

Cambridge
International
A Level

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

FURTHER MATHEMATICS

9231/23

Paper 2

May/June 2017

3 hours

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF10)

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.

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 is necessary, take the acceleration due to gravity to be 10 m s^{-2} .

The use of a calculator is expected, where appropriate.

Results obtained solely from a graphic calculator, without supporting working or reasoning, will not receive credit.

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.

This document consists of **22** printed pages and **2** blank pages.



BLANK PAGE

- (ii) Find the modulus of elasticity of the string in terms of W . [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (iii) Find the angle that the force acting on the rod at A makes with the horizontal. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

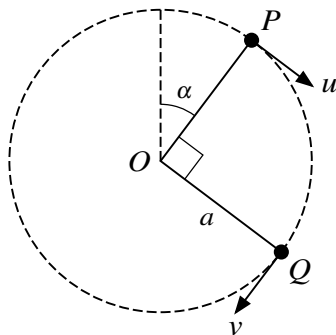
.....

.....

.....

.....

5



A particle of mass m is attached to one end of a light inextensible string of length a . The other end of the string is attached to a fixed point O . The particle is moving in complete vertical circles with the string taut. When the particle is at the point P , where OP makes an angle α with the upward vertical through O , its speed is u . When the particle is at the point Q , where angle $QOP = 90^\circ$, its speed is v (see diagram). It is given that $\cos \alpha = \frac{4}{5}$.

- (i) Show that $v^2 = u^2 + \frac{14}{5}ag$. [2]

.....

.....

.....

.....

.....

.....

The tension in the string when the particle is at Q is twice the tension in the string when the particle is at P .

- (ii) Obtain another equation relating u^2 , v^2 , a and g , and hence find u in terms of a and g . [5]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(iii) Find the least tension in the string during the motion. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

13

- 7 A random sample of twelve pairs of values of x and y is taken from a bivariate distribution. The equations of the regression lines of y on x and of x on y are respectively

$$y = 0.46x + 1.62 \quad \text{and} \quad x = 0.93y + 8.24.$$

- (i) Find the value of the product moment correlation coefficient for this sample. [2]

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) Using a 5% significance level, test whether there is non-zero correlation between the variables. [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

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 International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cie.org.uk after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.