

Cambridge International AS & A Level

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MATHEMATICS

9709/51

Paper 5 Probability & Statistics 1

October/November 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.
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- 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.

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- 1** The probability distribution table for a random variable X is shown below.

x	-2	-1	0.5	1	2
$P(X = x)$	0.12	p	q	0.16	0.3

Given that $E(X) = 0.28$, find the value of p and the value of q . [4]

[illegible]

- 2** The residents of Persham were surveyed about the reliability of their internet service. 12% rated the service as 'poor', 36% rated it as 'satisfactory' and 52% rated it as 'good'.

A random sample of 8 residents of Persham is chosen.

- (a)** Find the probability that more than 2 and fewer than 8 of them rate their internet service as poor or satisfactory. [3]

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A random sample of 125 residents of Persham is now chosen.

- (b)** Use an approximation to find the probability that more than 72 of these residents rate their internet service as good. [5]

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- 3 The Lions and the Tigers are two basketball clubs. The heights, in cm, of the 11 players in each of their first team squads are given in the table.

Lions	178	186	181	187	179	190	189	190	180	169	196
Tigers	194	179	187	190	183	201	184	180	195	191	197

- (a) Draw a back-to-back stem-and-leaf diagram to represent this information, with the Lions on the left. [4]

- (b) Find the median and the interquartile range of the heights of the Lions first team squad. [3]

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It is given that for the Tigers, the lower quartile is 183 cm, the median is 190 cm and the upper quartile is 195 cm.

- (c) Make two comparisons between the heights of the players in the Lions first team squad and the heights of the players in the Tigers first team squad. [2]

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- 4** In a large population, the systolic blood pressure (SBP) of adults is normally distributed with mean 125.4 and standard deviation 18.6.

(a) Find the probability that the SBP of a randomly chosen adult is less than 132. [2]

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The SBP of 12-year-old children in the same population is normally distributed with mean 117. Of these children 88% have SBP more than 108.

(b) Find the standard deviation of this distribution. [3]

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Three adults are chosen at random from this population.

- (c) Find the probability that each of these three adults has SBP within 1.5 standard deviations of the mean. [4]

This image shows a full page of a document template designed for handwriting practice or general note-taking. It consists of approximately 20 evenly spaced horizontal dotted lines across the entire width of the page. The background is plain white, and there are no margins, headers, footers, or other markings present.

- 5** A game is played with an ordinary fair 6-sided die. A player throws the die once. If the result is 2, 3, 4 or 5, that result is the player's score and the player does not throw the die again. If the result is 1 or 6, the player throws the die a second time and the player's score is the sum of the two numbers from the two throws.

(a) Draw a fully labelled tree diagram to represent this information. [2]

Events A and B are defined as follows.

A : the player's score is 5, 6, 7, 8 or 9

B : the player has two throws

(b) Show that $P(A) = \frac{1}{3}$. [3]

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- (c) Determine whether or not events A and B are independent. [2]

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- (d) Find $P(B \mid A')$. [3]

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- 6** A Social Club has 15 members, of whom 8 are men and 7 are women. The committee of the club consists of 5 of its members.
- (a)** Find the number of different ways in which the committee can be formed from the 15 members if it must include more men than women. [4]

[illegible]

The 15 members are having their photograph taken. They stand in three rows, with 3 people in the front row, 5 people in the middle row and 7 people in the back row.

- (b) In how many different ways can the 15 members of the club be divided into a group of 3, a group of 5 and a group of 7? [3]

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In one photograph Abel, Betty, Cally, Doug, Eve, Freya and Gino are the 7 members in the back row.

- (c) In how many different ways can these 7 members be arranged so that Abel and Betty are next to each other and Freya and Gino are not next to each other? [3]

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[illegible]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

October/November 2022

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

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- 1 On any day, Kino travels to school by bus, by car or on foot with probabilities 0.2, 0.1 and 0.7 respectively. The probability that he is late when he travels by bus is x . The probability that he is late when he travels by car is $2x$ and the probability that he is late when he travels on foot is 0.25.

The probability that, on a randomly chosen day, Kino is late is 0.235.

- (a) Find the value of x . [3]

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- (b) Find the probability that, on a randomly chosen day, Kino travels to school by car given that he is not late. [2]

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- 2** The lengths of the rods produced by a company are normally distributed with mean 55.6 mm and standard deviation 1.2 mm.

- (a)** In a random sample of 400 of these rods, how many would you expect to have length less than 54.8 mm? [4]

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- (b)** Find the probability that a randomly chosen rod produced by this company has a length that is within half a standard deviation of the mean. [3]

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- 3** Three fair 6-sided dice, each with faces marked 1, 2, 3, 4, 5, 6, are thrown at the same time repeatedly. The score on each throw is the sum of the numbers on the uppermost faces.

(a) Find the probability that a score of 17 or more is first obtained on the 6th throw. [3]

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(b) Find the probability that a score of 17 or more is obtained in fewer than 8 throws. [2]

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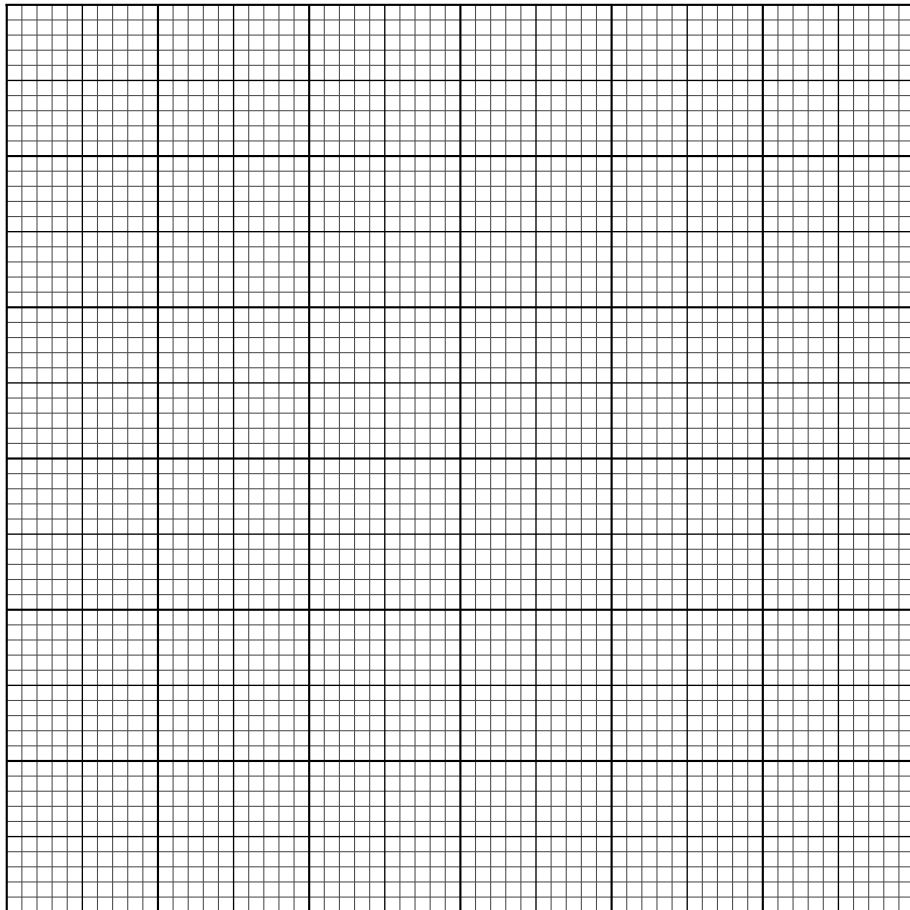
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- 4 The times taken, in minutes, to complete a word processing task by 250 employees at a particular company are summarised in the table.

Time taken (t minutes)	$0 \leq t < 20$	$20 \leq t < 40$	$40 \leq t < 50$	$50 \leq t < 60$	$60 \leq t < 100$
Frequency	32	46	96	52	24

- (a) Draw a histogram to represent this information.

[4]



From the data, the estimate of the mean time taken by these 250 employees is 43.2 minutes.

- (b)** Calculate an estimate for the standard deviation of these times. [3]

[illegible]

- 5 Eric has three coins. One of the coins is fair. The other two coins are each biased so that the probability of obtaining a head on any throw is $\frac{1}{4}$, independently of all other throws. Eric throws all three coins at the same time.

Events A and B are defined as follows.

A : all three coins show the same result

B : at least one of the biased coins shows a head

- (a) Show that $P(B) = \frac{7}{16}$. [2]

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- (b) Find $P(A | B)$. [2]

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The random variable X is the number of heads obtained when Eric throws the three coins.

(c) Draw up the probability distribution table for X . [3]

[illegible]

- 6 At a company's call centre, 90% of callers are connected immediately to a representative.

A random sample of 12 callers is chosen.

- (a) Find the probability that fewer than 10 of these callers are connected immediately. [3]

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A random sample of 80 callers is chosen.

- (b) Use an approximation to find the probability that more than 69 of these callers are connected immediately. [5]

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- (c) Justify the use of your approximation in part (b). [1]

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- 7 (a) Find the number of different arrangements of the 9 letters in the word ALLIGATOR in which the two As are together and the two Ls are together. [2]

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- (b) The 9 letters in the word ALLIGATOR are arranged in a random order.

Find the probability that the two Ls are together and there are exactly 6 letters between the two As. [5]

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- (c) Find the number of different selections of 5 letters from the 9 letters in the word ALLIGATOR which contain at least one A and at most one L. [3]

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[illegible]

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- 1** 50 values of the variable x are summarised by

$$\Sigma(x - 20) = 35 \quad \text{and} \quad \Sigma x^2 = 25\,036.$$

Find the variance of these 50 values.

[3]

[illegible]

- 2** In a large college, 32% of the students have blue eyes. A random sample of 80 students is chosen.

Use an approximation to find the probability that fewer than 20 of these students have blue eyes. [5]

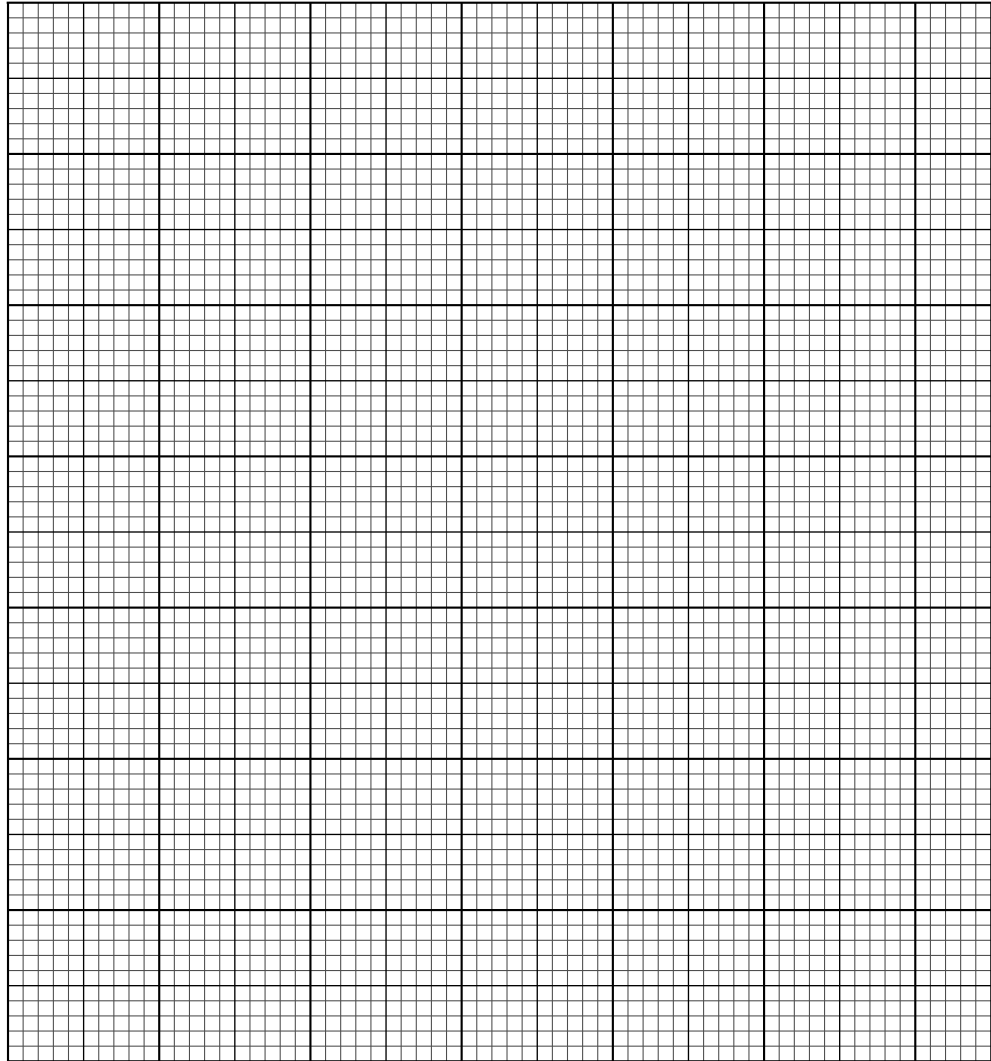
This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

- 3 The times, t minutes, taken to complete a walking challenge by 250 members of a club are summarised in the table.

Time taken (t minutes)	$t \leq 20$	$t \leq 30$	$t \leq 35$	$t \leq 40$	$t \leq 50$	$t \leq 60$
Cumulative frequency	32	66	112	178	228	250

- (a) Draw a cumulative frequency graph to illustrate the data.

[2]



- (b) Use your graph to estimate the 60th percentile of the data.

[1]

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It is given that an estimate for the mean time taken to complete the challenge by these 250 members is 34.4 minutes.

- (c) Calculate an estimate for the standard deviation of the times taken to complete the challenge by these 250 members. [4]

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.

- 4 Three fair 4-sided spinners each have sides labelled 1, 2, 3, 4. The spinners are spun at the same time and the number on the side on which each spinner lands is recorded. The random variable X denotes the highest number recorded.

(a) Show that $P(X = 2) = \frac{7}{64}$. [3]

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(b) Complete the probability distribution table for X . [2]

x	1	2	3	4
$P(X = x)$		$\frac{7}{64}$	$\frac{19}{64}$	

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On another occasion, one of the fair 4-sided spinners is spun repeatedly until a 3 is obtained. The random variable Y is the number of spins required to obtain a 3.

- (c) Find $P(Y = 6)$. [1]

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- (d) Find $P(Y > 4)$. [2]

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- 5** Company *A* produces bags of sugar. An inspector finds that on average 10% of the bags are underweight.

10 of the bags are chosen at random.

- (a)** Find the probability that fewer than 3 of these bags are underweight. [3]

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The weights of the bags of sugar produced by company *B* are normally distributed with mean 1.04 kg and standard deviation 0.06 kg.

- (b)** Find the probability that a randomly chosen bag produced by company *B* weighs more than 1.11 kg. [3]

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81% of the bags of sugar produced by company B weigh less than w kg.

(c) Find the value of w . [3]

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- 6 (a)** Find the number of different arrangements of the 9 letters in the word ACTIVATED. [2]

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- (b)** Find the number of different arrangements of the 9 letters in the word ACTIVATED in which there are at least 5 letters between the two As. [3]

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Five letters are selected at random from the 9 letters in the word ACTIVATED.

- (c) Find the probability that the selection does **not** contain more Ts than As. [5]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dotted lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.

- 7 Sam and Tom are playing a game which involves a bag containing 5 white discs and 3 red discs. They take turns to remove one disc from the bag at random. Discs that are removed are not replaced into the bag. The game ends as soon as one player has removed two red discs from the bag. That player wins the game.

Sam removes the first disc.

- (a) Find the probability that Tom removes a red disc on his first turn. [2]

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- (b) Find the probability that Tom wins the game on his second turn.

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- (c) Find the probability that Sam removes a red disc on his first turn given that Tom wins the game on his second turn.

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[illegible]

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