Do not write on these sheets.

For **Pearson Edexcel**
Level 3 GCE

Mathematics

Advanced Subsidiary
Paper 2: Statistics and Mechanics

Time: 1 hour 15 minutes | Churchill Paper 2A

You must have:
Mathematical Formulae and Statistical Tables, calculator

Total Marks

Instructions

- There are **two** sections in this question paper. Answer **all** the questions in Section A and **all** the questions in Section B.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 9 questions in this question paper. The total mark for this paper is 60.
- The marks for each question are shown in brackets
  - use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Churchill Maths

Written by Shaun Armstrong

SECTION A: STATISTICS

Answer ALL questions.

1 A factory manager decides to ask a sample of employees about changes to the working week. She decides to take a sample stratified by age.

This table gives information about the ages of all employees at the factory.

Age in years	Number of Employees
20 to 29	95
30 to 39	71
40 to 54	27
55 to 69	33

The manager decides to take a sample of size 40.

(a) Show that the sample should include 17 employees aged 20 to 29 and find the number required from each of the other age groups.

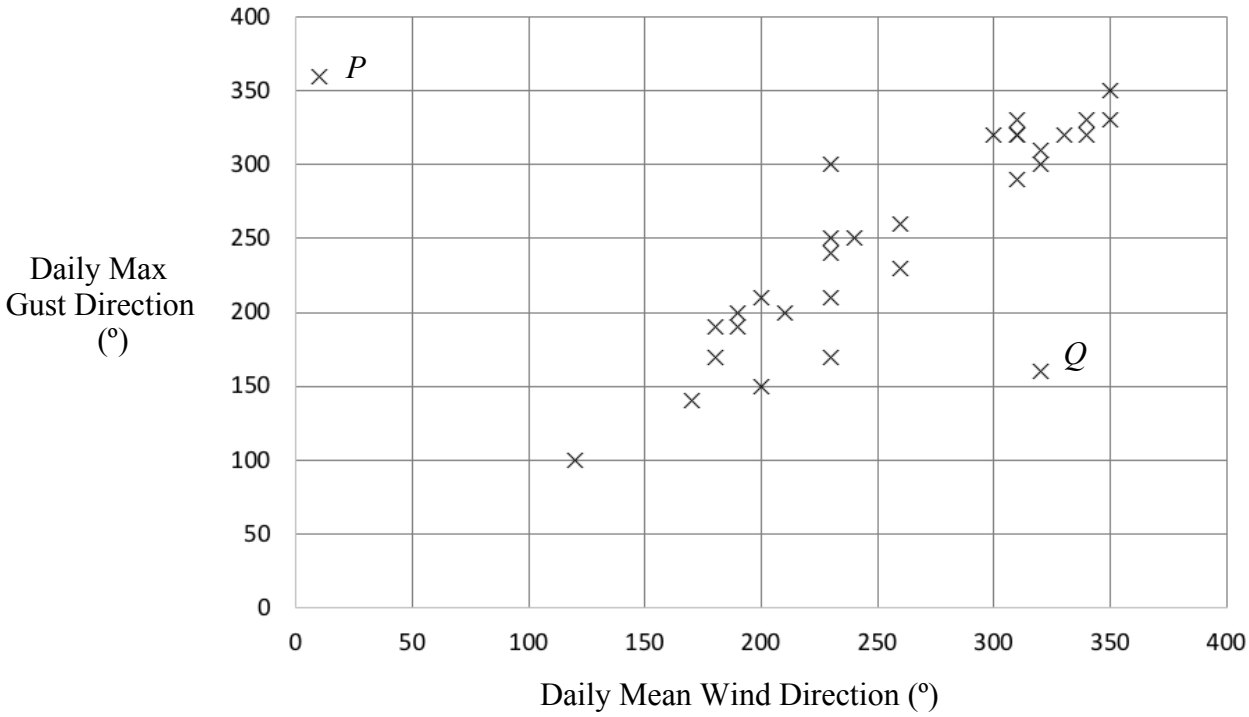
(3)

To select the sample the manager stands by the company gates at the end of a working day. She asks the first 17 employees aged 20 to 29 who come past her to fill in a short questionnaire and does likewise with the other age groups.

(b) Explain why this sample is likely to be biased.

(1)

2 The scatter diagram shows information from the large data set on the wind direction for Hurn in August 1987.



(a) Describe the nature of the relationship shown by this diagram.

(1)

(b) Giles says "The data points labelled P and Q probably come from errors in recording the data."

Giving reasons, say for each of the points P and Q whether you think Giles is likely to be correct.

(2)

The daily mean visibility, V Dm, for the same month in Hurn is summarised in this table.

Visibility	Frequency
$450 \leq V < 1150$	7
$1150 \leq V < 1950$	8
$1950 \leq V < 2350$	4
$2350 \leq V < 2950$	7
$2950 \leq V < 3750$	5

(c) Calculate an estimate for the mean and the standard deviation of the daily mean visibility for Hurn in August 1987.

(3)

3 *(a)* Given that $X \sim \text{B}(n, \frac{1}{6})$ and that $\text{P}(X = 0) = \text{P}(X = 1)$, find the value of n.

(2)

(b) The discrete random variable Y has the following probability distribution where k is a constant:

y	2	3	4	5
$\text{P}(Y = y)$	k	k^2	$2k$	$\frac{3}{4}k$

Find $\text{P}(Y \leq 3)$.

(4)

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4 A farm sells boxes of 6 eggs to supermarkets. The farm claims that 98% of the boxes it delivers to a supermarket will not contain any cracked eggs.

A supermarket manager believes the farm is claiming too high a percentage of boxes without any cracked eggs. He decides to test this by taking a sample of 60 boxes.

(a) The eggs are delivered in crates, each containing 120 boxes.

Explain why the manager's sample should not all be taken from the next crate that is delivered.

(1)

In the manager's sample, two boxes had 1 cracked egg and one box had 3 cracked eggs.

(b) Carry out a hypothesis test at the 10% significance level to find out if the supermarket manager's belief is right.

(6)

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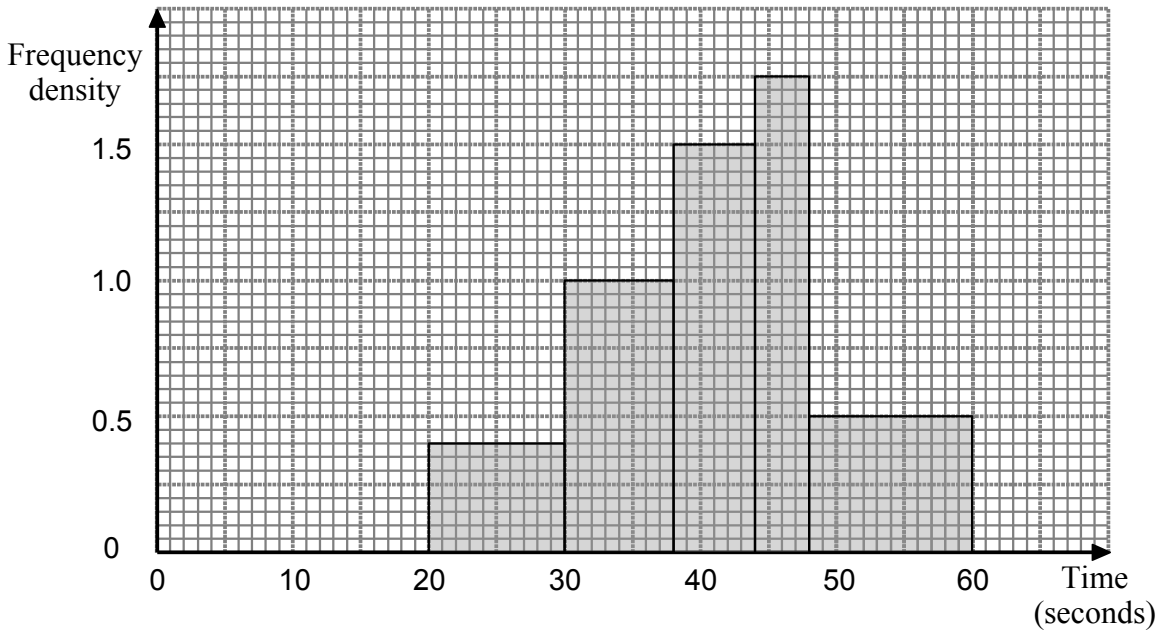
5 This histogram represents the time taken by 34 females to do 30 star jumps.



(a) Use the diagram to estimate

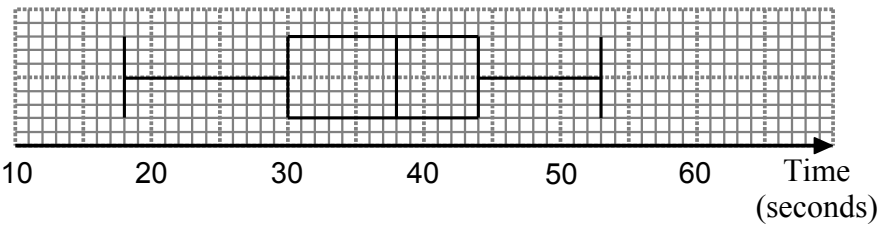
(i) the number of these females who took less than 35 seconds to do 30 star jumps,

(2)

(ii) the median time for these females to do 30 star jumps.

(2)

This boxplot summarises the time taken by a group of males to do 30 star jumps.



One person is chosen at random from the group of females and one person is chosen at random from the group of males.

(b) Calculate the probability that at least one of the two people chosen took longer than 38 seconds to do 30 star jumps.

You may assume than no individual took exactly 38 seconds.

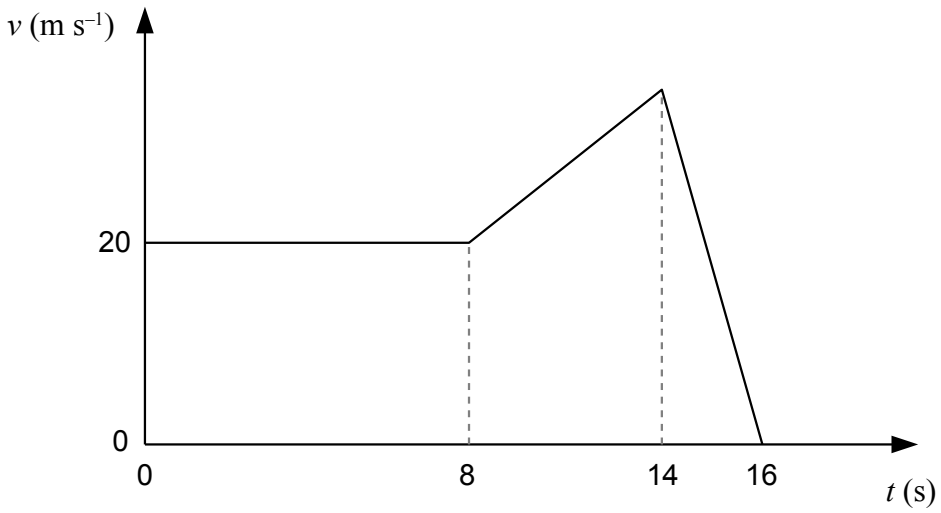
(3)

TOTAL FOR SECTION A IS 30 MARKS

SECTION B: MECHANICS

Answer ALL questions.

6



The velocity-time graph of a motorbike moving along a straight road is shown above. The velocity, v m s^{-1}, is shown at time t s after the motorbike passed a junction.

Given that the motorbike stopped 340 m from the junction,

(a) find the maximum velocity of the motorbike after it passed the junction.

(4)

During the 16 seconds after passing the junction, the motorbike had a period of constant acceleration and a period of constant deceleration.

(b) Show that the magnitude of the motorbike's deceleration was 9 times the magnitude of its acceleration.

(3)

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7 In this question the unit vectors **i** and **j** are in the directions east and north respectively.

A particle of mass 3 kg is initially at rest on a horizontal plane.

Three forces are acting on the particle.
The forces are $(4\mathbf{i} - \mathbf{j})$ N, $(-11\mathbf{i} + 14\mathbf{j})$ N and $(3\mathbf{i} - 6\mathbf{j})$ N.

(a) Work out the magnitude of the acceleration of the particle.

(4)

(b) Find how far the particle travels in the 4th second of its motion.

(3)

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8 A drone is at rest on the ground.

The drone begins to move in a vertical straight line such that after t seconds its velocity, v m s^{-1}, can be modelled by

$$v = 0.1(3t^2 - 32t + 64)$$

(a) Show that after 1 second the drone is 4.9 metres above the ground.

(4)

(b) *(i)* Find out how long it takes before the drone next comes to instantaneous rest.

(3)

(ii) Describe what someone watching the drone would notice at this time.

(1)

(c) Explain why this model cannot be used for all positive values of t.

(1)

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9 A car moving at 12 m s^{-1} is towing a trailer along a straight horizontal road. The car and trailer are connected by a horizontal tow bar.

The mass of the car is 1100 kg and the mass of the trailer is 250 kg.

A driving force of 800 N acts on the car.
A resistive force of 300 N acts on the car.
A resistive force of 50 N acts on the trailer.

(a) Find the acceleration of the car.

(4)

The car moves with constant acceleration.

(b) Find the distance the car travels while accelerating from 12 m s^{-1} to 15 m s^{-1}.

(2)

(c) Explain why the driving force is unlikely to remain constant during this period of constant acceleration.

(1)

TOTAL FOR SECTION B IS 30 MARKS
TOTAL FOR PAPER IS 60 MARKS