



Cambridge International AS & A Level

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MATHEMATICS

9709/51

Paper 5 Probability & Statistics 1

May/June 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.
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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 **16** pages. Any blank pages are indicated.



- 1** A bag contains 12 marbles, each of a different size. 8 of the marbles are red and 4 of the marbles are blue.

How many different selections of 5 marbles contain at least 4 marbles of the same colour? [4]

[illegible]

- 2 A company produces a particular type of metal rod. The lengths of these rods are normally distributed with mean 25.2 cm and standard deviation 0.4 cm. A random sample of 500 of these rods is chosen.

How many rods in this sample would you expect to have a length that is within 0.5 cm of the mean length? [5]

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, typical of notebook or legal stationery. There are no margins, text, or other markings on the page.

- 3 (a) How many different arrangements are there of the 8 letters in the word RELEASED? [1]

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- (b) How many different arrangements are there of the 8 letters in the word RELEASED in which the letters LED appear together in that order? [3]

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- (c) An arrangement of the 8 letters in the word RELEASED is chosen at random.

Find the probability that the letters A and D are not together.

[4]

[illegible]

- 4** To gain a place at a science college, students first have to pass a written test and then a practical test.

Each student is allowed a maximum of two attempts at the written test. A student is only allowed a second attempt if they fail the first attempt. No student is allowed more than one attempt at the practical test. If a student fails both attempts at the written test, then they cannot attempt the practical test.

The probability that a student will pass the written test at the first attempt is 0.8. If a student fails the first attempt at the written test, the probability that they will pass at the second attempt is 0.6. The probability that a student will pass the practical test is always 0.3.

- (a)** Draw a tree diagram to represent this information, showing the probabilities on the branches.

[3]

- (b)** Find the probability that a randomly chosen student will succeed in gaining a place at the college.

[2]

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- (c) Find the probability that a randomly chosen student passes the written test at the first attempt given that the student succeeds in gaining a place at the college. [2]

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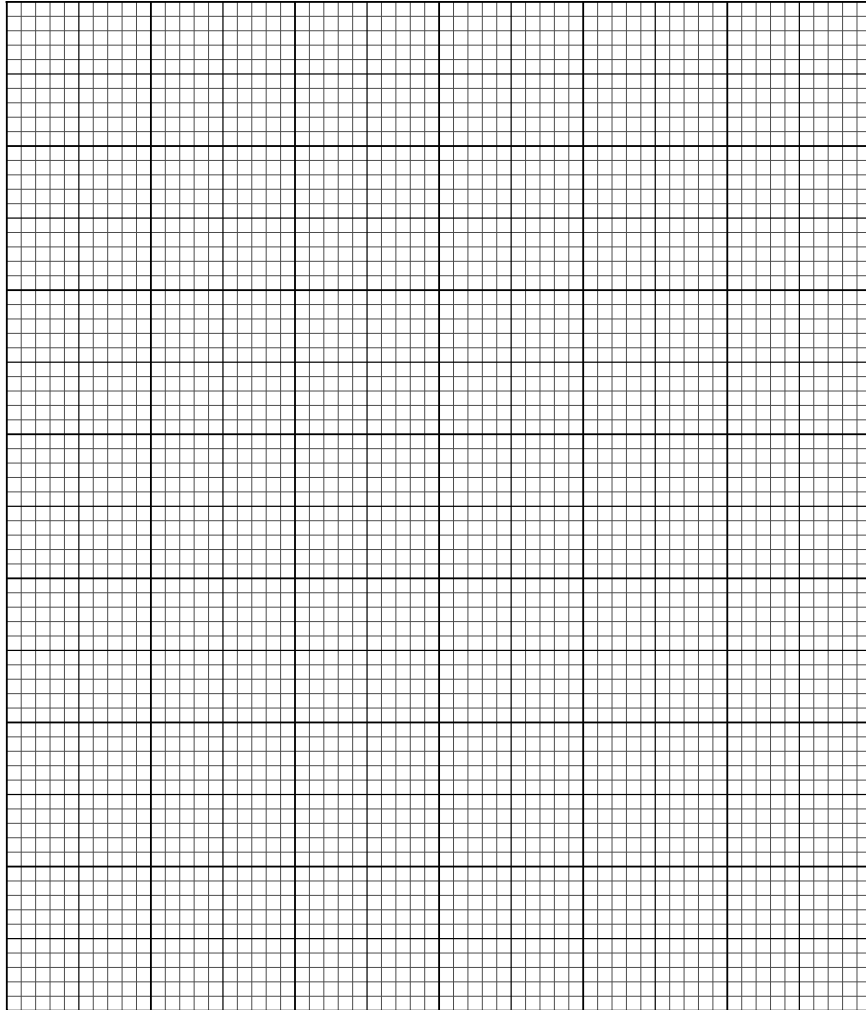
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- 5 The times taken by 200 players to solve a computer puzzle are summarised in the following table.

Time (t seconds)	$0 \leq t < 10$	$10 \leq t < 20$	$20 \leq t < 40$	$40 \leq t < 60$	$60 \leq t < 100$
Number of players	16	54	78	32	20

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

[4]



- (b) Calculate an estimate of the mean time taken by these 200 players. [2]

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- (c) Find the greatest possible value of the interquartile range of these times. [2]

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6 In Questa, 60% of the adults travel to work by car.

(a) A random sample of 12 adults from Questa is taken.

Find the probability that the number who travel to work by car is less than 10. [3]

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(b) A random sample of 150 adults from Questa is taken.

Use an approximation to find the probability that the number who travel to work by car is less than 81. [5]

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[illegible]

- 7 Sharma knows that she has 3 tins of carrots, 2 tins of peas and 2 tins of sweetcorn in her cupboard. All the tins are the same shape and size, but the labels have all been removed, so Sharma does not know what each tin contains.

Sharma wants carrots for her meal, and she starts opening the tins one at a time, chosen randomly, until she opens a tin of carrots. The random variable X is the number of tins that she needs to open.

- (a) Show that $P(X = 3) = \frac{6}{35}$. [2]

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- (b) Draw up the probability distribution table for X . [4]

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(c) Find $\text{Var}(X)$.

[3]

[illegible]

[illegible]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

May/June 2021

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
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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.



- 1** An ordinary fair die is thrown repeatedly until a 5 is obtained. The number of throws taken is denoted by the random variable X .

(a) Write down the mean of X . [1]

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(b) Find the probability that a 5 is first obtained after the 3rd throw but before the 8th throw. [2]

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(c) Find the probability that a 5 is first obtained in fewer than 10 throws. [2]

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- 2** The weights of bags of sugar are normally distributed with mean 1.04 kg and standard deviation σ kg. In a random sample of 2000 bags of sugar, 72 weighed more than 1.10 kg.

Find the value of σ .

[4]

[illegible]

- 3** On each day that Alexa goes to work, the probabilities that she travels by bus, by train or by car are 0.4, 0.35 and 0.25 respectively. When she travels by bus, the probability that she arrives late is 0.55. When she travels by train, the probability that she arrives late is 0.7. When she travels by car, the probability that she arrives late is x .

On a randomly chosen day when Alexa goes to work, the probability that she does not arrive late is 0.48.

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

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- (b)** Find the probability that Alexa travels to work by train given that she arrives late. [3]

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- 4** A fair spinner has sides numbered 1, 2, 2. Another fair spinner has sides numbered -2 , 0, 1. Each spinner is spun. The number on the side on which a spinner comes to rest is noted. The random variable X is the sum of the numbers for the two spinners.

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

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(b) Find $E(X)$ and $\text{Var}(X)$. [3]

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- 5 Every day Richard takes a flight between Astan and Bejin. On any day, the probability that the flight arrives early is 0.15, the probability that it arrives on time is 0.55 and the probability that it arrives late is 0.3.

- (a) Find the probability that on each of 3 randomly chosen days, Richard's flight does not arrive late. [1]

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- (b) Find the probability that for 9 randomly chosen days, Richard's flight arrives early at least 3 times. [3]

[illegible]

- (c) 60 days are chosen at random.

Use an approximation to find the probability that Richard's flight arrives early at least 12 times. [5]

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.

- 6 (a)** Find the total number of different arrangements of the 8 letters in the word TOMORROW. [2]

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- (b)** Find the total number of different arrangements of the 8 letters in the word TOMORROW that have an R at the beginning and an R at the end, and in which the three Os are not all together. [3]

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Four letters are selected at random from the 8 letters of the word TOMORROW.

(c) Find the probability that the selection contains at least one O and at least one R. [5]

[illegible]

- 7 The heights, in cm, of the 11 basketball players in each of two clubs, the Amazons and the Giants, are shown below.

Amazons	205	198	181	182	190	215	201	178	202	196	184
Giants	175	182	184	187	189	192	193	195	195	195	204

- (a) State an advantage of using a stem-and-leaf diagram compared to a box-and-whisker plot to illustrate this information. [1]

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- (b) Represent the data by drawing a back-to-back stem-and-leaf diagram with Amazons on the left-hand side of the diagram. [4]

- (c) Find the interquartile range of the heights of the players in the Amazons. [2]

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Four new players join the Amazons. The mean height of the 15 players in the Amazons is now 191.2 cm. The heights of three of the new players are 180 cm, 185 cm and 190 cm.

- (d) Find the height of the fourth new player. [3]

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[illegible]

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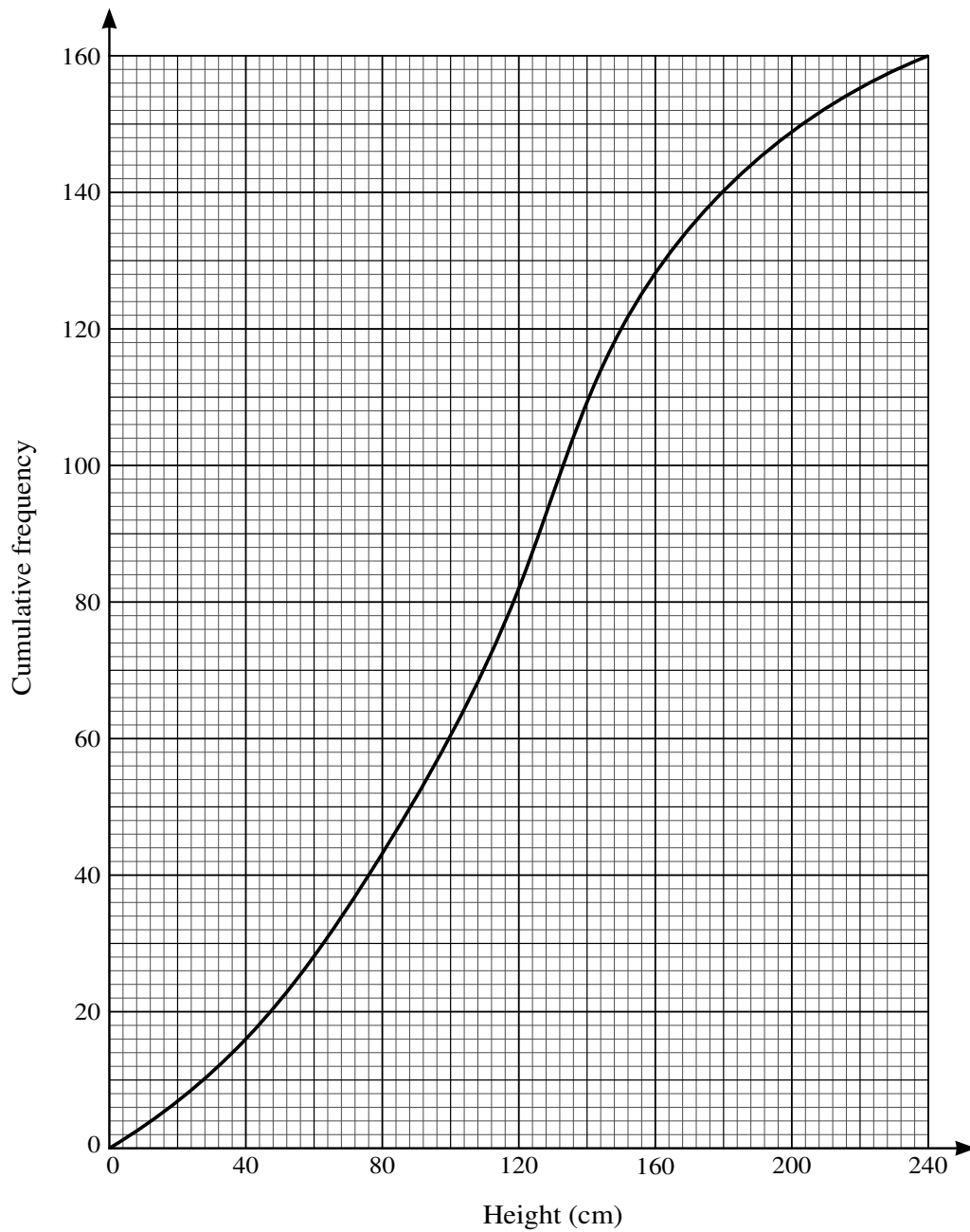
INFORMATION

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- 1 The heights in cm of 160 sunflower plants were measured. The results are summarised on the following cumulative frequency curve.



- (a) Use the graph to estimate the number of plants with heights less than 100 cm. [1]

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- (b) Use the graph to estimate the 65th percentile of the distribution. [2]

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- (c) Use the graph to estimate the interquartile range of the heights of these plants. [2]

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- 2 The random variable X can take only the values $-2, -1, 0, 1, 2$. The probability distribution of X is given in the following table.

x	-2	-1	0	1	2
$P(X = x)$	p	p	0.1	q	q

Given that $P(X \geq 0) = 3P(X < 0)$, find the values of p and q . [4]

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, providing a template for handwriting practice or general writing. There are no margins, text, or other markings on the page.

- 3** A sports club has a volleyball team and a hockey team. The heights of the 6 members of the volleyball team are summarised by $\Sigma x = 1050$ and $\Sigma x^2 = 193\,700$, where x is the height of a member in cm. The heights of the 11 members of the hockey team are summarised by $\Sigma y = 1991$ and $\Sigma y^2 = 366\,400$, where y is the height of a member in cm.

(a) Find the mean height of all 17 members of the club. [2]

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(b) Find the standard deviation of the heights of all 17 members of the club. [3]

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- 4 Three fair six-sided dice, each with faces marked 1, 2, 3, 4, 5, 6, are thrown at the same time, repeatedly. For a single throw of the three dice, the score is the sum of the numbers on the top faces.
- (a) Find the probability that the score is 4 on a single throw of the three dice. [3]

[illegible]

[illegible]

- 5 The lengths of the leaves of a particular type of tree are modelled by a normal distribution. A scientist measures the lengths of a random sample of 500 leaves from this type of tree and finds that 42 are less than 4 cm long and 100 are more than 10 cm long.

(a) Find estimates for the mean and standard deviation of the lengths of leaves from this type of tree. [5]

This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of 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.

The lengths, in cm, of the leaves of a different type of tree have the distribution $N(\mu, \sigma^2)$. The scientist takes a random sample of 800 leaves from this type of tree.

- (b) Find how many of these leaves the scientist would expect to have lengths, in cm, between $\mu - 2\sigma$ and $\mu + 2\sigma$. [4]

[illegible]

- 6 (a) How many different arrangements are there of the 11 letters in the word REQUIREMENT? [2]

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- (b) How many different arrangements are there of the 11 letters in the word REQUIREMENT in which the two Rs are together and the three Es are together? [1]

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- (c) How many different arrangements are there of the 11 letters in the word REQUIREMENT in which there are exactly three letters between the two Rs? [3]

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Five of the 11 letters in the word REQUIREMENT are selected.

(d) How many possible selections contain at least two Es and at least one R? [4]

[illegible]

- 7 In the region of Arka, the total number of households in the three villages Reeta, Shan and Teber is 800. Each of the households was asked about the quality of their broadband service. Their responses are summarised in the following table.

		Quality of broadband service		
		Excellent	Good	Poor
Village	Reeta	75	118	32
	Shan	223	177	40
	Teber	12	60	63

- (a) (i) Find the probability that a randomly chosen household is in Shan and has poor broadband service. [1]

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- (ii) Find the probability that a randomly chosen household has good broadband service given that the household is in Shan. [2]

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In the whole of Arka there are a large number of households. A survey showed that 35% of households in Arka have no broadband service.

- (b) (i) 10 households in Arka are chosen at random.

Find the probability that fewer than 3 of these households have no broadband service. [3]

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- (ii) 120 households in Arka are chosen at random.

Use an approximation to find the probability that more than 32 of these households have no broadband service. [5]

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