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Class: XII
Subject: Maths
Topic: Linear Programming
No. of Questions: 24

Q1. Consider the following Linear Programming Problem:
Maximize $3x_1 + 8x_2$
Subject to $2x_1 + 5x_2 \leq 10$
$6x_1 + x_2 \leq 6$
$x_1, x_2 \geq 0$
The optimal value of the objective function is

A. 0
B. 3
C. $\frac{111}{7}$
D. 16

Q2. The linear programming problem

Maximize $z = 2x + 3y$
Subject to
$2x + 3y \leq 12$
$2x - 3y \leq 0$
$y \leq 2$
$x, y \geq 0$ has
A. no feasible solution
B. unique optimal solution
C. alternative optimal solutions
D. unbounded solution

Q3. Consider the statements:
(P) If a linear programming problem has only one optimal solution, then this solution is an extreme point of the feasible region.
(Q) A linear programming problem either is infeasible or has at least one optimal

Solution.

(R) A linear programming problem can have exactly two optimal solutions.
(S) A feasible linear programming problem has an optimal solution or unbounded solution.
Which of the following group of statements is correct?
A. P, Q
B. P, R
C. R, S
D. P, S

Q4. Consider the following LPP
Minimize $2x_1 + 5x_2$
Subject to $3x_1 - 7x_2 \leq 10$
$-2x_1 + x_2 \leq 3$
$x_1 \geq 0$, x_2 is unrestricted in sign.
The optimal value of the objective function is
A. $-\frac{50}{7}$
B. 0
C. $-\frac{207}{11}$
D. unbounded

Q5. For the linear programming problem
Minimize $z = x - y$
subject to
$-2 \leq x \leq 3$
$-3 \leq y \leq 2$
the minimum value of z is
A. -6
B. -5
C. -4
D. 1

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Q6. An LPP having 2 optimal solutions must have

A. more than 3 constraints
B. more than 2 optimal solutions
C. even number of constraints
D. None of the above

Q7. If an LPP model in its standard form, three of the constraints are
(i) $x_1 + x_2 \leq 2$
(ii) $2x_1 + 2x_2 \leq 3$
(iii) $3x_1 + 3x_2 \leq 8$
Removal of which of the constraints will not affect the optimality?

A. (ii) and (iii)
B. and (ii)
C. and (iii)
D. only

Q8. A company produces two products A and B whose monthly production amount does not exceed 70 units of A and 90 units of B. To produce a unit of A requires 15 man – hours and a unit of B requires 8 man – hours. The company has a total of 400 man–hours available in a month. The profit margins on sale are Rs.120 per unit of A and Rs.85 per unit of B. Let x and y be respectively the number of units of A and B produced per month. The correct LPP formulation of this problem is

A. Maximize $400x + 85y$
Subject to
1. $8x + 15y \leq 120$
2. $x \leq 70$
3. $y \leq 90$
4. $x, y \geq 0$

B. Maximize $120x + 85y$
Subject to
1. $15x + 8y \leq 400$
2. $x \leq 70$
3. $y \leq 90$
4. $x, y \geq 0$

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C. Maximize 120x + 85y
Subject to
1. $15x + 8y \leq 400$
2. $x \leq 90$
3. $y \leq 70$
4. $x, y \geq 0$

D. Maximize 120x + 85y
Subject to
1. $8x + 15y \leq 400$
2. $x \leq 70$
3. $y \leq 90$

Q9. A fund manager of a mutual fund wants to buy some number of units of stocks of a software company and of an automobile company. The profit that will be generated over a year per unit of stock of the software company is Rs. 15 and that of the automobile company is Rs. 18. As per the guidelines to the manager, the units of stocks of the software company should be at least twice as much as that of the automobile company. The cost of procurement is Rs. 15 per unit of stock of the software company and Rs. 6 per unit of stock of the automobile company. The manager can use up to Rs. 200 towards the cost of procurement. If the aim is to maximize the profit, then the correct formulation of the LPP is

A.
$$\begin{aligned} \text{Maximize} \quad & 15x_1 + 18x_2 \\ \text{Subject to} \quad & x_1 - 15x_2 \geq 0 \\ & 6x_1 + 2x_2 \geq 200 \\ & x_1, x_2 \geq 0 \end{aligned}$$

B.
$$\begin{aligned} \text{Maximize} \quad & 15x_1 + 18x_2 \\ \text{Subject to} \quad & 2x_1 - x_2 \geq 0 \\ & 15x_1 + 6x_2 \leq 200 \\ & x_1, x_2 \geq 0 \end{aligned}$$

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C.
$$\begin{aligned} \text{Maximize} \quad & 15x_1 + 18x_2 \\ \text{Subject to} \quad & x_1 - 2x_2 \geq 0 \\ & 15x_1 + 6x_2 \leq 200 \\ & x_1, x_2 \geq 0 \end{aligned}$$

D.
$$\begin{aligned} \text{Maximize } & 15x_1 + 18x_2 \\ \text{Subject to } & x_1 - 2x_2 \geq 0 \\ & 15x_1 + 6x_2 \geq 200 \\ & x_1, x_2 \geq 0 \end{aligned}$$

Q10. Solve the following LPP by graphical method:
Maximize $Z = 2.80X_1 + 2.20X_2$
Subject to constraints
$X_1 \leq 20{,}000$
$X_2 \leq 40{,}000$
$0.003X_1 + 0.001X_2 \leq 66$
$X_1 + X_2 \leq 45{,}000$
$X_1 X_2 \geq 0$
A. $X_1 = 10{,}500, X_2 = 34{,}500$
B. $X_1 = 20{,}000, X_2 = 6{,}000$
C. $X_1 = 20{,}000, X_2 = 0$
D. $X_1 = 5{,}000, X_2 = 40{,}000$

Q11. Solve the following LPP by graphical method:
Maximize $Z = 10X_1 + 8X_2$
Subject to constraints
$2X_1 + X_2 \leq 20$
$X_1 + 3X_2 \leq 30$
$X_1 - 2X_2 \geq -15$
$X_1 X_2 \geq 0$
A. $X_1 = 6, X_2 = 8$
B. $X_1 = 3, X_2 = 9$
C. $X_1 = 0, X_2 = 0.75$
D. $X_1 = 10, X_2 = 0$

Q12. A person requires 10, 12 and 12 units of chemicals A, B and C respectively for herbal garden. A liquid product contains 5, 2 and 1 units of A, B and C respectively per jar. A dry product contains 1, 2 and 4 units of A, B and C per cartoon. If the liquid product sells for Rs. 3 per jar and dry product sells for Rs. 2 per cartoon, how many of each should be purchased to minimize the cost and meet the requirements.

A. Liquid product – 4 units, Dry product – 2 units
B. Liquid product – 1 unit, Dry product – 5 units
C. Liquid product – 12 units, Dry product – 0 units
D. Liquid product – 5 units, Dry product – 1 unit

Q13. Solve the following LPP by graphical method:
Maximize $Z = 5X_1 + 3X_2$
Subject to constraints
$2X_1 + X_2 \leq 1000$
$X_1 \leq 400$
$X_1 \leq 700$
$X_1, X_2 \geq 0$
A. $X_1 = 400, X_2 = 0$
B. $X_1 = 150, X_2 = 700$
C. $X_1 = 0, X_2 = 700$
D. $X_1 = 400, X_2 = 200$

Q14. A firm manufactures pain relieving pills in two sizes A and B, size A contains 4 grains of element a, 7 grains of element b and 2 grains of element c, size B contains 2 grains of element a, 10 grains of element b and 8 grains of c. It is found by users that it requires at least 12 grains of element a, 74 grains of element b and 24 grains of element c to provide immediate relief. It is required to determine the least no. of pills a patient should take to get immediate relief. Formulate the problem as standard LPP and solve it.

A. Size A – 0 pill, Size B – 8 pills
B. Size A – 12 pills, Size B – 0 pill
C. Size A – 10 pills, Size B – 1 pill
D. Size A – 3 pills, Size B – 0 pill

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Q15. An automobile manufacturer makes automobiles and trucks in a factory that is divided into two divisions. Division A which performs the basic assy operation must work 5 man days on each truck but only 2 man days on each automobile. Division B which performs finishing operations must work 3 man days for each automobile or truck that it produces. Because of men and machine limitations division A has 180 man days per week available while division B has 135 man days per week. If the manufacturer makes a profit of Rs. 300 on each truck and Rs. 200 on each automobile; how many of each should be produced to maximize his profit?

A. Automobile – 0 unit, Truck – 36 units
B. Automobile – 15 units, Truck – 30 units
C. Automobile – 45 units, Truck – 0 unit
D. Automobile – 0 units, Truck – 0 unit

Q16. On completing the construction of house, a person discovers that 100 square feet of plywood scrap and 80 square feet of white pine scrap are in useable for the construction of tables and book cases. It takes 16 square feet of plywood,8 square feet of white pine to make a table, 12 square feet of plywood and 16 square feet of white pine are required to construct a book case. By selling the finishing duct to a local furniture store the person can realize a profit of Rs. 25 on each table and Rs. 290 on each book case. How may the man most profitably use the left over wood? Use graphical method to solve problem.

A. Table – 0 unit, Book case – 0 unit
B. Table – 4 units, Book case – 3 units
C. Table – 0 unit, Book case – 5 units
D. Table – 6 units, Book case – 0 unit

Q17. A manufacturer produces two types of models M_1 and M_2.Each model of the type M_1 requires 4 hours of grinding and 2 hours of polishing; where as each model of M_2 requires 2 hours of grinding and 5 hours of polishing. The manufacturer has 2 grinders and 3 polishers. Each grinder works for 40 hours a week and each polisher works 60 hours a week. Profit on M_1 model is Rs. 3.00 and on model M_2 is Rs. 4.00.
Formulate this as a Linear Programming Problem to determine as to how many units of each of the models should be produced so that the manufacturer can earn maximum profit.

A.

Max $Z = 3X_1 + 4X_2$
Subject to constraints,
$4X_1 + 2X_2 \leq 80$
$2X_1 + 5X_2 \leq 180$

B.

Max $Z = 4X_1 + 3X_2$
Subject to constraints,

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$X_1 + 2X_2 \leq 80$
$2X_1 + 5X_2 \leq 180$

C.

Max $Z = 3X_1 + 4X_2$
Subject to constraints,
$2X_1 + X_2 \leq 80$
$5X_1 + 2X_2 \leq 180$

D.

Max $Z = X_1 + 2X_2$
Subject to constraints,
$3X_1 + 4X_2 \leq 80$
$2X_1 + 5X_2 \leq 180$

Q18. A firm is engaged in producing two products; A and B. Each unit of product A requires 2 kg of raw material and 4 labour hours for processing, where as each unit of B requires 3 kg of raw materials and 3 labour hours for the same type. Every week, the firm has an availability of 60 kg of raw material and 96 labour hours. One unit of product A sold yields Rs. 40 and one unit of product B sold gives Rs. 35 as profit. Formulate this as a Linear Programming Problem to determine as to how many units of each of the products should be produced per week so that the firm can earn maximum profit.

A.

Max $Z = 35X_1 + 40X_2$
Subject to constraints,
$3X_1 + 2X_2 \leq 60$
$3X_1 + 4X_2 \leq 96$
$X_1, X_2 \geq 0$

B.

Max $Z = 40X_1 + 35X_2$
Subject to constraints,
$4X_1 + 3X_2 \leq 60$
$2X_1 + 3X_2 \leq 96$
$X_1, X_2 \geq 0$

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C.

Max $Z = 35X_1 + 40X_2$
Subject to constraints,
$3X_1 + 2X_2 \leq 60$
$4X_1 + 3X_2 \leq 96$
$X_1, X_2 \geq 0$

D.

Max $Z = 40X_1 + 35X_2$
Subject to constraints,
$2X_1 + 3X_2 \leq 60$
$4X_1 + 3X_2 \leq 96$
$X_1, X_2 \geq 0$

Q19. A manufacturer considers that men and women workers are equally efficient and so he pays them at the same rate. He has 30 and 17 units of workers (male and female) and capital respectively, which he uses to produce two types of goods A and B. To produce one unit of A, 2 worker and 3 units of capital are required, while 3 workers and 1 unit of capital is required to produce one unit of B. If A and B are priced at Rs 100 and 120 per unit respectively, then how should he use his resources to maximise the total revenue? Formulate the above as an LPP and solve it graphically.

Q20. A manufacturer produces nuts and bolts. It takes 1 h of work on machine A and 3 h on machine B to produce package of nuts. It takes 3 h on machine A and 1 h on machine B to produce a package of bolts. He earns a profit of Rs 17.50 per package on nuts and Rs 7 per package on bolts. How many packages of each should be produced each day so as to maximise his profits, if he operates his machines for atmost 12 h a day? Formulate above as a Linear Programming Problem (LPP) and solve it graphically. [Delhi 2012, 2009C]

Q21. A library has to accommodate two different types of books on a shelf. The books are 6 cm and 4 cm thick and weight 1 kg and $1\frac{1}{2}$ kg each, respectively. The shelf is 96 cm long and atmost can support a weight of 21 kg. How should the shelf be filled with the books of two types in order to include the greatest number of books? Make it as an LPP and solve it graphically. [India 2010C]

Q22. A small firm manufactures gold rings and chains. The total number of rings and chains manufactured per day is atmost 24. It takes 1 h to make a ring and 30 min 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, then find the number of rings and chains that should be manufactured per day so as to earn the maximum profit. Make it as a LPP and solve it graphically. [Hots; Delhi 2010]

Q23. A dealer wishes to purchase a number of fans and sewing machines. He has only Rs 5760 to invest and has space for atmost 20 items. A fan costs Rs 360 and a sewing machine costs Rs 240. He can sell a fan at a profit of Rs 22 and a sewing machine at a profit of Rs 18. Assuming that he can sell all the items that he can buy, how should he invest his money in order to maximise his profit? Formulate the problem as an LLP and solve it graphically.
[All India 2009, Delhi 2009C]

Q24. A factory owner purchases two types of machines A and B for his factory. The requirements And the limitations for the machines are as follows

Machines	Area Occupied	Labour Force	Daily output (in units)
A	1000 m^2	12 men	60
B	1200 m^2	8 men	40

He has maximum area of 9000 m^2 available and 72 skilled labourers who can operate both the machines. How many machines of each type should be bought to maximise of each type should be bought to maximise the daily output? [Delhi 2008]