



Cambridge International AS & A Level

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MATHEMATICS**9709/61**

Paper 6 Probability & Statistics 2

October/November 2025**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.
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- 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.
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This document has **12** pages.

1 The random variables X and Y have independent distributions $X \sim \text{Po}(3)$ and $Y \sim \text{Po}(2)$ respectively.

(a) Find $P(2 < X < 5)$. [2]

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(b) Find $P(X + Y > 2)$. [3]

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(c) The total of 100 random values of X and 150 random values of Y is denoted by T .

Use a suitable approximating distribution to find $P(T < 560)$.

[4]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed 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.



- 2 The mean mass of packets of Trueleaf tea is supposed to be 500 grams. An inspector wishes to test whether this value is correct. He weighs 60 randomly chosen packets and notes the mass, x grams, of each packet. The results are summarised as follows.

$$n = 60 \quad \Sigma x = 29970 \quad \Sigma x^2 = 14970300$$

Test, at the 5% significance level, whether the population mean mass is 500 grams. [8]

[illegible]

- 3 The data produced by a certain data entry firm always include a small number of incorrect characters that occur at random. The proportion of incorrect characters is denoted by p , and experience has shown that $p = 0.0001$. A particular data set from the firm contains 14 500 characters, of which X characters are incorrect.

- (a) Use a suitable approximating distribution to find $P(X < 4)$. [3]

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The firm's management wishes to decrease the value of p by giving their employees some training. Their aim is that, for a data set containing 14 500 characters, the value of $P(X = 0)$ for the new value of p should be double the value of $P(X = 0)$ when $p = 0.0001$.

- (b) Use a suitable approximating distribution to find the new value of p . [3]

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- 4 The masses of a certain species of animal are known to be normally distributed with standard deviation σ kg. A researcher obtains the masses of a random sample of n animals of this species and uses these masses to find two confidence intervals ($\alpha\%$ and 90%) for the population mean. The width of the $\alpha\%$ confidence interval is $1.414 \times$ the width of the 90% confidence interval.

(a) Find α . [3]

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(b) Find the probability that the 90% confidence interval contains the population mean given that the $\alpha\%$ confidence interval contains the population mean. [1]

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- 5 It is known that 20% of households in a certain country contain more than 4 people. Laxmi believes that, in her town, the percentage is lower than 20%. She chooses a random sample of 40 households in her town and notes the number which contain more than 4 people. She then carries out a test at the 2.5% significance level using a binomial distribution.

(a) Find the probability of a Type I error.

[4]

[illegible]

(b) State the rejection region for the test.

[1]

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Laxmi finds that exactly 2 households in her sample contain more than 4 people.

(c) Explain why it is impossible for Laxmi to make a Type II error.

[1]

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- 6** The masses, in kilograms, of large and small bags of potatoes have the independent distributions $N(2.5, 0.05)$ and $N(0.8, 0.02)$ respectively.
- (a)** Find the probability that the total mass of a randomly chosen large bag of potatoes and a randomly chosen small bag of potatoes is more than 3.55 kg. [5]

[illegible]



- (b) Find the probability that the mass of a randomly chosen large bag of potatoes is less than 3 times the mass of a randomly chosen small bag of potatoes. [5]

[illegible]



- 7 The time, in minutes, taken by students to complete a test is modelled by the random variable X with probability density function

$$f(x) = \begin{cases} -\frac{3}{4}(x-3)(x-5) & 3 \leq x \leq 5, \\ 0 & \text{otherwise.} \end{cases}$$

- (a) Find the probability that a randomly chosen student takes longer than 4.5 minutes to complete the test. [4]

[illegible]



(b) Write down the median of X .

[1]

(c) Without performing an integration, use your answer to part (a) to find $P(3.5 < X < 4.5)$.

[2]





Additional page

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[illegible]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 2

October/November 2025

1 hour 15 minutes

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- 1** The number, X , of used computers donated to a charity has a constant average rate of 2.4 computers per week.

- (a) State a necessary condition for X to have a Poisson distribution. [1]

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Now assume that X has a Poisson distribution.

- (b) Calculate the probability that the number of computers donated during a 4-week period is more than 6 and less than 9. [3]

[illegible]

- (c) Use a suitable approximating distribution to calculate the probability that more than 50 computers are donated during a 20-week period. [4]

[illegible]

- 2 The random variable X has a normal distribution with mean 10 and standard deviation 3. The independent random variable Y has a Poisson distribution with mean 4.

(a) Find the standard deviation of $X + Y$. [3]

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(b) Find the standard deviation of $5X - Y$. [3]

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- 3 The times, in minutes, taken by students to complete a test have mean μ and standard deviation σ . The times taken by a random sample of 100 students are noted and are used to calculate a 95% confidence interval for μ .
- (a) Given that the end points of the 95% confidence interval are 31.02 and 33.98, correct to 4 significant figures, calculate the value of σ . [3]

[illegible]

- (b)** The calculation of the confidence interval required the use of the Central Limit theorem.

Explain why it is valid to use the Central Limit theorem in this case. [1]

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- (c) A researcher calculates a number, r , of 95% confidence interval for μ .

Find the largest value of r such that the probability that all r confidence intervals contain the true value of μ is greater than 0.5. [4]

[illegible]



- 4 An inspector believes that 18% of cups made at a certain factory contain flaws. The factory owner claims that the true percentage is less than 18%. The inspector examines a random sample of 40 cups and finds that 3 of them contain flaws.

- (a) Stating a necessary assumption, use a binomial distribution to test the factory owner's claim at the 5% significance level. [6]

This image shows a full page of white paper with horizontal dashed 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) Explain why it would **not** be appropriate to use the Poisson approximation to the binomial distribution to carry out the test in part (a). [1]

[illegible]



5 A random variable X has probability density function given by

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

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

[illegible]



The median of X is denoted by m .

- (b) (i)** Write down the value of $P(X \leq m)$. [1]

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- (ii) Hence find $P(E(X) \leq X \leq m)$. [5]

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- 6** The weekly profit, in dollars, made by a certain firm has a normal distribution. In the past, the weekly profit had the distribution $N(736, 26^2)$. Following a change in management, the mean weekly profit for 35 randomly chosen weeks is \$725.
- (a)** Stating a necessary assumption, test at the 2% significance level whether the mean weekly profit has decreased. [6]

[illegible]



The mean weekly profit for another random sample of 35 weeks is found and a similar test is carried out at the 2% significance level.

- (b) State the probability of a Type I error. [1]

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- (c) Given that the mean weekly profit is now in fact \$718, find the probability of a Type II error. [5]

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(b) Find $P(X + Y > 2)$. [3]

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(c) The total of 100 random values of X and 150 random values of Y is denoted by T .

Use a suitable approximating distribution to find $P(T < 560)$.

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- 2 The mean mass of packets of Trueleaf tea is supposed to be 500 grams. An inspector wishes to test whether this value is correct. He weighs 60 randomly chosen packets and notes the mass, x grams, of each packet. The results are summarised as follows.

$$n = 60 \quad \Sigma x = 29\,970 \quad \Sigma x^2 = 14\,970\,300$$

Test, at the 5% significance level, whether the population mean mass is 500 grams. [8]

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(a) Find α . [3]

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(b) Find the probability that the 90% confidence interval contains the population mean given that the $\alpha\%$ confidence interval contains the population mean. [1]

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- 5 It is known that 20% of households in a certain country contain more than 4 people. Laxmi believes that, in her town, the percentage is lower than 20%. She chooses a random sample of 40 households in her town and notes the number which contain more than 4 people. She then carries out a test at the 2.5% significance level using a binomial distribution.

(a) Find the probability of a Type I error.

[4]

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(b) State the rejection region for the test.

[1]

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Laxmi finds that exactly 2 households in her sample contain more than 4 people.

(c) Explain why it is impossible for Laxmi to make a Type II error.

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- 6** The masses, in kilograms, of large and small bags of potatoes have the independent distributions $N(2.5, 0.05)$ and $N(0.8, 0.02)$ respectively.
- (a)** Find the probability that the total mass of a randomly chosen large bag of potatoes and a randomly chosen small bag of potatoes is more than 3.55 kg. [5]

[illegible]



- (b) Find the probability that the mass of a randomly chosen large bag of potatoes is less than 3 times the mass of a randomly chosen small bag of potatoes. [5]

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- 7 The time, in minutes, taken by students to complete a test is modelled by the random variable X with probability density function

$$f(x) = \begin{cases} -\frac{3}{4}(x-3)(x-5) & 3 \leq x \leq 5, \\ 0 & \text{otherwise.} \end{cases}$$

- (a) Find the probability that a randomly chosen student takes longer than 4.5 minutes to complete the test. [4]

[illegible]



(b) Write down the median of X .

[1]

(c) Without performing an integration, use your answer to part (a) to find $P(3.5 < X < 4.5)$.

[2]





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[illegible]

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- 1 A student notes the length, t minutes, of certain lectures. The results for a random sample of 80 lectures are summarised as follows.

$$n = 80 \qquad \Sigma t = 6430 \qquad \Sigma t^2 = 519\,740$$

- (a) Calculate a 96% confidence interval for the population mean length of the lectures. [6]

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- (b) The method used in part (a) is valid because the sample size was large. Explain why the method would not be valid if the sample size were small. [1]

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- 2 A researcher is investigating whether the proportion of families who do not own a car in his town is different from the proportion of the population in the whole country, which is 10.1%. He takes a large random sample of families in his town and finds the proportion of families that do not own a car.

(a) Explain why a two-tailed test is appropriate in this context. [1]

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(b) State suitable null and alternative hypotheses for the test. [1]

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The researcher calculates the value of the test statistic z and finds that $z = 1.82$. He carries out the test at the 5% significance level.

(c) State the conclusion of the test, explaining your answer. [2]

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- 3 A certain website receives an average of μ hits per hour. In the past the value of μ was 14.4. After making some improvements, the owner of the website wishes to test whether the value of μ has increased. He chooses a 10-minute period at random and finds that there were 6 hits during this period. You may assume that the number of hits the website receives in any given time period follows a Poisson distribution.

(a) Carry out the test at the 2.5% significance level. [6]

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(b) Explain whether it is possible that a Type I error or a Type II error or both may have been made in carrying out the test. [2]

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4 A sports fan produces a magazine each month.

(a) On average 1 in 540 characters in the magazine is incorrect.

(i) Use an appropriate approximating distribution to find the probability that, in a magazine containing 2430 characters, there are at least 4 incorrect characters. [3]

[illegible]

(ii) Justify your approximating distribution. [1]

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(b) On average the number of copies, X , of the magazine sold per month is 123.4.

(i) State one condition for X to have a Poisson distribution.

[1]

You are now given that X has a Poisson distribution.

(ii) Use an appropriate approximating distribution to find the probability that in a randomly chosen month, more than 130 copies of the magazine are sold. [5]

[5]





- 5 The masses, in kg, of large and small bags of tomatoes have the distributions $L \sim N(2.10, 0.12)$ and $S \sim N(1.51, 0.09)$ respectively.

(a) Find $P(L > S + 0.5)$.

[5]

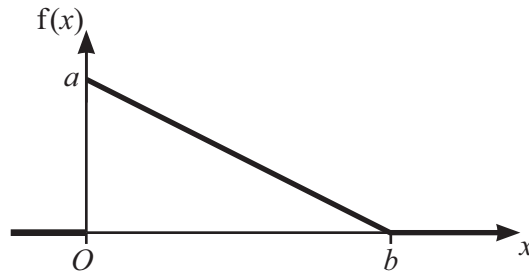
[illegible]



The price of tomatoes is \$4.30 per kg.

- (b) A large bag of tomatoes and a small bag of tomatoes are chosen at random. Find the probability that the total price of the tomatoes in the two bags is less than \$16. [5]

[illegible]



The diagram shows the graph of the probability density function, f , of a random variable X . The graph is a straight line from $(0, a)$ to $(b, 0)$ where a and b are constants. Elsewhere $f(x) = 0$.

- (a) Find an expression for b in terms of a . [2]

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- (b) Given that $E(X) = \frac{4}{9}$ find the value of a . [5]

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(c) Using the value of a found in part (b) find the value of k such that $P(X < k) = \frac{3}{4}$. [4]

[illegible]



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