



Attempt all questions before checking the answer key. Use graphical solutions with labelled boundary lines, feasible vertices and objective values.

A. Very short answers - 1 mark each

1. What is an objective function?
2. Define a feasible solution.
3. What does an infeasible system of constraints mean?
4. Can an unbounded feasible region have a finite minimum? Explain briefly.

B. Short answers / practice - 2 marks each

5. Represent $x \geq 0$, $y \geq 0$ and $x + y \leq 4$ graphically.
6. List the vertices of $x \geq 0$, $y \geq 0$, $x \leq 3$, $y \leq 2$.
7. Evaluate $Z = 3x + 2y$ at $(0, 0)$, $(4, 0)$, $(2, 3)$ and $(0, 3)$.
8. Explain how a constraint differs from an objective function using a production example.
9. Maximise $x+y$ on $0 \leq x \leq 2, 0 \leq y \leq 3$.
10. Minimise $2x+y$ on $x, y \geq 0$.
11. Find vertices of $x, y \geq 0, 2x+y \leq 6$.
12. Is $(2, 3)$ feasible for $x+y \leq 4$, $x, y \geq 0$?
13. Maximise $3x+y$ for $x+y \leq 4$, $x, y \geq 0$.
14. Minimise $x+y$ for $x+y \geq 5$, $x, y \geq 0$.
15. Can an LPP have more than one optimal point?
16. Find vertices of $x, y \geq 0, x \leq 1, y \leq 4$.
17. Maximise $2x+3y$ over the rectangle $0 \leq x \leq 1, 0 \leq y \leq 4$.
18. Does an infeasible LPP have an optimal solution?
19. Minimise $x+2y$ for $x+y \geq 3, x, y \geq 0$.
20. Maximise x over $x \geq 0, y \geq 0$.
21. For $x+y \leq 6, x, y \geq 0$, find maximum of $2x+2y$.
22. Explain the meaning of non-negativity constraints in a production problem.

C. Short answers - 3 marks each

23. Maximise $Z = 3x + 2y$ subject to $x + y \leq 4$, $x \leq 2$ and $x, y \geq 0$.

24. Minimise $Z = x + 2y$ subject to $x + y \geq 4$ and $x, y \geq 0$. Explain why the unbounded region does not prevent a minimum.

25. Show graphically that $x + y \leq 2$, $x + y \geq 5$ and $x, y \geq 0$ have no feasible solution.

26. Maximise $Z = x + y$ subject to $x + y \leq 6$, $x \leq 4$, $y \leq 4$ and $x, y \geq 0$. Identify all optimal points.

D. Long answers - 5 marks each

27. A workshop makes tables and chairs. A table needs 2 carpentry hours and 1 finishing hour; a chair needs 1 carpentry hour and 2 finishing hours. Available hours are 100 and 80. Profits are ₹300 and ₹200. Form and solve the LPP graphically.

28. A diet uses foods A and B. Each unit of A gives 2 protein and 1 vitamin units; B gives 1 protein and 2 vitamin units. At least 8 of each are needed. Costs are ₹30 and ₹20. Find the least-cost non-negative combination graphically.

29. Maximise $Z = 5x + 3y$ subject to $x + y \leq 8$, $2x + y \leq 10$ and $x, y \geq 0$. Find all vertices, objective values and the optimum, then interpret which constraints are tight there.

30. Minimise $Z = 4x + 6y$ subject to $x + y \geq 5$, $x + 2y \geq 8$ and $x, y \geq 0$. Draw the unbounded feasible region and justify that the selected corner gives a global minimum.

ANSWER KEY - Numerical / short answers

4) Yes; e.g. minimum of $x+y$ on $x, y \geq 0$ is 0. 5) Triangle with vertices $(0,0), (4,0), (0,4)$. 6) $(0,0), (3,0), (3,2), (0,2)$. 7) 0, 12, 12, 6. 9) 5 at $(2,3)$. 10) 0 at $(0,0)$. 11) $(0,0), (3,0), (0,6)$. 12) No. 13) 12 at $(4,0)$. 14) 5 on the segment joining $(5,0), (0,5)$. 15) Yes. 16) $(0,0), (1,0), (1,4), (0,4)$. 17) 14 at $(1,4)$. 18) No. 19) 3 at $(3,0)$. 20) Unbounded; no finite maximum. 21) 12 along $x+y=6$ in the first quadrant. 23) 10 at $(2,2)$. 24) 4 at $(4,0)$. 25) Empty feasible region. 26) 6 on segment $x+y=6$ between $(2,4), (4,2)$. 27) 40 tables, 20 chairs; ₹16000. 28) $A=B=8/3$; minimum cost ₹400/3. 29) Vertices $(0,0), (5,0), (2,6), (0,8)$; $Z=0, 25, 28, 24$; maximum 28 at $(2,6)$. 30) Minimum 26 at $(2,3)$.