Question 1: Solve the following linear program graphically, showing the objective function, all constraints and the feasible region, and marking all basic feasible solutions.

Minimize $Z = 3x_1 + 2x_2$,

subject to

$$2x_1 + x_2 \geq 10$$
$$-3x_1 + 2x_2 \leq 6$$
$$1x_1 + 1x_2 = 6$$

$$x_1 \geq 0, \quad x_2 \geq 0.$$

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ORExMid Makeup - Word

Question 2: Maka Police Station employs 30 police officers. Each officer works for 5 days per week. The crime rate fluctuates with the day of week, so the number of the police officers required each day depends on which day of the week it is: Monday, 18; Tuesday, 24; Wednesday, 25; Thursday, 16; Friday, 21; Saturday, 28; Sunday, 18. The Police Station wants to schedule police officers to minimize the number whose days off are not consecutive. Formulate a liner programming model that will accomplish this goal.

Question 4: Consider the following problem, where the value of c_1 has not yet been ascertained.

$$\text{Maximize} \quad Z = c_1x_1 + x_2,$$

subject to

$$x_1 + x_2 \le 6$$
$$x_1 + 2x_2 \le 10$$

and

$$x_1 \ge 0, \quad x_2 \ge 0.$$

Use graphical analysis to determine the optimal solution(s) for (x_1, x_2) for the various possible values of c_1 $(-\infty < c_1 < \infty)$.

Question 5: Heart Start produces automated external defibrillators (AEDs) in each of two different plants (A and B). The unit production costs and monthly production capacity of the two plants are indicated in the table below. The AEDs are sold through three wholesalers. The shipping cost from each plant to the warehouse of each wholesaler along with the monthly demand from each wholesaler are also indicated in the table. How many AEDs should be produced in each plant, and how should they be distributed to each of the three wholesaler warehouses so as to minimize the combined cost of production and shipping? **Formulate this problem as a transportation problem.**

	Unit Shipping Cost			*Unit Production Cost*	*Monthly Production Capacity*
	Warehouse 1	*Warehouse 2*	*Warehouse 3*		
Plant A	$22	$14	$30	$600	100
Plant B	$16	$20	$24	$625	120
Monthly Demand	80	60	70		

Question 4: For the following linear programming problem, use the SOB method to construct its dual problem.

$$\text{Minimize } Z = 3x_1 + 2x_2$$

subject to

$$2x_1 + x_2 \geq 10$$
$$-3x_1 + 2x_2 \leq 6$$
$$x_1 + x_2 = 6$$

$$x_1 \geq 0, \quad x_2 \geq 0.$$

Question 6: In the Industrial Engineering Department, suggesting different courses for the next semester and student registration can be considered as an optimization problem. Can you write and mathematically represent **EXAMPLES** for **DIFFERENT** objective functions, constraints and decision variables that should be considered when one needs to formulate such a case? (For example: Constraint: To register for OR course, you have to successfully complete the Engineering Analysis course. Represent such a constraints mathematically.)

Wafa'a A

created considerable excess production capacity. Management is considering devoting this excess capacity to one or more of three products; call them products 1, 2, and 3. The available capacity on the machines that might limit output is summarized in the following table:

Machine Type	Available Time (Machine Hours per Week)
Milling machine	500
Lathe	350
Grinder	150

The number of machine hours required for each unit of the respective products is

Productivity coefficient (in machine hours per unit)

Machine Type	Product 1	Product 2	Product 3
Milling machine	9	3	5
Lathe	5	4	0
Grinder	3	0	2

The sales department indicates that the sales potential for products 1 and 2 exceeds the maximum production rate and that the sales potential for product 3 is 20 units per week. The unit profit would be $50, $20, and $25, respectively, on products 1, 2, and 3. The objective is to determine how much of each product Omega should produce to maximize profit.

(a) Formulate a linear programming model for this problem.

C (b) Use a computer to solve this model by the simplex method.

D **3.1-12.** Consider the following problem, where the value of c_1 has not yet been ascertained.

Maximize $Z = c_1x_1 + x_2,$

subject to

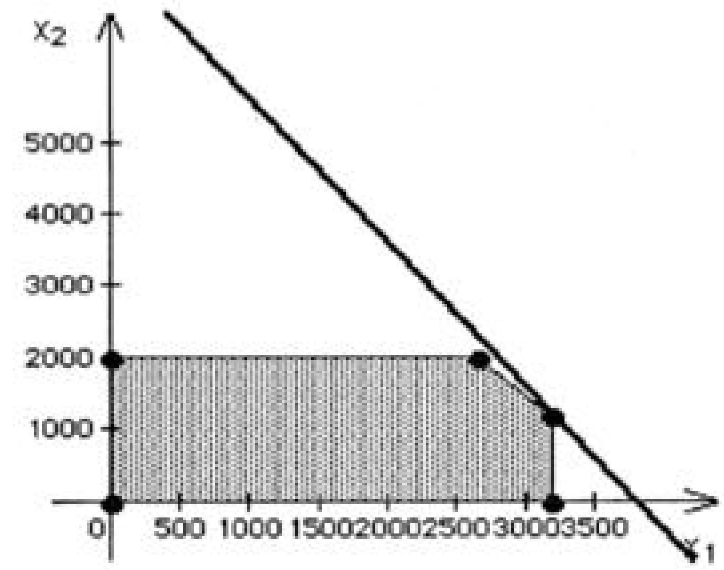
$$x_1 + x_2 \leq 6$$
$$x_1 + 2x_2 \leq 10$$

and

$$x_1 \geq 0, \quad x_2 \geq 0.$$

Use graphical analysis to determine the optimal solution(s) for (x_1, x_2) for the various possible values of $c_1 (-\infty < c_1 < \infty)$.

Optimal Solution: $(x_1^*, x_2^*) = (3200, 1200)$ and $P^* = 3212$



11.

Let x_i be the number of units of product i produced for $i = 1, 2, 3$.

maximize $Z = 50x_1 + 20x_2 + 25x_3$

subject to
$$9x_1 + 3x_2 + 5x_3 \leq 500$$
$$5x_1 + 4x_2 \leq 350$$
$$3x_1 + 2x_3 \leq 150$$
$$x_3 \leq 20$$
$$x_1, x_2, x_3 \geq 0$$

ve Automatically by the Simplex Method:

ptimal Solution

ue of the
ective Function: Z = 2904.7619

iable	Value
1	26.1905
2	54.7619
3	20

straint	Slack or Surplus	Shadow Price
1	0	4.7619
2	0	1.42857
3	31.4286	0
4	0	1.19048

Sensitivity

Objective Func

Current Value	All To Min
50	
20	
25	23.

Right Hand

Current Value	All To Min
500	36
350	276.
150	118.
20	

12.