Cambridge Assessment International Education

# Cambridge International AS & A Level

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

Paper 5 Probability & Statistics 1 **May/June 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.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- 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 summary of 20 values of $x$ gives

$$\Sigma(x-30) = 439, \qquad \Sigma(x-30)^2 = 12\,405.$$

A summary of another 25 values of $x$ gives

$$\Sigma(x-30) = 470, \qquad \Sigma(x-30)^2 = 11\,346.$$

**(a)** Find the mean of all 45 values of $x$. [2]

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**(b)** Find the standard deviation of all 45 values of $x$. [2]

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**2** The lengths of the tails of adult raccoons of a certain species are normally distributed with mean 28 cm and standard deviation 3.3 cm.

**(a)** Find the probability that a randomly chosen adult raccoon of this species has a tail length between 23 cm and 35 cm. [4]

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The masses of adult raccoons of this species are normally distributed with mean 8.5 kg and standard deviation $\sigma$ kg. 75% of adult raccoons of this species have mass greater than 7.6 kg.

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

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**3** The heights, in cm, of 200 adults in Barimba are summarised in the following table.

| Height ($h$ cm) | $130 \leqslant h < 150$ | $150 \leqslant h < 160$ | $160 \leqslant h < 170$ | $170 \leqslant h < 175$ | $175 \leqslant h < 195$ |
|---|---|---|---|---|---|
| Frequency | 16 | 32 | 76 | 64 | 12 |

**(a)** Draw a histogram to represent this information. [4]

**(b)** The interquartile range is $R$ cm. Show that $R$ is **not** greater than 15. [2]

**4** A game for two players is played using a fair 4-sided dice with sides numbered 1, 2, 3 and 4. One turn consists of throwing the dice repeatedly up to a maximum of three times. When a 4 is obtained, no further throws are made during that turn. A player who obtains a 4 in their turn scores 1 point.

**(a)** Show that the probability that a player obtains a 4 in one turn is $\frac{37}{64}$. [2]

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Xeno and Yao play this game.

**(b)** Find the probability that neither Xeno nor Yao score any points in their first two turns. [1]

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**(c)** Xeno and Yao each have three turns.

Find the probability that Xeno scores 2 more points than Yao. [3]

**5** In a certain area in the Arctic the probability that it snows on any given day is 0.7, independent of all other days.

**(a)** Find the probability that in a week (7 days) it snows on at least five days. [3]

A week in which it snows on at least five days out of seven is called a 'white' week.

**(b)** Find the probability that in three randomly chosen weeks at least one is a white week. [2]

In a different area in the Arctic, the probability that a week is a white week is 0.8 .

**(c)** Use a suitable approximation to find the probability that in 60 randomly chosen weeks fewer than 47 are white weeks. [5]

**6** Harry has three coins:

- One coin is biased so that the probability of obtaining a head when it is thrown is $\frac{1}{3}$.
- The second coin is biased so that the probability of obtaining a head when it is thrown is $\frac{1}{4}$.
- The third coin is biased so that the probability of obtaining a head when it is thrown is $\frac{1}{5}$.

Harry throws the three coins. The random variable $X$ is the number of heads that he obtains.

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

Harry has two other coins, each of which is biased so that the probability of obtaining a head when it is thrown is $p$. He throws all five coins at the same time. The random variable $Y$ is the number of heads that he obtains.

**(b)** Given that $\mathrm{P}(Y = 0) = 6\mathrm{P}(Y = 5)$, find the value of $p$. [3]

**7** The eight digits 1, 2, 2, 3, 4, 4, 4, 5 are arranged in a line.

**(a)** How many different arrangements are there of these 8 digits? [1]

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**(b)** Find the number of different arrangements of the 8 digits in which there is a 2 at the beginning, a 2 at the end and the three 4s are not all together. [4]

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Three digits are selected at random from the eight digits 1, 2, 2, 3, 4, 4, 4, 5.

**(c)** Find the probability that the three digits are all different. [5]

**Additional page**

If you use the following lined page to complete the answer(s) to any question(s), the question number(s) must be clearly shown.

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