LINEAR PROGRAMMING PROBLEMS

1 MARK QUESTIONS

1. In a LPP, the maximum value of z = 3x + 4y subject to the constraints $x + y \leq 40,\ x + 2y \leq 60,\ x, y \geq 0$ is

(A) 120 (B) 140 (C) 150 (D) 130

[March, 2025]

2. The graph of the inequation 2x + 3y > 6 is the :
(A) entire XOY-plane
(B) half-plane that contains the origin
(C) half-plane that neither contains the origin nor the points on the line 2x + 3y = 6
(D) whole XOY-plane excluding the points on the line 2x + 3y = 6

[March, 2024]

3. In an LPP, if the objective function Z = ax + by has same maximum value on two corner points of the feasible region, then the number of points at which maximum value of Z occurs is :

(A) 0 (B) 2 (C) finite (D) infinite

[March, 2024]

4. Region represented by x 0, y 0 lies in
(a) I quadrant (b) II quadrant (c) III quadrant (d) IV quadrant

[March, 2023]

5. The graph of the inequality 3x + 2y > 6 is the :
(A) entire XOY plane
(B) whole XOY plane excluding the points on the line 3x + 2y = 6
(C) half plane that contains the origin
(D) half plane that neither contains the origin nor the points on the line 3x + 2y = 6

[July, 2025]

6. The number of solutions of an L.P.P. to minimize z = 3x + 2y under the constraints x + y ≥ 8, 3x + 5y ≤ 15 and x, y ≥ 0, is :
(A) 2 (B) 5 (C) infinitely many (D) zero

[July, 2024]

7. The maximum value of the function z = 7x + 5y, subject to constraints x ≤ 3, y ≤ 2, x ≥ 0, y ≥ 0, is :

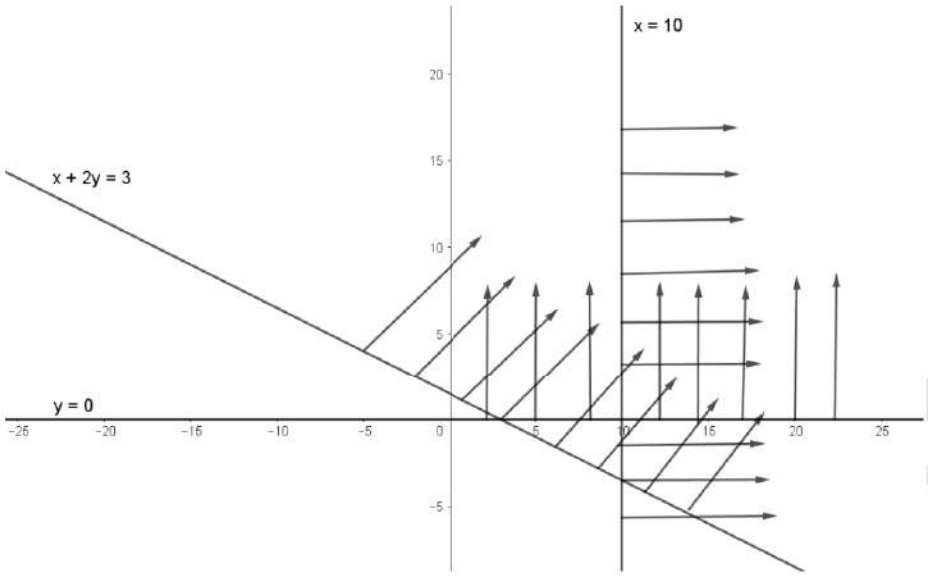
(a) 21 (b) 10 (c) 31 (d) 37

[July, 2023]

8. In solving the LPP: Minimize $Z = 6x + 10y$ subject to constraints $x \geq 6,\ y \geq 2,\ 2x + y \geq 10,\ x \geq 0,\ y \geq 0$ the redundant constraints are
(A) $x \geq 6,\ y \geq 2$ (B) $y \geq 2$
(C) $x \geq 6$ (D) $2x + y \geq 10,\ x \geq 0,\ y \geq 0$

[SQP 25-26]

9. The constraints of a linear programming problem along with their graphs is shown below:
x + 2y ≥ 3, x ≥ 10, y ≥ 0

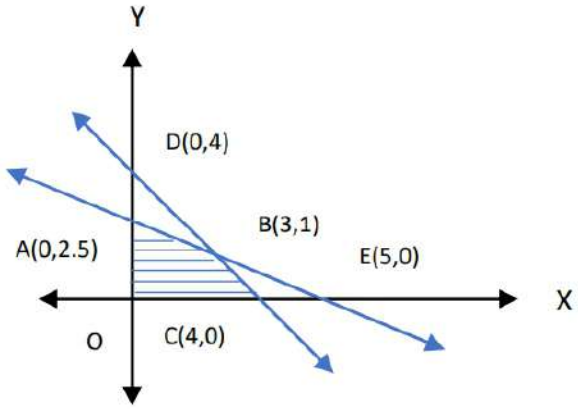


Which of the following inequality may be removed so that the feasible region remains the same in above graph?

(A) $x + 2y \geq 3$ (B) $x \geq 10$ (C) $y \geq 0$ (D) $x \geq 0$

[SQP 24-25]

10. Besides non negativity constraint the figure given below is subject to which of the following constraints

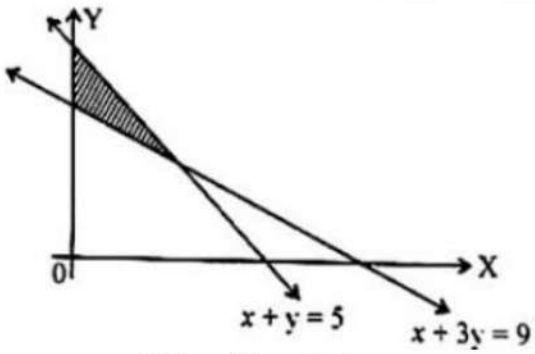


(a) $x + 2y \leq 5$; $x + y \leq 4$ (b) $x + 2y \geq 5$; $x + y \leq 4$

(c) $x + 2y \geq 5$; $x + y \geq 4$ (d) $x + 2y \leq 5$; $x + y \geq 4$

[SQP 23-24]

11. In the given figure (I), what is the LPP shaded region known as?



a) Feasible region b) Feasible solution

c) Optimal region d) Objective region

[SQP22-23]

2 MARKS QUESTIONS

12. Find the solution to the following linear programming problem (if it exists) graphically : Maximize Z = x + y , subject to the constraints x – y ≤ – 1, – x + y ≤ 0, x, y ≥ 0.

[March, 2024]

13. Maximize z = 3x + 4y, if possible, subject to the constraints : x – y ≤ –1 , x + y ≤ 0, x, y ≥ 0.

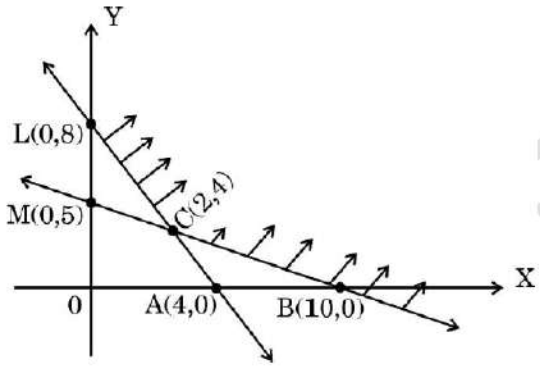
[March, 2022]

14. Two tailors A and B earn ₹ 1500 and ₹ 2000 per day, respectively. Tailor A can stitch 6 shirts and 4 pants, while tailor B can stitch 10 shirts and 4 pants per day. Form a linear programming problem to minimize the labour cost to produce at least 60 shirts and 32 pants.

[July, 2024]

15. The feasible region of the LPP, minimise z = 5x + 7y subjected to constraints 2x + y ≥ 8, x + 2y ≥ 10, x, y ≥ 0 is given below. Determine the optimal solution and justify your answer.

[July, 2022]



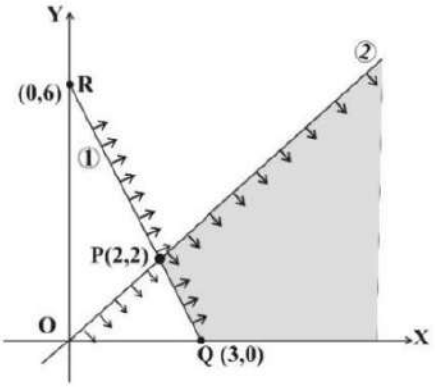
16. A Cooperative Society of farmers has 10 hectares of land to grow two crops A and B. To control weeds, pesticide has to be used for crops A and B at the rate of 30 grams per hectare and 15 grams per hectare respectively. Further, not more than 750 grams of pesticide should be used. The profit from crops A and B per hectare are estimated as 8000 and 9500. Formulate the above problem as LPP, in order to allocate land to each crop for maximum total profit.

[SQP 23-24]

17. A book publisher sells a hard cover edition of a book for ₹ 72 and a paperback edition for ₹ 40. In addition to a fixed weekly cost of ₹ 9,600, the cost of printing hardcover and paperback editions are ₹ 56 and ₹ 28 per book respectively. Each edition requires 5 minutes on the printing machine whereas hardcover binding takes 10 minutes and paperback takes 2 minutes on the binding machine. The printing machine and the binding machine are available for 80 hours each week. Formulate the linear programming problem to maximise the publisher's profit.

[SQP 22-23]

18. The feasible region of the LPP Min $Z = 3x + 2y$ subject to constraints $2x + y \geq 6$, $x - y \geq 0$, $x \geq 0$, $y \geq 0$ is given below:



Determine the optimal solution. Justify your answer.

[SQP 21-22]

3 MARKS QUESTIONS

19. There are two types of fertilizers F1 and F2. F1 consists of 10% nitrogen and 6% phosphoric acid. F2 consists of 5% nitrogen and 10% phosphoric acid. After testing the soil conditions, a farmer finds that he need at least 14 kg of nitrogen and 14 kg of phosphoric acid for his crop. If F1 cost Rs 6 per kg and F2 costs Rs 5 per kg, how much of each type of fertilizer should be used so that the cost is minimum. Formulate a linear programming problem

[March, 2025]

20. Solve the following linear programming problem graphically:
Minimise Z = 50x + 30 y, subject to $2x + y \leq 18$, $3x + 2y \leq 34$, $x, y \geq 0$.

[March, 2025]

21. Maximise z = 300x + 190y, subject to constraints : $x + y \leq 24$, $2x + y \leq 32$, $x \geq 0$, $y \geq 0$.

[March, 2023]

22. Minimise Z = 5x + 10y, subject to the constraints $x + 2y \leq 120$, $x + y \geq 60$, $x - 2y \geq 0$, $x, y \geq 0$

[July, 2025]

23. Formulate the following problem as an LPP :
A small firm manufactures gold rings and chains. The total number of rings and chains manufactured per day is at most 24. It takes 1 hour to make a ring and 30 minutes to make a chain. The maximum number of hours available per day is 16. If the profit on a ring is Rs. 300 and that on a chain is Rs. 190, find the number of rings and chains that should be manufactured per day, so as to earn the maximum profit.

[July, 2023]

24. A company produces two types of products, A and B. The company is limited by a constraint on the number of labour hours available, which is 500 hours. Product A requires 4 hours of labour per unit, while Product B requires 6 hours of labour per unit. Additionally, the company is restricted by a maximum of 80 units of product A and 60 units of product B that can be produced per day. The profit per unit of product A is ₹ 30, and the profit per unit of product B is ₹ 40. Formulate the Linear Programming Problem (LPP) to maximize the profit.

[SQP 25-26]

25. A small firm manufactures necklaces and bracelets. The total number of necklaces and bracelets that it can handle per day is at most 25. It takes one hour to make a bracelet and half an hour to make a necklace. The maximum number of hours available per day is 14. If the profit on a necklace is ₹ 100 and that on a bracelet is ₹ 300, formulate an L.P.P. for finding how many of each should be produced daily to maximize the profit? It is being given that at least one of each must be produced.

[SQP 24-25]

5 MARKS QUESTIONS

26. A dietician has to develop a special diet using two foods P and Q. Each packet (containing 30 g) of food P contains 12 units of calcium, 4 units of iron, 6 units of cholesterol and 6 units of Vitamin A. Each packet of the same quantity of food Q contains 3 units of calcium, 20 units of iron, 4 units of cholesterol and 3 units of Vitamin A. The diet requires at least 240 units of calcium, at least 460 units of iron and at most 300 units of cholesterol. How many packets of each food should be used to minimize the amount of Vitamin A ? What is the minimum amount of Vitamin A ? Formulate the above problem as an L.P.P. and solve it graphically.

[July, 2024]

27. A library has to accommodate two different types of books on a shelf. The books are each 6 cm and 4 cm thick and each weighs 1 kg and 1.5kg respectively. The shelf is 96 cm long and can support a weight of atmost 21 kg. How should the shelf be filled with the books of two types in order to include the greatest number of books ? Formulate it as an L.P.P and so solve it graphically.

[July, 2023]

28. A manufacturer has three machines I,II and III installed in his factory. Machines I and II are capable of being operated for at most 12 hours whereas machine III must be operated for at least 5 hours a day. He produces only two items M and N , each requiring the use of all the three machines. The number of hours required for producing 1 unit of M and N on three machines are given in the following table:

Items	**Number of hours required on machines**		
	I	II	III
M	1	2	1
N	2	1	1.25

He makes a profit of 600 and 400 on one unit of items M and N respectively. Formulate the above problem as LPP and solve it graphically to find how many units of each item be produced to maximize profit. Also find the maximum profit.

[SQP 23-24]

29. Rahul is at the whole sale market to purchase folding tables and chairs, to later sell them at his furniture shop. He has only ₹ 5,760 to spend and his van has space to carry at the most 20 items. A table costs him ₹ 360 and a chair costs ₹ 240. Back at his shop, he plans to sell a table at a profit of ₹ 22 and a chair at a profit of ₹ 18. Given that he can sell all the items that he purchases, how many tables and chairs shall he purchase in order to maximise his profit?

[SQP 22-23]

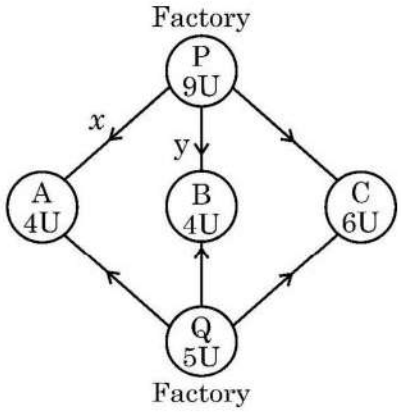
CASE-BASED QUESTIONS

30. There are two factories located one at P and the other at Q. From these locations, a certain commodity is to be delivered to each of the three depots situated at A, B and C. The weekly requirements of the depots are respectively 4, 4 and 6 units of the commodity while the production capacity of the factories at P and Q are 9 and 5 units respectively. The cost of transportation per unit is given as:

From / To	**Cost (in ₹)**		
	A	B	C
P	160	100	150
Q	100	120	100

Based on the above information, answer the following questions:

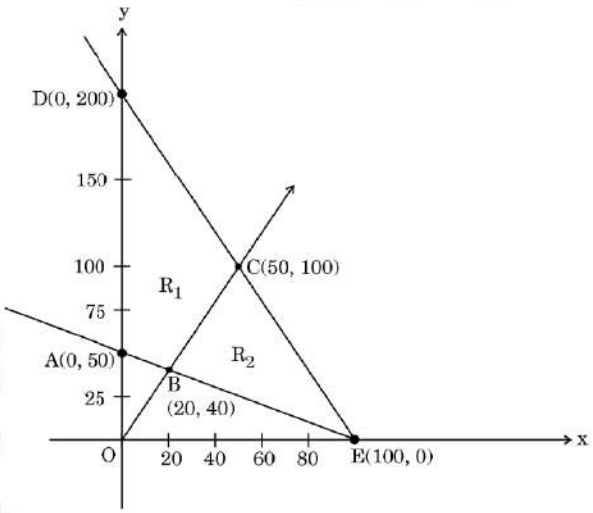
Let x units and y units of the commodity be transported from factory P to the depots at A and B respectively, then



Find (in terms of x and y) how many units of commodity be transported from factory P to depot C.
Find how many units of commodity be transported from factory Q to A, B and C respectively.
Using (i) and (ii), find the minimum total transportation cost z. [2]

[March, 2025]

31. In number theory, it is often important to find factors of an integer N. The number N has two trivial factors, namely 1 and N. Any other factor, if exists, is called non-trivial factor of N. Naresh has plotted a graph of some constraints (linear inequations) with points A (0, 50), B (20, 40), C (50, 100), D (0, 200) and E (100, 0). This graph is constructed using three non-trivial constraints and two trivial constraints. One of the non-trivial constraints is $x + 2y \geq 100$.



Based on the above information, answer the following questions :
(i) What are the two trivial constraints ?
(ii) (a) If R1 is the feasible region, then what are the other two non-trivial constraints ?

OR

(b) If R2 is the feasible region, then what are the other two non-trivial constraints ?
(iii) If R1 is the feasible region, then find the maximum value of the objective function $z = 5x + 2y$.

[March, 2024]

32. A factory manufactures tennis rackets and cricket bats. A tennis racket takes 1.5 hours of machine time and 3 hours of craftsmanship in its making; while a cricket bat takes 3 hours of machine time and 1 hour of craftsmanship. In a day, the factory has availability of not more than 42 hours of machine time and 24 hours of craftsmanship. Profit on a racket and on a bat are Rs. 20 and Rs. 10 respectively.
Based on the above information, answer the following questions :
(i) If x and y are the numbers of bats and rackets manufactured by the factory, then write the expression of total profit.

(ii) Write the constraint that relates the number of craftsmanship hours.
(iii) (a) Determine the maximum profit (in Rs.) earned by the factory.

OR

(iii) (b) How many bats and rackets respectively, are to be manufactured to earn maximum profit?

[March, 2023]

33. A dietician wishes to mix two types of foods F1 and F2 in such a way that the vitamin content of the mixture contains at least 8 units of vitamin A and 10 units of vitamin C. Food F1 contains 2 units/kg of vitamin A and 1 unit/kg of vitamin C, while Food F2 contains 1 unit/kg of vitamin A and 2 units/kg of vitamin C. It costs Rs. 5 per kg to purchase Food F1 and Rs. 7 per kg to purchase Food F2.

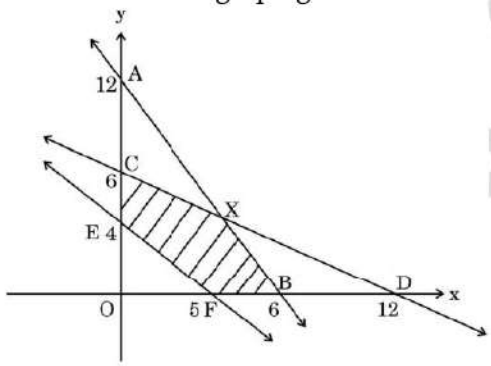
Based on the above information, answer the following questions :

(a) To find out the minimum cost of such a mixture, formulate the above problem as a LPP.

(b) Determine the minimum cost of the mixture.

[March, 2022]

34. The feasible region for an LPP is shown in the graph given below :



Based on the above information, answer the following questions :

(i) Determine the equation of CD.

(ii) Determine the equation EF.

(iii) (a) Determine all the constraints for the LPP.

OR

(iii) (b) Find the maximum value of the objective function $Z = 600x + 400y$.

[July, 2025]

35. A diet for a sick person must contain at least 4,000 units of vitamins, 50 units of minerals and 1400 units of calories. Two foods X and Y are available at a cost of Rs. 4 and Rs. 3 per unit respectively. One unit of food X contains 200 units of vitamins, 1 unit of minerals and 40 units of calories, whereas one unit of food Y contains 100 units of vitamins, 2 units of minerals and 40 units of calories.

Based on the above information, answer the following questions:

(i) To minimise the cost of diet, formular the above problem as an LPP.

(ii) Determine the number of units of each food required to satisfy the requirements.

[July, 2022]

36. If a young man rides his motorcycle at 25 km/hr, he had to spend ₹ 2 per km on petrol. If he rides at a faster speed of 40 km/hr, the petrol cost increases to ₹ 5 per km. He has ₹ 100 to spend on petrol and wishes to find the maximum distance he can travel within one hour.

Based on the given information, answer the following questions:

(i) Formulate the objective function and the constraints of the above Linear programming problem.

(ii) Find the maximum distance the man can travel within one hour.

[SQP 25-26]

37. A company has two factories located at P and Q and has three depots situated at A, B and C. The weekly requirement of the depots at A, B and C is respectively 5, 5 and 4 units, while the

production capacity of the factories P and. Q are respectively 8 and 6 units. The cost (in ₹) of transportation per unit is given below.

Cost (in ₹)			
To / From	A	B	C
P	160	100	150
Q	100	120	100

Based on the above information, answer the following questions:

(i) Formulate the objective function and the constraints of the above Linear programming problem.

(ii) How many units should be transported from each factory to each depot in order that the transportation cost is minimum?

[SQP 24-25]

38. S & D chemicals produce two products, an alkaline solution and a base oil that are sold as raw material to companies manufacturing soaps and detergents. On the basis of current inventory levels and estimated demand for the coming month, S & D's management has decided that combined production of alkaline solution and base oil must be at least 3500 gallons. S & D chemicals are also committed to supply 1250 gallons of alkaline solution to one of its major customer. The alkaline solution and base oil requires respectively 2 hours and 1 hour of processing time per gallon. The total processing time available for the coming month is 6000 hours. The production cost is ₹200 per gallon for the alkaline solution and ₹300 per gallon for base oil. Formulate the above as a L.P.P and solve it by graphical method to help S & D chemicals determine the minimum production cost.

[SQP 21-22]