National University of Computer and Emerging Sciences, Lahore Campus

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Instruction/Notes: Attempt all questions. Programmable calculators are not allowed.
For Question-1, the best option according to the given statement. (CUTTING IS NOT ALLOWED)

QUESTION # 1: (08)

21.5/25

1. The term ________ implies that one or more variables in the solution and the profit can be infinitely large.
   a. Degeneracy
   b. Unbounded
   c. infeasibility
   d. alternate solutions

2. LP theory states that the optimal solution to any problem will lie at:
   a. the origin
   b. a corner point of the feasible region
   c. the highest point of the feasible region
   d. the lowest point in the feasible region

3. If, when we are using a Simplex table to solve a maximization problem, we find that the ratios for determining the pivot row are all negative, then we know that the solution is:
   a. Unbounded
   b. Infeasible
   c. Degenerate
   d. Optimal

4. The Z_j row in a simplex table for maximization represents:
   a. Profit per Unit
   b. Gross Profit
   c. Net Profit
   d. None of the above

5. Unboundedness is usually a sign that the LP problem:
   a. has finite multiple solutions
   b. is degenerate
   c. contains too many redundant constraints
   d. has been formulated improperly

07

6. The C_j row in a simplex table for maximization represents:
   a. Profit per Unit
   b. Gross Profit
   c. Net Profit
   d. None of the above

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7. **A feasible solution requires that all artificial variables is:**
   a. Greater than zero
   b. Less than Zero
   c. Equal to zero
   d. there are no special requirements on artificial variables; they may take on any value
   e. None of the above

8. **Infeasibility means that the number of solutions to the linear programming models that satisfy all constraints is:**
   a. At least 1
   b. 0
   c. An infinite number
   d. at least 2

QUESTION # 2: (07)

XYZ manufacturing company has a division that produces two models of grates, model–A and model–B. To produce each model–A grate requires '3' g. of cast iron and '6' minutes of labor. To produce each model–B grate requires '4' g. of cast iron and '3' minutes of labor. The profit for each model–A grate is Rs.2 and the profit for each model–B grate is Rs.1.50. One thousand g. of cast iron and 20 hours of labor are available for grate production each day. Because of an excess inventory of model–A grates, Company's manager has decided to limit the production of model–A grates to no more than 180 grates per day.

The company wants to know the number of grates, model–A & model–B, to produce in order to maximize the profit. [**Note:** Only Linear Programming Model formulation required]

Suppose:

x_1 =#model A

x_2 =#mode B

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Objective Function:

$$Z = 2x_1 + \frac{1}{2}x_2$$

Constraints:

$$3x_1 + 4x_2 \leq 1000$$

$$6x_1 + 3x_2 \leq 1200 \quad \therefore 20 \times 60 = 1200 \text{ mi}$$

$$x_1 \leq 180$$

Constraints name.

$x_1 \geq 0$; $x_2 \geq 0$. Non-negativity constraint

QUESTION # 3: Solve the following linear programming problem using Graphical Method. **(05)**

Max: $Z = 3x_1 + 6x_2$

Subject to:

$3x_1 + 2x_2 \le 18$ (C1) (0,9), (6,0)

$x_1 + x_2 \le 5$ (C2) (0,5), (5,0)

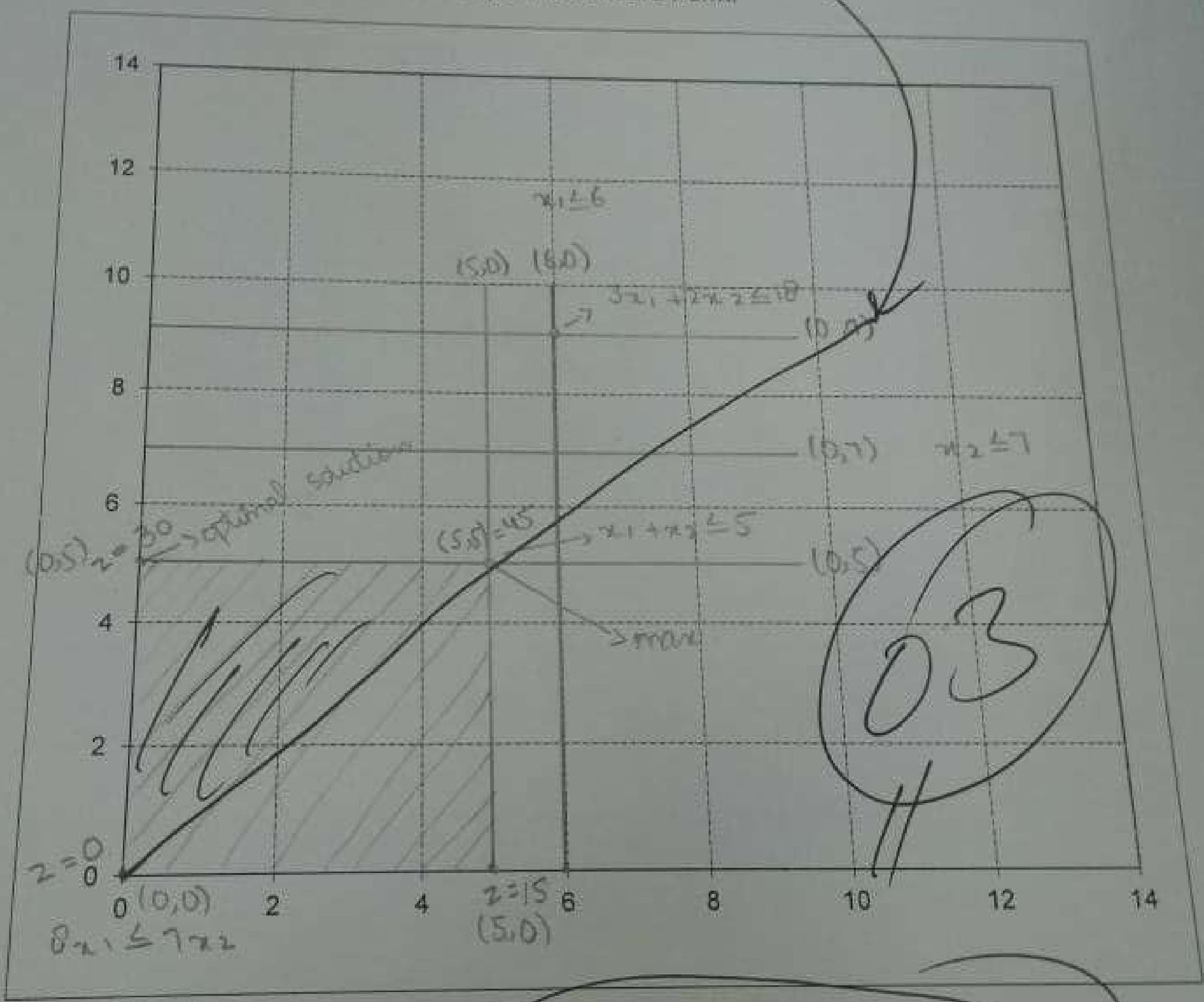
$x_1 \le 6$ (C3) (6)

$x_2 \le 7$ (C4) (7)

$x_1 / x_2 \le 7/8$ (C5) $\to 8x_1 \le 7x_2$

$x_1, x_2 \ge 0$

Hint: constraint C5 is linear, but needs to be put in Standard Form.



On the diagram above:

a. Plot and label the constraints

b. Shade the feasible region

c. Identify and label the optimal solution

$z =$

$z = 0(3) + 2(5) = 10 \le 18.$

$z = 3(5) + 6(0) = 30$ optimal.

d. If constraint (C4) is changed from $x_2 \le 7$ to $x_2 \ge 7$, what is the effect on the problem?

- Unbounded problem
- Infeasible problem
- Alternate optima
- No change

(2.5)

QUESTION # 4:

Consider the following linear programming problem

Max: $Z = 4x_1 + 5x_2$

Subject to:

$x_1 + 2x_2 \le 10$ (1)

$6x_1 + 6x_2 \le 36$ (2)

$x_1 \le 4$ (3)

$x_1, x_2 \ge 0$

& its initial Simplex tableau:

pivot cell

		C_j	4	5	0	0	0	RATIO
C_{Bi}	B	Quantity (Qty)	X_1	X_2	S_1	S_2	S_3	
0	S_1	10	1	$\boxed{2}$	1	0	0	10/2 = 5
0	S_2	36	6	6	0	1	0	36/6 = 6
0	S_3	4	1	0	0	0	1	
Z_j		0	0	0	0	0	0	
$(C_j - Z_j)$			4	5	0	0	0	

pivot row

pivot column

2.5

On the table above:

a. Identify the pivot column X_2, 2nd
b. Identify the pivot row S_1, Ist
c. Identify the pivot cell
d. Upon pivoting, which variable will enter the basis?

Entering Variable	X_2

e. Upon pivoting, which variable will leave the basis?

Leaving Variable	S_1

QUESTION # 5: (01+0.5+0.5+0.5 = 2.5)

LP Simplex Tableau Interpretation: In the Simplex solution shown here:

		C_j	3	2	0	0	0
C_{Bi}	B	Quantity (Qty)	X_1	X_2	S_1	S_2	S_3
2	X_2	60	0	1	–1	2	0
0	S_3	20	0	0	–1	1	1
3	X_1	20	1	0	1	–1	0
	(Z_j)	180	3	2	0	2	1
		$(C_j - Z_j)$	0	0	0	–2	–1

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a. What are the current values of the variables and of the Z?

X_1	X_2	S_1	S_2	S_3	Z
20	60	0	2	20	180

b. Which variables are currently **BASIC**? X_2, S_3, X_1

c. Which variables are currently **NON-BASIC**? S_1, S_2

d. Which constraints are currently **BINDING**? $x_2 = 60, S_3 = 20, x_1 = 20$