



# Cambridge International AS & A Level

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**MATHEMATICS****9709/51**

Paper 5 Probability &amp; Statistics 1

**October/November 2024****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 **16** pages. Any blank pages are indicated.



- 1 Nicola throws an ordinary fair six-sided dice. The random variable  $X$  is the number of throws that she takes to obtain a 6.

(a) Find  $P(X < 8)$ . [2]

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(b) Find the probability that Nicola obtains a 6 for the second time on her 8th throw. [2]

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2 The random variable  $X$  takes the values  $-2, -1, 0, 2, 3$ . It is given that  $P(X = x) = k(x^2 + 2)$ , where  $k$  is a positive constant.

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

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

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- 3 The time taken, in minutes, to walk to school was recorded for 200 pupils at a certain school. These times are summarised in the following table.

|                              |             |             |             |             |             |             |
|------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Time taken<br>( $t$ minutes) | $t \leq 15$ | $t \leq 25$ | $t \leq 30$ | $t \leq 40$ | $t \leq 50$ | $t \leq 70$ |
| Cumulative<br>frequency      | 18          | 46          | 88          | 140         | 176         | 200         |

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

[2]



- (b) Use your graph to estimate the median and the interquartile range of the data.

[3]

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[illegible]

- (a) Find the probability that a randomly chosen green apple weighs between 83 grams and 95 grams. [4]

[illegible]



- Use a suitable approximation to find the probability that fewer than 105 of the chosen red apples weigh more than 80 grams. [5]

[illegible]

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- [illegible]



- 7 (a) How many different arrangements are there of the 9 letters in the word INTELLECT in which the two Ts are together? [2]

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- (b) How many different arrangements are there of the 9 letters in the word INTELLECT in which there is a T at each end and the two Es are not next to each other? [3]

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**MATHEMATICS**

**9709/52**

Paper 5 Probability & Statistics 1

**October/November 2024**

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



- 1 At a college, the students choose exactly one of tennis, hockey or netball to play. The table shows the numbers of students in Year 1 and Year 2 at the college playing each of these sports.

|        | Tennis | Hockey | Netball |
|--------|--------|--------|---------|
| Year 1 | 16     | 22     | 12      |
| Year 2 | 24     | 18     | 28      |

One student is chosen at random from the 120 students. Events  $X$  and  $N$  are defined as follows:

$X$ : the student is in Year 1

$N$ : the student plays netball.

- (a) Find  $P(X|N)$ . [1]

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- (b) Find  $P(N|X)$ . [1]

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- (c) Determine whether or not  $X$  and  $N$  are independent events. [1]

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One of the students who plays netball takes 8 shots at goal. On each shot, the probability that she will succeed is 0.15, independently of all other shots.

- (d) Find the probability that she succeeds on fewer than 3 of these shots. [3]

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- [illegible]

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3 A fair coin and an ordinary fair six-sided dice are thrown at the same time. The random variable  $X$  is defined as follows.

- If the coin shows a tail,  $X$  is twice the score on the dice.
- If the coin shows a head,  $X$  is the score on the dice if the score is even and  $X$  is 0 otherwise.

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

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

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- 4 The heights, in metres, of white pine trees are normally distributed with mean 19.8 and standard deviation 2.4 .

In a certain forest there are 450 white pine trees.

- (a) How many of these trees would you expect to have height less than 18.2 metres? [4]

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The heights, in metres, of red pine trees are normally distributed with mean 23.4 and standard deviation  $\sigma$ . It is known that 26% of red pine trees have height greater than 25.5 metres.

- (b) Find the value of  $\sigma$ . [3]

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- 5 In a class of 21 students, there are 10 violinists, 6 guitarists and 5 pianists. A group of 7 is to be chosen from these 21 students. The group will consist of 4 violinists, 2 guitarists and 1 pianist.

(a) In how many ways can the group of 7 be chosen? [2]

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On another occasion a group of 5 will be chosen from the 21 students. The group must contain at least 2 violinists, at least 1 guitarist and at most 1 pianist.

(b) In how many ways can the group of 5 be chosen? [4]

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- 6 Teams of 15 runners took part in a charity run last Saturday. The times taken, in minutes, to complete the course by the runners from the Falcons and the runners from the Kites are shown in the table.

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|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Falcons | 38 | 39 | 42 | 44 | 46 | 48 | 50 | 51 | 52 | 56 | 58 | 59 | 64 | 69 | 76 |
| Kites   | 32 | 40 | 40 | 45 | 47 | 48 | 52 | 54 | 58 | 59 | 59 | 60 | 61 | 63 | 65 |

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

- (b) Find the median and the interquartile range of the times for the Falcons. [3]

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(c) Find the mean and the standard deviation of the times taken by all 30 runners from the two teams. [3]

[illegible]





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**MATHEMATICS****9709/53**

Paper 5 Probability &amp; Statistics 1

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1 30% of the residents of Wimfield own an electric car. Three residents are chosen at random.

- (a) Find the probability that either all three own an electric car or none of them owns an electric car. [2]

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A random sample of 125 of the residents of Wimfield is selected.

- (b) Use a suitable approximation to find the probability that more than 45 of these residents own an electric car. [5]

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- 2 A red fair six-sided dice has faces labelled 1, 1, 1, 2, 2, 2. A blue fair six-sided dice has faces labelled 1, 1, 2, 2, 3, 3. Both dice are thrown. The random variable  $X$  is the product of the scores on the two dice.

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

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

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3 In Molimba, the heights, in cm, of adult males are normally distributed with mean 176 cm and standard deviation 4.8 cm.

(a) Find the probability that a randomly chosen adult male in Molimba has a height greater than 170 cm. [3]

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60% of adult males in Molimba have a height between 170 cm and  $k$  cm, where  $k$  is greater than 170.

(b) Find the value of  $k$ , giving your answer correct to 1 decimal place. [4]

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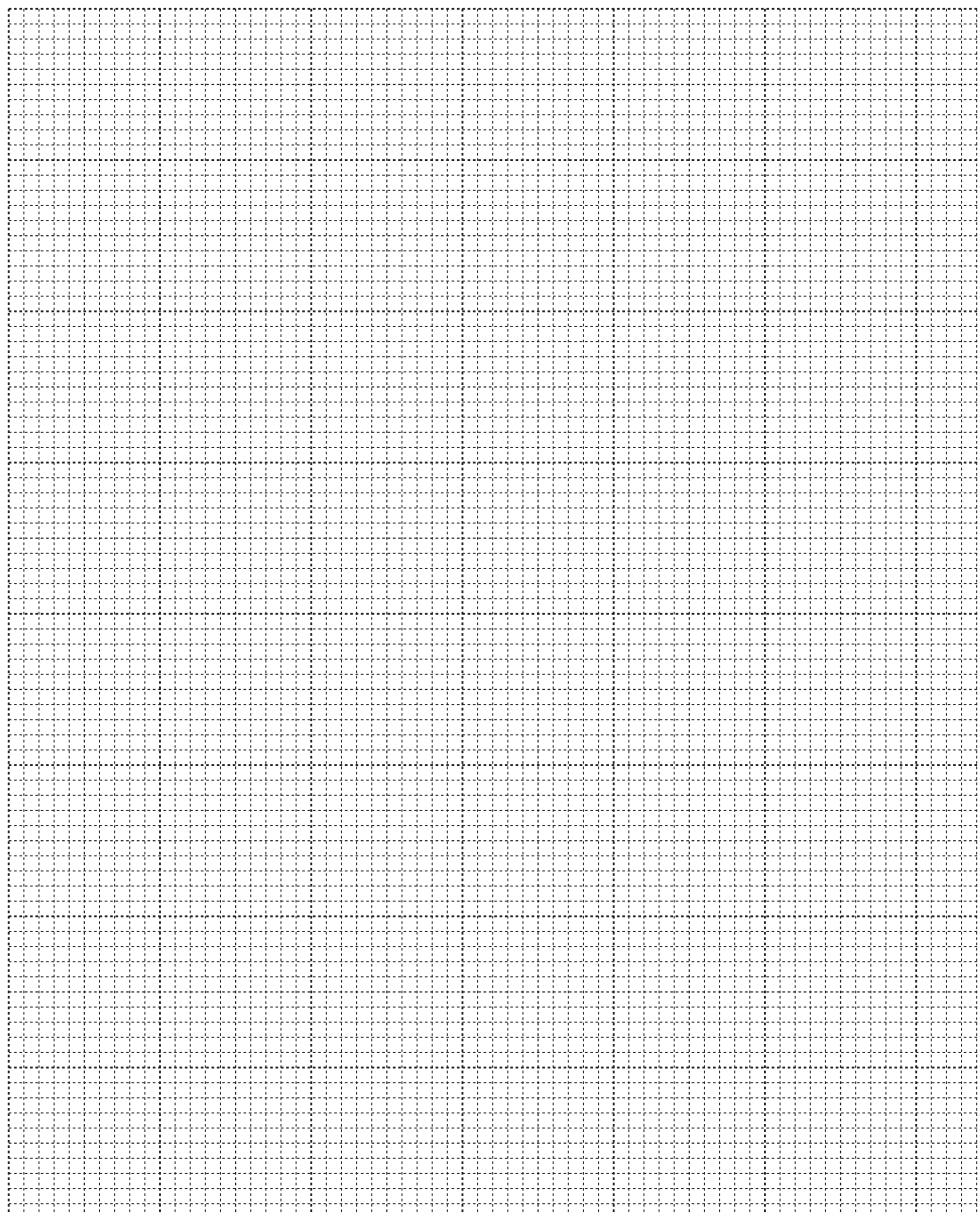




- 4 On a certain day, the heights of 150 sunflower plants grown by children at a local school are measured, correct to the nearest cm. These heights are summarised in the following table.

| Height (cm) | 10–19 | 20–29 | 30–39 | 40–44 | 45–49 | 50–54 | 55–59 |
|-------------|-------|-------|-------|-------|-------|-------|-------|
| Frequency   | 10    | 18    | 32    | 42    | 28    | 14    | 6     |

- (a) Draw a cumulative frequency graph to illustrate the data. [4]



- (b) Use your graph to estimate the 30th percentile of the heights of the sunflower plants. [2]

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[illegible]



- 5 A factory produces chocolates. 30% of the chocolates are wrapped in gold foil, 25% are wrapped in red foil and the remainder are unwrapped.

Indigo chooses 8 chocolates at random from the production line.

- (a) Find the probability that she obtains no more than 2 chocolates that are wrapped in red foil. [3]

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Jake chooses chocolates one at a time at random from the production line.

- (b) Find the probability that the first time he obtains a chocolate that is wrapped in red foil is before the 7th choice. [2]

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[illegible][illegible]



- (c) Find the number of different arrangements of the 9 letters in the word HAPPINESS in which the two Ps are together and there are exactly two letters between the two Ss. [4]

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The 9 letters in the word HAPPINESS are divided at random into a group of 5 and a group of 4.

- (d) Find the probability that both Ps are in one group and both Ss are in the other group. [3]

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