1. Adam draws cards from a shuffled deck of regular playing cards, one at a time without replacement. There are 52 cards in total, and 4 of these cards are "King" cards.

   Adam will stop drawing once he draws the first "King" card. Let X denote the random variable of the total number of cards he draws (including the first "King" card).

   (a) Give, in context, three reasons why X cannot be modeled by a binomial distribution. [3]

   (b) Find $\mathrm{P}(X = 10)$. [2]

2. A shop sells apples in bags of 8. The probability that an apple is sour is p.

   (a) State, in context, two assumptions such that the number of apples that are sour in a bag can be modeled by a binomial distribution. [2]

   For the rest of question, assume the assumptions above are valid.

   (b) Find an expression, in terms of p, for the probability that there are at most 1 sour apple in a randomly chosen bag.

   (c) It is now given that $p = 0.25$. Bala buys a bag of apples with at least 1 sour apple. Find the probability that the bag contains less than 3 sour apples. [4]

3. Men and women stay at a large hotel. Their masses, in kg, are modeled by normal distributions with means 77 and 62 respectively and standard deviation 9.8 and 10.6 respectively.

   (a) Stating a necessary assumption, find the probability that the mass of a man chosen at random is within ± 10 kg of the mass of women chosen at random. [3]

   (b) The lift in the hotel has a safety limit of 460 kg. Three men and four women are chosen at random. Find the probability that they can safely travel in the lift together. [3]

   (c) After a heavy meal, the mass of each of the three men and four women increased by 1%. Find the new probability that they can safely travel in the lift together. [3]

4. A scientist claims that the mean length of fish in a particular lake is less than 18 cm. The lengths of a random sample of 50 fishes from the lake are summarised as follows, where x cm denotes the length of a fish in the lake.

$$\sum (x - 18) = -16 \qquad \sum (x - 18)^2 = 163$$

   (a) Find unbiased estimates of the population mean and variance. [2]

   (b) Test, at the 10% level of significance, whether there is any evidence to support the scientist's claim.

   Also explain if it is necessary to make any assumptions on the distribution of the length of fishes. [4]

   (c) Explain, in context, the meaning of testing at the '10% level of significance'.

5. A company producing barbecue sauce claims that the mass of salt in a bottle has a mean of 12 g. The mass of salt is known to have a normal distribution with standard deviation 0.8 g.

   A random sample of 20 bottles is selected. The sample mean is m g.

   A test at the 5% significance level is carried out on this sample, and the company's claim is rejected.

   (a) Explain why a sample size of 20 is sufficient in carrying out this test. [1]

   (b) Find the set of possible values of m, correct to 2 decimal places. [5]

6. For Project Work, Clarice and her team are interested in the attitude the students in her school have towards Mathematics.

   They construct a questionnaire to carry out this investigation.

   (a) Briefly explain what the population in their study would be, and why they may not want to send the questionnaire to the entire population. [2]

   (b) Giving an example of a suitable sample, briefly explain how she should distribute her questionnaire. [3]

[3]

7. Four girls, Dolores, Edna and Flora and Gloria and three boys, Harold, Imran and Jack stand in a straight line in random order.

   (a) Find the probability that the first two in the queue are Dolores and Edna, in that order. [2]

   (b) Find the probability that either Harold is first or Jack is last (or both). [3]

   (c) Find the probability that all four girls stand next to each other. [2]

   (d) Find the probability that no two boys are next to each other. [3]