



## Cambridge International AS & A Level

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**MATHEMATICS**

**9709/62**

Paper 6 Probability & Statistics 2

**February/March 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 **12** pages.

1 The lengths, in millimetres, of a random sample of 12 rods made by a certain machine are as follows.

200 201 198 202 200 199 199 201 197 202 200 199

(a) Find unbiased estimates of the population mean and variance. [3]

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(b) Give a statistical reason why these estimates may not be reliable. [1]

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- 2 Harry has a five-sided spinner with sectors coloured blue, green, red, yellow and black. Harry thinks the spinner may be biased. He plans to carry out a hypothesis test with the following hypotheses.

$$H_0: P(\text{the spinner lands on blue}) = \frac{1}{5}$$

$$H_1: P(\text{the spinner lands on blue}) \neq \frac{1}{5}$$

Harry spins the spinner 300 times. It lands on blue on 45 spins.

Use a suitable approximation to carry out Harry's test at the 5% significance level. [5]

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- 3 A random sample of 500 households in a certain town was chosen. Using this sample, a confidence interval for the proportion,  $p$ , of all households in that town that owned two or more cars was found to be  $0.355 < p < 0.445$ .

Find the confidence level of this confidence interval. Give your answer correct to the nearest integer.

[5]

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**4** In the past the time, in minutes, taken by students to complete a certain challenge had mean 25.5 and standard deviation 5.2. A new challenge is devised and it is expected that students will take, on average, less than 25.5 minutes to complete this challenge. A random sample of 40 students is chosen and their mean time for the new challenge is found to be 23.7 minutes.

**(a)** Assuming that the standard deviation of the time for the new challenge is 5.2 minutes, test at the 1% significance level whether the population mean time for the new challenge is less than 25.5 minutes. [5]

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**(b)** State, with a reason, whether it is possible that a Type I error was made in the test in part (a). [1]

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5 The heights of buildings in a large city are normally distributed with mean 18.3 m and standard deviation 2.5 m.

(a) Find the probability that the total height of 5 randomly chosen buildings in the city is more than 95 m. [4]

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- (b) Find the probability that the difference between the heights of two randomly chosen buildings in the city is less than 1 m. [5]

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- 6 In a game a ball is rolled down a slope and along a track until it stops. The distance, in metres, travelled by the ball is modelled by the random variable  $X$  with probability density function

$$f(x) = \begin{cases} -k(x - 1)(x - 3) & 1 \leq x \leq 3, \\ 0 & \text{otherwise,} \end{cases}$$

where  $k$  is a constant.

- (a) Without calculation, explain why  $E(X) = 2$ . [1]

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- (b) Show that  $k = \frac{3}{4}$ . [3]

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(c) Find  $\text{Var}(X)$ .

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One turn consists of rolling the ball 3 times and noting the largest value of  $X$  obtained. If this largest value is greater than 2.5, the player scores a point.

(d) Find the probability that on a particular turn the player scores a point.

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- 7 (a) Two ponds, *A* and *B*, each contain a large number of fish. It is known that 2.4% of fish in pond *A* are carp and 1.8% of fish in pond *B* are carp. Random samples of 50 fish from pond *A* and 60 fish from pond *B* are selected.

Use appropriate Poisson approximations to find the following probabilities.

- (i) The samples contain at least 2 carp from pond *A* and at least 2 carp from pond *B*. [3]

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- (ii) The samples contain at least 4 carp altogether. [3]

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(b) The random variables  $X$  and  $Y$  have the distributions  $Po(\lambda)$  and  $Po(\mu)$  respectively. It is given that

- $P(X = 0) = [P(Y = 0)]^2$ ,
- $P(X = 2) = k[P(Y = 1)]^2$ , where  $k$  is a non-zero constant.

Find the value of  $k$ .

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**Additional Page**

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