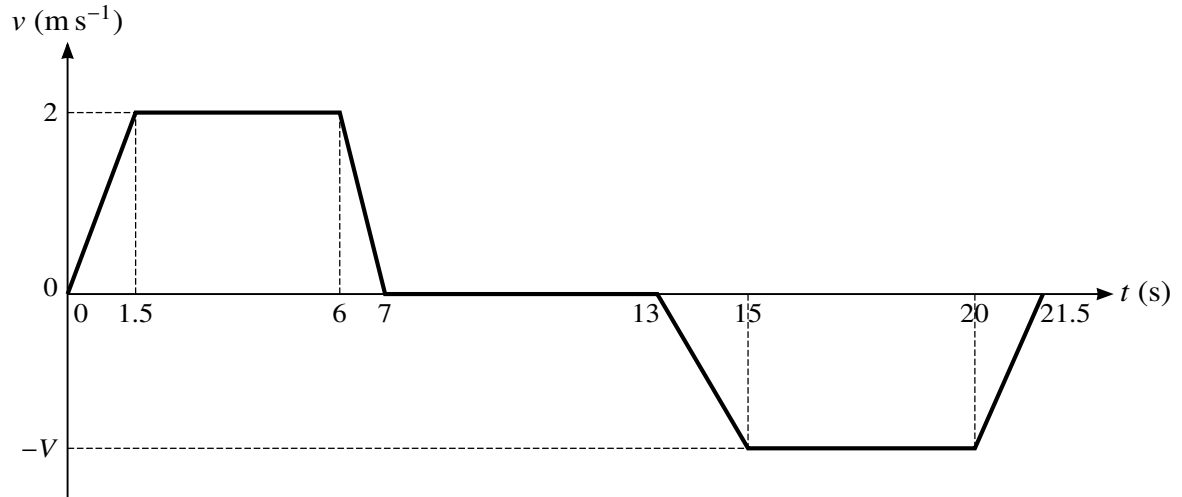
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An elevator moves vertically, supported by a cable. The diagram shows a velocity-time graph which models the motion of the elevator. The graph consists of 7 straight line segments.

The elevator accelerates upwards from rest to a speed of 2 m s^{-1} over a period of 1.5 s and then travels at this speed for 4.5 s, before decelerating to rest over a period of 1 s.

The elevator then remains at rest for 6 s, before accelerating to a speed of $V \text{ m s}^{-1}$ downwards over a period of 2 s. The elevator travels at this speed for a period of 5 s, before decelerating to rest over a period of 1.5 s.

- (a) Find the acceleration of the elevator during the first 1.5 s. [1]

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- (b) Given that the elevator starts and finishes its journey on the ground floor, find V . [2]

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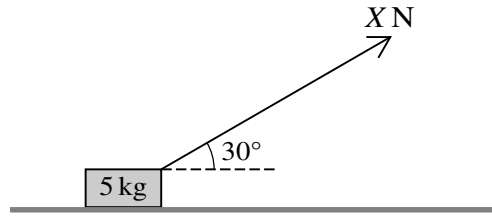
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5



A block of mass 5 kg is being pulled along a rough horizontal floor by a force of magnitude X N acting at 30° above the horizontal (see diagram). The block starts from rest and travels 2 m in the first 5 s of its motion.

- (a) Find the acceleration of the block. [2]

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- (b) Given that the coefficient of friction between the block and the floor is 0.4, find X . [4]

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