

Centre Number				

Candidate Number

ADVANCED General Certificate of Education

Mathematics

Assessment Unit A2 2 assessing **Applied Mathematics**

AMT21

[AMT21]

TIME

Assessment

Assessment Level of Control:

Tick the relevant box (✓)

1 hour 30 minutes.

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 $\ln z \equiv \log_2 z$ 12390

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Answer all questions.

SECTION A

Mechanics

(I)	Find the speed of the pile-driver just before it strikes the post.

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Find the speed of the pile-driver and post immediately after impact. [5]

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The post and pile-driver come to rest after travelling a distance of 0.05 m.	Assume the
resistive force created by the ground is constant.	

[2	Find the magnitude of this resistive force.
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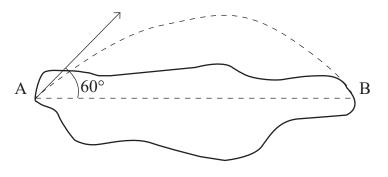
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[4]

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.





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

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(ii) Assuming <i>u</i> remains the same, suggest a change that could be made to maximise the horizontal distance covered by the rocket. [1]			
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Andrew and Steven play on a see-saw. Steven has mass m_2 kg where $m_2 > m_1$

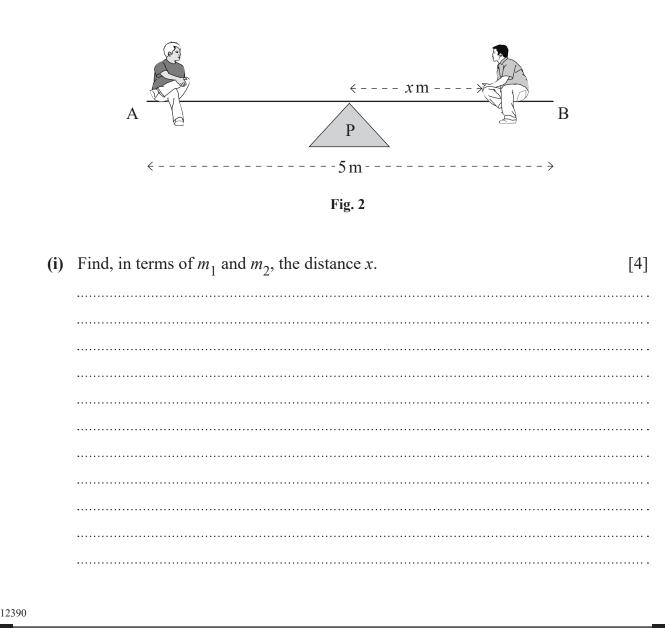
The see-saw AB has length 5 m and mass 15 kg.

The pivot P is at the midpoint.

And rew has mass m_1 kg.

3

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.





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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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(ii	i) Find, in terms of m_1 and m_2 , the position of the centre of gravity of the see-sa relative to A.



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		time <i>t</i> seconds the velocity $\mathbf{v} \mathbf{m} \mathbf{s}^{-1}$ is given by
		$\mathbf{v} = 2t\mathbf{i} + 2t^2\mathbf{j}$
	(i)	Find the acceleration of the particle when $t = 4$ [3]
	(ii)	Find an expression for the displacement of the particle from O, at time <i>t</i> seconds and hence show that the particle never returns to O. [7]
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(b)	A model car moving in a straight line has acceleration $a \text{ m s}^-$	2 at time
	<i>t</i> seconds where	

a = 4t - 1	1	
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[2]

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 :	ρ	=	0
Н ₁ :	ρ	>	0

where ρ is the population correlation coefficient.

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

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?

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6 (a) E	Events X and Y are such that	
	P(X) = 0.44 P(Y) = 0.79	
F	$P(X \cup Y) = 0.92$	
(Calculate	
((i) $P(X \cap Y)$ [2]	
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(b) Th	ree dealers, Anne, Bill and Carl supply antiques to an auction house.	
		nne supplies 45% of the antiques, Bill supplies 38% and the remaining antique e supplied by Carl.	s
	Th	st records indicate that 5% of the antiques supplied by Anne are fake. The percentages of antiques supplied by Bill and Carl which are fake are 7% and % respectively.	d
	Jaı	mes buys an antique from the auction.	
	(i)	Find the probability that the antique is fake.	[5]
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'he	auctioneer notices that an antique he is about to sell is fake.	
ne	ductioneer notices that an antique ne is about to sen is take.	
i)	Find the probability that this antique was supplied by Bill.	[3]
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(i)	Find the probability that a randomly selected π -phone has a standby time of more than 195 hours. [4]
(ii)	Hence find the percentage of π -phones with a standby time between 165 hours and 195 hours. [4]

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artphones with a standby time of less the Given that 2.5% of π -phones are found of <i>T</i> .	han <i>T</i> hours are unsuitable for sale. I to be unsuitable for sale, find the value [4



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Scores in an intelligence test are known to be normally distributed with mean 100 standard deviation 15
Lynsey wishes to test her theory that drinking coffee before the test affects your sc She selects a random sample of 80 adults and gives each a cup of coffee before the take the test.
Following the test, Lynsey calculates the mean score for this sample to be 104
Test Lynsey's theory using a 5% level of significance.

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9	Ad	rug to treat hay fever is claimed to be effective on 80% of sufferers.
		octor specialising in allergies suspects that the effectiveness of the drug has n overstated.
		takes a random sample of 20 of his patients whom he has treated with the drug and finds that the drug was effective on 12 of them.
	(i)	What assumptions need to be made for a binomial model to be appropriate in this context? [3]
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U	sing a 5% level of significance, test the doctor's suspicion.	[8]
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