MATHEMATICS CLASS XII
CHAPTER -12 LINEAR PROGRAMMING

Q.1. A shopkeeper deals in two items – wall hangings and artificial plants. He has ₹15000 to invest and a space to store atmost 80 pieces . A wall hanging costs him ₹ 300 and an artificial plant ₹ 150. He can sell a wall hanging at a profit of ₹ 50 and an artificial plant at a profit of ₹ 18. Assuming that he can sell all the items he buys, formulate a linear programming problem in order to maximize his profit.

Q.2. (Manufacturing problem) A manufacturer produces nuts and bolts for industrial machinery. It takes 1 hour of work on machine A and 3 hours on machine B to produce a package of nuts, while it takes 3 hours on machine A and 1 hour on machine B to produce a package of bolts. He earns a profit of ₹ 2.50 per package on nuts and ₹ 1 per package on bolts. Form a linear programming problem to maximize his profit, if he operates each machine for atmost 12 hours.

Q.3. A furniture dealer deals in only two items – tables and chairs. He has ₹ 20,000 to invest and a space to store atmost 80 pieces. A table costs him ₹ 800 and a chair costs him ₹ 200. He can sell a table for ₹ 950 and a chair for ₹ 280. Assume that he can sell all the items that he buys. Formulate this problem as an L.P.P. so that he can maximize his profit.

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Q.4. A retired person wants to invest an amount of upto ₹ 20,000. His broker recommends investing in two types of bonds A and B, bond A yielding 10% return on the amount invested and bond B yielding 15% return on the amount invested. After some consideration, he decides to invest atleast ₹ 5000 in bond A and no more than ₹ 8000 in bond B. He also wants to invest atleast as much in bond A as in bond B. Formulate as L.P.P to maximize his return on investments.

Q.5. There is a factory located at two place P and Q . From these locations, a certain commodity is delivered to each of three depots situated at A, B and C . The weekly requirements of the depots are respectively, 5,5 and 4 units of the commodity while the production capacity of the factories at P and Q are respectively 8 and 6 units. The cost of transportation per unit is given below :

From \ To	Cost (₹/unit)		
	A	B	C
P	16	10	15
Q	10	12	10

How many units should be transported from each factory to each depot in order that transportation cost is minimum? Formulate the above linear programming problem mathematically.

Q.6. Solve the following linear programming problem graphically :

Minimize Z = 3x + 5y subject to the constraints

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$x + y = 6, x \leq 4, y \leq 5, x \geq 0, y \geq 0.$

Q.7. Maximize Z = 2x + 3y subject to the constraints

$x + y \leq 1, 2x + 2y \geq 6, x \geq 0, y \geq 0.$

Q.8. Maximize Z = x + 2y subject to the constraints

$x - y \geq 0, 2y \leq x + 2, x \geq 0, y \geq 0.$

Q.9. A merchant plans to sell two types of personal computers – a desktop model and a portable model that will cost ₹ 25000 and ₹ 40000 respectively. He estimates that the total monthly demand of computers will not exceed 250 units. Determine the number of units of each type of computers which the merchant should stock to get maximum profit if he does not want to invest more than ₹ 70 lakhs and his profit on the desktop model is ₹ 4500 and on portable model is ₹ 5000. Make an L.P.P. and solve it graphically.

Q.10. A manufacturer produces two types of steel trunks. He has two machines A and B. The first type of trunk requires 3 hours on machine A and 3 hours on machine B. The second type of trunk requires 3 hours on machine A and 2 hours on machine B. Machines A and B can work atmost for 18 hours and 15 hours per day respectively. How many trunks of each type must he make each day to make maximum profit?

Q.11. One kind of cake requires 300 g of flour and 15 g of fat , another kind of cake requires 150 g of flour and 30 g of fat. Find the maximum number of cakes which can be make from 75 kg of flour and 600 g of fat, assuming that there is

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no shortage of the other ingredients used in making the cakes. Make it an L.P.P and solve it graphically.

Q.12. If a young man rides his motor cycle at 25 km per hour, he has to spend ₹ 2 per kilometer on petrol; if he rides at a faster speed of 40 km per hour, the petrol cost increases to ₹ 5 per kilometer. He has ₹ 100 to spend on petrol and wishes to find the maximum distance he can travel distance he can travel within one hour. Express this as a linear programming problem and then solve it.

Q.13. A manufacturer makes ₹ 600 profit on each 21^n TV set it produces and ₹ 400 profit on each 14^n TV set. A 21^n TV requires 1 hour on machine X, 1 hour on machine Y and 4 hours on machine Z. The 14^n TV requires 2 hours on X, 1 hours on Y and 1 hour on Z. In a given day, machines X, Y and Z can work a maximum of 16, 9 and 24 hours respectively. How many 21^n TV sets and how many 14^n TV sets should be produced per day to maximize the profit?

Q.14. A manufacturer makes two types of calculators. Deluxe sells for ₹ 120 and standard sells for ₹ 100. It costs ₹ 90 to produce a deluxe and ₹ 80 to produce a standard calculator. In one week, manufacturer can produce from 200 to 300 deluxe calculators and from 100 to 250 standard calculators, but no more than 500 total calculators. How many of each type should be produced per week to maximum the profits ?

Q.15. A diet is to contain atleast 80 units of vitamin A and 100 units of minerals. Two foods F_1 and F_2 are available. Food F_1 costs ₹ 4 per unit and F_2 cost ₹ 6 per unit. One unit of food F_1 contains 3 units of vitamin A and 4 units of minerals .

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One unit of F_2 contains 6 units of vitamin A and 3 units of minerals. Formulate this a linear programming problem and find graphically the minimum cost for diet that consists of mixture of these two foods and also meets the minimal nutritional requirements.

Q.16. A diet for a sick person must contain atleast 4000 units of vitamins, 50 units of minerals and 1400 units of calories. Two foods A and B are available at a cost of ₹ 4 and ₹ 3 per unit respectively. If one unit of A contains 200 units of vitamin, 1 unit of minerals and 40 units of calories, then find what combination of foods should be used to have the least cost?

Q.17. A housewife wishes to mix together two kinds of food F_1 and F_2 in such a way that the mixture contains atleast 10 units of vitamin A, 12 units of vitamin B and 8 units of vitamin C. The vitamin contents of one kg of foods F_1 and F_2 are as below:

	Vitamin A	Vitamin B	Vitamin C
Food F_1	1	2	3
Food F_2	2	2	1

One kg of food F_1 costs ₹ 16 and one kg of food F_2 costs ₹ 20. Formulate the above problem as an L.P.P and solve it graphically to find the least cost of the mixture which will produce the diet. What type of food should a student consume?

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Q.18. A manufacturer consider 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 workers 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 ₹ 100 and ₹120 per unit respectively, how should he use his resources to maximise the total revenue? From the above as an L.P.P and solve graphically.

Do you agree with this view of the manufacturer that men and women workers are equally efficient and so should be paid at the same rate?

Q.19. A factory makes tennis rackets and cricket bats. A tennis racket takes 1.5 hours of machine time and 3 hours of craftman's time in its making while a cricket bat takes 3 hours of machine time and 1 hour of craftman's time. In a day, the factory has the ability of not more than 42 hours of machine time and 24 hours of craftman's time . If the profit on a racket and on a bat is ₹ 20 and ₹ 10 respectively, then find the number of tennis rackets and cricket bats that the factory must manufacture to earn the maximum profit. Make it an L.P.P. and solve graphically.

Q.20. A manufacturing company makes two models A and B of a product. Each piece of model A requires 9 labour hours for fabricating and 1 labour hour of finishing. For fabricating and finishing, the maximum labour hours available are 180 and 30 respectively. The company makes a profit of ₹ 8000 on each model

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of A and ₹ 12000 on each model of B. How many pieces of model A and model B should be manufactured to realise a maximum profit? What is the maximum profit.

Q.21. A cooperative society of farmers has 50 hactare of land to grow two crops X and Y. The profit from X and Y per hectare are estimated as ₹ 10500 and ₹ 9000 respectively. To control weeds, a liquid herbicide has to be used for crops X and Y at the rate of 20 litres and 10 litres per hectare. Further, no more than 800 litres of herbicide should be used in order to protect fish and wild life using a pond which collects drainage from this land.

Keeping in mind that the protection of fish and other wildlife is more important than earning profit, how much land be allocated to each crop so as to maximize the total profit? Form an L.P.P. from the above and solve it graphically. Do you agree with the message that the protection of wildlife is utmost necessary to preserve the balance in environment?

Q.22. On kind of cake requires 200g of flour and 25 g of fat, and another kind of cake requires 100 g of flour and 50 g of fat. Find the maximum number of cakes which can be made from 5 kg of flour and 1 kg of fat assuming that there is no shortage of other ingredients used in making the cakes. Formulate the above as a linear programming problem and solve graphically.

Q.23. A manufacturer produces nuts and bolts. It takes 1 hour of work on machine A and 3 hours on machine B to produce a package of nuts. It takes 3 hours on machine A and 1 hour on machine B to produce a package of bolts. He

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earns a profit of ₹ 17.50 per package on nuts and ₹ 7 per package on bolts. How many packages of each should be produced each day, so as to maximize his profit, if he operates his machines for at most 12 hours a day.

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