

CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**MATHEMATICS**

**9709/51**

Paper 5 Mechanics 2 (M2)

**October/November 2018**

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

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 **15** printed pages and **1** blank page.



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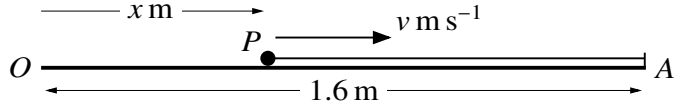








4



A particle  $P$  of mass  $0.5 \text{ kg}$  is projected along a smooth horizontal surface towards a fixed point  $A$ . Initially  $P$  is at a point  $O$  on the surface, and after projection,  $P$  has a displacement from  $O$  of  $x \text{ m}$  and velocity  $v \text{ m s}^{-1}$ . The particle  $P$  is connected to  $A$  by a light elastic string of natural length  $0.8 \text{ m}$  and modulus of elasticity  $16 \text{ N}$ . The distance  $OA$  is  $1.6 \text{ m}$  (see diagram). The motion of  $P$  is resisted by a force of magnitude  $24x^2 \text{ N}$ .

(i) Show that  $v \frac{dv}{dx} = 32 - 40x - 48x^2$  while  $P$  is in motion and the string is stretched. [3]

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The maximum value of  $v$  is  $4.5$ .

(ii) Find the initial value of  $v$ . [5]

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