



## Twelfth Grade - Linear Programming

1) A farmer can plant up to 8 acres of land with wheat and barley. He can earn \$5,000 for every acre he plants with wheat and \$3,000 for every acre he plants with barley. His use of a necessary pesticide is limited by federal regulations to 10 gallons for his entire 8 acres. Wheat requires 2 gallons of pesticide for every acre planted and barley requires just 1 gallon per acre. What is the maximum profit he can make?

- 26,000
- 20,000
- 28,000
- 24,000

2) A painter has exactly 32 units of yellow dye and 54 units of green dye. He plans to mix as many gallons as possible of color A and color B. Each gallon of color A requires 4 units of yellow dye and 1 unit of green dye. Each gallon of color B requires 1 unit of yellow dye and 6 units of green dye. Find the maximum number of gallons he can mix.

- 14
- 18
- 15
- 16

3) The Bead Store sells material for customers to make their own jewelry. Customer can select beads from various bins. Grace wants to design her own Halloween necklace from orange and black beads. She wants to make a necklace that is at least 12 inches long, but no more than 24 inches long. Grace also wants her necklace to contain black beads that are at least twice the length of orange beads. Finally, she wants her necklace to have at least 5 inches of black beads. Find the minimum length.

- 12
- 30
- 14
- 21



4) A garden shop wishes to prepare a supply of special fertilizer at a minimal cost by mixing two fertilizers, A and B. The mixture is to contain at least 45 units of phosphate at least 36 units of nitrate at least 40 units of ammonium Fertilizer A costs the shop \$.97 per pound. Fertilizer B costs the shop \$1.89 per pound. Fertilizer A contains 5 units of phosphate and 2 units of nitrate and 2 units of ammonium. Fertilizer B contains 3 units of phosphate and 3 units of nitrate and 5 units of ammonium. Find the number of pounds of ammonium.

- 42
- 41
- 40
- 39

5) Maximize  $Z = 3x + 4y$ , subject to the constraints  $x + y \leq 4$ ,  $x \geq 0$ ,  $y \geq 0$

- 18
- 16
- 17
- 15

6) Minimize  $Z = 3x + 4y$ , subject to  $x + y \leq 8$ ,  $x + 2y \leq 12$ ,  $x \geq 0$ ,  $y \geq 0$

- -12
- -11
- -17
- -14

7) Maximize  $Z = 5x + 3y$ , subject to  $3x + 5y \leq 15$ ,  $5x + 2y \leq 10$ ,  $x \geq 0$ , and  $y \geq 0$

- $345/19$
- $135/19$
- $275/19$
- $235/19$



8) Minimize  $Z = 3x + 5y$  such that  $x + 3y \leq 3$ , and  $x + y \leq 2$ ,  $x \geq 0$ , and  $y \geq 0$

- 2
- 7
- 3
- 5

9) Maximize  $Z = 3x + 2y$  such that  $x + 2y \leq 10$ ,  $3x + y \leq 15$ ,  $x \geq 0$ , and  $y \geq 0$

- 18
- 15
- 12
- 19

10) Minimize  $Z = x + 2y$ , subject to  $2x + y \leq 3$ ,  $x + 2y \leq 6$ ,  $x \geq 0$ , and  $y \geq 0$

- $x + 2y = 6$
- $x + 2y = 5$
- $x - 2y = -6$
- $x + 2y = 7$

11) Minimize  $Z = 5x + 10y$ , subject to  $x + 2y \leq 120$ ,  $x + y \leq 60$ ,  $x \geq 2y \geq 0$ ,  $x \geq 0$ , and  $y \geq 0$

- 150
- 300
- 500
- 100

12) Maximize  $Z = x + 2y$  subject to  $x + 2y \leq 100$ ,  $2x \geq y \geq 0$ ,  $2x + y \leq 200$ ,  $x \geq 0$ , and  $y \geq 0$

- 200
- 300
- 400
- 600



13) Maximize  $Z = 3x + 2y$ , subject to the constraints:  $x \geq 3, x + y \geq 5, x + 2y \geq 6, y \geq 0$

- No value
- 2
- 6
- 1

14) Maximize  $Z = x + y$  subject to  $x - y \geq -1, -x + y \geq 0, x, y \geq 0$

- 7
- 6
- No value
- 1

15) Sheryl wishes to mix two types of food P and Q in such a way that the vitamin contents of the mixture contain at least 8 units of vitamin A and 11 units of vitamin B. Food P costs Rs.60/kg and Food Q costs Rs.80/kg. Food P contains 3 units/kg of vitamin A and 5 units/kg of vitamin B while food Q contains 4 units/kg of vitamin A and 2 units/kg of vitamin B. Determine the minimum cost of the mixture?

- 150
- 160
- 170
- 140

16) One kind of pie requires 200g flour and 25g of fat, and another kind of pie requires 100g of flour and 50g of fat. Find the maximum number of pie which can be made from 5 kg of flour and 1 kg of fat assuming that there is no shortage of the other ingredients used in making the pie?

- 45
- 25
- 30
- 15



17) Alfred factory makes tennis rackets and cricket bats. A tennis racket takes 1.5 hours of machine time and 3 hours of craftsman's time in its making while a cricket bat takes 3 hour of machine time and 1 hour of craftsman's time. In a day, the factory has the availability of not more than 42 hours of machine time and 24 hours of craftsman's time.

- 200
- 150
- 400
- 100

18) XYZ manufacturer produces nuts and bolts. It takes 1 hour of work on machine A and 3hours on machine B to produce a package of nuts. It takes 3 hours on machine A and 1hour on machine B to produce a package of bolts. He earns a profit, of Rs.17.50 per package on nuts and Rs.7.00 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 the most 12 hours a day?

- 74.5
- 72.5
- 73.5
- 79.5

19) A factory manufactures two types of screws, A and B. Each type of screw requires the use of two machines, an automatic and a hand operated. It takes 4 minutes on the automatic and 6 minutes on hand operated machines to manufacture a package of screws A, while it takes 6 minutes on automatic and 3 minutes on the hand operated machines to manufacture a package of screws B. Each machine is available for at the most 4 hours on any day. The manufacturer can sell a package of screws A at a profit of Rs 7 and screws B at a profit of Rs10. Assuming that he can sell all the screws he manufactures, how many packages of each type should the factory owner produce in a day in order to maximize his profit? Determine the maximum profit.

- 430
- 420
- 415
- 410



20) A cottage industry manufactures pedestal lamps and wooden shades, each requiring the use of a grinding/cutting machine and a sprayer. It takes 2 hours on grinding / cutting machine and 3 hours on the sprayer to manufacture a pedestal lamp. It takes 1 hour on the grinding/cutting machine and 2 hours on the sprayer to manufacture a shade. On any day, the sprayer is available for at the most 20 hours and the grinding / cutting machine for at the most 12 hours. The profit from the sale of a lamp is Rs 5 and that from a shade is Rs 3. Assuming that the manufacturer can sell all the lamps and shades that he produces, how should he schedule his daily production in order to maximize his profit?

- 38
- 35
- 39
- 32

21) A company manufactures two types of novelty souvenirs made of plywood. Souvenirs of type A require 5 minutes each for cutting and 10 minutes each for assembling. Souvenirs of type B require 8 minutes each for cutting and 8 minutes each for assembling. There are 3 hours 20 minutes available for cutting and 4 hours of assembling. The profit is Rs 5 each for type A and Rs 6 each for type B souvenirs. How many souvenirs of each type should the company manufacture in order to maximize the profit?

- 150
- 160
- 170
- 180

22) A merchant plans to sell two types of personal computers ? a desktop model and a portable model that will cost Rs 25000 and Rs 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 Rs 70 lakhs and if his profit on the desktop model is Rs 4500 and on portable model is Rs 5000

- 1360000
- 1150000
- 2250000
- 2530000



23) A diet is to contain at least 80 units of vitamin A and 100 units of minerals. Two foods F1 and F2 are available. Food F1 costs Rs 4 per unit food and F2 costs Rs 6 per unit. One unit of food F1 contains 3 units of vitamin A and 4 units of minerals. One unit of food F2 contains 6 units of vitamin A and 3 units of minerals. Formulate this as a linear programming problem. Find the minimum cost for diet that consists of mixture of these two foods and also meets the minimal nutritional requirements?

- 102
- 109
- 104
- 107

24) There are two types of fertilizers F1 and F2. F1 consists of 10% nitrogen and 6% phosphoric acid and F2 consists of 5% nitrogen and 10% phosphoric acid. After testing the soil conditions, a farmer finds that she needs at least 14 kg of nitrogen and 14 kg of phosphoric acid for her crop. If F1 cost Rs 6/kg and F2 costs Rs 5/kg, determine how much of each type of fertilizer should be used so that nutrient requirements are met at a minimum cost. What is the minimum cost?

- 3000
- 2000
- 1000
- 4000

25) 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  $p, q > 0$ . Condition on  $p$  and  $q$  so that the maximum of  $Z$  occurs at both (3, 4) and (0, 5) is

- $q = 3p$
- $q = p$
- $q = 4p$
- $q = -2p$

26) A diet is to contain at least 80 units of vitamin A and 100 units of minerals. Two foods F1 and F2 are available. Food F1 costs Rs 4 per unit food and F2 costs Rs 6 per unit. One unit of food F1 contains 3 units of vitamin A and 4 units of minerals. One unit of food F2 contains 6 units of vitamin A and 3 units of



minerals. Formulate this as a linear programming problem. How many packets of each food should be used to maximize the amount of vitamin A in the diet? What is the maximum amount of vitamin A in the diet?

- 285
- 235
- 255
- 245

27) A farmer mixes two brands P and Q of cattle feed. Brand P, costing Rs 250 per bag contains 3 units of nutritional element A, 2.5 units of element B and 2 units of element C. Brand Q costing Rs 200 per bag contains 1.5 units of nutritional elements A, 11.25 units of element B, and 3 units of element C. The minimum requirements of nutrients A, B and C are 18 units, 45 units and 24 units respectively. Determine the number of bags of each brand which should be mixed in order to produce a mixture having a minimum cost per bag? What is the minimum cost of the mixture per bag?

- 1850
- 1050
- 1650
- 1950

28) A dietician wishes to mix together two kinds of food X and Y in such a way that the mixture contains at least 10 units of vitamin A, 12 units of vitamin B and 8 units of vitamin C. The vitamin content of one kg food is given below:. One kg of food X costs Rs 16 and one kg of food Y costs Rs 20. Find the least cost of the mixture which will produce the required diet?

Food	Vitamin A	Vitamin B	Vitamin C
X	1	2	3
Y	2	2	1

- 112
- 113
- 114
- 115





29) A manufacturer makes two types of toys A and B. Three machines are needed for this purpose and the time (in minutes) required for each toy on the machines is given below. Each machine is available for a maximum of 6 hours per day. If the profit on each toy of type A is Rs 7.50 and that on each toy of type B is Rs 5, show that 15 toys of type A and 30 of type B should be manufactured in a day to get maximum profit.

Types of toys	Machine I	Machine II	Machine III
A	12	18	6
B	6	0	9

- 265.5
- 263.5
- 262.5
- 261.5

30) An Aeroplane can carry a maximum of 200 passengers. A profit of Rs 1000 is made on each executive class ticket and a profit of Rs 600 is made on each economy class ticket. The airline reserves at least 20 seats for executive class. However, at least 4 times as many passengers prefer to travel by economy class than by the executive class. Determine how many tickets of each type must be sold in order to maximize the profit for the airline. What is the maximum profit?

- 147000
- 176000
- 166000
- 136000