

2920/106

COMPUTATIONAL MATHEMATICS

November 2016

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY

MODULE I

COMPUTATIONAL MATHEMATICS

3 hours

INSTRUCTIONS TO THE CANDIDATE

You should have a scientific calculator for this examination.

*This paper consists of **EIGHT** questions.*

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

All questions carry equal marks.

Candidates should answer the questions in English.

This paper consists of 6 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) Define each of the following terms as used in mathematics:

- (i) interpolation;
- (ii) extrapolation;
- (iii) mode.

(6 marks)

- (b) Use the matrix method to solve the following system of simultaneous equations:

$$\begin{aligned} 4x - 3y &= 18 \\ 2y - x &= 1 \end{aligned}$$

(4 marks)

- (c) Using the decimal number 3.14159265, perform the following instructions:

- (i) truncate the number to 4 significant figures;
- (ii) round off the number to 4 decimal places.

(4 marks)

- (d) (i) Explain the term *infinite difference table* as used in numerical analysis. (2 marks)

- (ii) Table 1 shows values for x_i and y_i . Use it to answer the question that follows.

x_i	1	2	3	4	5	6
y_i	9	25	71	162	313	539

Table 1

Using the Newton forward interpolation method, construct the forward difference table. (4 marks)

2. (a) Explain **two** advantages of the *median* over the *arithmetic mean* as statistical measures. (4 marks)

- (b) Explain **three** assumptions in interpolation. (6 marks)

- (c) Distinguish between *permutation* and *combination* as used in mathematics. (2 marks)

- (d) (i) Figure 1 shows three straight line graphs. Identify the line graph that corresponds to the following equations: (3 marks)

I. $y = x - \frac{1}{2};$

II. $y = \frac{1}{4}x + 1\frac{1}{2};$

III. $y = -x + 3.$

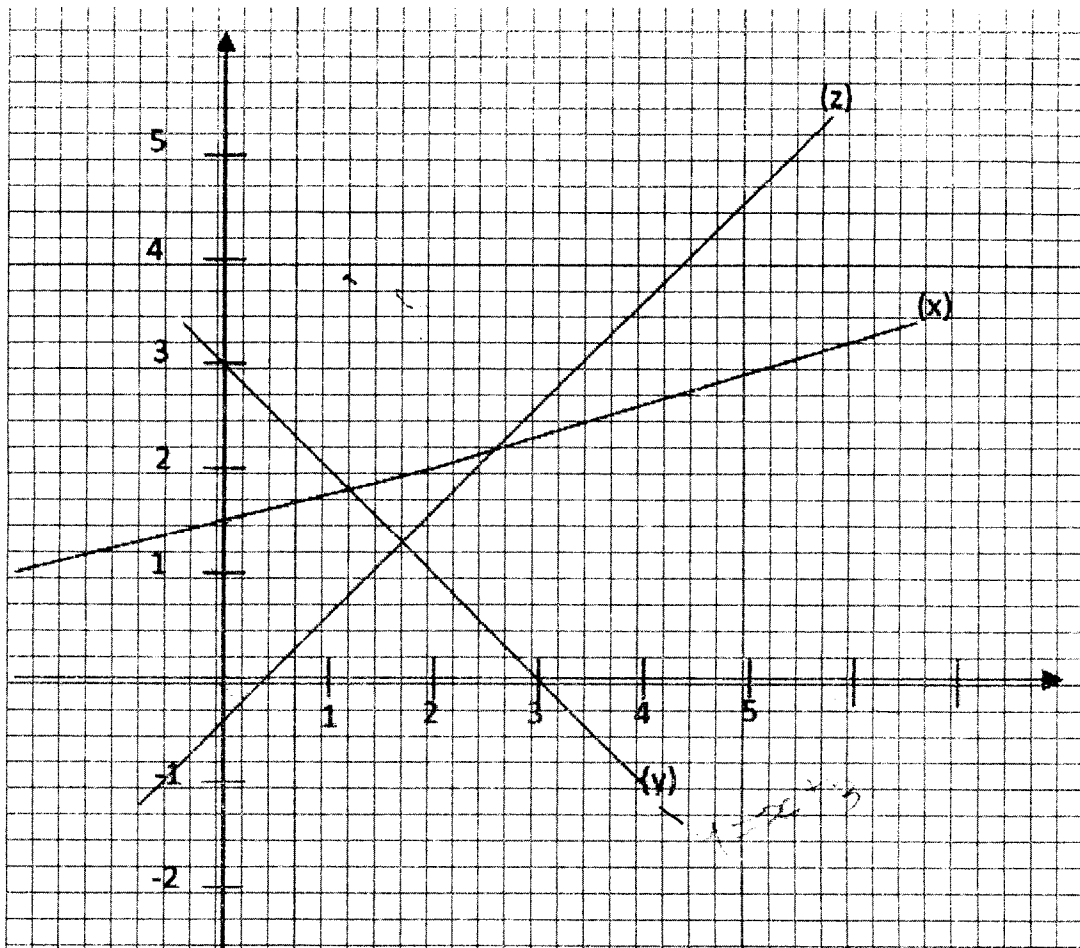


Figure 1

- (ii) Using the Gaussian elimination method, solve the following simultaneous equations. (5 marks)

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

$$2z - 4x + 2y = 18$$

$$-3z + 8x + 9y = -9$$

3. (a) Define each of the following types of measures as used in statistics:

(i) absolute;

(ii) relative.

- (b) Describe **three** ways in which statistical data can be classified.

- (c) Solve each of the following:

(i) using 2's complement, subtract 37_{10} from 52_{10} ;

(ii) convert the binary number 10101.11_2 to its octal equivalent;

(iii) convert 1359_{10} to its octal equivalent;

(iv) convert $6AD_{16}$ to its decimal equivalent.

(8 marks)

- (d) A line passes through the points (0, 3) and (9, 6). Derive the equation of the line. (2 marks)
4. (a) Define each of the following terms as used in matrices:
- (i) identity matrix;
- (ii) singular matrix. (4 marks)
- (b) The following are examples of the probability of an event occurring. Classify them as *dependent*, *mutually exclusive* or *independent*. (4 marks)
- (i) Drawing a red ball when a ball is drawn at random from a bag that contains 4 red and 5 green balls with replacement; *dependent*
- (ii) Selecting a male at random from a group of 15 males and 20 females;
- (iii) Winning a prize in a raffle by buying 5 tickets when there are 6 prizes and a total of 200 tickets are sold; *mutually exclusive*
- (iv) A couple giving birth to a baby girl as their second born if their first born is a boy. *independent*
- (c) Given two input binary signals: A=100101 and B=110110, use truth tables to determine the output C when applied to each of the following gates:
- (i) OR;
- (ii) NAND;
- (iii) XNOR. (6 marks)
- (d) Show that: ${}^{2n}C_2 = 2 \times {}^nC_2 + n^2$. (6 marks)
5. (a) Use a mathematical notation to state the *binomial theorem*. (2 marks)
- (b) With the aid of a diagram in each case, differentiate between *kurtosis* and *skewness* as used in statistics. (6 marks)
- (c) Use an illustration to describe the code formats of each of the following computer coding systems:
- (i) ASCII;
- (ii) EBCDIC. (6 marks)
- (d) A football team scores an average of 3 goals per match in 45 matches. Assuming a Poisson distribution, determine in how many matches they would expect to score each of the following :
- (i) 4 goals;
- (ii) less than 2 goals. (6 marks)
6. (a) Explain each of the following terms as used in statistics:
- (i) spatial modelling;
- (ii) logical models;
- (iii) symbolic modelling. (6 marks)

8, 13, 4, 2
24, 15, 6, 7
11

- (b) Given that Matrix $Q = \begin{bmatrix} 2 & 8 & 2 \\ 1 & 2 & -2 \\ 3 & 4 & -6 \end{bmatrix}$, determine each of the following:
- (i) $3Q$; (2 marks)
- (ii) $3Q^{-1}$ using the cofactor method (8 marks)
- (c) Figure 2 shows a certain logic gate. Use it to answer the questions that follow.

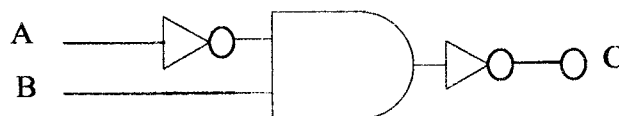


Figure 2

- (i) write the Boolean equation for the output C;
- (ii) determine the value of C when A=1 and B=0. (4 marks)
7. (a) Define the term *pseudo code* as used in modelling. (2 marks)
- (b) (i) Plot the graph of $y = 2x^2 - 5x - 4$ for values of x ranging from -2 to 4 (4 marks)
- (ii) Table 1 shows the air resistance $R(r)$ on a vehicle when it is moving at the speed of S (m/s). Represent this data on a graph. (4 marks)

S(m/s)	0	5	10	15	20	25	30
R(r)	0	23	58	82	121	162	209

Table 1

- (c) With the aid of a Venn diagram in each case, describe the following as used in set theory:
- (i) $A \cup B$;
- (ii) $A \cap B$. (4 marks)

- (d) Given that matrix $A = \begin{bmatrix} -1 & 2 \\ 3 & 5 \\ 8 & 3 \end{bmatrix}$, $B = \begin{bmatrix} 9 & 3 & 4 \\ 1 & 0 & 7 \end{bmatrix}$ and $C = \begin{bmatrix} 0 & 3 & -7 \\ 2 & -1 & 8 \end{bmatrix}$

Evaluate whether each of the following matrix operations is possible giving a reason for your answer.

- I. $(AB)C$;
- II. BC ;
- III. $(B + C)A$. (6 marks)

8.

(a) Describe each of the following models as used in statistical data representation:

(i) histograms;

(ii) frequency polygons.

(4 marks)

(b) The probability of three events occurring are $\frac{1}{8}$ for event X, $\frac{1}{5}$ for event Y and $\frac{2}{7}$ for event Z. Determine the probability of each of the following:

(i) event X and Y occurring but not event Z;

(ii) event Y occurring but not event X and not event Z;

(iii) event X or event Y happening but not event Z.

(7 marks)

(c) A certain examination carries a total of 10 questions and the student is required to answer 7 questions only. The paper is divided into Section A; comprising the first five questions and Section B; comprising the last five questions. Determine the number of ways the student can answer the examination:

(i) If the student must answer 3 questions from the Section A and four questions from the Section B;

(4 marks)

(ii) If at least three questions are selected from the Section A.

(5 marks)

$$\frac{1}{8} + \frac{1}{5} + \frac{2}{7} = \frac{28 + 56 + 112}{280} = \frac{196}{280} = \frac{7}{10}$$

$$\frac{1}{8} + \frac{1}{5} = \frac{5 + 8}{40} = \frac{13}{40}$$

$$\frac{13}{40} + \frac{2}{7} = \frac{91 + 80}{280} = \frac{171}{280}$$

$$\frac{171}{280} - \frac{13}{40} = \frac{171 - 91}{280} = \frac{80}{280} = \frac{2}{7}$$

$$\frac{1}{8} + \frac{2}{7} = \frac{7 + 16}{56} = \frac{23}{56}$$

$$\frac{23}{56} + \frac{1}{5} = \frac{115 + 56}{280} = \frac{171}{280}$$

$$\frac{171}{280} - \frac{2}{7} = \frac{171 - 80}{280} = \frac{91}{280} = \frac{13}{40}$$

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