



**NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF HEALTH AND APPLIED SCIENCES**

DEPARTMENT OF MATHEMATICS AND STATISTICS

QUALIFICATION: Bachelor of science in Applied Mathematics and Statistics	
QUALIFICATION CODE: 07BSAM	LEVEL: 6
COURSE CODE: MAP602S	COURSE NAME: MATHEMATICAL PROGRAMMING
SESSION: JANUARY 2023	PAPER: THEORY
DURATION: 3 HOURS	MARKS: 100

SUPPLEMENTARY/SECOND OPPORTUNITY QUESTION PAPER	
EXAMINERS	MR. B.E OBABUEKI, MR J AMUNYELA
MODERATOR:	PROFESSOR ADETAYO EEGUNJOBI

INSTRUCTIONS
<ol style="list-style-type: none">1. Answer ALL questions in the booklet provided.2. Show clearly all the steps used in the calculations.3. All written work must be done in blue or black ink and sketches must be done in pencil.

PERMISSIBLE MATERIALS

1. Non-programmable calculator without a cover.

THIS QUESTION PAPER CONSISTS OF 3 PAGES (Excluding this front page)

Question 1 (10 marks)

A landscaper wants to mix her own fertilizer containing a minimum of 50 units of phosphates, 240 units of nitrates and 210 units of calcium. Brand 1 contains 1 unit of phosphates, 6 units of nitrates and 15 units of calcium. Brand 2 contains 5 units of phosphates, 8 units of nitrates and 6 units of calcium. Brand 1 costs \$250 per kilogramme; brand 2 costs \$500 per kilogramme. Model this information into a linear programming problem. Declare your variables unambiguously and name the constraints. DO NOT SOLVE. (10)

Question 2 (13 marks)

Solve the following minimization problem graphically. Use a scale of 1cm to 25 units on the x-axis and a scale of 1cm to 5 units on the y-axis. (13)

$$\begin{aligned}
 \text{Minimize} \quad & C = 20x + 30y \\
 \text{Subject to} \quad & 9x + 100y \geq 4500 \\
 & 3x + 20y \leq 1200 \\
 & 15000 \leq 75x + 200y \\
 & y \leq 60 \\
 & x ; y \geq 0
 \end{aligned}$$

Question 3 (29 marks)

Consider the following L-P model:

$$\begin{aligned}
 \text{Minimize} \quad & Z = 240x + 120y \\
 \text{Subject to} \quad & 4x + 8y \geq 56 \\
 & 2x + 2y \geq 24 \\
 & 3x + y \geq 18 \\
 & x \geq 0 ; y \geq 0
 \end{aligned}$$

3.1 Write down the dual of the model. (5)

3.2 Solve the dual model. (14)

3.3 Suppose the solution of the dual model is $a = 0 ; b = 30 ; c = 60 ; t_1 = 0 ; t_2 = 0 ; D = 1800$. Use this solution to determine the solution of the given primal model. (10)

Question 4 (17 marks)

Consider the following L-P model:

$$\begin{aligned} \text{Minimize } Q &= 2x + 4y + 5z + 3t \\ \text{Subject to } & -x - 2y + 2z \geq 40 \\ & 3x + 2z + t \leq 100 \\ & x - 2y - z + 4t \geq 50 \\ & x; y; z; t \geq 0 \end{aligned}$$

- 4.1 Re-write the model to include all the necessary variables. (5)
- 4.2 Develop the **first** (not just the initial) tableau for the model and circle the pivot. DO NOT SOLVE. (12)

Question 5 (17 marks)

Consider the following transportation table:

	Destination 1	Destination 2	Destination 3	Supply
Source 1	10	15	20	20
Source 2	12	7	9	20
Source 3	6	14	16	20
Demand	30	15	15	

- 5.1 Determine the initial transportation cost using the North-west corner method. (6)
- 5.2 The following table is an estimate of the minimum cost of the transportation problem:

10	15	20
20		
12	7	9
	15	5
6	14	16
10		10

Use this table to determine the minimum cost for the transportation problem. (11)

Question 6 (14 marks)

Given the following assignment table, assign workers A, B, C, and D to the tasks 1, 2, 3, and 4 in such a way that assignment cost is at its minimum. Also calculate the minimum cost. (14)

	Task 1	Task 2	Task 3	Task 4
Worker A	100	85	85	90
Worker B	45	95	65	75
Worker C	135	105	100	115
Worker D	55	120	105	125

END OF PAPER

TOTAL MARKS: 100