



# Cambridge International AS & A Level

CANDIDATE  
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## FURTHER MATHEMATICS

9231/42

Paper 4 Further Probability & Statistics

May/June 2024

1 hour 30 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 The times taken by members of a large cycling club to complete a cross-country circuit have a normal distribution with mean  $\mu$  minutes. The times taken,  $x$  minutes, are recorded for a random sample of 14 members of the club. The results are summarised as follows, where  $\bar{x}$  is the sample mean.

$$\bar{x} = 42.8$$

$$\Sigma(x - \bar{x})^2 = 941.5$$

Find a 95% confidence interval for  $\mu$ .

[4]

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



- 3 A factory produces metal discs. The manager claims that the diameters of these discs have a median of 22.0 mm. The diameters, in mm, of a random sample of 12 discs produced by this factory are as follows.

22.4 20.9 22.8 21.5 23.2 22.9 23.9 21.7 19.8 23.6 22.6 23.0

- (a) Carry out a Wilcoxon signed-rank test, at the 10% significance level, to test whether there is any evidence against the manager's claim. [7]

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

- (b) State an assumption that is necessary for this test to be valid. [1]

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- 4 The random variable  $Y$  is the sum of two independent observations of the random variable  $X$ . The probability generating function  $G_Y(t)$  of  $Y$  is given by

$$G_Y(t) = \frac{t^2}{(4-3t)^4}.$$

- (a) Find  $E(Y)$ . [3]

This image shows a single sheet 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.

- (b)** Write down an expression for the probability generating function of  $X$ . [1]

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

(c) Find  $P(X = 4)$ .

[3]

[illegible]



[illegible]

**(b)** Compare the quality of the brushes produced by the two companies. [1]

This image shows a single sheet of white paper with ten horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and extend across the width of the page. There is no handwriting or other markings on the paper.



This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**(b)** State an assumption that is necessary for this test to be valid.

[1]

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The continuous random variable  $Y$  is defined by  $Y = X^2$ .

- (b) Find the probability density function of  $Y$ . [4]

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- (c) Find the exact value of the median of  $Y$ . [2]

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**Additional page**

If you use the following page to complete the answer to any question, the question number must be clearly shown.

[illegible]



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