THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

A. M. E. C. E. A

MAIN EXAMINATION

AUGUST - DECEMBER 2018 TRIMESTER

FACULTY OF COMMERCE

DEPARTMENT OF ACCOUNTING AND FINANCE

REGULAR PROGRAMME

CMS 121: BUSINESS MATHEMATICS

Date: DECEMBER 2018	Duration: 2 Hours
INSTRUCTIONS: Answer Question ONE and ANY OTHER TWO Questions	

Q1. a) (I) Define the following terminologies related to the algebra of set theory, providing an example or illustration as appropriate:
  i) A set **(1 mark)**
  ii) Disjoint sets **(1 mark)**
  iii) Compliment of a set **(1 mark)**

(II) For each of the following (i) and (ii) draw a venn diagram using the given information ti fill in the number of elements for the respective regions (distinctive sets) of the venn diagram)
  (i) c($\coprod$) = 38, c(A) = 12, c(A n B) = 12, c(B') =20 **(4 marks)**
  (ii) c(A u B) = 17, c(A n B) = 3, c(A) = 8, c(A' u B')
  (4 marks)

where, for instance, c($\coprod$) = 38 is the universal set and A' or B' = compliment of set A and set B, respectively.

(III) In a survey of 10, 281 people restricted to those who were either Kenyan or male, a Kenyan military officer conducting a vetting recruitment exercise provided the following data:

Category (set)	Number
Kenyan	3,490
Kenyan males	1,745
Over 18 years and Kenyan	1,341
Male	5,822

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Over 18 years and male	859
Kenyan male over 18	239
Over 18 years	4,722

Required:
Using set theory technique, determine whether the data provided by the military officer is consistent or not. Provide a clear justification for your conclusion. **(8 marks)**

b) The percentage of people who have a Bachelor of Commerce (BComm) degree in Kenya has been increasing with time and data relating to the period 1997 to 2017 is summarized in the table below:

Year	1997	2002	2007	2012	2017
Percentage with BComm degree	30	34	38	42	46

Required:
- (I) Develop an appropriate function that relates the year to the percentage of people with a Bachelor of Commerce degree. **(5 marks)**
- (II) If the trend continues, estimate the percentage of people who will have a BComm degree by the year 2027. **(2 marks)**
- (III) Determine the year in which BComm degree holders will reach 58%. **(2 marks)**

c) Find the slope of $f(x) = x^3 - 2x^2 + 4x + 1$ at the point (3, 22) **(2 marks)**

Q2 a) The selling price of a commodity per unit is Kshs 200 while the variable cost per unit is 70% of the selling price. The fixed cost is Kshs 800,000.

Required:
- (I) Determine the breakeven sales **(3 marks)**
- (II) Sales units required to make a profit of Kshs 2 million **(2 marks)**

b) A company wholesales a certain shampoo in a particular city. Their marketing research department established the following weekly supply and demand functions:

$$p = \frac{X}{450} + \frac{1}{2}, \text{ supply function}$$

$$p = \frac{6,300}{X}, \text{ demand function}$$

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Required:

Determine the equilibrium quantity and the market price for this brand of shampoo. **(7 marks)**

c) A major bank offers a credit card which can be used domestically. Data given over time indicates that the collection percentage for credit issued in any month is an exponential function of the time since the credit was issued. Specifically, the function approximating the relationship is:

$p = 0.90(1- e^{-0.08t})$, for $t > 0$,

and where p equals to the percentage of amounts receivable in shillings collected t months after the credit is granted.

Required:

(I)   What percentage is expected after 4 months? **(2 marks)**

(II) What value does p approach as t (time in months) increases without bound (limit) and hence what is the expected percentage of bad debts? **(2marks)**

d) For a certain commodity, the demand equation is given by D = -3p + 20. It is known that at a price of K£1, four units of the commodity are supplied. If the supply equation is linear and the market equilibrium price is £4, find the supply equation. **(4marks)**

Q3. a) The market research department of a company recommends that the company
manufactures and markets a new toilet air freshener for use in homes. After suitable test marketing, the research department presents the following price-demand function:

x = 10,000 – 1,000p, where x is the number of units (cans) of the freshener of a given standard size that retailers are likely to buy at K£p per unit.

The financial department provides the following function:

C = 7,000 + 2x, where 7,000 is the estimate of the fixed cost (tooling and overhead) and K£2 is the estimate of variable cost per unit (material, labour, transport, etc).

Required:

(I)   Determine the revenue function for the company.   **(3 marks)**

(II)   Determine the profit function for the company   **(2 marks)**

(III) Find the level of production that maximizes profit and the maximum profit in K£s. **(4 marks)**

(IV)   What price should the company charge in order to maximize profit? **(2 marks)**

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b)   Suppose that the cost of production increases by K£0.50 per unit because of the tax levy on the business by the government, find the level of production that maximizes profit and the maximum profit in K£s **(9 marks)**

Q4.   a)   If marginal cost of producing x units of a product is given by:

$c'(x)$ or $\dfrac{dc}{dx} = 0.3x^2$, and fixed cost is £2,000.

Required:
Find the cost function and determine the cost of producing 20 units
(4 marks)

b)   The monthly sales of a particular type of computer are expected to decline at the rate of $s'(t)$ or $\dfrac{dc}{dt} = -25t^{2/3}$ computers per month, where t is the time in months and s(t) is the number of computers sold each month. The company plans to stop manufacturing this type of computer when the monthly sales reach 800.

Required:
If the monthly sales now (when t = 0) are 2,000 computers:

(I)   Find the function that relates the number of computers sold (s) to time in months (t), i.e find s(t). (Hint: Integral calculus technique could be of help) **(3 marks)**

(II)   Use the function determined in (I) above to determine the monthly sales after 4 months. **(1 mark)**

(III) How long will the company continue to manufacture the computer, given that it stops manufacturing when monthly sales reach 800?
(4 marks)

c)   The rate of change of monthly sales of a new video game cartridge is given by:

$s'(t)$ or $\dfrac{ds}{dt} = 500t^{1/4}$,   s(0) = 0 or when t = 0, s = 0,

where t is the number of months since the game was released and s(t) is the number of cartridges sold each month.

Required:
(I)   Determine s(t) function or the function that relates the number of cartridges sold to the time that has passed in months. Hence determine the monthly sales after 3 months. **(4 marks)**

(II)   When will monthly sales reach 2,000 cartridges? **(4 marks)**
END

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