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DICT LEVEL I

COMPUTER MATHEMATICS

MONDAY: 30 August 2021.   **Time Allowed: 3 hours.**

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

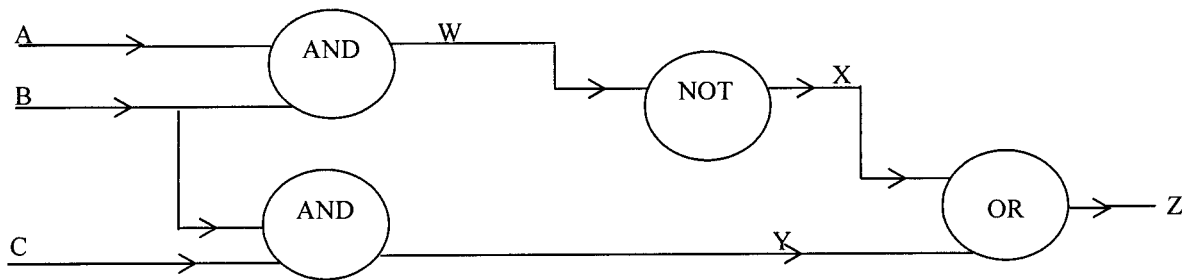**QUESTION ONE**

(a)   Explain the term "overflow" as used in arithmetic computer operations: (2 marks)

(b)   Given that set A = {1, 2, 3, 4, 5}, list the members of the following sets:

      (i) $\{x^2 : x \in A\}$ (2 marks)

      (ii) $\left\{\dfrac{1}{x} : x \in A\right\}$ (2 marks)

      (iii) $\{2x : x \in A\}$ (2 marks)

      (iv) $\{4x + 1 : x \in A\}$ (2 marks)

(c)   Convert the following:

      (i) $3E7_{16}$ to decimal form.   (2 marks)

      (ii) $4A5C_{16}$ to decimal form.   (2 marks)

      (iii) 111110.101111_2 to hexadecimal form.   (2 marks)

(d)   Find the 15_s and 16_s complement of $5D309_{16}$.   (2 marks)

(e)   Evaluate $45376_8 + 36274_8$.   (2 marks)
                                                                      (Total: 20 marks)

QUESTION TWO

(a)   Determine the following:

      (i)   Contrapositive of $\bar{P} \rightarrow Q$.   (1 mark)

      (ii)   Converse of the contrapositive of $\bar{P} \rightarrow \bar{Q}$.   (1 mark)

(b)   Find the truth table for each of the following propositions:

      (i) $(P \leftrightarrow \bar{Q}) \rightarrow (\bar{P} \wedge Q)$.   (4 marks)

      (ii) $(\bar{Q} \vee P) \leftrightarrow (Q \rightarrow \bar{P})$.   (4 marks)

(c)   A, B, and C are inputs of certain computer operation. Given that X = A and B is an intermediate product; construct a truth table for "NOT(A and B) or C by denoting the output of the truth table as W.   (5 marks)

(d)   Given below is a logic circuit designed with inputs A, B and C. It has intermediate outputs W, X and Y and a final output Z.

Required:
A truth table for the above circuit.   (5 marks)
                                                                                                          (Total: 20 marks)

QUESTION THREE
(a)   Outline four steps followed in determining the inverse of a 2 by 2 matrix.   (4 marks)

(b)   A trader in electronic goods purchased 200 speakers and 300 resistors for a total of Sh.850,000 during the month of January 2021. In February 2021, he purchased 90 speakers and 120 resistors for a total of Sh. 360,000.
       Required:
       The prices of a speaker and a resistor using the matrix method. Assume that the prices were the same in the two months.   (6 marks)

(c)   A soap manufacturer produces three brands of washing powder; White, Extra and Blue. Each washing powder contains four ingredients namely; colouring, fragrance, emulsifier and petrolatum. The unit cost of the ingredients in year 2020 were Sh.2, Sh.6, Sh.4 and Sh.8 for colouring, fragrance, emulsifier and petrolatum respectively. The percentages of the ingredients required to produce a unit of each of the powders are given below:

	Percentage		
Ingredient	White	Extra	Blue
Colouring	30	50	10
Fragrance	20	10	30
Emulsifier	40	10	40
Petrolatum	10	30	20

On 1 January 2021, the market prices of colouring and fragrance were halved whereas emulsifier and petrolatum doubled in cost.

Required:
(i)   The unit costs of producing White, Extra and Blue washing powders in the year 2020.   (4 marks)

(ii)   The quantity of each brand of washing powder that the manufacturer can produce in January 2021 with a total cash outlay of Sh.39,000.   (6 marks)
                                                                                                          (Total: 20 marks)

QUESTION FOUR
(a)   Solve the following equations:

(i) $\dfrac{x-5}{x+1} = \dfrac{x-7}{x-2}$ (4 marks)

(ii) $y^2 = 4x + 1$
       $y = x + 1$ (4 marks)

(b)   Electronit Limited manufactures two electronic products, X and Y using two processes, A and B. The production of one unit of product X requires 8 hours in process A and 4 hours in process B. The production of two units of product Y requires 4 hours in process A and 20 hours in process B. The maximum capacities of processes A and B are 3,800 hours and 10,000 hours respectively.

Required:
The number of units of products X and Y that should be manufactured in order to utilise A and B to full capacity.

(4 marks)

(c)   The total electricity cost incurred by Viwanda Limited per month is given by the equation: y = a + bx

Where: y is the total electricity cost per month in shillings.
        x is the number of kilowatt hours used per month

During the month of March 2021, Viwanda Limited used 100,000 kilowatt hours and incurred total electricity cost of Sh.600,000. During the month of April 2021 the company used 190,000 kilowatt hours and incurred total electricity cost of Sh.1,005,000.

Required:
(i)   The values of a and b. Interpret their meaning.   (4 marks)

(ii)   The total electricity cost incurred in a month when Viwanda Limited used 175,000 kilowatt hours.

(2 marks)

(iii)   The number of kilowatt hours used in a month when Viwanda Limited incurred total electricity cost of Sh.1,045,500.   (2 marks)

(Total: 20 marks)

QUESTION FIVE

(a)   Distinguish between "independent events" and "complement of an event".   (4 marks)

(b)   Highlight five qualities of a good average.   (5 marks)

(c)   Describe how the median can be obtained graphically.   (5 marks)

(d)   An ICT distributor has provided the following information about their customers:

10 per cent of the customers purchase their hardware.
25 per cent of the customers purchase their software.
Out of the customers who purchase their hardware, 80 per cent also purchase their software.

Required:
(i)   The probability that a customer purchases both the software and hardware from the distributor. (2 marks)

(ii)   The probability that a customer purchases either the hardware or the software from the distributor.

(2 marks)

(iii)   Determine whether the events "purchase of hardware" and "purchase of software" are independent.

(2 marks)
(Total: 20 marks)

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