

CANDIDATE
NAME
CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

MATHEMATICS**9709/53**

Paper 5 Mechanics 2 (M2)

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.

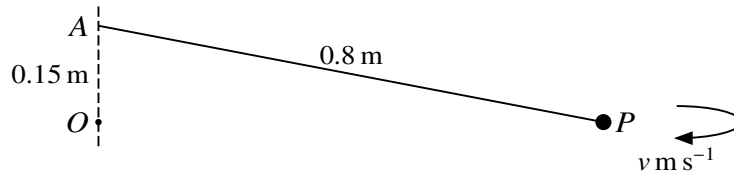
The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 50.

This document consists of **13** printed pages and **3** blank pages.

BLANK PAGE

1



A particle P of mass 0.3 kg is attached to a fixed point A by a light inextensible string of length 0.8 m . The fixed point O is 0.15 m vertically below A . The particle P moves with constant speed $v\text{ m s}^{-1}$ in a horizontal circle with centre O (see diagram).

(i) Show that the tension in the string is 16 N . [2]

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Find the value of v . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

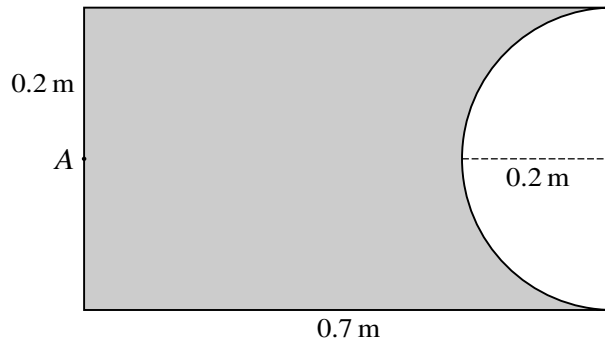
.....

.....

.....

.....

3



The diagram shows the cross-section through the centre of mass of a uniform solid object. The object is a cylinder of radius 0.2 m and length 0.7 m, from which a hemisphere of radius 0.2 m has been removed at one end. The point A is the centre of the plane face at the other end of the object. Find the distance of the centre of mass of the object from A. [5]

[The volume of a hemisphere is $\frac{2}{3}\pi r^3$.]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

5 A particle P of mass 0.4 kg is attached to one end of a light elastic string of natural length 0.5 m and modulus of elasticity 6 N. The other end of the string is attached to a fixed point O . The particle P is released from rest at the point $(0.5 + x)$ m vertically below O . The particle P comes to instantaneous rest at O .

(i) Find x . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) Find the greatest speed of P . [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

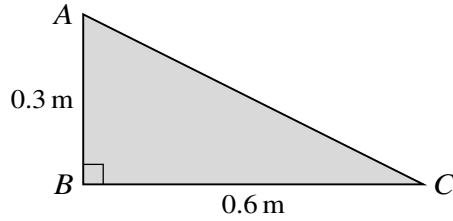
.....

.....

.....

A series of 25 horizontal dotted lines for writing.

6



ABC is a uniform lamina in the form of a triangle with $AB = 0.3$ m, $BC = 0.6$ m and a right angle at B (see diagram).

- (i) State the distances of the centre of mass of the lamina from AB and from BC . [2]

Distance from AB

.....

.....

Distance from BC

.....

.....

The lamina is freely suspended at B and hangs in equilibrium.

- (ii) Find the angle between AB and the horizontal. [2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

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.