



THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE

FIRST SEMESTER EXAMINATIONS – JUNE 2023

FIRST YEAR BACHELOR IN COMMERCE IN ACCOUNTANCY, APPLIED ECONOMICS,
MANAGEMENT, BUSINESS IT & FIRST YEAR BACHELOR IN PROPERTY STUDIES

MA114 QUANTITATIVE METHODS I

TIME ALLOWED: 3 HOURS

INFORMATION FOR CANDIDATES

1. Write your name and student number clearly on the front of the examination booklet.
2. You have 10 minutes to read this paper. You must not begin writing during this time.
3. There are **five** questions, you should answer all questions.
4. All answers must be written in examination booklets only. No other written material will be accepted.
5. Start the answer for each question on a **new** page. Do **not** use red ink.
6. Notes and textbooks are not allowed in the examination room.
7. All mobile phones and electronic/recording devices must be switched off during the examination.
8. **Cheating of any form is prohibited.**
9. Scientific and business calculators are allowed in the examination room.

MARKING SCHEME

Marks are indicated at the beginning of each question. Total mark is 90.

Question 1 [5 + 5 + 5 = 15 Marks]

(a) $8^{-x^2+x} = 2^{5x-1}$

(b) Solve for p given the equation $\log_a(2p + 1) + \log_a(3p - 10) = \log_a(11p)$ for $p > 0$.

(c) $\log_2(x) - 3 + \log_2(x + 3) = 0$

Question 2 [(5 + 5 + 5) + (5) = 20 Marks]

(a) PNG Power is introducing a new system called “Controlled Usages” that will substitute for the currently used *easy pay* policy. The following shows a monthly hypothetical charging rule for an electricity utility;

- An installation fee is K15,
- 50 toea per unit is charged for the first 200 units (kilowatt hours), and 60 toea is charged for each unit exceeding first 200 units.

If these charges include VAT, answer the following questions:

- (i) Construct a formula for this charging function.
- (ii) Use the formula to find the charge for 200 kilowatt hours.
- (iii) If the total charge is K120, calculate the corresponding units.

(b) Use the multiple formula below to find the value of x when $y = 25$.

$$y = \begin{cases} 3x - 1 & , 0 \leq x < 15 \\ 5x & , 15 \leq x \leq 25 \\ 3(x + 1) & , x > 25 \end{cases}$$

Question 3 [5 + 5 + 5 = 15 Marks]

During normal breathing, about 12% of the air in the lungs is replaced after one breath. If the initial amount of air in the lung is 500 mls;

- (a) Write an exponentially decay model in the form $y = ae^{kx}$ for the amount of the original air left in the lungs where y being the amount of air in the lungs while x represents the number of breaths
- (b) How much of the original air is present after 24 breaths?
- (c) What happens to the content of the air present as number of breaths increases?

Question 4 [(5 + 5) + 5 + 5 = 20 Marks]

- (a) Find a linear regression equation for the two sets of data below and estimate the value of x when $y = 9$.

x	2	4	6	8
y	3	7	5	10

- (b) One of the Digicel Cup team has 10 officials. How many ways can a coach, a trainer and an assistant coach be selected?
- (c) The profit function for a certain production process is $P(x) = 2x^2 + 40x + 2000$ and the cost function is $C(x) = x^2 - 30x + 500$. Evaluate the marginal revenue at $x = 2$.

Question 5 [20 Marks]

A company manufactures and sells two models of lamps, L_1 and L_2 . To manufacture each lamp, the manual work involved in model L_1 is 20 minutes and for L_2 is 30 minutes. The mechanical (machine) work involved for L_1 is 20 minutes and for L_2 is 10 minutes. The manual work available per month is 100 hours and the machine is limited to only 80 hours per month. Knowing that the profit per unit is K15 and K10 for L_1 and L_2 respectively, determine the quantities of each lamp that should be manufactured to obtain the maximum benefit.

[Hints: Following are the steps in solving the problem above and the marking guide].

1. Decision Variables: [2 marks]
2. Objective Functions: [2 marks]
3. Setting Constraints: [4 marks]
4. Graphing for Optimum Points: [4 marks]
5. Solving for maximum values: [3 marks]
6. Required Answers: [5 marks]

End of Examination