CBSE ACADEMY PLUS

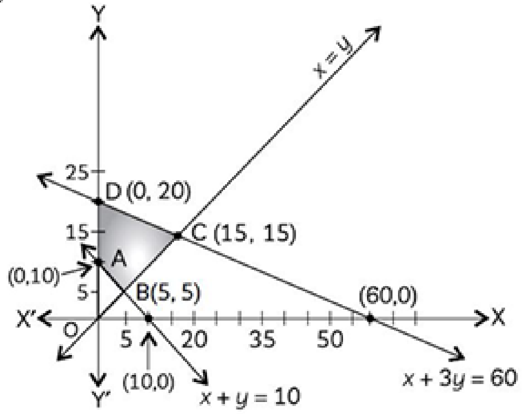
UNIT 12

LINEAR PROGRAMMING

SECTION – A

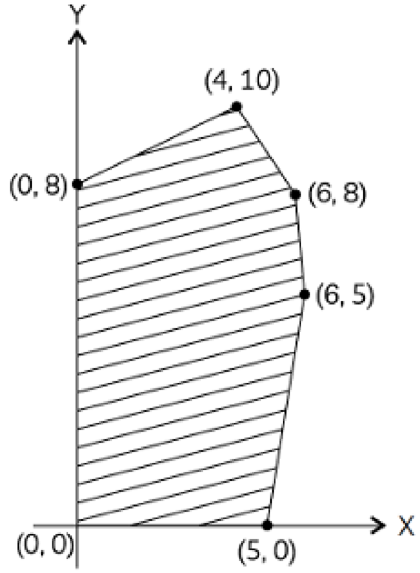
Questions 1 to 10 carry 1 mark each.

1. Based on the given shaded region as the feasible region in the graph, at which point(s) is the objective function Z = 3x + 9y maximum?



(a) Point B (b) Point C (c) Point D (d) Every point on the line segment CD

2. In the given graph, the feasible region for a LPP is shaded.



The objective function Z = 2x – 3y will be minimum at:

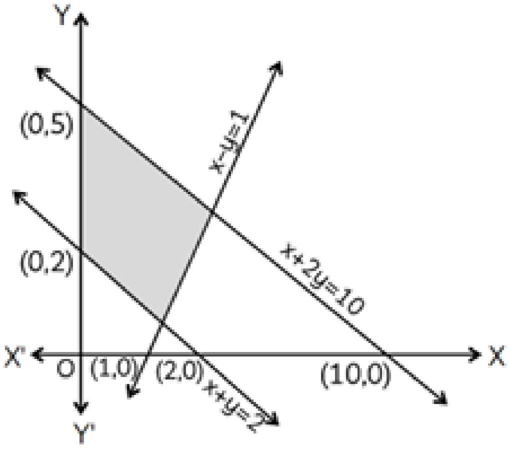
(a) (4, 10) (b) (6, 8) (c) (0, 8) (d) (6, 5)

3. In a linear programming problem, the constraints on the decision variables x and y are $x - 3y \geq 0$, $y \geq 0$, $0 \leq x \leq 3$. The feasible region:

(a) is not in the first quadrant.

(b) is bounded in the first quadrant.
(c) is unbounded in the first quadrant.
(d) does not exist.

4. The feasible region corresponding to the linear constraints of a linear programming problem is shown in figure.



Which of the following is not a constraint to the given linear programming problem?
(a) $x + y \geq 2$ (b) $x + 2y \leq 10$ (c) $x - y \geq 1$ (d) $x - y \leq 1$

5. The solution set of the inequality $3x + 5y < 4$ is:
(a) an open half-plane not containing the origin.
(b) an open half-plane containing the origin.
(c) the whole XY-plane not containing the line $3x + 5y = 4$.
(d) a closed half plane containing the origin.

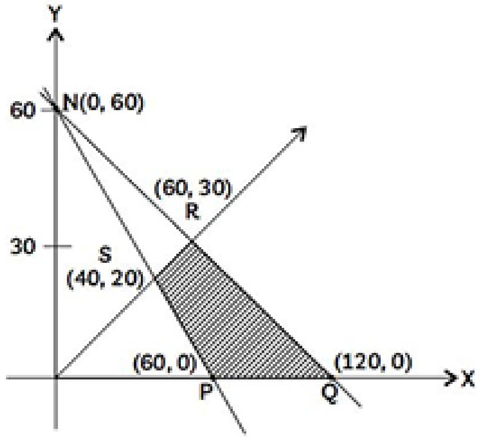
6. The optimal value of the objective function is attained at the points
(a) given by intersection of inequation with y-axis only.
(b) given by intersection of inequation with x-axis only.
(c) given by corner points of the feasible region.
(d) none of these

7. The objective function $Z = ax + by$ of an LPP has maximum value 42 at (4, 6) and minimum value 19 at (3, 2). Which of the following is true?
(a) $a = 9, b = 1$ (b) $a = 5, b = 2$ (c) $a = 3, b = 5$ (d) $a = 5, b = 3$

8. The corner points of the feasible region of a linear programming problem are (0, 4), (8, 0) and $\left(\frac{20}{3}, \frac{4}{3}\right)$. If $Z = 30x + 24y$ is the objective function, then (maximum value of Z – minimum value of Z) is equal to:
(a) 40 (b) 96 (c) 136 (d) 144

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both Assertion (A) and Reason (R) are true and Reason(R) is the correct explanation of assertion (A).
(b) Both Assertion (A) and Reason (R) are true but Reason(R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

9. **Assertion (A):** The corner points of the bounded feasible region of a LPP are shown below. The maximum value of $Z = x + 2y$ occurs at infinite points.



Reason (R): The optimal solution of a LPP having bounded feasible region must occur at corner points.

10. Assertion (A): Maximum value of $Z = 3x + 2y$, subject to the constraints $x + 2y \leq 2$; $x \geq 0$; $y \geq 0$ will be obtained at point (2, 0).
Reason (R): In a bounded feasible region, it always exist a maximum and minimum value.

SECTION – B

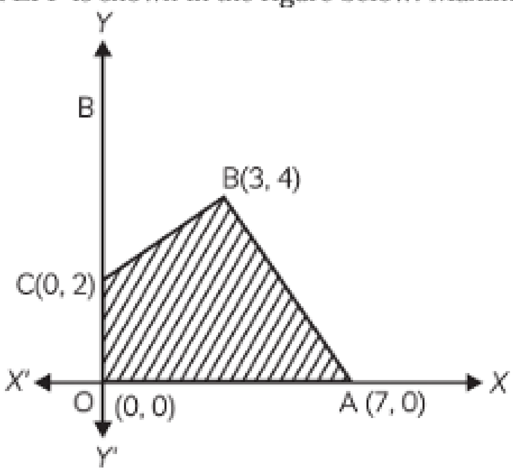
Questions 11 to 14 carry 2 marks each.

11. One kind of cake requires 200 g of flour and 25 g of fat and another kind of cake requires 100 g of flour and 50 g of fat, 5 kg of flour and 1 kg of fat is available, formulate the problem to find the maximum number of cakes which can be made, assuming that there is no shortage of the other ingredients used in making the cakes.

OR

The corner points of the feasible region determined by the following system of linear inequalities: $2x + y \leq 10$, $x + 3y \leq 15$, $x, y \geq 0$ are (0, 0), (5, 0), (3, 4) and (0, 5)
Let $Z = px + qy$, where $p, q > 0$. What is the condition on p, q. that maximum Z occurs at both (3, 4) and (0, 5)?

12. Feasible region (shaded) for a LPP is shown in the figure below. Maximise $Z = 5x + 7y$.



13. Solve the following problem graphically: Minimise $Z = 3x + 2y$ subject to the constraints: $x + y \geq 8$, $3x + 5y \leq 15$, $x \geq 0$, $y \geq 0$

14. A firm has to transport atleast 1200 packages daily using large vans which carry 200 packages each and small vans which can take 80 packages each. The cost for engaging each large van is ₹400 and each small van is ₹200. Not more than ₹3,000 is to be spent daily on the job and the number of large vans cannot exceed the number of small vans. Formulate this problem as a LPP given that the objective is to minimize cost.

OR

A company produces two types of goods A and B, that require gold and silver. Each unit of type A requires 3 g of silver and 1 g of gold while that of type B requires 1 g of silver and 2 g of gold. The company can produce a maximum of 9 g of silver and 8 g of gold. If each unit of type A brings a profit of ₹40 and that of type B ₹50, formulate LPP to maximize profit.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Find graphically, the maximum value of $Z = 2x + 5y$, subject to constraints given below: $2x + 4y \leq 8$; $3x + y \leq 6$; $x + y \leq 4$; $x \geq 0$, $y \geq 0$

16. Minimise and Maximise $Z = 5x + 2y$ subject to the following constraints:
$x - 2y \leq 2$, $3x + 2y \leq 12$, $-3x + 2y \leq 3$ and $x \geq 0$, $y \geq 0$

17. Solve graphically: Maximise $Z = 2.5x + y$
subject to constraints: $x + 3y \leq 12$, $3x + y \leq 12$, $x, y \geq 0$

OR

Maximise Z = 3x + 4y, subject to the constraints: $x + y \leq 1$, $x \geq 0$, $y \geq 0$.

SECTION – D

Questions 18 carry 5 marks.

18. Show that the minimum of Z occurs at more than two points. Minimise and Maximise $Z = x + 2y$ subject to $x + 2y \geq 100$, $2x - y \leq 0$, $2x + y \leq 200$; $x, y \geq 0$.

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Case-Study 1: Read the following passage and answer the questions given below.

A firm produces bottles of disinfectant and a bathroom cleaner.

- It can produce maximum of 600 bottles in a day.
- It needs to produce at least 300 bottles everyday.
- It takes 6 hours to produce a bottle of disinfectant and 2 hours for a bottle of bathroom cleaner.
- At least 1200 hours of production time should be used daily.
- Manufacturing cost per bottle of disinfectant is ₹ 50 and ₹ 20 for a bottle of bathroom cleaner.

Based on above, answer the following questions.

(i) What is the objective function and constraints for this LPP keeping manufacturing cost as low as possible? (1)

(ii) Find the number of bottles of disinfectant and bathroom cleaner to be produced per day keeping total cost of manufacturing the lowest. (2)

(iii) If Z = 50x + 20y, then find the value of Z at (150, 150). (1)

OR

If Z = 50x + 20y, then find the value of Z at (300, 0). (1)

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20. Case-Study 2: Read the following passage and answer the questions given below.

Different activities are taken up daily, for its implementation lots of work and calculations are required as we work within limitations. A company is planning some manufacturing activity and based on information available the following data is obtained for some variables x and y related to manufacturing activity.

$Z = 2x + 3y$

$x \geq 0, y \geq 0$

$x + 2y \leq 40$

$2x + y \leq 50$

(i) Find the maximum value of z.

(ii) Find the relation between p and q if the objective function $z = px + qy$, where $p, q > 0$ attains equal values at (3, 4) and (2, 7).

(iii) Check whether the ordered pair (12, 27) lies in the graphical solution of $2x + y \leq 50$.

OR

Check whether the ordered pair (20, 10) lies in the graphical solution of $2x - y \geq 50$.