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ADVANCED SUBSIDIARY (AS) General Certificate of Education 2019

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# **Mathematics**

Assessment Unit AS 2 assessing
Applied Mathematics



\*SMT21\*

[SMT21]

**WEDNESDAY 22 MAY, MORNING** 

#### TIME

1 hour 15 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, 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 70. The total available mark for each section of this paper is 35. 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  $g = 9.8 \,\mathrm{m \, s^{-2}}$ , 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  $\ln z \equiv \log_e z$ 



## Answer all questions.

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## **SECTION A**

## Mechanics

1 Fig. 1 below shows three forces acting on a particle.

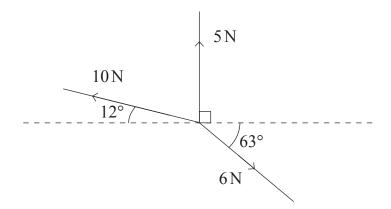


Fig. 1

Find the magnitude and direction of the resultant of these three forces. [6]



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2	Ac	drone is flown, with constant acceleration, in a horizontal plane.	
	Wł	nen initially observed, at a point P, it has a velocity of $(2\mathbf{i} - 7\mathbf{j}) \mathrm{ms}^{-1}$	
		ar seconds later the drone is at a point Q and has a velocity of $(14\mathbf{i} + \mathbf{j}) \mathrm{ms}^{-1}$	
	100		
	(i)	Find the acceleration of the drone in terms of <b>i</b> and <b>j</b> .	[3]
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(ii)	Find the distance PQ.	[5]
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**3 Fig. 2** below shows the velocity–time graph for an athlete running a 100 m race in 11.8 seconds.

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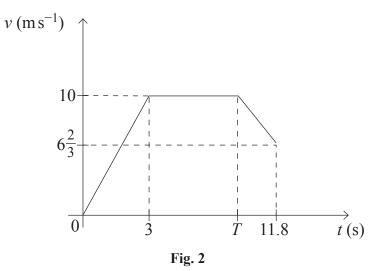
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(i)	Describe the motion of the athlete between $t = 0$ and $t = 3$	[1]

The athlete starts to decelerate at time T.

(ii)	Find the value of $T$ . [5]



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**4 Fig. 3** below shows two boxes, A and B, connected by a rope passing over a smooth, light, fixed pulley.

Box A is held at rest on a rough horizontal table 5 m from the pulley.

Box B hangs 2.5 m vertically above the floor.

A and B have masses 8 kg and 6 kg respectively.

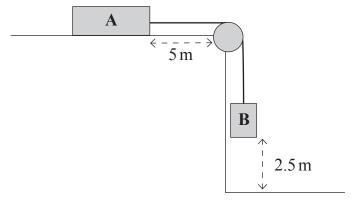


Fig. 3

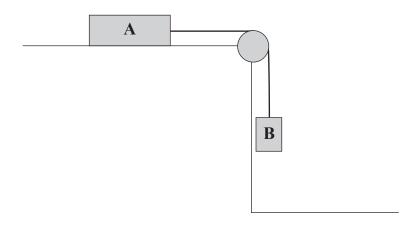
Box A is released from rest.

(i) Complete the diagram below showing all the external forces acting on A and B.

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(ii)	Find the value of the coefficient of friction between A and the table.	
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(iii	Determine whether box A will collide with the pulley. [4]
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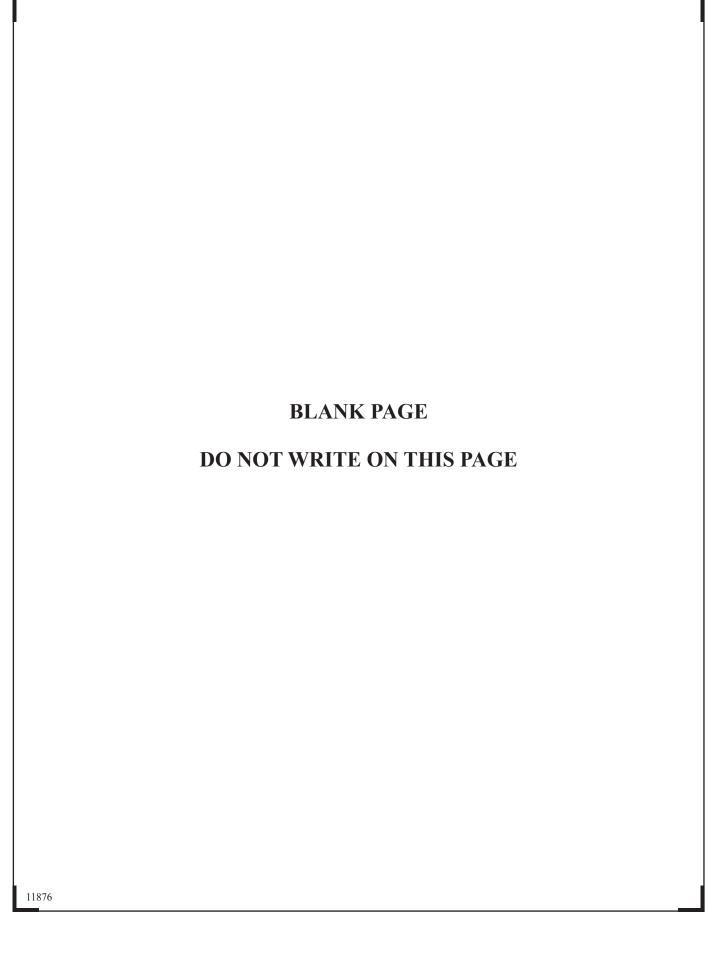
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(iv	v) State one modelling assumption you have made about the rope. [1]
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	SECTION B
	Statistics
(a)	Explain the difference between a census and a sample. [2]
<b>(b</b> )	A market researcher is interested to find out the opinions of nurses living in Northern Ireland.
(b)	
<b>(b</b> )	Northern Ireland.  To get a random sample, he questions women that he meets entering the Royal
(b)	Northern Ireland.  To get a random sample, he questions women that he meets entering the Royal Victoria Hospital on a Monday morning after 9 am.
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(11)	Show that £374 is an outlier.	
inc	rther investigations suggested that the weekly incomported and should in fact have been £347	
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**(b)** The histogram in **Fig. 4** below shows the weekly incomes, in £, of a random sample of households in a neighbourhood.

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## Histogram showing weekly incomes

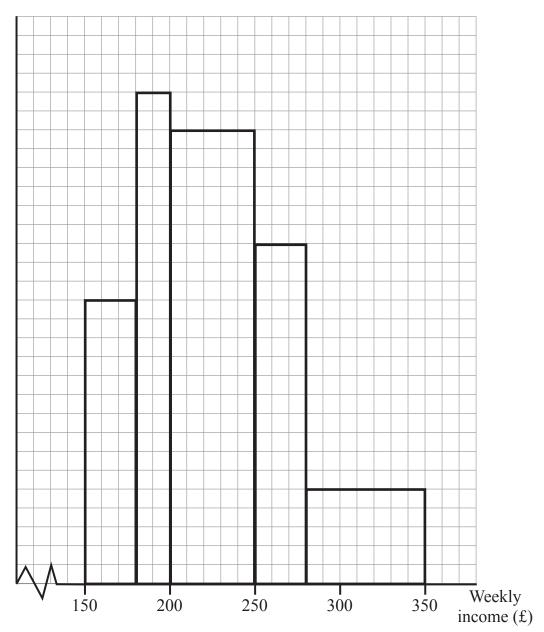


Fig. 4



Washir in sames (C)	Number of households	
Weekly incomes (£)	Number of households	_
150 –	45	
180 –	52	
200 –	120	
250 –		
280 –	35	
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350 –	ousehold chosen at random received	
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7 The percentage unemployment rate (U) and percentage change in average wages (W) per year were recorded over a period of 10 years. These are shown in **Table 1** below. Table 1 % Unemployment Rate (U) 2.1 2.5 1.8 1.7 2.2 1.5 1.8 2.3 1.6 1.6 % Change in Wages (W) 2.7 2.7 3.2 3.6 4.6 4.4 3.5 4.3 4.1 2.9 (i) Calculate the product moment correlation coefficient between U and W. [5] 11876

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(ii) Comment on the value obtained in part (i). [1]
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8		chool sports club has 15 members. The probability of any member, chosen at dom, being injured throughout the school year is $p$ .	
		<i>X</i> be the random variable "the number of members injured throughout the lool year".	
	(i)	Find an expression, in terms of $p$ , for $P(X = 1)$ [3]	]
	It is	s known that $P(X = 2) = 3P(X = 1)$	•
	(ii)	Prove that $p = 0.3$	]
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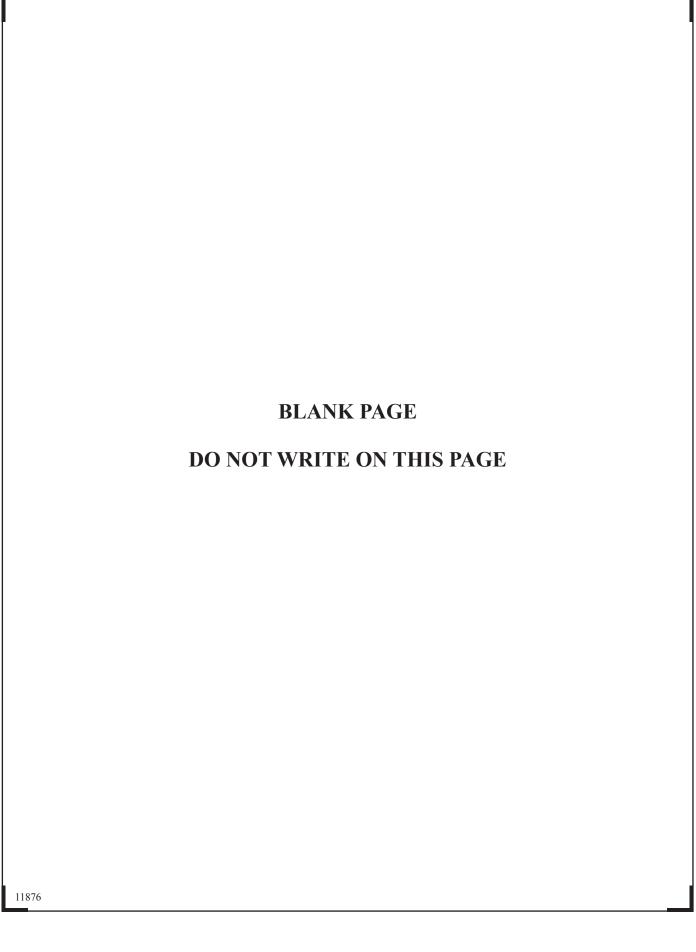
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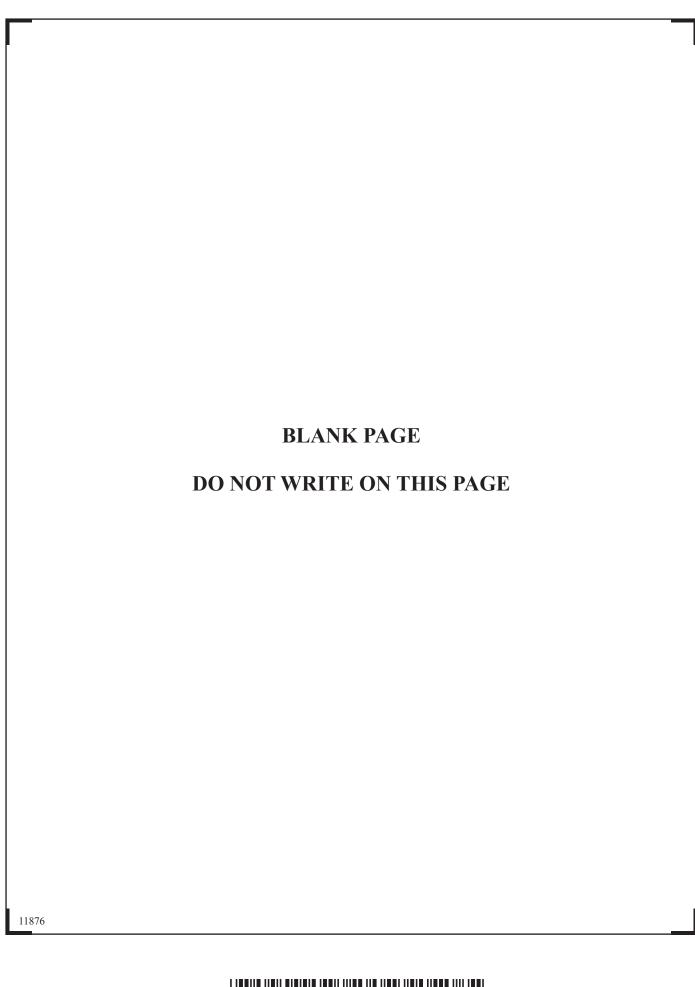
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