



# Cambridge International AS & A Level

CANDIDATE  
NAMECENTRE  
NUMBER

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

CANDIDATE  
NUMBER

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

## FURTHER MATHEMATICS

9231/42

Paper 4 Further Probability &amp; Statistics

October/November 2025

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 **12** pages. Any blank pages are indicated.

**BLANK PAGE**

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN





- 1 A large company claims that the median salary of its employees is \$32 500. The salaries (\$) of 15 randomly selected employees are listed below.

|        |        |         |        |        |
|--------|--------|---------|--------|--------|
| 18 750 | 30 500 | 125 000 | 42 500 | 25 000 |
| 26 000 | 52 500 | 23 000  | 27 500 | 19 500 |
| 25 500 | 33 000 | 30 000  | 21 500 | 29 000 |

- (a) Explain why a Wilcoxon signed-rank test may not be appropriate to test the company's claim in this case. [1]

.....

.....

.....

.....

- (b)** Carry out a sign test at the 10% significance level to investigate the company's claim. [5]

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

- 2 A factory produces packets of biscuits. The total mass of biscuits in a packet has a normal distribution with mean  $\mu$ . A random sample of 12 packets is taken and the mass of the contents of each packet,  $x$  g, is recorded. The results are summarised as follows.

$$\sum x = 2390 \quad \sum x^2 = 476117$$

- (a) Find a 99% confidence interval for  $\mu$ . [4]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

A test of the null hypothesis  $\mu = k$  is carried out on this sample using a 5% significance level. The test does not support the alternative hypothesis  $\mu < k$ .

- (b) Find the greatest possible value of  $k$ . [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





- 3 A traffic expert claims that the number of breakdowns occurring each day on a busy section of a motorway follows a Poisson distribution with mean 0.7. The number of breakdowns each day over a 200-day period was recorded. The following table contains the observed frequencies together with some of the expected frequencies using the expert's distribution.

|                              |        |     |        |       |       |          |
|------------------------------|--------|-----|--------|-------|-------|----------|
| Number of breakdowns per day | 0      | 1   | 2      | 3     | 4     | $\geq 5$ |
| Observed frequency           | 88     | 73  | 26     | 7     | 3     | 3        |
| Expected frequency           | 99.317 | $m$ | 24.333 | 5.678 | 0.994 | $n$      |

- (a) Find the value of  $m$  and the value of  $n$ , correct to 3 decimal places. [2]

.....

.....

.....

- (b)** Carry out a goodness of fit test at the 5% significance level to investigate the expert's claim. [6]

[illegible]

- 4 A continuous random variable  $X$  has cumulative distribution function  $F$  given by

$$F(x) = \begin{cases} 0 & x < 1, \\ \frac{1}{5}x + a & 1 \leq x < 4, \\ \frac{1}{50}x^2 + b & 4 \leq x \leq 6, \\ 1 & x > 6, \end{cases}$$

where  $a$  and  $b$  are constants.

- (a) Find the value of  $a$  and the value of  $b$ .

[2]

.....

.....

.....

.....

.....

.....

.....

.....

- (b) Find the probability density function of  $X$ .

[2]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





(c) Given that  $E(X) = \frac{529}{150}$ , find  $\text{Var}(X)$ .

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(d) Find the 10th and 90th percentiles of  $X$ .

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....





- 5 An engineer is comparing the tensile strengths of steel rods made from two machines,  $A$  and  $B$ . The engineer randomly selects 8 rods from machine  $A$  and 6 rods from machine  $B$ . The tensile strengths, in appropriate units, are given in the following table.

|             |     |     |     |     |     |     |     |     |
|-------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Machine $A$ | 402 | 403 | 415 | 412 | 409 | 407 | 406 | 410 |
| Machine $B$ | 401 | 398 | 395 | 397 | 410 | 405 |     |     |

You should assume that the two distributions are normal and have the same population variance.

Use a  $t$ -test at the 5% significance level to test whether there is any difference in the mean tensile strengths of steel rods from the two machines. [9]

[illegible]



9

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.



6 The discrete random variable  $X$  has probability generating function  $G_X(t)$  given by

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

**(a)** Find  $E(X)$  and  $\text{Var}(X)$ .

[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.



The discrete random variable  $Y$  has probability generating function  $G_Y(t)$  given by

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

The random variable  $Z$  is the sum of the random variables  $X$  and  $Y$ .

(b) Assuming  $X$  and  $Y$  are independent, find  $P(Z > 4)$ .

[5]

[illegible]



## Additional page

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

[illegible]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cambridgeinternational.org](http://www.cambridgeinternational.org) after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.

