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ADVANCED SUBSIDIARY (AS) General Certificate of Education

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Mathematics

Assessment Unit AS 2

assessing

Applied Mathematics



SMT21

[SMT21]

Assessment

Assessment Level of Control:

Tick the relevant box (✓)

Controlled Conditions
Other

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

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| Αb | pall is projected vertically upwards from ground level with a speed of 30.4 m s ⁻¹ |
| (i) | Find the speed of the ball after two seconds. |
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| ii) State one modelling assumption made in answering this question. | i) Fi | ind the maximum height reached by the ball. | [|
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| | $\mathbf{F_1} = (3\mathbf{i} + 6\mathbf{j}) \text{ N}$ $\mathbf{F_2} = (2\mathbf{i} - 7\mathbf{j}) \text{ N}$ |
|-----|---|
| (i) | Find $\mathbf{F_3}$ |
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| If $\mathbf{F_2}$ and $\mathbf{F_3}$ are unchanged, find the magnitude of the acceleration produced and the angle it makes with the vector \mathbf{i} . |
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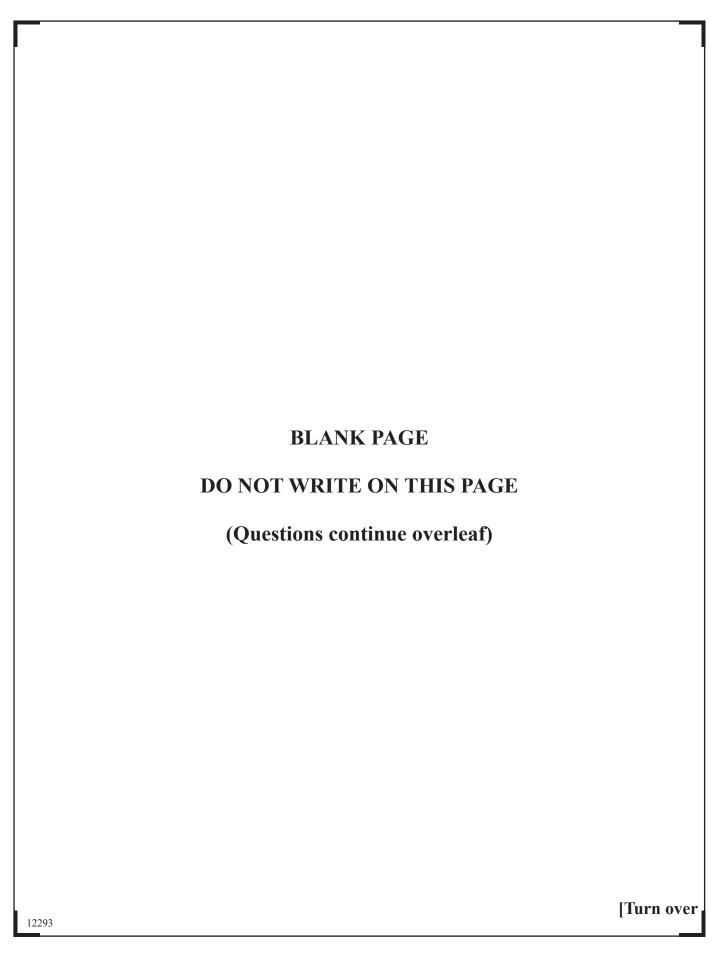




Fig. 1 below shows crates P and Q resting on two planes each inclined at 45° to the horizontal.

P and Q are connected using a light, inextensible string passing over a smooth, light fixed pulley.

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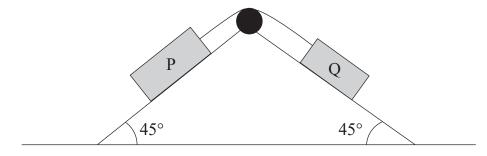


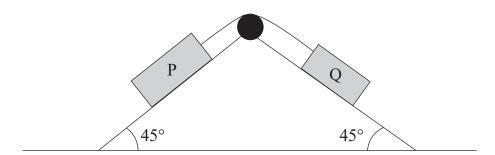
Fig. 1

P has mass $3m \log$ and rests on a smooth plane.

Q has mass $2m \log n$ and rests on a rough plane with coefficient of friction μ .

The system is released from rest and motion occurs.

(i) Complete the diagram below to show all the external forces acting on P and Q.



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| i) I | Find, in terms of μ and g, the acceleration produced. | [7 |
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| acceleration is found to be 1.3 m s ⁻² Find the value of μ . |
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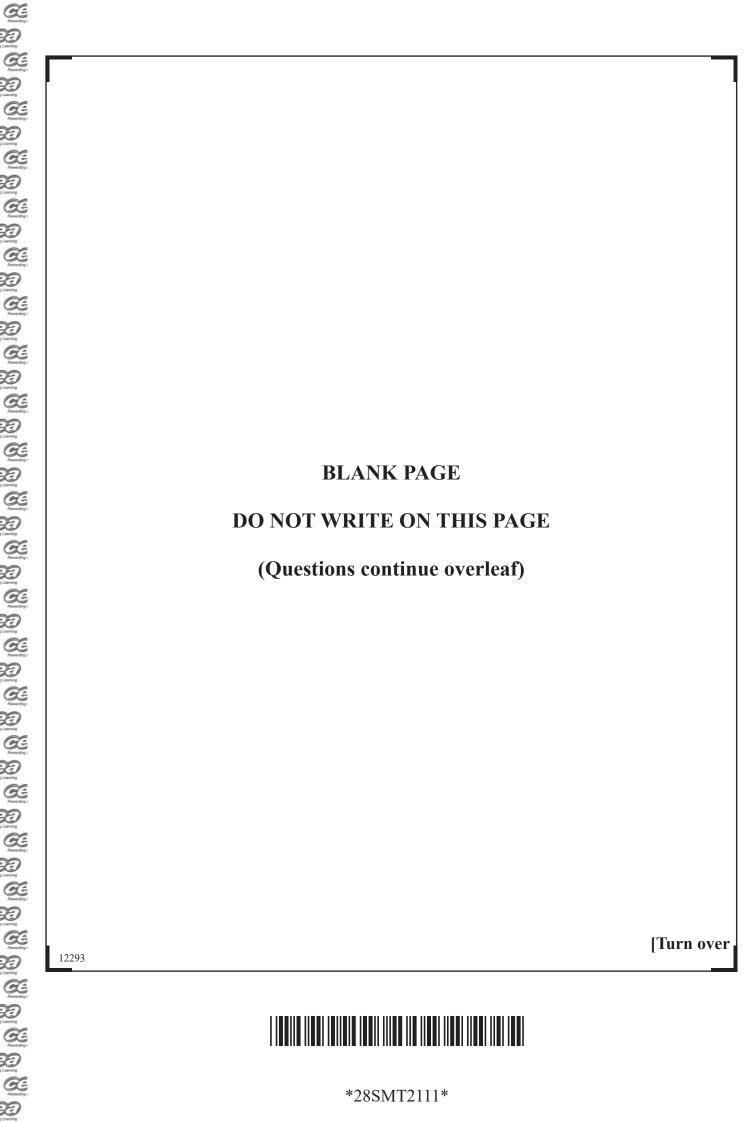
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| 4 | A car is travelling along a straight stretch of road at a constant speed of 30 m s ⁻¹ when it passes a stationary police motorcycle at time $t = 0$ seconds. | | | | | |
|-------|---|-----|--|--|--|--|
| | Two seconds later the police motorcycle gives chase accelerating from 0 m s^{-1} to 35 m s^{-1} with constant acceleration of 7 m s^{-2} | | | | | |
| | The police motorcycle maintains this speed of 35 m s ^{-1} until it catches up with the car at time T . | | | | | |
| | By drawing a velocity–time graph find the value of T . | 8] | | | | |
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SECTION B

Statistics

5 Over the past eight years, a farmer records the annual rainfall, x, in mm, and the annual yield of wheat, y, in bushels per hectare, on his farm.

Some of the summary values he calculated are:

$$\Sigma xy = 181397.65$$

$$\Sigma x^2 = 861132.58$$

$$\Sigma y^2 = 39042.42$$

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$$n = 8$$

$$\Sigma x = 2512.8$$

$$\Sigma y = 551.8$$

(i) Calculate the product-moment correlation coefficient between the annual rainfall and the annual yield of wheat. [5]

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| (ii) Comment on who | at the value obtained in (i) suggests to the farmer. | [1] |
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| Based on his data, the | e farmer calculates an equation of the y on x regression | line to be |
| | y = 33.7 + 0.112x | |
| (***) C: | | |
| regression line. | ration, in context, of the value of the gradient of this | [2 |
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6 (a) The random variable X can take the values 3, 4, 5, 6 or 7
 Table 1 below shows the probability that X takes each value.
 Table 1

| x | 3 | 4 | 5 | 6 | 7 |
|--------|-----|---|------|------|------------|
| P(X=x) | 0.2 | С | 0.47 | 0.09 | 3 <i>c</i> |

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| (1) | Find the value of c . | [2] |
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| | (ii) | Find $P(X < 5)$. | [2] |
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| (b) | | breakfast each day Ian eats either cereal or toast, and also drinks either fruit ce, tea or coffee. | | | |
|-----|-----|---|--|--|--|
| | The | e probability that Ian has toast is 0.4 | | | |
| | | probability that he has fruit juice is 0.64 and he is equally likely to have r tea or coffee. | | | |
| | On | a randomly chosen morning, find the probability that Ian | | | |
| | (i) | has coffee; [1] | | | |
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| (ii) | does not have toast or tea. | [2] |
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| | | lls is longer than the target of 15 seconds. ne Tuesday morning, she records the time taken, t seconds, to answer each of the est 800 calls to the centre. | | | | | | | |
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| | Soı | me summary values are: | | | | | | | |
| | | | n = 800 | | $\Sigma t = 13600$ |) | $\Sigma t^2 = 3666$ | 500 | |
| | (i) | Calculate t | the mean of the | he times | taken to ans | swer these | e calls. | | [2] |
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| (11) | What might this value suggest to the manager? | [|
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| (iii) | Calculate an estimate of the variance of the times taken to answer a call. | [2 |
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| V) | Suggest three improvements to the manager's strategy for sampling. |
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The manager remembers that, on the morning she collected the data, some staff were

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| | ty. Twenty components are randomly chosen and inspected. |
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| (i) | Find the probability that exactly two of the components in the batch are faulty. [3] |
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| te probability that no components are faulty in batches of this size cimal places. | e is 0.2957 to 4 |
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| i) Find the value of <i>n</i> . | |
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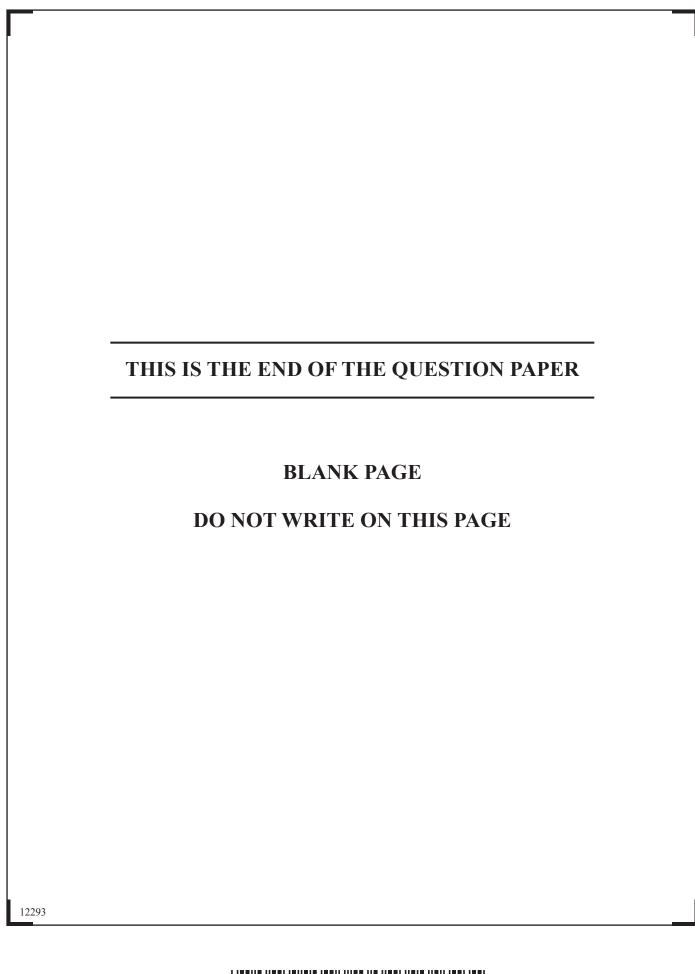
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