

2920/106
COMPUTATIONAL MATHEMATICS
July 2019
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY
MODULE I

COMPUTATIONAL MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

- *a scientific calculator.*
- *a graph paper.*

This paper consists of EIGHT questions.

Answer any FIVE questions in the answer booklet provided.

All questions carry equal marks.

Candidates should answer the questions in English.

This paper consists 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) Explain each of the following terms as applied in probability:
- mutually exclusive event;
 - sample space;
 - dependent event. (6 marks)
- (b) Convert each of the following number systems to their respective equivalents;
- 754_8 to binary;
 - $2E7A_{16}$ to decimal;
 - 457_8 to hexadecimal. (6 marks)
- (c) Given two sets $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ and $A = \{1, 3, 5, 7, 8\}$, distinguish between a *subset of a set* and the *complement of set A* as used in set theory. (4 marks)
- (d) Use the laws of Boolean algebra to show that $A.B + A'.C + B.C = A.B + A'.C$ (4 marks)

2. (a) Outline **four** properties of the *Poisson probability distribution*. (4 marks)
- (b) A student measured the height of the classroom wall using a ruler that was graduated in millimetres and found that it was 3215mm. Explain the *absolute* and *relative* errors using this scenario, given that the actual height is 3200mm. (4 marks)
- (c) The profits of Keitha Company is represented by the equation $y = 18x - 3x^2 - 4$, where y is the amount of profit in million Kenya shillings and x is the number of years of operation. The CEO of the company would like to know when the company is on the downturn and to sell it before it ends up in debt. Using the graphical method, determine each of the following:
- the duration it will take for the business to realize maximum profits;
 - the maximum profit possible for the company;
 - the duration after which the business will start making loses. (6 marks)
- (d) Table 1 shows the amount of money in thousands of Kenya shillings paid to employees as terminal benefits after their company was closed down. Use it to answer the questions that follow.

Amount Ksh	29 - 29	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79	80 - 89
No of Employees	50	69	70	90	52	40	11

Table 1

Estimate by calculation each of the following measures about the benefits paid:

- the inter-quartile range; (3 marks)
 - the minimum amount to paid to the top 10 % of the employees. (3 marks)
3. (a) Define each of the following terms as used in counting:
- permutation;
 - combination;

(iii) equal sets. (3 marks)

- (b) The following are examples of sets. For each, identify whether each is *finite* or *infinite* set.
- Set of all positive integers which are multiple of 3;
 - $P = \{5, 10, 15, 20, 25, 30\}$;
 - $Q = \{\text{natural numbers less than } 25\}$;
 - $N = \{1, 2, 3, \dots\}$;
 - $R = \{\text{whole numbers between } 5 \text{ and } 45\}$;
 - $W = \{\text{the set of all people who reside in Nairobi}\}$. (6 marks)

(c) Use the Cramers' method to solve the following set of simultaneous equations:

$$3x + 3y + z = 3$$

$$4x + 5y + 2z = 12$$

$$2x + 7y + 3z = 6$$

(11 marks)

4. (a) Define each of the following terms as used in computer data storage:

(i) byte;

(ii) bit. (2 marks)

(b) Given the following matrices, $G = \begin{pmatrix} 3 & 4 & 6 \\ 4 & 5 & 7 \end{pmatrix}$, $H = \begin{pmatrix} 2 & 5 & 6 \\ 3 & 8 & 7 \\ 3 & 5 & 4 \\ 7 & 9 & 1 \end{pmatrix}$ and $L = \begin{pmatrix} 4 & 6 & 8 \\ 1 & 0 & 1 \\ 6 & 7 & 3 \end{pmatrix}$

State whether each of the following matrix operations is possible or not justifying your answer.

(i) $G \times L$

(ii) $(H \times L) + G$

(iii) $(G \times H) - L$ (6 marks)

(c) Use the graphical method to solve the following set of simultaneous equations.

$$3x + 2y = 17$$

$$2x - 3y = -6$$

(6 marks)

(d) Distinguish between a *bar chart* and a *histogram* as used in statistical data presentation, giving an illustration in each case. (6 marks)

5. (a) (i) Define the term *model* as used in mathematics. (2 marks)
- (ii) Outline **two** objectives of a model. (2 marks)

- (b) To produce a certain drug with different efficacies, three ingredients p , u , and v are mixed as shown in Table 1. Use it to answer the questions that follow.

T (K)	P (kg/m ³)	V(m ³ /kg)	U (kJ/kg)
320	40.7	24.565	2439.7
340	38.2	26.116	2468.4
360	36.1	27.662	2497.0

Table 1

Construct a linear interpolation table showing the amount in kg of metal p , u , and v required to produce each of the following tonnes of alloys:

- (i) $T = 330$ K
- (ii) $T = 347$ K (8 marks)
- (c) Use the binomial theorem to expand the expression $(x^2 + 3y)^3$ in descending powers of x . (4 marks)
- (d) Determine the 10th term in the binomial expression $(y + 3)^{12}$. (4 marks)
- 6. (a) Outline **four** properties of the standard deviation as a statistical measure of dispersion. (4 marks)
- (b) Describe each of the following terms as applied in binary codes:
 - (i) non- weighted binary codes;
 - (ii) sequential codes. (4 marks)
- (c) A straight line passes through the points (0, 4) and (6, 12). Determine the value of x along the line when $y = 8$. (4 marks)
- (d) The marks of a group of 1000 students who sat for an examination in a certain college are normally distributed with a mean of 70 and a standard deviation of 10.
 - (i) A student is randomly selected from the group. Determine the probability that the student's mark:
 - (I) is greater than 80; (2 marks)
 - (II) is between 40 and 75 inclusive; (3 marks)
 - (iii) The teacher decided that only the top 5% of the students should score grade A in this examination. Determine the minimum marks for a student to score grade A. (3 marks)
- 7. (a) Explain the following types of data, stating **two** examples in each case.
 - (i) categorical data;
 - (ii) numerical data. (6 marks)
- (b) Distinguish between a *scalar matrix* and a *diagonal matrix* using an illustration of a 3 X 3 matrix in each case. (4 marks)

- (c) A certain company has 12 employees and intends to send a group of 4 for first aid training for a period of one month. Determine the number of ways of selecting this group of trainees if:
 - (i) there are 2 employees who want to go together, that is either they both go or both don't go; (2 marks)
 - (ii) there are 2 employees who want to go together and 2 employees who have refused to go together. (4 marks)
- (d) A certain string of data was binary coded as 01000001 and then transmitted. The data was received as 01000011 and the system detected that an error had occurred.
 - (i) Explain this error. (2 marks)
 - (ii) Explain the reason why this is not the perfect method for error detection in data transmission. (2 marks)

8. (a) Use the data set in Table 2 to construct Newton-Raphson's forward difference table. (4 marks)

x_j	11	12	13	14	15	16
y_j	44265	63760	89625	123120	165625	218640

Table 2

(b) Use the co-factor method to determine the inverse of matrix A.

$$A = \begin{pmatrix} 4 & -3 & 5 \\ 1 & 6 & -4 \\ -3 & 5 & 2 \end{pmatrix} \quad (8 \text{ marks})$$

- (c) (i) Use truth tables to show that ;
 - (I) $\overline{A + B} = \overline{A} \overline{B}$;
 - (II) $\overline{A B} = \overline{A} + \overline{B}$. (4 marks)
- (ii) Describe each of the following logic gates:
 - (I) XOR gate;
 - (II) NOR gate. (4 marks)

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