



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



[AMT21]

AMT21

TUESDAY 13 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

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 outside the boxed area on each page or on blank pages.

Complete in black ink only. Questions which require drawing or sketching should be completed using an HB pencil. **Do not write with a gel pen.**

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 down the right-hand side of pages 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 $\ln z \equiv \log_e z$

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28AMT2101

Mechanics

- The cannon, which is initially at rest, fires a cannonball of mass m kg with a speed of u m s⁻¹

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The duration of the force acting on the cannon due to the explosion is 0.002 s.

(ii) Find the average force that is exerted on the cannon in terms of m and u . [5]

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2 (In this question, $\mathbf{i}$ and $\mathbf{j}$ are perpendicular unit vectors in horizontal and vertical directions, respectively.)

A ball is projected from a point whose position vector is $10\mathbf{j}$ m relative to a fixed point O.

The ball's velocity of projection is $(23\mathbf{i} + 49\mathbf{j})\text{ m s}^{-1}$

The ball moves under gravity.

- (i) Show that at time t seconds after projection, the position vector of the ball relative to O is

$$[23t \mathbf{i} + (10 + 49t - 4.9t^2) \mathbf{j}] \text{ m}$$

[5]

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[5]

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[1]

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28AMT2105

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.

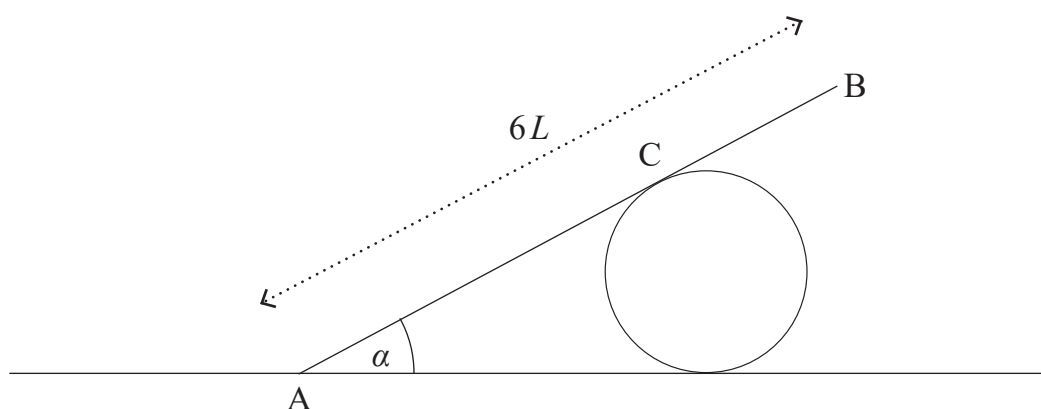
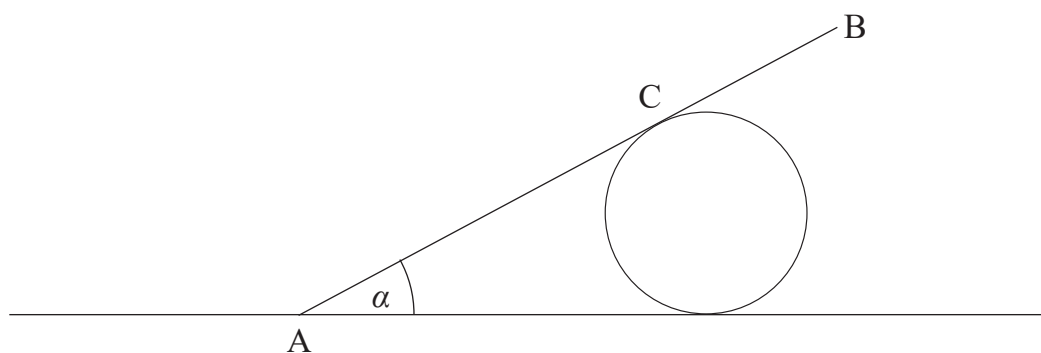


Fig. 1

(i) Complete the diagram below showing all the external forces acting on the plank.



[3]



The reaction at C between the cylinder and the plank is $\frac{3}{5}$ Mg newtons.

(ii) By taking moments about A find the value of α .

[5]

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28AMT2107

[7]



28AMT2108

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[Turn over



28AMT2109

- 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.

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- (ii) Find its velocity at B.

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

[6]

[illegible]

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28AMT2111

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(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]

[illegible]

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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]

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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 p -value for the test to be 0.00845

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

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

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(iv) If instead the economist had tested $H_1: \rho \neq 0$, what would his conclusion have been?

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[illegible]

[4]

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[2]

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28AMT2123

[2]

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[2]

[illegible]

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28AMT2125

The examination contained 40 questions and Daniel got 12 of his answers correct.

- (iv) Complete the hypothesis test, stating clearly whether the teacher's suspicion is justified.

[7]

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THIS IS THE END OF THE QUESTION PAPER



28AMT2127

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	Marks
1	
2	
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9	

Total Marks	
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Examiner Number

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