

Section A (36 marks)

- 1 The stem and leaf diagram illustrates the weights in grams of 20 house sparrows.

| | | | |
|----|---|---|---|
| 25 | 0 | | |
| 26 | 0 | 5 | 8 |
| 27 | 7 | 9 | |
| 28 | 1 | 4 | 5 |
| 29 | 0 | 0 | 2 |
| 30 | 7 | 7 | |
| 31 | 6 | | |
| 32 | 0 | 4 | 7 |
| 33 | 3 | 3 | |

Key: 27 | 7 represents 27.7 grams

- (i) Find the median and interquartile range of the data. [3]
- (ii) Determine whether there are any outliers. [4]
- 2 In a hockey league, each team plays every other team 3 times. The probabilities that Team A wins, draws and loses to Team B are given below.
- $P(\text{Wins}) = 0.5$
 - $P(\text{Draws}) = 0.3$
 - $P(\text{Loses}) = 0.2$
- The outcomes of the 3 matches are independent.
- (i) Find the probability that Team A does not lose in any of the 3 matches. [1]
- (ii) Find the probability that Team A either wins all 3 matches or draws all 3 matches or loses all 3 matches. [2]
- (iii) Find the probability that, in the 3 matches, exactly two of the outcomes, 'Wins', 'Draws' and 'Loses' occur for Team A. [4]
- 3 (i) There are 5 runners in a race. How many different finishing orders are possible? [You should assume that there are no 'dead heats', where two runners are given the same position.] [1]
- For the remainder of this question you should assume that all finishing orders are equally likely.
- (ii) The runners are denoted by A, B, C, D, E. Find the probability that they either finish in the order ABCDE or in the order EDCBA. [2]
- (iii) Find the probability that the first 3 runners to finish are A, B and C, in that order. [1]
- (iv) Find the probability that the first 3 runners to finish are A, B and C, in any order. [2]

- 4 The probability distribution of the random variable X is given by the formula

$$P(X = r) = \frac{k}{r(r-1)} \text{ for } r = 2, 3, 4, 5, 6.$$

(i) Show that the value of k is 1.2. Using this value of k , show the probability distribution of X in a table. [3]

(ii) Find $E(X)$ and $\text{Var}(X)$. [5]

- 5 Measurements of sunshine and rainfall are made each day at a particular weather station. For a randomly chosen day,

- R is the event that at least 1 mm of rainfall is recorded,
- S is the event that at least 1 hour of sunshine is recorded.

You are given that $P(R) = 0.28$, $P(S) = 0.87$ and $P(R \cup S) = 0.94$.

(i) Find $P(R \cap S)$. [2]

(ii) Draw a Venn diagram showing the events R and S , and fill in the probability corresponding to each of the four regions of your diagram. [3]

(iii) Find $P(R | S)$ and state what this probability represents in this context. [3]

Section B (36 marks)

- 6 An online store has a total of 930 different types of women's running shoe on sale. The prices in pounds of the types of women's running shoe are summarised in the table below.

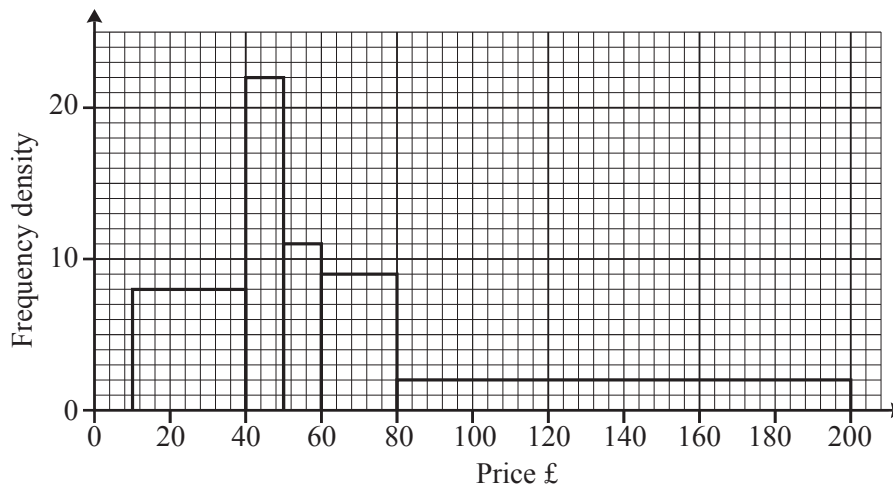
| | | | | | |
|----------------|---------------------|------------------|------------------|------------------|-------------------|
| Price (£ x) | $10 \leq x \leq 40$ | $40 < x \leq 50$ | $50 < x \leq 60$ | $60 < x \leq 80$ | $80 < x \leq 200$ |
| Frequency | 147 | 109 | 182 | 317 | 175 |

(i) Calculate estimates of the mean and standard deviation of the shoe prices. [4]

(ii) Calculate an estimate of the percentage of types of shoe that cost at least £100. [3]

(iii) Draw a histogram to illustrate the data. [5]

The corresponding histogram below shows the prices in pounds of the 990 types of men's running shoe on sale at the same online store.



- (iv) State the type of skewness shown by the histogram for men's running shoes. [1]
- (v) Martin is investigating the percentage of types of shoe on sale at the store that cost more than £100. He believes that this percentage is greater for men's shoes than for women's shoes. Estimate the percentage for men's shoes and comment on whether you can be certain which percentage is higher. [3]
- (vi) You are given that the mean and standard deviation of the prices of men's running shoes are £68.83 and £42.93 respectively. Compare the central tendency and variation of the prices of men's and women's running shoes at the store. [2]

7 To withdraw money from a cash machine, the user has to enter a 4-digit PIN (personal identification number). There are several thousand possible 4-digit PINs, but a survey found that 10% of cash machine users use the PIN '1234'.

- (i) 16 cash machine users are selected at random.
- (A) Find the probability that exactly 3 of them use 1234 as their PIN. [3]
- (B) Find the probability that at least 3 of them use 1234 as their PIN. [2]
- (C) Find the expected number of them who use 1234 as their PIN. [1]

An advertising campaign aims to reduce the number of people who use 1234 as their PIN. A hypothesis test is to be carried out to investigate whether the advertising campaign has been successful.

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

(iii) A random sample of 20 cash machine users is selected.

(A) Explain why the test could not be carried out at the 10% significance level. [3]

(B) The test is to be carried out at the $k\%$ significance level. State the lowest integer value of k for which the test could result in the rejection of the null hypothesis. [1]

(iv) A new random sample of 60 cash machine users is selected. It is found that 2 of them use 1234 as their PIN. You are given that, if $X \sim B(60, 0.1)$, then (to 4 decimal places)

$$P(X = 2) = 0.0393, \quad P(X < 2) = 0.0138, \quad P(X \leq 2) = 0.0530.$$

Using the same hypotheses as in part (ii), carry out the test at the 5% significance level. [4]

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