

ADVANCED General Certificate of Education 2022

Mathematics

Assessment Unit A2 2 assessing Applied Mathematics

AMT21

Centre Number

Candidate Number

[AMT21] TUESDAY 14 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 $\ln z \equiv \log_e z$ 12950.05 R

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Answer all questions.

SECTION A

Mechanics

1	Bodies P and Q	are travelling in	the same direction	along the same	straight line.
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P has a of mass of 3 kg and a speed of 5 m s⁻¹ Q has a of mass of 2 kg and a speed of 2 m s⁻¹

P collides directly with Q.

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(i) If P and Q coalesce, find the velocity of the combined body after the collision. [4]

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(II	i) Find the impulse exerted on P by Q.	[2
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Its ₁	position vector \mathbf{r} metres, relative to O, at time t is given by
	r = 12t ² i + (−t ³ + 5t ² + 18t) j for 0 ≤ t ≤ 4
(i)	Find an expression for the velocity of the rocket at time <i>t</i> .

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(ii) Find the value of t when the acceleration of the rocket is parallel to the i vector.

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	$v = 5t^2 + 2t - 3$	
Ini	tially, the displacement of the particle is 0.5 m from O.	
(i)	Find an expression for the displacement of the particle from O at time <i>t</i> .	[
		•••••
(ii)	Find the distance travelled by the particle in the first 3 seconds.	
(ii)	Find the distance travelled by the particle in the first 3 seconds.	
(ii)	Find the distance travelled by the particle in the first 3 seconds.	
(ii)	Find the distance travelled by the particle in the first 3 seconds.	
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4 Fig. 1 below shows a golfer striking a golf ball. The golf ball is projected from a point O on horizontal ground.

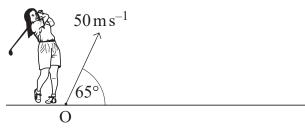


Fig. 1

It has an initial velocity of $50 \,\mathrm{m\,s^{-1}}$ at an angle of 65° to the horizontal.

	Find the magnitude and direction of its velocity after 4 seconds.
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-	$50 \mathrm{ms^{-1}}$ 65° 0 $-180 \mathrm{m}$		25 m	
	Fig. 2			
(ii) Determine whether the ball will clear the tre	e.		
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Fig. 2 below shows a tree in the plane of projection which is 180 m from O and

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5 Fig. 3 below shows a uniform rod AB of length 4 m and mass 8 kg. The rod is smoothly hinged at end A to a vertical wall.

One end of a light inextensible string of length 5 m is attached to the rod at a point C, where C is 1 m from B.

The other end of the string is attached to the wall at a point D vertically above A.

The rod rests in equilibrium in a horizontal position.

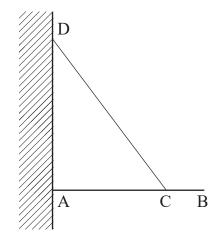
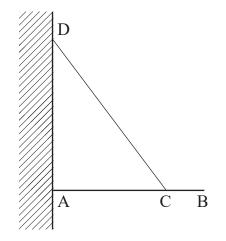


Fig. 3

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



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]	Define the term <i>null hypothesis</i> .	[
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SECTION B

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Over time, a mechanic has noticed that cars with smaller depths of tyre tread seem to
consume more fuel per mile.

He wishes to use a sample of 10 cars to test this observation.

For the sample, the mechanic calculates the product–moment correlation coefficient between the depth of tyre tread and fuel consumption per mile to be r = -0.6172

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(iii) State the critical region for the test.]
(iv) What conclusion can the mechanic draw from this information?	[
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(i)	Find the probability that a healthy adult, selected at random, has a systolic blood pressure of less than 125 mmHg. [2]

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(ii) Calculate the interquartile range of this distribution.

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A clinical trial is to be carried out involving healthy adults whose systolic blood pressure is below 104 mmHg or above 130 mmHg.(iii) Estimate the percentage of healthy adults who are eligible for the trial.	[6]
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	fisł	nanufacturer of nylon fishing lines claims that the breaking strength of its nylon ning lines is normally distributed with mean 3.5 kg and variance 0.43 kg ² lowing the installation of a new machine, the manager wishes to carry out a			
	hyp	bothesis test at the 5% level of significance to see if the breaking strength of the hing lines has increased.			
	In a	a random sample of 50 lines, the mean breaking strength is found to be 3.7 kg.	found to be 3.7 kg.		
	(i)	Calculate the value of the standardised test statistic.	[4		
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	$P(A \mid B) = 0.45$	$P(A \cap B) = 0.18$	and	P(B A) = 0.72	
(i)	Find the values of $P(A)$	and P(<i>B</i>).			[
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(ii)	Hence determine whether or not A and B are independent.	[2
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(iii) Using a Venn diagram, or otherwise, calculate $P(\overline{A} \cap \overline{B})$.

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10	The organisers of a large sporting competition believe that 15% of the athletes involved have taken a banned performance-enhancing substance.
	A journalist suggests that the number is more than 15%.
	The organisers wish to investigate the journalist's claim.
	A random sample of 20 athletes is taken and tested for the banned substance. Six of the athletes in the sample are found to have taken the banned substance.
	Test the journalist's claim at the 5% level of significance. [9]
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