



# Cambridge International AS & A Level

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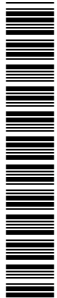
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**MATHEMATICS**

**9709/43**

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  $10 \text{ m s}^{-2}$ .

## 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.



2 A minibus of mass 4000 kg is travelling along a straight horizontal road. The resistance to motion is 900 N.

(a) Find the driving force when the acceleration of the minibus is  $0.5 \text{ m s}^{-2}$ . [2]

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(b) Find the power required for the minibus to maintain a constant speed of  $25 \text{ m s}^{-1}$ . [2]

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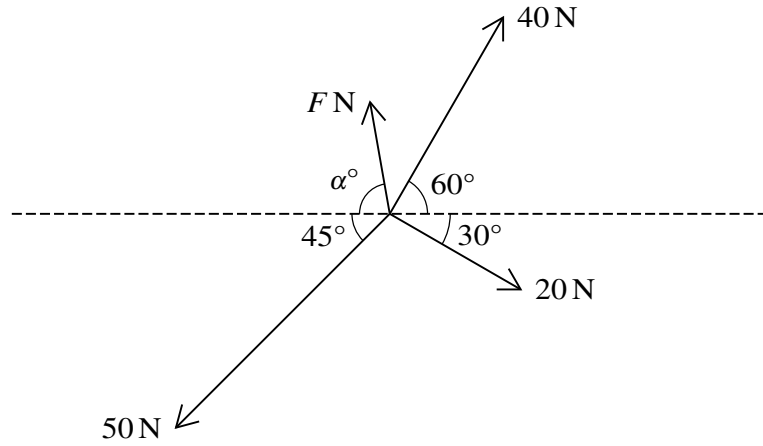
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Four coplanar forces of magnitudes 40 N, 20 N, 50 N and  $F$  N act at a point in the directions shown in the diagram. The four forces are in equilibrium.

Find  $F$  and  $\alpha$ . [6]

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4 A car starts from rest and moves in a straight line with constant acceleration  $a \text{ m s}^{-2}$  for a distance of 50 m. The car then travels with constant velocity for 500 m for a period of 25 s, before decelerating to rest. The magnitude of this deceleration is  $2a \text{ m s}^{-2}$ .

(a) Sketch the velocity-time graph for the motion of the car. [1]



(b) Find the value of  $a$ . [3]

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(c) Find the total time for which the car is in motion. [3]

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5 A block *B* of mass 4 kg is pushed up a line of greatest slope of a smooth plane inclined at  $30^\circ$  to the horizontal by a force applied to *B*, acting in the direction of motion of *B*. The block passes through points *P* and *Q* with speeds  $12\text{ m s}^{-1}$  and  $8\text{ m s}^{-1}$  respectively. *P* and *Q* are 10 m apart with *P* below the level of *Q*.

(a) Find the decrease in kinetic energy of the block as it moves from *P* to *Q*. [2]

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(b) Hence find the work done by the force pushing the block up the slope as the block moves from *P* to *Q*. [3]

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(c) At the instant the block reaches *Q*, the force pushing the block up the slope is removed.

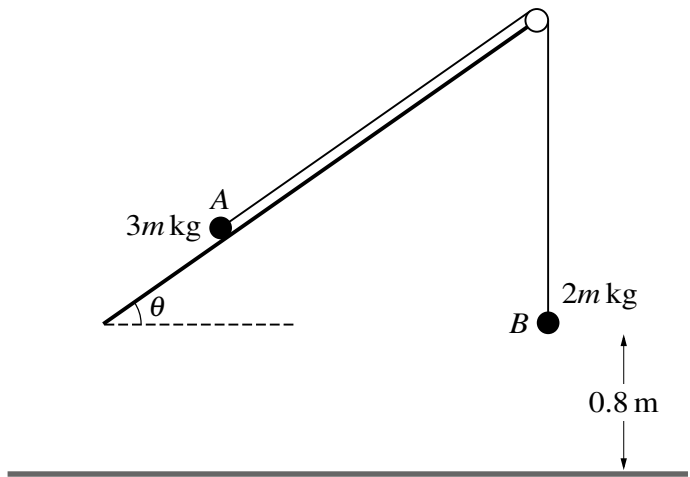
Find the time taken, after this instant, for the block to return to *P*. [4]

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Two particles  $A$  and  $B$ , of masses  $3m$  kg and  $2m$  kg respectively, are attached to the ends of a light inextensible string. The string passes over a fixed smooth pulley which is attached to the edge of a plane. The plane is inclined at an angle  $\theta$  to the horizontal.  $A$  lies on the plane and  $B$  hangs vertically,  $0.8$  m above the floor, which is horizontal. The string between  $A$  and the pulley is parallel to a line of greatest slope of the plane (see diagram). Initially  $A$  and  $B$  are at rest.

- (a) Given that the plane is smooth, find the value of  $\theta$  for which  $A$  remains at rest. [3]

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It is given instead that the plane is rough,  $\theta = 30^\circ$  and the acceleration of  $A$  up the plane is  $0.1 \text{ m s}^{-2}$ .

- (b) Show that the coefficient of friction between  $A$  and the plane is  $\frac{1}{10}\sqrt{3}$ . [5]

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(c) When  $B$  reaches the floor it comes to rest.

Find the length of time after  $B$  reaches the floor for which  $A$  is moving up the plane. [You may assume that  $A$  does not reach the pulley.] [4]

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**Additional Page**

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