

CANDIDATE
NAME

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CENTRE
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CANDIDATE
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MATHEMATICS

9709/41

Paper 4 Mechanics 1 (M1)

May/June 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

Where a numerical value for the acceleration due to gravity is needed, use 10 m s^{-2} .

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

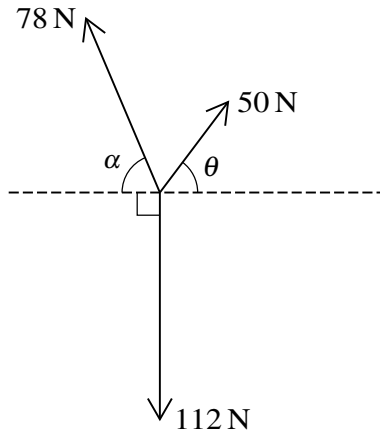
The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 50.

This document consists of **14** printed pages and **2** blank pages.



1



Given that $\tan \alpha = \frac{12}{5}$ and $\tan \theta = \frac{4}{3}$, show that the coplanar forces shown in the diagram are in equilibrium. [3]

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2 A particle P is projected vertically upwards with speed 25 m s^{-1} from a point 3 m above horizontal ground.

(i) Find the time taken for P to reach its greatest height. [2]

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(ii) Find the length of time for which P is higher than 23 m above the ground. [3]

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(iii) P is higher than h m above the ground for 1 second. Find h . [2]

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When the speed of the lorry is $v \text{ m s}^{-1}$ the magnitude of the resistance to motion is $kv^2 \text{ N}$, where k is a constant.

(ii) Show that $k = 60$. [1]

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(iii) The lorry now moves at a constant speed on a straight level road. Given that its engine is still working at 55.5 kW, find the lorry's speed. [3]

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The force of magnitude 20 N is now removed.

(ii) Find the acceleration of the particle. [2]

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(iii) Find the work done against friction during the first 2 s of motion. [3]

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

$$v = t^2 - 8t + 12 \quad \text{for } 0 \leq t \leq 8.$$

(i) Find the minimum velocity of P . [3]

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(ii) Find the total distance travelled by P in the interval $0 \leq t \leq 8$. [7]

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(ii) It is given instead that $\theta = 20$. In the subsequent motion particle A does not reach P and B remains at rest after reaching the ground.

(a) Find the tension in the string and the acceleration of the system. [4]

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(b) Find the speed of A at the instant B reaches the ground. [2]

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[Question 6 continues on the next page.]

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