

2920/106

COMPUTATIONAL MATHEMATICS

July 2022

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY I

MODULE I

COMPUTATIONAL MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

This paper consists of EIGHT questions.

Answer any FIVE of the EIGHT questions in the answer booklet provided.

Candidate should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

1. (a) Using a 3×3 matrix, give an example of each of the following:
- (i) zero matrix;
 - (ii) lower triangular matrix;
 - (iii) diagonal matrix;
 - (iv) identity matrix. (4 marks)
- (b) Perform each of the following matrix operations:
- (i) $-5 \begin{bmatrix} 5 & -6 \\ 4 & 9 \end{bmatrix}^T$; (2 marks)
 - (ii) $2 \begin{bmatrix} x & x+y & 6 \\ -2 & -x & 1 \end{bmatrix} - 3 \begin{bmatrix} -x & -2y & 0 \\ 3x & x & -1 \end{bmatrix}$. (4 marks)
- (c) Table 1 shows frequency distribution of the favourite sport among 120 students in a school. Use it to answer the questions that follow.
- | Sport | Frequency |
|------------|-----------|
| Football | 26 |
| Cricket | 22 |
| Swimming | 22 |
| Basketball | 30 |
| Athletics | 20 |
- Table 1
- (i) Represent the information using a pie chart. (3 marks)
 - (ii) Outline **four** uses of charts in data presentation. (4 marks)
- (d) Kihoto Self-help Group comprises of 58 members. They intend to choose 3 officials from the group to represent them in a conference. Determine the number of ways the 3 members can be chosen. (3 marks)
2. (a) (i) Explain the term *random variable* as used in probability. (2 marks)
- (ii) State **two** differences between a *discrete* variable and a *continuous* variable. (4 marks)
- (b) Distinguish between each of the following pairs of terms as used in number systems:
- (i) fixed point and floating point; (4 marks)
 - (ii) word and byte. (4 marks)
- (c) Simplify the expression $(A + B)(A + C)$ stating the law of Boolean algebra applied at each step. (6 marks)
3. (a) (i) Explain **two** ways in which *parity bit* is used for error detection in computer systems. (4 marks)
- (ii) State four categories of binary codes used in computer systems. (2 marks)

- (b) Peter, John and Mary intend to purchase 15, 16, 18 books and 9, 11, 15 pens each respectively. In shop A, a book costs KShs 250 and a pen costs KShs 175 while in shop B, a book costs KShs 225 while a pen costs KShs 190.

- (i) Represent this information in matrix form; (2 marks)
- (ii) Using matrix method, determine the total cost the three students would spend to acquire the items from shop A and from shop B. (4 marks)

- (c) Given that matrix $C = \begin{bmatrix} -1 & 0 & 3 \\ 3 & 2 & 2 \\ 0 & 0 & 1 \end{bmatrix}$, determine C^{-1} using the co-factor method. (8 marks)

4. (a) Explain each of the following terms as used in probability:

- (i) independent event;
- (ii) mutually exclusive event;
- (iii) exhaustive event. (6 marks)

15 16 18
9 11 15

- (b) Table 2 shows the amount of water in litres (x) and the respective heights (y) attained by 5 plants after being watered for a period of time. Use it to answer the questions that follow.

Amount of water (x)	0	10	20	30	40
Heights of plant in cm (y)	7	18	32	51	87

Table 2

- (i) Construct a forward difference table. (3 marks)
- (ii) Determine the Newton's interpolating polynomial. (5 marks)
- (c) Solve each of the following equations using the method indicated:
- (i) $2x^2 - 8x - 7 = 0$: using the *formula* method; (3 marks)
- (ii) $x^2 + 5x = 14$: using factorisation method. (3 marks)

5. (a) (i) Outline the meaning of the term *sample space* as used in probability. (1 mark)
- (ii) A student tossed a coin four times. Outline **four** possible outcomes from this experiment. (4 marks)
- (iii) Determine the sample space of getting exactly two heads from the experiment in (ii). (3 marks)
- (b) With the aid of a logic circuit, describe the complement of the Boolean variable A. (4 marks)

- (c) A researcher conducted a survey on drinks consumed by students in a college over a period of time in a college and obtained the following results:

- 51 drunk Coca-Cola, 49 drunk Fanta and 60 drunk Sprite;
- 34 drunk both Coca-Cola and Fanta;
- 32 drunk both Fanta, and Sprite;
- 36 drunk both Coca-Cola and Sprite;
- 24 drunk the three drinks;
- 1 drunk none.

- (i) Represent this information using a Venn diagram. (3 marks)
- (ii) Determine the number of students who:
- (I) were surveyed;
 - (II) drunk Sprite, but not Fanta nor Coca-Cola;
 - (III) drunk Fanta or Sprite;
 - (IV) drunk exactly one type of drink;
 - (V) drunk exactly two types of drink. (5 marks)

6. (a) Outline **four** properties of binomial probability distribution. (4 marks)

- (b) A survey found that 85% of women in a given city enjoy shopping online. Six women are randomly selected from the city and asked whether or not they enjoy shopping online. Determine the probability that the following women enjoy shopping online:

- (i) exactly 4;
- (ii) at most 2. (6 marks)

- (c) Explain a circumstance that would necessitate the use of each of the following in estimation:

- (i) linear extrapolation; (2 marks)
- (ii) linear interpolation. (2 marks)

- (d) Using the graphical method, solve the following simultaneous equations for $-3 \leq x \leq 4$:

$$\begin{aligned} 2x + 3y &= 1 \\ y &= 2x^2 - 2x - 5 \end{aligned} \quad (6 \text{ marks})$$

7. (a) State the **four** types of data measurement scales used in statistics. (4 marks)

- (b) Derive the truth tables for each of the following logic gates having 2 inputs:

- (i) NOR gate;
- (ii) NAND gate;
- iii) XNOR gate. (6 marks)

- (c) Using the Boolean algebraic expressions, show that the OR operation could be performed by each of the following properties:
- (i) distributive;
 - (ii) commutative;
 - (iii) associative.
- (6 marks)

- (d) In a series of successive measurements in an experiment, the readings of the period in seconds (s) of oscillation of a simple pendulum were found to be 2.63s, 2.56 s, 2.42s, 2.71s and 2.80s.

Calculate each of the following:

- (i) mean value of the period of oscillation;
 - (ii) absolute error in the reading.
- (4 marks)

8. (a) Define each of the following terms as used in statistics:

- (i) absolute measure;
 - (ii) relative measure.
- (2 marks)

- (b) Describe **three** types of Kurtosis used in statistics.
- (6 marks)

- (c) The data in table 3 shows the distribution of heights in cm of 500 male students of a certain secondary school. Use it to answer the questions that follow.

Marks	0 - 9	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79
Frequency	30✓	40✓	50✓	48	24	162	132	14

Table 3

- (i) Represent the information using a frequency polygon.
 - (ii) Calculate the following measures about the height of the students:
 - (I) the mean;
 - (II) the standard deviation;
 - (III) upper quartile.
- (8 marks)

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