

# Cambridge International AS & A Level

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## MATHEMATICS

**9709/63**

Paper 6 Probability &amp; Statistics 2

October/November 2021

**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.

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- 1** It is known that the height  $H$ , in metres, of trees of a certain kind has the distribution  $N(12.5, 10.24)$ . A scientist takes a random sample of 25 trees of this kind and finds the sample mean,  $\bar{H}$ , of the heights.

**(a)** State the distribution of  $\bar{H}$ , giving the values of any parameters. [2]

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**(b)** Find  $P(12 < \bar{H} < 13)$ . [3]

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- 2 The number of enquiries received per day at a customer service desk has a Poisson distribution with mean 45.2. If more than 60 enquiries are received in a day, the customer service desk cannot deal with them all.

Use a suitable approximating distribution to find the probability that, on a randomly chosen day, the customer service desk cannot deal with all the enquiries that are received. [4]

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- 3 A random sample of 75 students at a large college was selected for a survey. 15 of these students said that they owned a car. From this result an approximate  $\alpha\%$  confidence interval for the proportion of all students at the college who own a car was calculated. The width of this interval was found to be 0.162.

Calculate the value of  $\alpha$  correct to 2 significant figures.

[5]

[illegible]

- 4** A random variable  $X$  has probability density function given by

$$f(x) = \begin{cases} \frac{1}{18}(9 - x^2) & 0 \leq x \leq 3, \\ 0 & \text{otherwise.} \end{cases}$$

- (a)** Find  $P(X < 1.2)$ . [3]

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- (b)** Find  $E(X)$ . [3]

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The median of  $X$  is  $m$ .

- (c) Show that  $m^3 - 27m + 27 = 0$ . [3]

This image shows a full page of primary-ruled paper. It features approximately 20 horizontal dashed lines spaced evenly down the page, providing a guide for handwriting practice. The background is white, and there are no margins or other markings present.

- 5 (a) The proportion of people having a particular medical condition is 1 in 100 000. A random sample of 2500 people is obtained. The number of people in the sample having the condition is denoted by  $X$ .

- (i) State, with a justification, a suitable approximating distribution for  $X$ , giving the values of any parameters. [2]

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- (ii) Use the approximating distribution to calculate  $P(X > 0)$ . [2]

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[illegible]

- 6 The random variable  $T$  denotes the time, in seconds, for 100 m races run by Tania.  $T$  is normally distributed with mean  $\mu$  and variance  $\sigma^2$ . A random sample of 40 races run by Tania gave the following results.

$$n = 40 \quad \Sigma t = 560 \quad \Sigma t^2 = 7850$$

- (a) Calculate unbiased estimates of  $\mu$  and  $\sigma^2$ . [3]

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The random variable  $S$  denotes the time, in seconds, for 100 m races run by Suki.  $S$  has the independent distribution  $N(14.2, 0.3)$ .

- (b)** Using your answers to part **(a)**, find the probability that, in a randomly chosen 100 m race, Suki's time will be at least 0.1 s more than Tania's time. [5]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- 7 The masses, in grams, of apples from a certain farm have mean  $\mu$  and standard deviation 5.2. The farmer says that the value of  $\mu$  is 64.6. A quality control inspector claims that the value of  $\mu$  is actually less than 64.6. In order to test his claim he chooses a random sample of 100 apples from the farm.
- (a) The mean mass of the 100 apples is found to be 63.5 g.

Carry out the test at the 2.5% significance level. [5]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

- (b)** Later another test of the same hypotheses at the 2.5% significance level, with another random sample of 100 apples from the same farm, is carried out.

Given that the value of  $\mu$  is in fact 62.7, calculate the probability of a Type II error. [5]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dotted lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.



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