

- (a) Differentiate between each of the following types of classification of statistical data:
- nominal scale* and *ordinal scale*; (4 marks)
 - dependent variable* and *independent variable*. (4 marks)
- (b) Given two polynomial functions:
- $R(x) = 13x - x^2 - 10$ representing revenue function; and
- $C(x) = x + 10$ representing cost function.
- Determine, by calculation, the break-even point(s); (3 marks)
 - Determine the maximum value of the profit function $P(x)$. Use the relationship $P(x) = R(x) - C(x)$. (4 marks)
 - Determine the area enclosed between the profit function and the x-axis. (5 marks)

2. (a) Explain the term *algorithm* as used in computer based solutions. (2 marks)
- (b) The data in Table 1 shows the distribution of grades scored by 200 students of a certain secondary school. Use it to answer the questions that follow.

Grade	1	2	3	4	5	6	7	8	9	10	11	12
No of Students	2	4	8	13	20	28	35	38	34	12	4	2

Table 1

- Determine each of the following statistical measures for the grades scored by the students:
 - mean;
 - median;
 - mode;
 - inter-quartile range. (8 marks)
 - Construct a frequency curve to represent the data. (5 marks)
 - Using the curve constructed in I, identify the type of skewness for the data. (1 mark)
 - Explain whether the three measures of central tendency computed in (i) conform with the skewness identified in (ii) Justifying your answer. (4 marks)
3. (a) (i) Define the term *coding system* as used in digital computer systems. (2 marks)
- (ii) State **three** computer coding systems. (3 marks)
- (b) Expand the binomial expression $(4x + 3y)^5$ in descending powers of x . (6 marks)

- (c) In a certain school the examination performance pass rates for subjects are as follows: Mathematics 65%, English 75%, Physics 60%, and Biology 70%.

The performance requirements for certain courses are as follows:

- Education Science requires a pass in Mathematics, English and any one of the Science subjects;
- Business requires a pass in Mathematics or English and both Science subjects;
- Medicine requires a pass in all the four subjects;

A student is picked at random from the school, determine the probability that he qualifies for each of the following courses:

- Education Science;
- Business;
- Medicine. (9 marks)

4. (a) (i) Describe the function of a *parity check* as used in error detection in a digital computer system. (2 marks)
- (ii) Explain **one** disadvantage of a *parity check* in a digital computer system. (2 marks)
- (b) Convert each of the following numbers to their respective equivalent number systems:
- (i) 43264_8 to hexadecimal;
- (ii) $B6E_{16}$ to octal;
- (iii) 64528_{10} to octal. (6 marks)
- (c) A cubic polynomial function is given by $f(x) = x^3 - 8x^2 + 5x + 12$. Using the Newton-Raphson iterative method, determine the root of the equation rounded off to 8 decimal places. Take the initial root $x_0 = 2.0$. (10 marks)

5. (a) Explain the term *conditional probability* as used in statistics. (2 marks)
- (b) A certain area has encountered an outbreak of a new disease with a known symptom. However, doctors realised that not all the people suffering from the disease display the symptom and not all those who display the symptom suffer from the disease. After conducting a medical survey among a random sample of 540 residents in the area, the findings were as follows:
- 180 patients who had the disease displayed the symptom;
 - 140 patients who had the disease did not display the symptom;
 - 108 patients who did not have the disease displayed the symptom;
 - 112 patients did not have the disease and did not display the symptom;

- (i) Present this information in a contingency table. (2 marks)
- (ii) A patient who has the disease is selected at random from the area, determine the probability that he displays the symptom. (3 marks)
- (iii) A patient who displays the symptom is selected at random from the area, determine the probability that he has the disease. (3 marks)

(c) Given two matrices A and B such that:

$$A = \begin{bmatrix} 6 & 4 \\ 7 & 5 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} 5 & 6 \\ 2 & 4 \end{bmatrix}$$

- Show that:
- (i) matrix addition is commutative while matrix multiplication is not commutative; (8 marks)
- (ii) each of the two matrices is not a singular matrix. (2 marks)

6. (a) (i) Explain the term *measures of deviation* as used in Statistics. (2 marks)
- (ii) Explain the circumstance in which a statistician would prefer to use the *co-efficient of variation* as a statistical measure of dispersion. (2 marks)

- (b) The following data set represents electricity consumption in kilowatt hours by 10 residents who live in an urban estate:
- $8, 12, 15, 10, 11, 14, 9, 11, 10, 280.$
- (i) Determine the mean and the median for electricity consumption; (4 marks)
- (ii) Evaluate which of the two measures computed in (i) is suitable in describing the data set, justifying your answer. (3 marks)

- (c) A clerical officer purchased compact disks in the months indicated, to store his office documents.
- In April he purchased 8 pieces of CD-Rs, 4 pieces of DVD-Rs and paid Ksh 800.
 - In May he purchased 6 pieces of CD-Rs, 5 pieces of DVD-Rs and paid Ksh 760.
- (i) Model this problem as a system of simultaneous equations. (3 marks)
- (ii) Determine the price of each type of disk assuming that the CDs were on all occasions purchased from the same shop and prices remained constant over the period under consideration. (6 marks)

7. (a) Define the term *logic gate* as used in digital systems. (2 marks)
- (b) With the aid of truth tables comprising only two inputs, explain each of the following logic gates:
- (i) OR gate;
 - (ii) AND gate;
 - (iii) XOR gate.
- (12 marks)

(c) Perform each of the following operations on octal numbers:

- (i) $4625_8 + 2543_8$
 - (ii) $4625_8 - 2543_8$
- (6 marks)

8. (a) (i) Outline four properties of *standard deviation* as a measure of dispersion. (4 marks)
- (ii) Differentiate between *interpolation* and *extrapolation* as mathematical techniques of estimation. (4 marks)
- (b) A polynomial function is defined by the equation $y = 8x - x^2 - 7$. Determine the roots of the equation using factorisation method. Hence determine the area enclosed between the curve and the x -axis between the two roots. (6 marks)
- (c) A polynomial function is defined by the equation $y = x^3 - 5x^2 - 18x + 72$. By using calculus techniques, determine the coordinates of the turning point(s) of the curve, and for each turning point, specify whether it is at a minimum or maximum point. (6 marks)