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2920/106
COMPUTATIONAL MATHEMATICS
July 2016
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 a scientific calculator for this examination.
*Answer any **FIVE** of the following **EIGHT** questions in the answer booklet provided.*
All questions carry equal marks.
Candidates 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.

Turn over

1. (a) (i) State the *additive law* of probability. (2 marks)

(ii) A manufacturer assembles watches from four independently produced components each of which has a probability of 0.01 of being defective. Determine the probability that a watch selected at random is defective. (4 marks)

(b) Given two matrices: $X = \begin{bmatrix} 3 & 2 \\ 2 & 5 \end{bmatrix}$ and $Y = \begin{bmatrix} 3 & 2 \\ 4 & -1 \end{bmatrix}$.

Show that $(X \times Y) \times (X \times Y)^{-1} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (7 marks)

(c) Table 1 shows the total sales of different products from Mwango wholesalers for three years. Use it to answer the questions that follow.

Year	Wheat Flour	Sugar	Cooking Oil
2007	185	100	85
2008	199	140	110
2009	225	165	150

Table 1

(i) Present this information in a component bar chart by year. (4 marks)

(ii) Use a pie chart to present the total sales for the year 2009. (3 marks)

2. (a) Define each of the following terms:

(i) finite difference as used in numerical analysis; (2 marks)

(ii) range as used in measures of dispersion. (2 marks)

(b) Explain each of the following terms as used in probability theory:

(i) outcome set; (2 marks)

(ii) independent events. (2 marks)

(c) (i) Using binomial theorem, expand the expression $(x + y)^6$ in descending powers of y. (4 marks)

(ii) Using the *two's complement* method, determine 15 – 33. (2 marks)

(d) Using the graphical method, solve the following set of simultaneous equation.

$$3x + 5y = 30$$
$$2x + 2y = 16$$

(6 marks)

3. (a) Define the term *parity bit* as used in data transmission. (2 marks)

(b) Explain **two** types of parity bits as used in data communication. (4 marks)

(c) Given the following sequence of numbers 12, 28, 50, 78, 112 and 152.

(i) Create the forward difference table for the sequence. (2 marks)

x

y

(ii) Using the relationship $ax^2 + bx + c$, compute the values for $x = 1, 2, 3, 4, 5$ and 6 to represent the values in the first and subsequent rows. (6 marks)

(iii) Create the difference table with the general terms. (3 marks)

(iv) Determine the values of a, b and c. (3 marks)

4. (a) Define each of the following terms as used in mathematics:

(i) absolute error; (2 marks)

(ii) linear interpolation. (2 marks)

(b) Explain **three** properties of *standard deviation* as a measure of dispersion. (6 marks)

(c) Given that set $A = \{1, 2, \{2\}\}$, state whether the following statements are true or false.

(i) $\{1\} \in A$; (1 mark)

(ii) $\{\{2\}\} \subseteq A$; (1 mark)

(iii) $\{2\} \in A$; (1 mark)

(iv) $\{\{1\}\} \subseteq A$. (1 mark)

(d) Table 2 shows the age distribution of tourists who visited a certain game park on a certain day. Use it to answer the questions that follow.

Age	0 - 20	20 - 40	40 - 60	60 - 80	80 - 100
Frequency	25	42	64	40	29

Table 2

Determine each of the following measures about the age distribution of the tourists:

(i) the median age; (3 marks)

(ii) the mean age. (3 marks)

5. (a) Outline **four** types of bias that could occur during data collection. (4 marks)

(b) Describe each of the following logic gates:

(i) NAND; (2 marks)

(ii) NOR; (2 marks)

(iii) XOR. (2 marks)

(c) Differentiate between the terms *rounding off* and *truncating* numbers as used in mathematics. (4 marks)

(d) In a certain bank, customers arrive randomly at an average rate of 3.4 customers per minute. Assuming that the customer arrivals form a Poisson distribution, determine the probability that in any particular minute:

(i) no customer arrives; (2 marks)

(ii) exactly one customer arrives; (2 marks)

(iii) two or more customers arrive. (2 marks)

6. (a) (i) State **two** properties of the arithmetic mean. (2 marks)

(ii) Outline **three** ways that could be used in the classification of statistical data. (3 marks)

(b) Use the graph for the equation $3x + 4y = 12$ to determine the value of y when $x = 2$. (3 marks)

(c) Differentiate between *histogram* and *frequency polygon* as used in statistical modelling. (4 marks)

(d) A manufacturer introduced two new products: A and B. The cost of making 15 units of product A and 10 units of product B was Ksh. 725 while the cost of making 5 units of product A and 8 units of product B was Ksh. 405. After selling the products, he made a loss of 10% and 15% on each unit of product A and B respectively.

(i) Express the cost of making one unit of each product A and B as simultaneous equations. (2 marks)

(ii) Determine the cost of making one unit of each product. (4 marks)

(iii) Determine the selling price of one unit of each product. (2 marks)

7. (a) Convert each of the following numbers to their respective equivalents:

(i) 6923_{10} to binary; (2 marks)

(ii) $A2DEF_{16}$ to octal. (2 marks)

(b) Given three matrices: $A = \begin{bmatrix} 1 & 2 & 1 \\ 4 & 2 & 3 \end{bmatrix}$, $B = \begin{bmatrix} 7 \\ 2 \\ 6 \end{bmatrix}$ and $C = \begin{bmatrix} 3 & 2 & 1 \end{bmatrix}$.

State whether each of the following matrix operations is possible or not giving reasons.

(i) $A \times B$; (1½ marks)

(ii) $A \times C$; (1½ marks)

(iii) $(C + B) \times A$; (1½ marks)

(iv) $(B \times C) \times A$. (1½ marks)

(c) The games master intends to select a volleyball team of 9 girls from a total of 28 juniors and 25 seniors. Determine the number of possible ways in which he can:

(i) select the team; (2 marks)

(ii) select the team comprising 4 juniors and 5 seniors. (2 marks)

(d) Using truth tables, show that:

(i) $\overline{AB} = \overline{A} + \overline{B}$; (3 marks)

(ii) $A(\overline{A} + B) = AB$ (3 marks)

8. (a) Outline **three** characteristics of the normal probability distribution. (3 marks)

(b) Differentiate between the terms *skewness* and *kurtosis* as used in measures of dispersion. (4 marks)

(c) Certain luxury cars are manufactured in 4 models, 12 colours, 3 engine sizes and 2 transmission types.

(i) Determine the number of distinct cars that can be manufactured. (2 marks)

(ii) If one of the available colours is blue, determine the number of different blue luxury cars that can be manufactured. (2 marks)

(d) Below are two Boolean expressions:

I. $\neg p \vee q$

II. $(x \vee y) \wedge \neg x$

(i) Use logic gates to represent each expression; (5 marks)

(ii) Daw a truth table for each logic gates in (i). (4 marks)

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$\overline{AB}$	$\bar{A}$	$\bar{B}$
0	0	1
0	1	0
1	0	0
1	1	1

$\overline{AB}$	$\bar{A}$	$\bar{B}$
0	1	1
1	0	1
0	1	0
[illegible]	0	0

A	B	$\bar{A}$	AB
0	0	0	1
0	0	1	0
0	1	0	0
1	0	0	0
1	1	1	1

A	B	$\bar{A}+B$	AB	$\bar{A}$
1	0	0	0	0
0	0	0	1	0
0	1	0	0	0
0	0	1	0	0
1	1	1	1	1
0	0	0	0	1