



Rewarding Learning

ADVANCED
General Certificate of Education
2023

Centre Number

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Candidate Number

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Mathematics

Assessment Unit A2 2

assessing

Applied Mathematics

MV18

[AMT21]

TUESDAY 13 JUNE, AFTERNOON

Time

1 hour 30 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write on blank pages.

Complete in black ink only. Questions which require drawing or sketching should be completed using an HB pencil.

Candidates must answer **all** questions from sections A and B.

Equal time should be spent on each section. Show clearly the full development of your answers.

Answers without working may not gain full credit.

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

Information for Candidates

The total mark for this paper is 100. The total available mark for each section of this paper is 50.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Answers should include diagrams where appropriate and marks may be awarded for them.

Take $g = 9.8 \text{ m s}^{-2}$, unless specified otherwise.

A copy of the **Mathematical Formulae and Tables booklet** is provided.

Throughout the paper the logarithmic notation used is $\ln z$ where it is noted that $\ln z \equiv \log_e z$

(iii) What modelling assumption have you made?
[1 mark]

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(Questions continue overleaf)

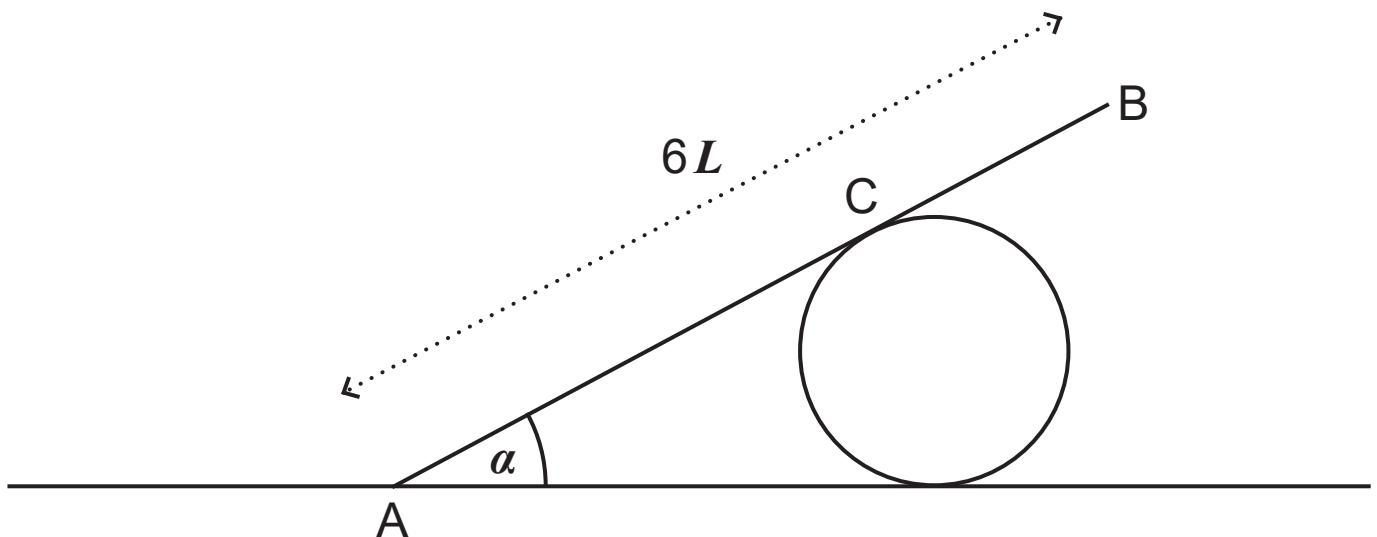
3 A uniform thin plank AB has mass M kg and length $6L$ metres.

C is a point on the plank where $AC = 4L$ metres.

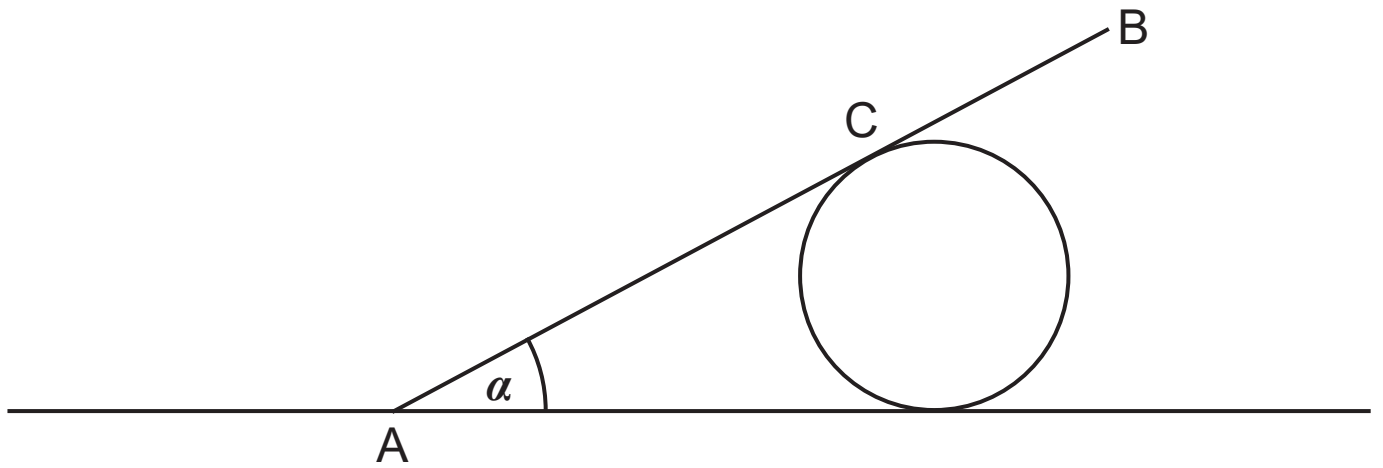
A carpenter places end A on rough horizontal ground and uses a smooth fixed cylinder to support the plank at C as shown in **Fig. 1** below.

The plank rests in equilibrium when inclined at α degrees to the horizontal.

Fig. 1



- (i) Complete the diagram below showing all the external forces acting on the plank. [3 marks]



(iii) Hence, if the plank is about to slip, find the value of the coefficient of friction between the plank and the ground. [7 marks]

- 4 A particle moves along a straight line.
Points A, B and C lie on this line.

At time t seconds, the particle's displacement x metres from A is given by

$$x = \frac{1}{3}t^3 + \frac{3}{4}t^2 + 7t \quad (0 \leq t \leq 2)$$

When $t = 2$ the particle is at B.

- (i) Find the displacement of B from A. [2 marks]

- (ii) Find its velocity at B. [4 marks]

For $2 \leq t < 4$ the velocity $v \text{ ms}^{-1}$ of the particle can now be modelled as

$$v = 14\text{sec}^2 \left(\frac{\pi t}{4} - \frac{\pi}{2} \right)$$

At $t = 3$ the particle is at C.

(iii) Find the displacement of C from A. [6 marks]

(iv) If the particle models a train on a straight track, what is the problem with using this model as t gets closer to 4? [2 marks]

Section B

Statistics

- 5 An economist studies the correlation between unemployment percentage and average income for a large city. He sets up a hypothesis test on ρ , the population correlation coefficient. His hypotheses are:

$$H_0: \rho = 0$$

$$H_1: \rho < 0$$

- (i) Will the test be one-tailed or two-tailed? [1 mark]

The economist uses a random sample of records over an extended period of time.

He calculates the product–moment correlation coefficient for his sample and finds the ρ -value for the test to be 0.00845

(ii) Explain what is meant by the term ρ -value. [2 marks]

(iii) Using a significance level of 1%, complete the hypothesis test. [3 marks]

The office manager introduces a bonus scheme designed to reduce the amount of time taken for calls to be answered.

He claims that the scheme has been successful.

Following the introduction of the scheme, the office manager calculates the average time taken to answer calls in a random sample of 40 to be 10.8 seconds.

(ii) Test the office manager’s claim at the 5% level of significance. [7 marks]



This is the end of the question paper

SOURCES

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Question Number	Marks
1	
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8	
9	
Total Marks	

Examiner Number

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