

2920/106

COMPUTATIONAL MATHEMATICS

July 2023

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN INFORMATION COMMUNICATION TECHNOLOGY

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) Solve each of the following quadratic equations using the method indicated:
- (i) $2y^2 - 11y + 12 = 0$ using the quadratic formula; (3 marks)
- (ii) $x^2 + 2x - 24 = 0$ using factorization. (2 marks)
- (b) With the aid of an example in each case, describe the following types of matrices:
- (i) column matrix;
- (ii) null matrix;
- (iii) Lower triangular matrix. (6 marks)
- (c) Explain a circumstance that would cause each of the following errors to occur during mathematical computation:
- (i) round off error;
- (ii) truncation error. (4 marks)
- (d) Use graphical method to determine the values of x and y satisfying the following simultaneous equations for $-7 < x < 4$:
- $$y = x + 3$$
- $$y = x^2 + 5x - 2$$
- (5 marks)

2. (a) A researcher conducted a survey among 400 people about their favourite beverages. The results were presented in the pie chart as shown in Figure 1. Use it to answer the question that follows.

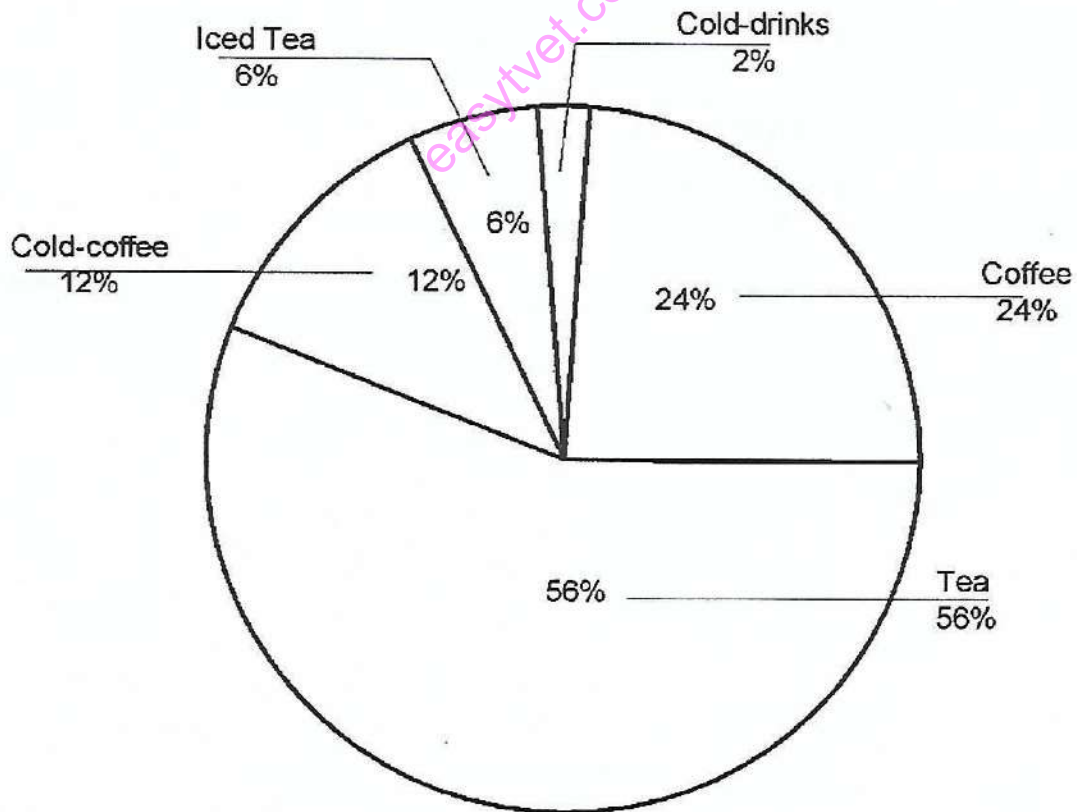


Figure 1

Determine by calculation the number of people who:

- (i) like tea;
 - (ii) whose favourite beverage is not tea.
 - (ii) like iced tea. (6 marks)
- (b) Distinguish between *pseudocode* and *an algorithm* as applied in mathematical modelling. (4 marks)
- (c) Describe each of the following graphical methods of representing data:
- (i) bar graph;
 - (ii) frequency polygon. (4 marks)
- (d) With the aid of examples in each case, explain the following categories of data:
- (i) nominal data;
 - (ii) ordinal data;
 - (iii) interval data. (6 marks)
3. (a) Outline **four** properties of *standard deviation* as a measure of dispersion in statistics. (4 marks)
- (b) Explain each of the following types of binary codes:
- (i) reflective code;
 - (ii) sequential code; (4 marks)
- (c) A student measured the width of a piece of wood as 4.81 mm. The measurement is given to the nearest 0.01 mm. Determine each of the following:
- (i) the absolute error;
 - (ii) the range in which the actual measurement lies. (4 marks)
- (d) Data from a police department showed that of all phones stolen, 80% were stolen by a group of criminals and 20% were stolen by an individual. For all phones stolen by a group of criminals, 24 % were recovered within 48 hours, 16% were recovered after 48 hours and 60% were never recovered. For those stolen by individual criminals, 38% were recovered within 48 hours, 58% recovered after 48 hours and 4 % were never recovered.
- (i) Present this information using a probability tree diagram. (4 marks)
 - (ii) Determine the probability that if a phone is stolen, it will be stolen by a group of criminals and will be recovered within 48 hours. (2 marks)
 - (iii) A stolen phone will not be recovered. (2 marks)
4. (a) Convert each of the following numbers to their respective number system equivalent:
- (i) 987_{10} to hexadecimal;
 - (ii) 763_8 to decimal;
 - (iii) 658_{10} to binary. (6 marks)

- (b) Outline **four** advantages of using mathematical models. (4 marks)
- (c) Use the *Boolean Algebra Laws* to simplify the Boolean expression $AB(BC + AC)$ to its simplest algebraic form. (4 marks)
- (d) A group consists of 4 women and 7 men. A team of 5 members is to be selected from the group. Determine the number of ways of selecting a team consisting of:
- no woman; (1 mark)
 - at least three women; (2 marks)
 - at least one man and one woman. (3 marks)
5. (a) Explain **three** advantages of using interview method in data collection. (6 marks)
- (b) Distinguish between *qualitative data* and *quantitative data* as used in statistics. (4 marks)
- (c) Convert the decimal value 583_{10} to each of the following:
- BCD code;
 - Excess-3 code;
 - Gray code (6 marks)
- (d) Use the Pascal's triangle to expand the expression $(2 + x)^5$ leaving the terms simplified. (4 marks)
6. (a) Outline **two** types of modes that may be found in a frequency data distribution. (2 marks)
- (b) Describe each of the following logic gates as applied in digital electronic:
- NAND gate;
 - NOR gate. (4 marks)
- (c) The following are two statements about parity bits:
- In an even parity scheme the binary string **0010 0001** would be detected as containing an error.
 - In an odd parity scheme the binary string **1100 0110** would be detected as containing an error.
- State whether each of the statements are true or false. (2 marks)
 - State **two** reasons for each of your answer in (i). (4 marks)
- (d) Table 1 shows the frequency distribution of the weight of expectant mothers who attended antenatal clinic for a period of one month. Use it to answer the questions that follow:

Weight	40-50	50-60	60-70	70-80	80-90	90-100
Frequency	25	75	120	115	60	15

Table 1

Estimate by calculation each of the following measures about the weight:

- (i) mean; (2 marks)
- (ii) standard deviation; (2 marks)
- (iii) interquartile range. (4 marks)

7. (a) (i) Determine the first 4 terms of the binomial expansion in ascending powers of x of the expression $(1 + \frac{x}{4})^8$, simplifying the terms. (4 marks)
- (ii) Use the expansion in (i) to estimate the value of $(1.025)^8$, giving the answer to 4 decimal places. (2 marks)
- (b) A welfare group consists of 15 men and 10 women. A committee of three persons is to be constituted. If the members are selected at random, determine the probability that 1 woman and 2 men will be selected. (4 marks)

- (c) Table 2 shows data that relates to the amount of rainfall (x) required to produce the stated amount of coffee (y) in tonnes. Use it to answer the questions that follow.

x	1.4	1.6	1.8	2	2.2
y	4.0552	4.953	6.0496	7.3891	9.025

Table 2

- (i) Construct Newton's backward difference table. (4 marks)
 - (ii) Determine the Newton's interpolating polynomial and estimate the amount of coffee that would be produced when rainfall is at 1.9. (6 marks)
8. (a) Outline **four** assumptions of interpolation in mathematics. (4 marks)
- (b) (i) Use Pascal's triangle to expand $(x + y)^4$. (2 marks)
- (ii) The coefficient of the x^3 term in the expansion of $(x + a)^4$ is 256. Determine the value of a . (3 marks)
- (c) (i) Draw the logical symbol of a XOR gate. (2 marks)
- (ii) Derive the truth table of an XOR gate with 3 inputs. (3 marks)
- (d) Table 3 shows the findings of a survey done in a county on speeding offences and drivers who use cell phones while driving. Use it to answer the questions that follow.

	Speeding Offences	No Speeding Offences
Cell phone user	25	280
Not a cell phone user	45	405

Table 3

A driver is selected at random, determine the probability that:

- (i) the driver had no offence and was a cell phone user; (2 marks)
- (ii) the driver is a cell phone user or the driver had no offence. (2 marks)
- (iii) driver is a cell phone user given that driver had a speeding offence. (2 marks)

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