

Please write clearly in block capitals.

Centre number

| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

Candidate number

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

Surname

Forename(s)

Candidate signature

I declare this is my own work.

A-level FURTHER MATHEMATICS

Paper 3 Statistics

Time allowed: 2 hours

Materials

- You must have the AQA Formulae and statistical tables booklet for A-level Mathematics and A-level Further Mathematics.
- You should have a scientific calculator that meets the requirements of the specification.
- You must ensure you have the other optional Question Paper/Answer Book for which you are entered (**either** Discrete **or** Mechanics). You will have 2 hours to complete **both** papers.

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer each question in the space provided for that question. If you require extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do **not** write outside the box around each page or on blank pages.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 50.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

| For Examiner's Use | |
|--------------------|------|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| TOTAL | |



Answer **all** questions in the spaces provided.

- 1** The random variable T follows a discrete uniform distribution and can take values 1, 2, 3, ..., 16

Find the variance of T

Circle your answer.

[1 mark]

1.25

18.75

21.25

21.33

- 2** The random variable X has probability density function

$$f(x) = \begin{cases} 1 & 0 < x \leq \frac{1}{2} \\ \frac{3}{8}x^{-2} & \frac{1}{2} < x \leq \frac{3}{2} \\ 0 & \text{otherwise} \end{cases}$$

Find $P(X < 1)$

Circle your answer.

[1 mark]

$\frac{1}{8}$

$\frac{3}{8}$

$\frac{5}{8}$

$\frac{7}{8}$



Turn over for the next question

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



0 3

3 The random variable X has an exponential distribution with probability density function $f(x) = \lambda e^{-\lambda x}$ where $x \geq 0$

3 (a) Show that the cumulative distribution function, for $x \geq 0$, is given by $F(x) = 1 - e^{-\lambda x}$
[3 marks]

3 (b) Given that $\lambda = 2$, find $P(X > 1)$, giving your answer to three decimal places.
[2 marks]



4 Daisies and dandelions are the only flowers growing in a field.

 The number of daisies per square metre in the field has a mean of 16

 The number of dandelions per square metre in the field has a mean of 10

 The number of daisies per square metre and the number of dandelions per square metre are independent.

4 (a) Using a Poisson model, find the probability that a randomly selected square metre from the field has a total of at least 30 flowers, giving your answer to three decimal places.

[3 marks]

4 (b) A survey of the entire field is taken.

 The standard deviation of the total number of flowers per square metre is 10

 State, with a reason, whether the model used in part (a) is valid.

[2 marks]

Turn over ►



5 (b) Padraig claims that the population mean mass of the apples is 85 grams.

He carries out a hypothesis test at the 1% level of significance using the random sample of 12 apples.

The hypotheses are

$$H_0: \mu = 85$$

$$H_1: \mu \neq 85$$

State, with a reason, whether the null hypothesis is accepted or rejected.

[1 mark]

5 (c) Interpret, in context, the conclusion to the hypothesis test in part (b).

[1 mark]

Turn over for the next question

Turn over ►



6 (b) The continuous random variable Y is independent of X and has variance 15

Find $\text{Var}(X - 2Y - 11)$

[2 marks]

Turn over for the next question

Turn over ►



7 A scientist is investigating the air quality in two countries, *A* and *B*

Measurements of the air quality are taken at sites throughout both countries and assigned a rank.

The air quality is given Rank 1 if the level of air pollution is lower than a specified threshold.

The air quality is given Rank 2 if the level of air pollution is higher than the specified threshold.

A random sample of 500 measurements is collected.

The results are summarised in the following table.

| | | Air Quality | | |
|---------|----------|-------------|--------|-------|
| | | Rank 1 | Rank 2 | Total |
| Country | <i>A</i> | 87 | 101 | 188 |
| | <i>B</i> | 167 | 145 | 312 |
| | Total | 254 | 246 | 500 |

The scientist claims that there is an association between country and air quality.

7 (a) Test the scientist's claim, using the 10% level of significance.

[8 marks]



Do not write
outside the
box

7 (b) For the context of the test carried out in part (a), state the meaning of a Type I error. **[1 mark]**

Turn over for the next question

Turn over ►



8 The continuous random variable X has cumulative distribution function $F(x)$ where

$$F(x) = \begin{cases} 0 & x = 0 \\ e^{kx} - 1 & 0 \leq x \leq 5 \\ 1 & x > 5 \end{cases}$$

8 (a) Show that $k = \frac{1}{5} \ln 2$

[2 marks]

8 (b) Show that the median of X is $a \frac{\ln b}{\ln 2} - c$, where a , b and c are integers to be found.

[3 marks]



8 (c) Show that the mean of X is $p - \frac{q}{\ln 2}$, where p and q are integers to be found.

[6 marks]

Turn over ►



9 Lianne models the maximum time in hours that a rechargeable battery can be used, before needing to be recharged, with a rectangular distribution with values between 8 and 12

9 (a) The probability that the maximum time the battery can be used before needing to be recharged is more than 10.5 hours is equal to p

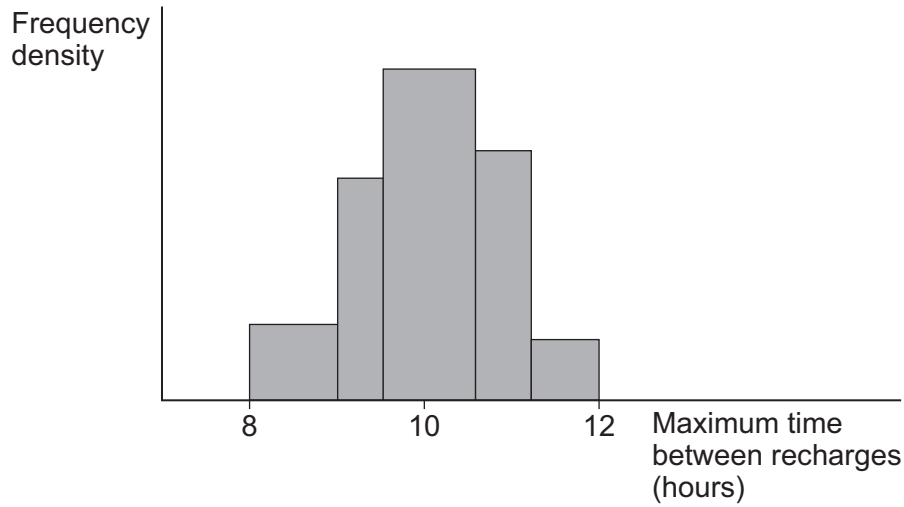
Lianne will only buy the battery if p is more than 0.4

Determine whether Lianne will buy the battery.

[2 marks]



9 (b) A histogram is plotted for 100 recharges showing the maximum time the battery can be used before needing to be recharged.



Explain why the model used in part (a) may not be valid and suggest the name of a different distribution that could be used to model the maximum time between recharges.

[2 marks]

END OF QUESTIONS



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Copyright information

For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from www.aqa.org.uk.

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team.

Copyright © 2022 AQA and its licensors. All rights reserved.



2 0

Jun22/7367/3S



2 2 6 A 7 3 6 7 / 3 S