

1. (a) Convert each of the following numbers to the equivalent number system indicated showing all your workings:
- (i) 764_8 to decimal $7 \times 8^2 + 6 \times 8^1 + 4 \times 8^0 = 500_{10}$
- (ii) $E5_{16}$ to octal $4 \times 8 + 4 \times 8 + 4$
- (iii) 679_{10} to binary
- (iv) 111010_2 to hexadecimal (8 marks)
- (b) Distinguish between a *weighted binary code* and *un-weighted binary code* giving an example in each case. (5 marks)
- (c) Peter and Winnie play a game and their chances of winning are in the ratio 3:5. Given that they played 6 games, determine the probability that:
- (i) Peter wins all the games; (2 marks)
- (ii) Peter wins in 2 or 3 games; (3 marks)
- (iii) Winnie wins at most in 5 games. (2 marks)

2. (a) The following statements describe properties about finite sets.
- (i) $P = \{3,4,5\} = \{5,3,4\} = \{4,3,5,4,3\}$;
- (ii) Given $Q = \{6,7,8\}$ and $R = \{7,8,9,6,5\}$ $Q \not\subseteq R$;
- (iii) If $A = \{21,22,23, \dots, 30\}$ then $|A| = 20$;
- (iv) If $A = \{1,2\}$ then $|P\{1,2\}| = 3$.
- State whether each of the statements are true or false. (4 marks)
- (b) Using the event "tossing coin", explain each of the following events as applied in probability.
- (i) equally likely;
- (ii) complementary. (6 marks)
- (c) Tom, Mary and Peter went to a shop to purchase supplies for making decorations. Tom spent Kshs 2,440 when he purchased 3 sheets of craft paper, 4 boxes of markers and 5 glue sticks. Mary spent Kshs 3,040 when she bought 6 sheets of craft paper, 5 boxes of markers and 2 glue sticks. Peter spent Kshs 1,340 when he bought 3 sheets of craft paper, 2 boxes of markers and 1 glue stick.
- (i) Write the narrative as a system of equations. (4 marks)
- (ii) Determine the cost of each item. (6 marks)

3. (a) Explain each of the following levels for variable measurements as applied in statistical data.
- (i) Nominal level;
- (ii) Ordinal level; - follows an order (specific order)
- (iii) Interval. - specified interval (6 marks)

- (b) Rama, Shem and Mogan purchased cookies of different brands P, Q and R. Rama purchased 10 packets of P, 7 packets of Q and 3 packets of R. Shem purchased 4 packets of P, 8 packets of Q and 10 packets of R. Mogan purchased 4 packets of P, 7 packets of Q and 8 packets of R. The cost of each brand is Kshs 40, 50 and 60 respectively.
- (i) Represent the information in matrices notation (4 marks)
- (ii) Use the matrix method to determine the amount of money spent by each person. (2 marks)

(c) Use the cofactor method to determine the inverse of matrix $D = \begin{bmatrix} 3 & 1 & 6 \\ 2 & 0 & 4 \\ 5 & 7 & 2 \end{bmatrix}$. (8 marks)

4. (a) (i) Outline **three** features of *symbolic model*. (3 marks)
- (ii) A certain shop has all their commodities on sale with a 15% discount offer.
- (I) Formulate a mathematical model that could be used to determine the sale price of each commodity in the shop. (3 marks)
- (II) Using the model formulated in (I), determine the sale price of a commodity whose original price is Ksh 500. (2 marks)
- (b) The following statements describes various operations:

- (i) Picking a team of 3 student leaders' from a group of 10 students; **C**
- (ii) Picking a chairman, secretary and treasurer from a group of 10 students; **C**
- (iii) Choosing 3 desserts from a menu of 10; **C**
- (iv) Listing your 3 favourite desserts, in order, from a menu of 10; **P**

State whether each of the statement requires a *permutation* or a *combination* operation. (4 marks)

- (c) A 4-digit PIN number is to be formed using the digits 0, 3, 5, 7, 8 and 9 such that the PIN is divisible by 10 and there is no repeating digit. Determine the number of PINs that would be formed. (4 marks)

- (d) Distinguish between *absolute error* and *relative error* as used in measurement. (4 marks)

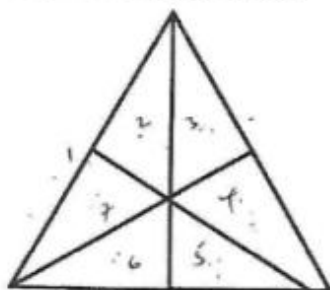
5. (a) (i) State the meaning of the following terms as used in logical mathematical statements:

- (I) Tautology;
- (II) Contradiction. (2 marks)

- (ii) Use a truth table to determine whether each of the following is either a tautology or contradiction:

- (I) $A \wedge (\sim (A \vee B))$;
- (II) $P \vee (P \leftrightarrow Q) \vee Q$. (6 marks)

- (b) A pupil in nursery school was asked to paint each section of the following shape using 8 crayons of different colours.



20 ways

13

Determine the total number of ways of painting the shape.

(4 marks)

- (c) With the aid of a truth table, describe each of the following gates as applied in electronics.

- (i) AND Any or all
- (ii) OR All or nothing
- (iii) NOT

A	B	AND
0	0	0
0	1	0
1	0	0
1	1	1

(8 marks)

6. (a) Outline **three** characteristics of each of the following types of skewness:

- (i) positive skewness;
- (ii) negative skewness.

(6 marks)

- (b) Explain **three** differences between *absolute measures* and *relative measures* as used in statistics.

(6 marks)

- (c) Use truth tables to prove the following digital algebraic equation:

$$\overline{AB} = \overline{A} + \overline{B}$$

(4 marks)

- (d) Use the graphical method to solve the quadratic equation:

$$3x^2 + 5x - 2 = 0$$

(4 marks)

7. (a) (i) Outline **two** limitations of using charts to represent statistical data. (2 marks)

- (ii) Table 1 shows the frequency distribution of packets of milk produced by a farm for a period of six months. Use it to answer the question that follows.

Month	Jan	Feb	march	April	May	June
Frequency	10490	12325	10201	7496	4816	3678

Table 1

Represent the information using a histogram

(4 marks)

- (b) A polynomial function is given by $f(x) = x^2 - 4x - 7 = 0$. Using the *Newton Raphson iterative* method, determine the root of the equation rounded off to 4 decimal places. Take the initial root $x_0 = 5$.

(6 marks)

- (c) The radius of a sphere was measured and found to be 20 cm with a possible error in measurement of 0.01 cm.
- (i) Determine the maximum error in the computation of volume using this value of the radius. (4 marks)
 - (ii) Determine the relative error in each of the following measures:
 - (I) Radius;
 - (II) Volume. (4 marks)
8. (a) State the meaning of each of the following terms as used in probability:
- (i) random experiment;
 - (ii) sample space;
 - (iii) outcome;
 - (iv) sample point. (4 marks)
- (b) Distinguish between *discrete random variable* and *continuous random variable* as used in probability. (4 marks)
- (c) Distinguish between *odd* and *even* parity as applied in digital communications. (4 marks)
- (d) Use the algebraic iterative formula $x_{n+1} = \sqrt[3]{20 - 5x_n}$ to determine the solution of the equation $x^3 + 5x - 20$ given the initial value $x_0 = 2$. Give your answer to 3 decimal places. (8 marks)

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