



Cambridge International AS & A Level

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MATHEMATICS**9709/51**

Paper 5 Probability & Statistics 1

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 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

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- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Any blank pages are indicated.



- 1 The random variable X takes the value x with probability kx^2 , where k is a constant and x takes the values $-2, 1, 2, 3$ only.

- (a) Draw up the probability distribution table for X , giving the probabilities as numerical fractions. [3]

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- (b) Find $E(X)$. [1]

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- (c) Find $P(X \neq 2 | X > 0)$. [2]

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2 A fair six-sided dice with faces labelled 1, 2, 3, 4, 5, 6 is thrown repeatedly until a 6 is obtained.

(a) Find the probability that a 6 is obtained for the first time on the 8th throw. [1]

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(b) Find the probability that a 6 is obtained for the third time on the 7th throw. [3]

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- 3 The back-to-back stem-and-leaf diagram shows the annual salaries, in dollars, of 27 employees at each of two companies, Browns and Greens.

Browns										Greens									
(3)						9	8	4	30	6	8								(2)
(7)	8	8	5	3	3	1	0		31	2	4	5	8						(4)
(7)	9	7	6	4	2	2	0		32	3	6	6	7	9					(5)
(6)		8	7	5	5	3	1		33	1	1	3	7	8	8	9	9		(8)
(3)						4	2	2	34	0	2	3	5	6	9				(6)
(1)								7	35	3	7								(2)

Key: 6|32|7 means \$32 600 for Browns and \$32 700 for Greens.

- (a) Find the median and interquartile range for the annual salaries of employees at Browns. [3]

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The annual salary of an employee at Browns is denoted by x thousand dollars and the annual salary of an employee at Greens is denoted by y thousand dollars. It is given that, for the 27 employees at each of the companies,

$$\Sigma x = 878.3, \quad \Sigma x^2 = 28\,616.09, \quad \Sigma y = 896.5, \quad \Sigma y^2 = 29\,815.63.$$

- (b) Find the mean and standard deviation of the annual salaries of these 54 employees. [5]

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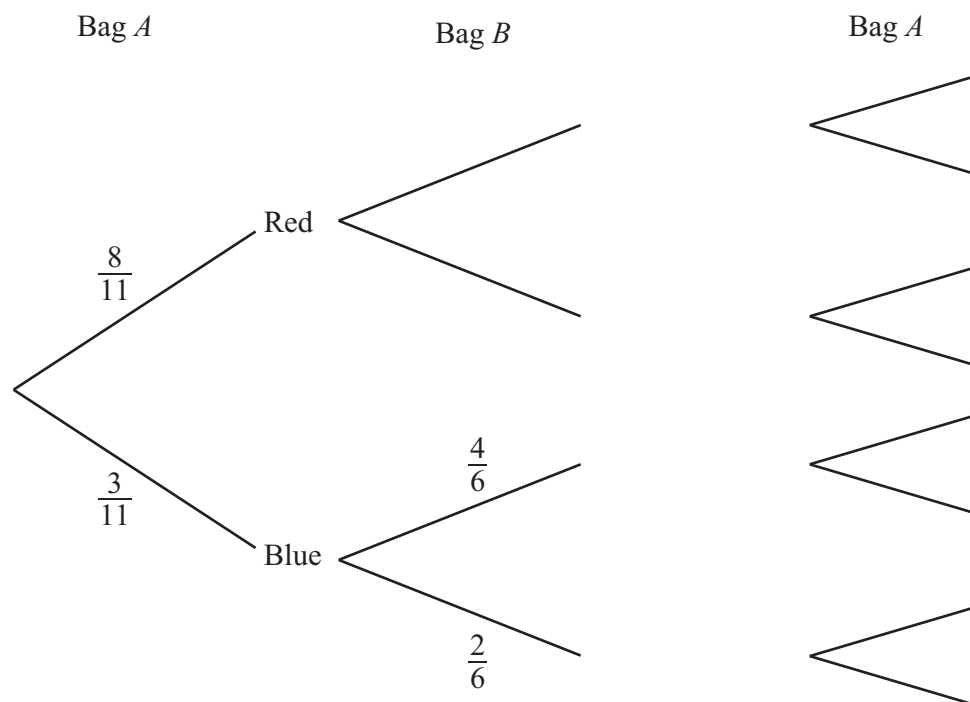
- 4 Bag *A* contains 8 red marbles and 3 blue marbles. Bag *B* contains 4 red marbles and 1 blue marble.

A marble is chosen at random from bag *A*. If the marble chosen is red, it is discarded. If the marble chosen is blue, it is placed in bag *B*.

A marble is then chosen at random from bag *B*. If the marble chosen is red, it is discarded. If the marble chosen is blue, it is placed in bag *A*.

A marble is now chosen at random from bag *A*.

- (a) Complete the tree diagram below by entering all the remaining outcomes and probabilities. [3]



- (b) Find the probability that all three marbles chosen are the same colour. [2]

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- 5 On any given day, Cooper either wears a blue jumper or he wears a green jumper or he does not wear a jumper. The probability that he wears a blue jumper is 0.6 and the probability that he wears a green jumper is 0.3. Whether Cooper wears a jumper of either colour, or does not wear a jumper, on any day is independent of his choice on any other day.

- (a) Find the probability, that in a week (7 days), Cooper wears a blue jumper on at least 5 days. [3]

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- (b) Use a suitable approximation to find the probability that, in any 150-day period, Cooper does not wear a jumper on fewer than 22 days. [5]

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- 6 A factory produces chocolate bars. The weights of the bars are normally distributed with mean 155 g and standard deviation 6 g. A random sample of 350 of these bars is chosen.

- (a) How many of these 350 bars would you expect to weigh between 148 g and 160 g? [4]

This image shows a full page of primary-ruled paper. It features approximately 20 horizontal dashed lines spaced evenly down the page, providing a guide for handwriting practice. The lines are thin and light gray, set against a plain white background. There are no margins, text, or other markings on the page.



A second factory also produces chocolate bars. The weights of these bars are normally distributed with mean μ g and standard deviation σ g. Tests show that 8% of the bars weigh more than 114.0 g and 20% weigh less than 99.5 g.

- (b) Find the value of μ and the value of σ .

[5]

[illegible]



7 (a) How many different arrangements are there of the 10 letters in the word SEYCHELLES? [1]

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(b) How many different arrangements are there of the 10 letters in the word SEYCHELLES in which there are exactly two letters between the Ss and one of these two letters is C? [3]

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- (c) How many different arrangements are there of the 10 letters in the word SEYCHELLES in which there is an S at the beginning, an S at the end and the three Es are **not** all next to each other? [3]

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5 letters are selected at random from the 10 letters in the word SEYCHELLES.

- (d) Find the probability that these 5 letters include the three Es. [3]

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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.

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MATHEMATICS**9709/52**

Paper 5 Probability & Statistics 1

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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INFORMATION

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- 1 A coin is biased so that the probability of obtaining a head when it is thrown is 0.4. The coin is thrown repeatedly until the first head is obtained.

(a) Find the probability that the first head is obtained on the 5th throw. [1]

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(b) Find the probability that the first head is obtained after the 6th throw. [2]

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- 2 Kayla has a bag containing 3 red marbles, 1 blue marble and 2 green marbles. She selects one marble from the bag at random and does not replace it in the bag. She repeats this process until she obtains a green marble. The random variable X is the number of marbles that she needs to select until she obtains a green marble.

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

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

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- 3 The heights of the 124 Senior members of the Giraffes basketball club are normally distributed with mean 187.4 cm and standard deviation 6.4 cm.

- (a) How many members of the club would you expect to have heights within 5 cm of the mean? [4]

[illegible]



The heights of the Junior members of the Giraffes club are normally distributed with mean 172.7 cm and standard deviation σ cm. 23% of these members have height less than 170.3 cm.

- (b) Find the value of σ .

[3]

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.



- 4** Gio has a pack of 18 cards. Ivy has a pack of x cards.

Each card has a picture of a bus or a car or a train. The number of cards with each picture in the two packs is shown in the table.

	Bus	Car	Train
Gio's pack	6	10	2
Ivy's pack	$x - 12$	9	3

One card is chosen at random from each pack. The probability that the two cards have pictures of buses on them is equal to twice the probability that the two cards have pictures of cars on them.

- (a) Write down an equation in terms of x and hence find the value of x . [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.



(b) Find the probability that the two cards have pictures of the same type of vehicle on them. [3]

[illegible]

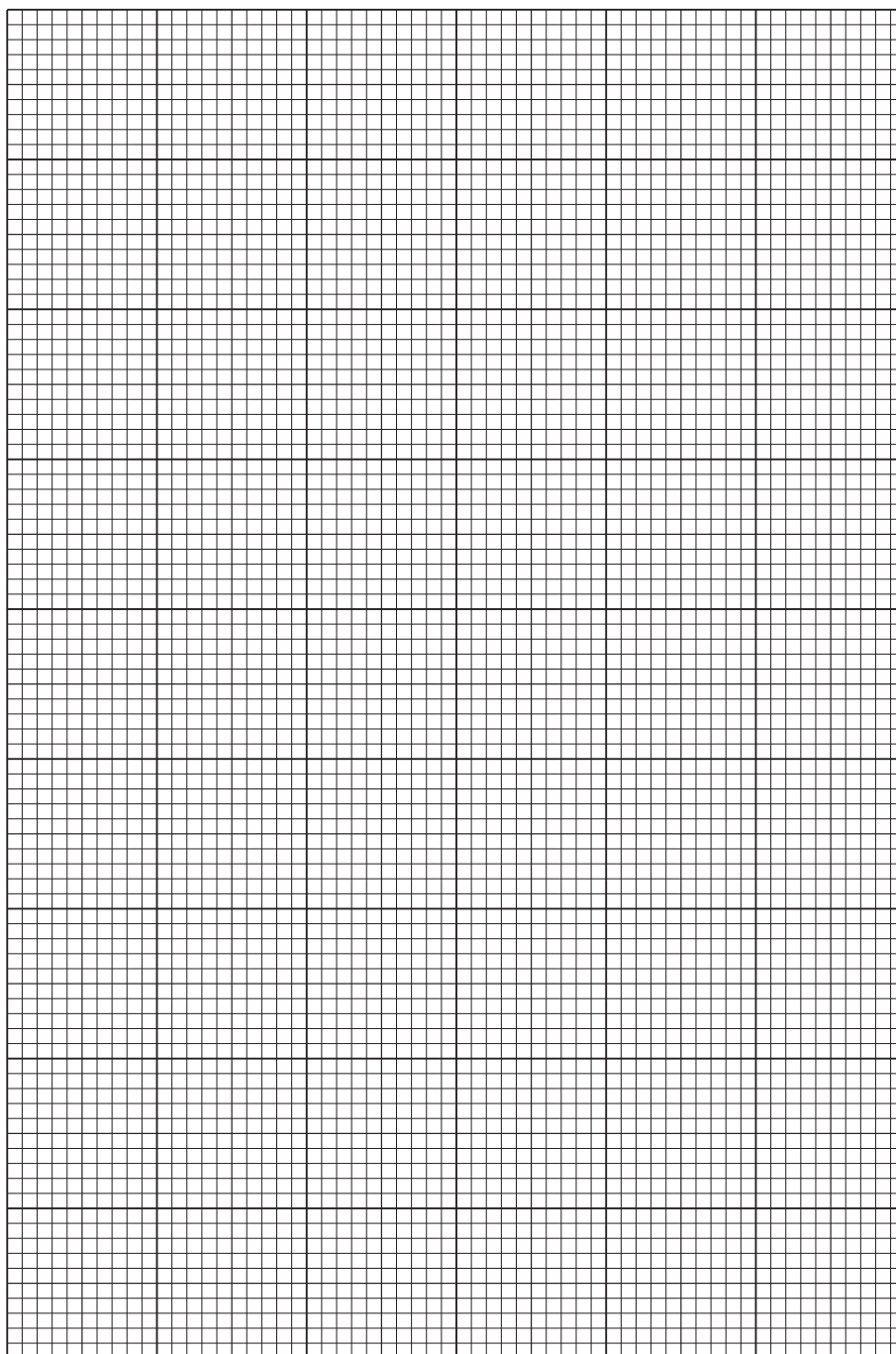


- 5 The times of 240 competitors taking part in an event are recorded correct to the nearest minute. The results are summarised in the table.

Time (minutes)	1 – 10	11 – 20	21 – 25	26 – 30	31 – 50
Frequency	12	38	68	76	46

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

[4]





(b) Calculate an estimate of the mean time taken by the 240 competitors.

[3]

[illegible]



6 For a randomly chosen person, their next birthday is equally likely to occur on any day of the week, independently of any other person's birthday.

(a) Find the probability that, out of 10 randomly chosen people, none of them will have their next birthday on a Saturday or Sunday. [1]

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(b) Find the probability that, out of 10 randomly chosen people, fewer than 3 will have their next birthday on a Wednesday. [3]

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- (c) Use a suitable approximation to find the probability that, out of 392 randomly chosen people, more than 65 will have their next birthday on a Friday. [5]

[illegible]



- 7 (a) Find the number of different arrangements of the 10 letters in the word ZOOLOGICAL in which the three Os are together and the two Ls are **not** next to each other. [4]

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- (b) Find the number of different arrangements of the 10 letters in the word ZOOLOGICAL in which there are exactly 5 letters between the two Ls. [3]

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Two letters are chosen at random from the 10 letters in the word ZOOLOGICAL.

- (c) Find the probability that these two letters are different.

[3]

[illegible]



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MATHEMATICS**9709/53**

Paper 5 Probability & Statistics 1

October/November 2025**1 hour 15 minutes**

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- 1 There are a large number of students at Greenfield college. Each student travels to college by car, by bus or on foot, independently of any other student. The probability that any student travels by car is 0.4. The probability that any student travels by bus is 0.35.

- (a) 3 students from Greenfield college are selected at random.

Find the probability that none of these 3 students travel to college by car. [1]

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- (b) 11 students from Greenfield college are selected at random.

Find the probability that fewer than 9 of these 11 students travel to college by car or by bus. [3]

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- 2 The Splash Club has 26 members, of whom 16 are swimmers and 10 are divers. No member is both a swimmer and a diver. The club committee consists of 6 of these 26 members.

In how many ways can the club committee be selected if it must include at least 2 swimmers and at least 2 divers? [4]

[illegible]

- 3 (a) Find the number of different arrangements of the 9 letters in the word DAFFODILS in which there is a D at each end and the two Fs are **not** next to each other. [3]

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- (b) Find the probability that a randomly chosen arrangement of the 9 letters in the word DAFFODILS has exactly 4 letters between the two Ds. [3]

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- 4 A fair red spinner has 4 sides, numbered 1, 2, 3, 4. A fair blue spinner has 4 sides, numbered 0, 1, 2, 3. When a spinner is spun, the score is the number on the side on which it lands. The two spinners are spun at the same time.

The random variable X denotes the higher of the two scores obtained. If the two scores are equal, then the value of X is 0.

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

[illegible]



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

[3]

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The red spinner, with sides numbered 1, 2, 3, 4, is spun repeatedly.

(c) Find the probability that it lands on 4 for the first time before the 8th spin.

[2]

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- 5 Chen has three boxes. Box A contains 5 counters, of which 3 are white and 2 are yellow. Box W contains 4 red marbles and 3 blue marbles. Box Y contains 5 red marbles and 3 blue marbles.

Chen chooses one counter at random from box A . If the counter is white, he chooses two marbles from box W , at random and without replacement. If the counter is yellow, he chooses two marbles from box Y , at random and without replacement.

- (a) Draw a fully labelled tree diagram to illustrate this information, including all the probabilities. [3]





(b) Find the probability that one red marble and one blue marble are obtained.

[3]

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(c) Find the probability that a white counter is chosen from box *A*, given that one red marble and one blue marble are obtained.

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- 6 Last Saturday, a cycling competition for teams of 11 cyclists took place. For each cyclist, the time taken to complete the course was recorded to the nearest minute. The times taken by the cyclists from two teams, the Linnets and the Puffins, are shown in the following table.

Linnets	48	51	54	57	59	60	64	64	65	68	70
Puffins	45	49	51	55	55	58	59	62	64	64	74

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

- (b) Find the interquartile range of the times taken by the Linnets. [2]

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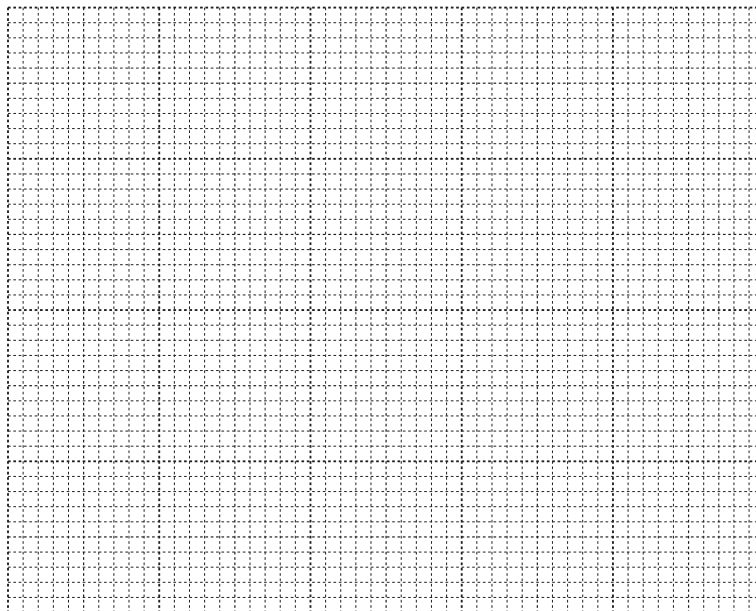
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- (c) On the grid below, draw a box-and-whisker plot to represent the information for the Linnets and the Puffins. [3]



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- (d) Make one comparison between the times taken by the Linnets and the times taken by the Puffins. [1]

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7 The times taken by Obi to walk to work each morning are normally distributed with mean 14.8 minutes and standard deviation 1.5 minutes.

(a) Find the probability that, on a randomly chosen day, Obi takes more than 15.6 minutes to walk to work. [3]

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(b) On 90% of days, Obi takes more than t minutes to walk to work.
Find the value of t . [3]

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Obi walks to work 5 days a week for 45 weeks in a year.

- (c) On how many days in a year would you expect Obi to take within one minute of the mean time to walk to work? [4]

[illegible]

[illegible]





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MATHEMATICS

9709/55

Paper 5 Probability & Statistics 1

October/November 2025

1 hour 15 minutes

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- 1 A fair 6-sided dice with faces labelled 1, 2, 3, 4, 5, 6 is thrown repeatedly. The random variable X denotes the number of throws required to obtain a 6.

(a) Find $P(X = 7)$. [1]

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(b) Find $P(3 \leq X \leq 5)$. [2]

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- 2 Kai has a spinner with four sides, labelled 1, 2, 3, 4. When the spinner is spun, the score is the number on the side on which the spinner lands. The random variable X denotes this score. The probability distribution table for X is given below.

x	1	2	3	4
$P(X=x)$	p	0.4	$2p$	p

- (a) Find the numerical value of $\text{Var}(X)$.

[4]

This image shows a full page of handwriting practice paper. It features multiple sets 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 margins or additional markings.



Kai spins his spinner 10 times.

- (b)** Find the probability that a score of 2 is obtained fewer than 8 times.

[3]

[illegible]

3 Priti has two bags of discs, X and Y .

Bag X contains 8 red discs and 7 blue discs.

Bag Y contains 6 red discs and 9 blue discs.

Priti tosses a fair coin.

If she obtains a head, she chooses at random and **without** replacement two discs from bag X .

If she obtains a tail, she chooses at random and **with** replacement two discs from bag Y .

(a) Draw a tree diagram to represent this information, showing all the probabilities.

[2]





(b) Find the probability that the two discs that Priti chooses are blue.

[2]

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(c) Find the probability that the two discs that Priti chooses come from bag X given that at least one of the discs is red.

[4]

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- 4 The heights, in cm, of 15 players from each of two sports teams, Pelicans and Swans, are given in the table.

Pelicans	156	160	164	165	167	170	171	173	178	182	182	184	185	186	187
Swans	170	180	183	165	174	158	170	181	162	178	174	163	191	182	174

- (a) Draw a back-to-back stem-and-leaf diagram to represent the heights of the players from Pelicans and Swans, with Pelicans on the left-hand side. [4]



- (b) Find the median and the interquartile range of the heights of the Pelicans.

[3]

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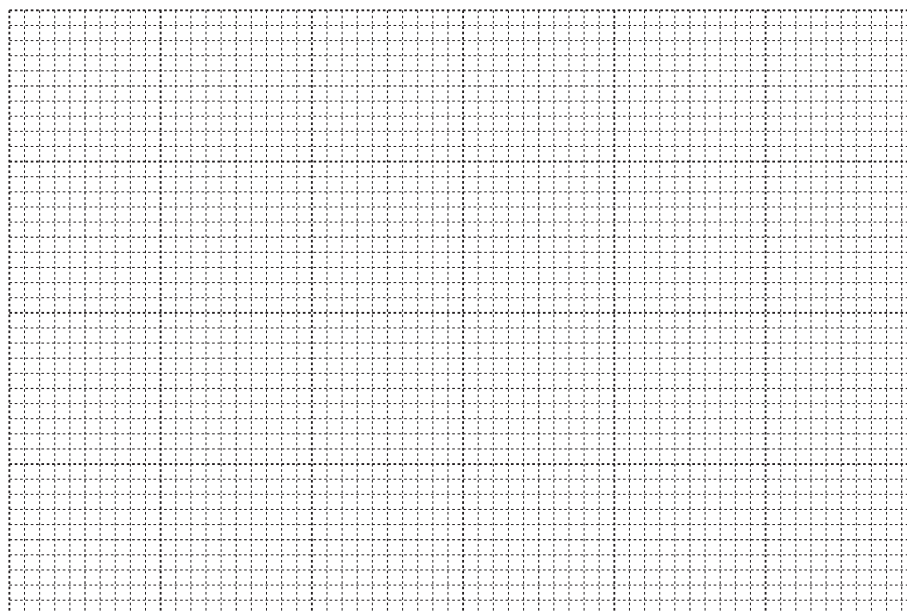
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For the Swans, the lower quartile of the heights is 165 cm, the median is 174 cm and the upper quartile is 181 cm.

- (c) Represent the data shown in the back-to-back stem-and-leaf diagram by a pair of box-and-whisker plots in a single diagram.

[3]



- (d) Make one comparison between the heights of the Pelicans players and the heights of the Swans players.

[1]

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- 5** In a group of 25 athletes, there are 8 sprinters, 5 hurdlers and 12 throwers.
- (a)** Find the number of different ways in which a team of 6 athletes can be selected if it consists of at least 3 sprinters, at most 2 hurdlers and at most 1 thrower. [4]

[illegible]

A group of 8 athletes chosen from the group of 25 athletes consists of 1 sprinter, 3 hurdlers and 4 throwers. These 8 athletes stand in a row.

- (b) How many different arrangements of the 8 athletes are there if the 3 hurdlers do not stand all together? [3]

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- (c) How many different arrangements of the 8 athletes are there in which there are at least two athletes between any two hurdlers? [3]

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- 6 A large number of runners took part in two charity runs to raise money for a new community centre.

In the first run, the times to complete the run were normally distributed with mean 46.3 seconds and standard deviation 6.4 seconds.

- (a) Find the probability that a randomly chosen runner took more than 55.1 seconds to complete the run. [3]

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In the second run, the times to complete the run were normally distributed with mean 39.8 seconds and standard deviation σ seconds. 10% of the runners took more than 48.6 seconds.

- (b) Find the value of σ . [3]

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150 runners are chosen at random from those who took part in the second run.

- (c) Use an approximation to find the probability that fewer than 20 of the 150 runners took more than 48.6 seconds to complete the run. [5]

[illegible]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The lines are evenly spaced across the entire page, providing a guide for consistent letter formation. There is no text or other markings on the page.





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