# Important Questions Class 12 Maths Chapter 12 Linear Programming

6 Marks Questions

1. Reshma 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.

Ans. Let food P consist of x Kg and food Q consists of Y Kg.
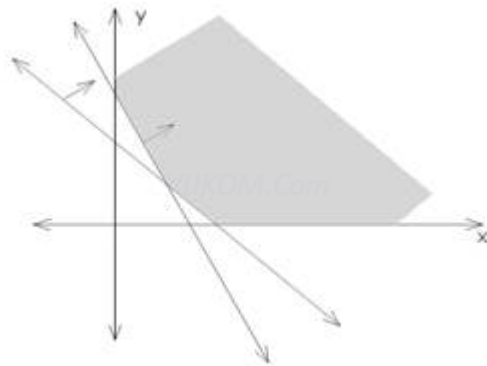
Z = 60x + 80y

$3x + 4y \geq 8$

$5x + 2y \geq 11$

$x \geq 0$

$y \geq 0$

Hence, Cost is minimum = Rs 160

When x = 2, y = $\dfrac{1}{2}$

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

Ans. Let x be number of cakes of first kind and y the number of cakes of other kind.
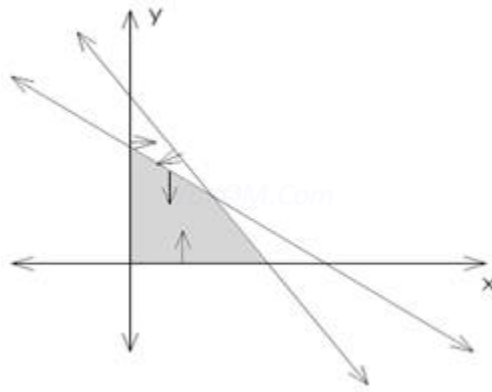
Z = x + y

200x + 100y ≤ 5000

⟹ 2x + y ≤ 50

25x + 50y ≤ 1000

⟹ x + 2y ≤ 40

x ≥ 0, y ≥ 0

Maximum number of cakes

Z = 30

When x = 20, y = 10.

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3. 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 hour of machine time an 1 hour of craftman'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.

(i) What number of rackets and bats must be made if the factory is t work at full capacity?

(ii) If the profit on a racket and on a bat is Rs 20 and Rs 10 respectively, find the maximum profit of the factory when it works at full capacity.

Ans. Let the number of cricket and the number of cricket bats to be made in a day be x and y respectively.

Z = x + y
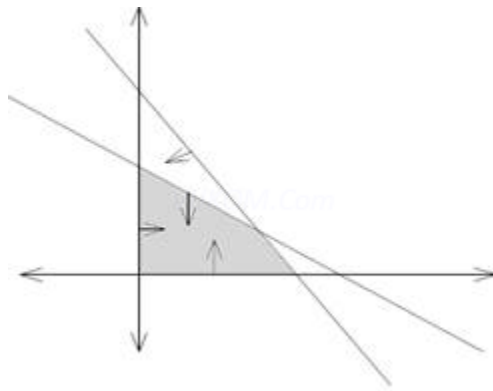
and also P = 20x + 10y

$$\frac{3}{2}x + 3y \leq 42$$

$$\Rightarrow x + 2y \leq 28$$

$$3x + y \leq 24$$

$$x \geq 0, y \geq 0$$

(i) Maximum Z = 16 at x = 4 y = 12

(ii) P = 20×4 +10×12

= 200

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4. A manufacturer produces nuts and bolts. It takes 1 hours of work on machine A and 3 hours on machine B to produce a package of nuts and bolts. He earns a profit of Rs 17.50 per package on nuts and Rs 7.00 per package on bolts. How many package of each should be produced each day so as to maximise his profit, if he operates his machines for at the most 12 hours a day?

Ans. Let the manufacture produce x nuts and y bolts.
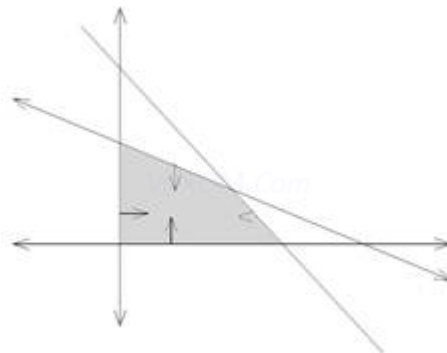
$Z = 17.50x + 7y$

$x + 3y \leq 12$

$3x + y \leq 12$

$X_1\, y \geq 0$

Maximum profit

$Z = $ Rs 73. 50 at

$X = 3, y = 3$

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5. 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

screws A, while it takes 6 minutes on automatic and 3 minutes and 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 Rs 10. Assuming that he can sell all the screws he manufactures, how many package of each type should the factory owner produce in a day in order to maximise his profit? Determine the maximum profit.

Ans. Let the manufacturer produce x packages of screw A and y packages Screw B.
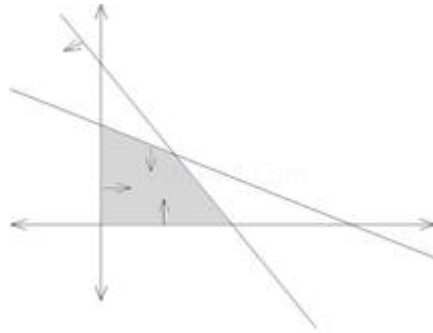
Z = 7x +10y

4x + 6y ≤ 240

$$\Rightarrow 2x+3y \leq 120$$

$6x+3y \leq 240$
$\Rightarrow 2x+y \leq 80$

x≥0,y ≥0

profit is maximum = 410

When 30 packages of screw A and 20 package of screw B.

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6. 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 hour 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 form 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 maximise his profit?

Ans. Let x be pedestal lamps and y wooden shades
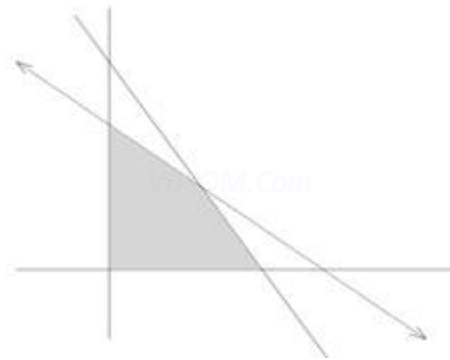
Z = 5x + 3y
2x + y ≤ 12
3x + 2y ≤ 20
x ≥ 0, y ≥ 0
profit maximum
when 4 pedestal lamps
4 wooden shades

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7. 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 for assembling. The profit is Rs 5 each for type A and Rs 6 each for type B souvenirs. How may souvenirs of each type should the company manufacture in order to maximise the profit?
Ans. Let x souvenirs of type A and y souvenirs of type B
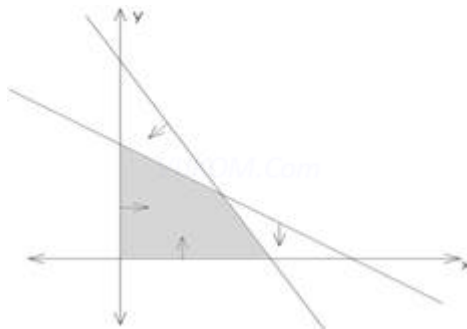
Z = 5x + 6y
5x + 8y ≤ 200
10x + 8y ≤ 240
 ⟹ 5x + 4y ≤ 120

x ≥ 0, y ≥ 0.

Maximum profit is Rs 160

When 8 souvenirs of Type A and 20 souvenirs of type B.

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8. 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.

Ans. Let the merchant stock x desktop computers and y portable computer.
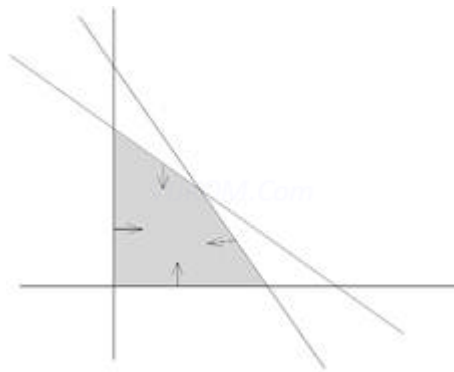
$Z = 4500x + 5000y$

$x + y \leq 250$

$25000x + 40000y \leq 700000$

$\Rightarrow 5x + 8y \leq 1400$

$x \geq 0, y \geq 0$.

Profit is maximum = 1150000

When 250 desktop computers and 50 portable computers are stocked.

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9. A diet is to contain at least 80 units of vitamin A and 100 units of minerals. Two foods F_1 and F_2 are available. Food F1 costs Rs 4 per unit food and F_2 costs Rs 6 per unit. On unit of food F_1 contains 3 units of vitamin A and 4 units of minerals. One unit of food F_2 contains 6 units of vitamin A and 3 units of minerals. Formulate this as linear programming problem. Find the minimum cost for diet that consists of mixture of these two foods and also meets the minimal nutritional requirements.

Ans. Let the diet contain x unit of food F_1 and y units of food F_2.
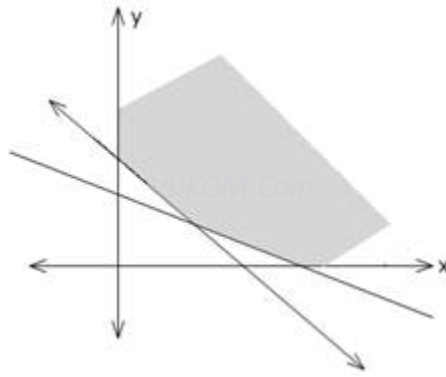
Z = 4x +6y
3x + 6y ≥ 80
4x + 3y ≥ 100
X ≥ 0, y ≥ 0

Z is minimum when 24 units of food F_1 and $\dfrac{4}{3}$ unit of food F_2 are mixed minimum cost

= 104 .

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10. There are two types of fertilizers F_1 and F_2. F_1 consists of 10% nitrogen and 6% phosphoric acid and F_2 consists of 5% nitrogen and 10% phosphoric acid. After testing the soil conditions, a farmer finds that she needs atleast 14kg of nitrogen and 14kg of phosphoric acid for her crop. If F_1 costs Rs 6/kg and F_2 costs Rs 5/kg, determine requirements are met at a minimum cost. What is the minimum cost?
Ans. Let the farmer use x Kg of F_1 and y Kg of F_2.
Z = 6x + 5y
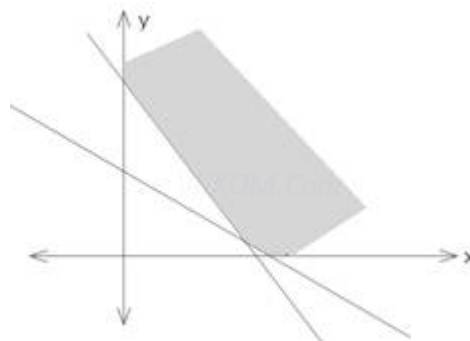
$$\frac{10x}{100} + \frac{5y}{100} \geq 14$$

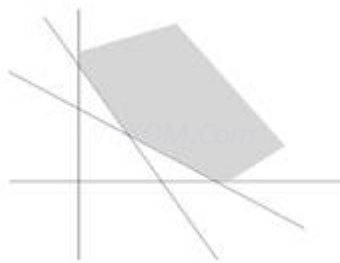$$\frac{6x}{100} + \frac{10y}{100} \geq 14$$

$x \geq 0, y \geq 0.$
Minimum cost
Z = 100
at x = 100
y = 80

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11. Two tailors A and B earn Rs 150 and Rs 200 per day respectively. A can stitch 6 shirts and 4 pants per day while B can stich 10 shirts and 4 Pants per day. How many days each work if it is desired to produce at least 60 shirts and 32 pants at a minimum labour cast?
Ans. Let the two tailors work for x days and y days respectively

$\qquad$ Z = 150x + 200y
6x + 10y ≥ 60

$$\Rightarrow 3x + 5y \geq 30$$

$4x + 4y \geq 32$

$$\Rightarrow x + y \geq 8 \text{ and } x \geq 0, y \geq 0$$

Z is minimum = 1350
When A work for 5 days B work for 3 days

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12. A farmer mixes two brands p and Q of cattle feed. Brand P, costing Rs 250 per bag, contains 3 units of nutritional elements 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 element 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?

Ans. Let P = x
Q = y
Z = 250x + 200y
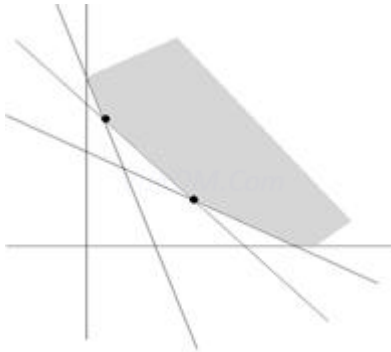
3x + 1.5y ≥ 18
2.5x + 11.25y ≥ 45
2x + 3y ≥ 24
x ≥0, y ≥ 0
Z = Rs 1950
When x = 3 y = 6
Number of bags of brand P = 3 bags of brand Q = 6

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13. 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 contents of one kg food are given below. Find the minimum cost if x cost Rs.16/- per Kg and y cost Rs.20/- per Kg.

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

Ans. Let the dietician mix x Kg of food X and y Kg of food Y.
Z = 16x + 20y
x + 2y ≥ 10
2x + 2y ≥12
$\Rightarrow x + y \geq 6$
$3x + y \geq 8$
Cost is minimum = 112 When 2 Kg of food X and 4 Kg of food Y are mixed.

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14. A manufacture makes tow types of toys A and B. three machines are needs for this purpose and the time (in minutes) required for each toy on the machines is given below:

Types of toys	Machines		
	I	II	III
A	12	18	06
B	06	00	09

Each machine is available for a maximum of 6 hours per day. If the profit on each toy on 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 manufacture in a day to get maximum profit.
Ans. Let x toys of type A and y toys of type B
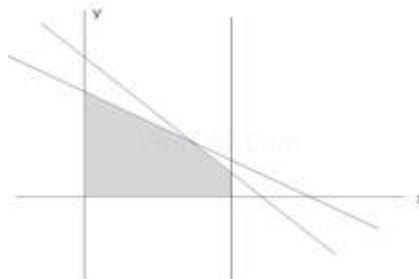
$$Z = \frac{15}{2}x + 5y$$
$$12x + 6y \leq 360$$
$$\Rightarrow 2x + y \leq 60$$
$$18x \leq 360$$
$$\Rightarrow x \leq 20$$
$$6x + 9y \leq 360$$

$$\Rightarrow 2x + 3y \leq 120$$

$$x \geq 0, \ y \geq 0$$
profit is maximum = 262.5 at A = 15 B = 30

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15. 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 maximise the profit for the airline. What is the maximum profit?

Ans. X passengers travel by executive class and y passengers travel by economy class. L
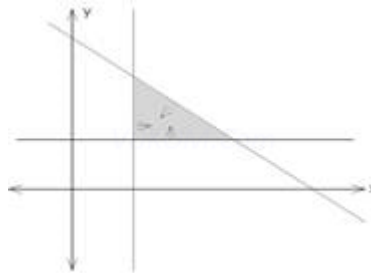
Z = 1000x + 600y

x + y $\leq$ 200
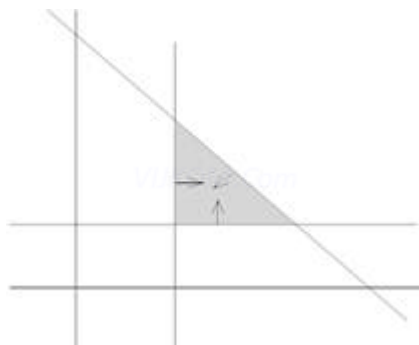
x $\geq$ 20

y $\geq$ 80

x $\geq$ 0, y $\geq$ 0

profit is maximum = 168000

When x = 120, y = 80

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16. Anil wants to invest at most Rs 12,000 in bonds A and B. According to the rules he has to invest at least Rs 2000 in bond A and at least Rs 4000 in bond B. If the rate of interest on bond A is 8% per annum and on bond B, it is 10% per annum, how should be invest the money for maximum interest.

Ans. Let Anil invest x in bond A and Y in bond B,

$$P = \frac{8x}{100} + \frac{10y}{100}$$

x + y $\leq$ 12000

x $\geq$ 2000

y $\geq$ 4000

$x \geq 0$, $y \geq 0$

P is maximum = 1160

x = 2000

y = 10,000

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17. A toy company manufactures two types of dolls. A and B market tests and available resources have indicated that the combined production level should not exceed 1200 dolls per week and the demand for dolls of type B is at most half of that for dolls of type A. Further, the production level of dolls of type A can exceed three times the production of dolls of other type by at most 600 units. If the company makes profit of Rs 12 and Rs 16 per doll respectively on dolls A and B, how many of each should be produced weekly in order to maximise the profit?

Ans. X dolls of type A and y dolls of type B.
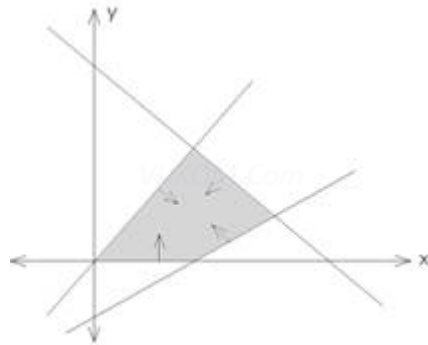
Z = 12x + 16y

X + y ≤ 1200

$$y \leq \frac{x}{2}$$

$$x \leq 3y + 600$$

Profit is maximum = 16000

A = 800

B = 400