



## Cambridge International AS & A Level

CANDIDATE  
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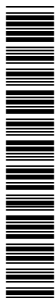
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**MATHEMATICS**

**9709/63**

Paper 6 Probability & Statistics 2

**May/June 2022**

**1 hour 15 minutes**

You must answer on the question paper.

You will need: List of formulae (MF19)

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

### INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.



2 Anton believes that 10% of students at his college are left-handed. Aliya believes that this is an underestimate. She plans to carry out a hypothesis test of the null hypothesis  $p = 0.1$  against the alternative hypothesis  $p > 0.1$ , where  $p$  is the actual proportion of students at the college that are left-handed. She chooses a random sample of 20 students from the college. She will reject the null hypothesis if at least 5 of these students are left-handed.

(a) Explain what is meant by a Type I error in this context. [1]

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(b) Find the probability of a Type I error in the test. [3]

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(c) Given that the true value of  $p$  is 0.3, find the probability of a Type II error in the test. [2]

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3 Batteries of type *A* are known to have a mean life of 150 hours. It is required to test whether a new type of battery, type *B*, has a shorter mean life than type *A* batteries.

(a) Give a reason for using a sample rather than the whole population in carrying out this test. [1]

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A random sample of 120 type *B* batteries are tested and it is found that their mean life is 147 hours, and an unbiased estimate of the population variance is 225 hours<sup>2</sup>.

(b) Test, at the 2% significance level, whether type *B* batteries have a shorter mean life than type *A* batteries. [5]

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5 The number of clients who arrive at an information desk has a Poisson distribution with mean 2.2 per 5-minute period.

(a) Find the probability that, in a randomly chosen 15-minute period, exactly 6 clients arrive at the desk. [3]

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(b) If more than 4 clients arrive during a 5-minute period, they cannot all be served.

Find the probability that, during a randomly chosen 5-minute period, not all the clients who arrive at the desk can be served. [2]

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6 A random sample of 5 values of a variable  $X$  is given below.

2    3    3    5     $a$

(a) Find an expression, in terms of  $a$ , for the mean of these values. [1]

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It is given that an unbiased estimate of the population variance of  $X$ , using these values, is 4. It is also given that  $a$  is positive.

(b) Find and simplify a quadratic equation in terms of  $a$  and hence find the value of  $a$ . [3]

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7 The random variables  $X$  and  $W$  have probability density functions  $f$  and  $g$  defined as follows:

$$f(x) = \begin{cases} p(a^2 - x^2) & 0 \leq x \leq a, \\ 0 & \text{otherwise,} \end{cases}$$

$$g(w) = \begin{cases} q(a^2 - w^2) & -a \leq w \leq a, \\ 0 & \text{otherwise,} \end{cases}$$

where  $a$ ,  $p$  and  $q$  are constants.

(a) (i) Write down the value of  $P(X \geq 0)$ . [1]

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(ii) Write down the value of  $P(W \geq 0)$ . [1]

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(iii) Write down an expression for  $q$  in terms of  $p$  only. [1]

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