

New
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ADVANCED
General Certificate of Education

Centre Number

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Mathematics

Assessment Unit A2 2

assessing

Applied Mathematics



[AMT21]

AMT21

Assessment

TIME

1 hour 30 minutes.

Assessment Level of Control:

Tick the relevant box (✓)

Controlled Conditions	
Other	

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, on blank pages or tracing paper.

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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32AMT2101

Answer all questions.

SECTION A

Mechanics

1 A farmer is placing fence posts around the sides of a field. He does this using a pile-driver which is dropped, from rest, from a height 2 m above each post.

(i) Find the speed of the pile-driver just before it strikes the post. [2]

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- 2 John is taking part in a school science experiment. He has to create a rocket that can be projected at an angle of 60° to the horizontal and fly across the school pond as shown in Fig. 1 below.

A and B are on the same horizontal level.

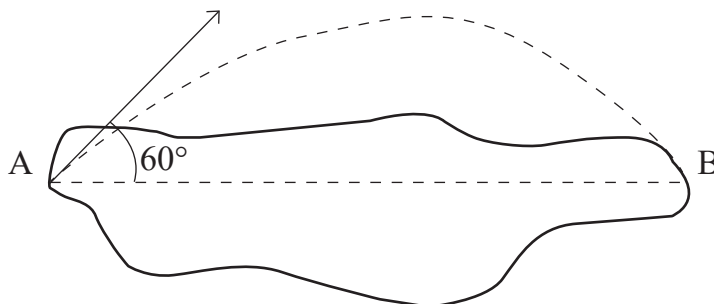


Fig. 1

The rocket is projected from A and must land at B.

- (i) Show that the time of flight T seconds is such that

$$T = \frac{\sqrt{3}u}{g}$$

where $u \text{ ms}^{-1}$ is the initial speed of the rocket.

[4]

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The distance AB is 12.6 m.

- (ii) Hence find the speed at which John should project his rocket to be successful in the experiment. [3]

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(iii) Assuming u remains the same, suggest a change that could be made to maximise the horizontal distance covered by the rocket. [1]





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3 Andrew and Steven play on a see-saw.

Andrew has mass m_1 kg.

Steven has mass m_2 kg where $m_2 > m_1$

The see-saw AB has length 5 m and mass 15 kg.

The pivot P is at the midpoint.

Steven assumes the see-saw to be uniform and calculates that he should sit a distance of x metres from the centre of the see-saw for it to balance with Andrew at A as shown in Fig. 2 below.

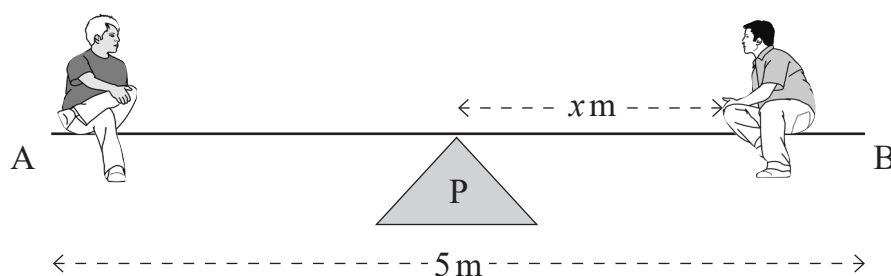


Fig. 2

(i) Find, in terms of m_1 and m_2 , the distance x .

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When Steven sits this distance from the centre, the see-saw starts to rotate about the pivot and his side of the see-saw lowers.

(ii) Using this information, what can you state about the see-saw? [1]

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32AMT2113

- 4 (a) A particle, initially at rest, starts to move from point O.
At time t seconds the velocity \mathbf{v} ms^{-1} is given by

$$\mathbf{v} = 2t\mathbf{i} + 2t^2\mathbf{j}$$

- (i) Find the acceleration of the particle when $t = 4$ [3]

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- (ii) Find an expression for the displacement of the particle from O, at time t seconds and hence show that the particle never returns to O. [7]

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SECTION B

Statistics

- 5 Neil is a zoologist. He is investigating the correlation between the mass of an animal's brain and the mass of its heart.

Neil decides to carry out a hypothesis test.
He states the following hypothesis:

$$H_0: \rho = 0$$

$$H_1: \rho > 0$$

where ρ is the population correlation coefficient.

- (i) Is this test one-tailed or two-tailed? [1]

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For a sample of 12 animals, Neil calculates the product-moment correlation coefficient to be $r = 0.715$

At the 5% level of significance, the critical value for Neil's test is 0.4973

- (ii) Using this value, what conclusion can Neil draw? [2]

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(iii) Write down the probability of incorrectly rejecting H_0 for this test. [1]

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(ii) $P(Y | \bar{X})$, where \bar{X} is the complement of event X .

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The auctioneer notices that an antique he is about to sell is fake.

(ii) Find the probability that this antique was supplied by Bill. [3]

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7 The standby times of a type of smartphone, π -phone, are normally distributed with mean 180 hours and standard deviation 8 hours.

(i) Find the probability that a randomly selected π -phone has a standby time of more than 195 hours. [4]

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(ii) Hence find the percentage of π -phones with a standby time between 165 hours and 195 hours. [4]

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Smartphones with a standby time of less than T hours are unsuitable for sale.

(iii) Given that 2.5% of π -phones are found to be unsuitable for sale, find the value of T . [4]

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(ii) Using a 5% level of significance, test the doctor's suspicion.

[8]

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For Examiner's use only	
Question Number	Marks
1	
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Total Marks	
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Examiner Number

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