

Section A (36 marks)

- 1 The numbers of units of electricity, x kWh (kilowatt-hours), used by 50 customers of an energy firm in a period of one month are summarised as follows.

$$\Sigma x = 17\,100$$

$$\Sigma x^2 = 6\,115\,108$$

- (i) Calculate the mean and standard deviation of x . [3]
- (ii) The cost, $\pounds y$, of the electricity used by each customer is given by the formula $y = 0.108x + 7.2$. Use your answers to part (i) to deduce the mean and standard deviation of the costs of the electricity used by these customers. [3]
- 2 Tom is carrying out a survey into the way in which students travel to school. He selects 50 students and asks each of them 'How did you get to school this morning?' The results are given in the table below.

Walk	Cycle	Bus	Car
17	9	13	11

Tom then randomly selects 4 of these students to interview in more detail.

- (i) Find the number of ways in which Tom can select the 4 students. [2]
- (ii) Find the probability that all 4 of these students walked to school. [2]
- (iii) Find the probability that at least 2 of the 4 students used the same method to get to school. [4]
- 3 Two fair four-sided dice, with faces numbered 1 to 4, are thrown. The random variable X denotes the difference between the scores on the two dice.

- (i) Show that $P(X = 1) = \frac{3}{8}$. [2]

The table shows the complete probability distribution of X .

r	0	1	2	3
$P(X = r)$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{8}$

- (ii) Find $E(X)$ and $\text{Var}(X)$. [5]
- 4 Every day Axel takes the train to work. The probability that he gets a seat on his journey to work is 0.4. The probability that he gets a seat on his journey back home from work is 0.8, independently of whether he gets a seat on his journey to work.
- (i) Find the probability that Axel gets a seat on his journey home, but not on his journey to work. [2]
- (ii) Find the probability that he gets a seat on at least one of the journeys on a day. [3]
- (iii) Given that he gets a seat on at least one of the journeys on a day, find the probability that he gets a seat on both journeys. [3]

- 5 Sakura and Emily are playing a table tennis match. The winner of the match is the first player to win three games. The probability that Sakura wins a game is 0.55, independently of all other games. Games cannot be drawn.
- (i) Find the probability that Sakura wins the match in three games. [2]
- (ii) Find the probability that Emily wins the match. [5]

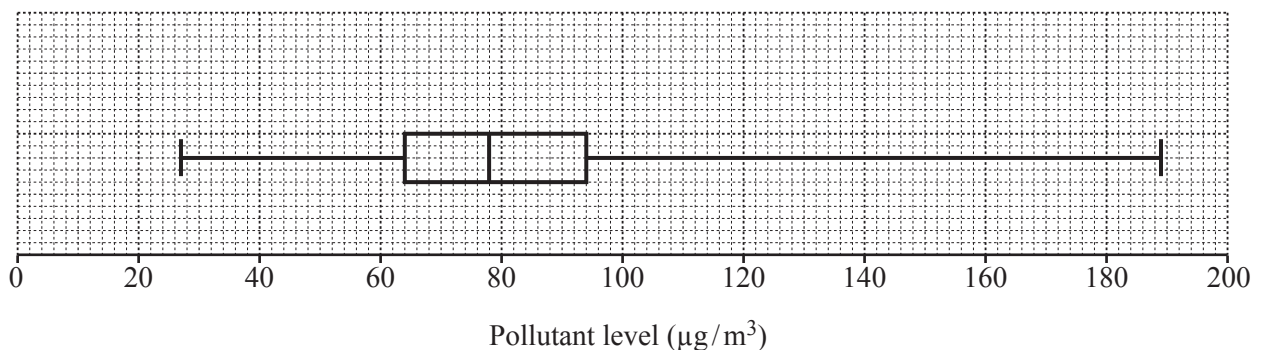
Section B (36 marks)

- 6 The table below shows the maximum daily level of the pollutant nitrogen dioxide in Marylebone Road in London in 2015. The levels are measured in micrograms per cubic metre ($\mu\text{g}/\text{m}^3$). There were 7 days where no figures were available.

Pollutant level ($x \mu\text{g}/\text{m}^3$)	$40 \leq x < 80$	$80 \leq x < 120$	$120 \leq x < 140$	$140 \leq x < 180$	$180 \leq x < 220$	$220 \leq x \leq 300$
Frequency	29	74	52	129	64	10

- (i) Draw a cumulative frequency diagram to illustrate the data. [5]
- (ii) Levels of nitrogen dioxide below 200 are classified as low. Estimate the proportion of days on which the level was low. [2]
- (iii) Use your diagram to estimate the median and interquartile range of the data. [3]
- (iv) For each end of the distribution, explain whether outliers definitely exist, may possibly exist or definitely do not exist. [4]
- (v) Draw a box and whisker plot to illustrate the data. [3]

The box and whisker plot below shows similar data for a roadside location in Tower Hamlets in London.



- (vi) Compare the skewness of the data from the two locations. [2]

7 A type of shampoo is known to relieve the symptoms of 75% of dogs who suffer from a particular minor allergy.

(i) 12 dogs who suffer from this allergy are selected at random. Find the probability that the number of these dogs who have their symptoms relieved is

(A) exactly 9, [3]

(B) at least 9. [2]

A new type of shampoo has been developed to treat the allergy. A hypothesis test is to be carried out to determine whether it relieves the symptoms of a higher proportion of dogs who suffer from the allergy.

(ii) Write down suitable null and alternative hypotheses for the test. Give a reason for your choice of alternative hypothesis. [4]

A random sample of n dogs who suffer from the allergy is selected.

(iii) (A) Given that $n = 18$ and the symptoms of 16 dogs are relieved, carry out the test at the 10% significance level. [4]

(B) Given instead that $n = 50$ and the symptoms of 42 dogs are relieved, carry out the test at the 10% significance level. You may use the information that, for $X \sim B(50, 0.75)$,

$$P(X = 41) = 0.0721, \quad P(X = 42) = 0.0463, \quad P(X \leq 41) = 0.9084, \quad P(X \leq 42) = 0.9547. \quad [4]$$

END OF QUESTION PAPER

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