MATHS

BOOKS - KUMAR PRAKASHAN KENDRA MATHS (GUJRATI ENGLISH)

LINEAR PROGRAMMING

Exercise 12 1

1. Solve the following Linear Programming Problems graphically :

Maximise Z=3x+4y

subject to the constraints : $x + y \leq 4, x \geq 0, y \geq 0$

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2. Solve the following Linear Programming Problems graphically :

Minimise Z = -3x + 4y

subject to $x + 2y \leq 8, 3x + 2y \leq 12, x \geq 0, y \geq 0$

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3. Solve the following Linear Programming Problems graphically :

Maximise Z = 5x + 3y

subject to $3x + 5y \leq 15, 5x + 2y \leq 10, x \geq 0, y \geq 0$

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4. Solve the following Linear Programming Problems graphically :

Minimise Z = 3x + 5y

such that $x + 3y \geq 3, x + y \geq 2, x, y \geq 0.$

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5. Solve the following Linear Programming Problems graphically :

Maximise Z = 3x + 2y

subject to $x + 2y \leq 10, 3x + y \leq 15, x, y \geq 0$

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6. Solve the following Linear Programming Problems graphically :

Minimise Z = x + 2y

subject to $2x + y \geq 3, x + 2y \geq 6, x, y \geq 0$

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7. Show that the minimum of Z occurs at more than two points.

Minimise and Maximise $Z = 5x + 10y$

subject to

$x + 2y \leq 120, x + y \geq 60, x - 2y \geq 0, x, y \geq 0$

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8. Find the maximum and minimum value of Z = x + 2y, subject to the constraints $x + 2y \geq 100, 2x - y \leq 0, 2x + y \leq 200, x, y \geq 0.$

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9. Maximise $Z = -x + 2y$, subject to the constraint, $x \geq 3, x + y \geq 5, x + 2y \geq 6, y \geq 0$

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10. Show that the minimum of Z occurs at more than two points.

Maximise Z = x + y,

subject to $x - y \leq -1, -x + y \leq 0, x, y \geq 0$

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Exercise 12 2

1. Reshma wishes to mix 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.

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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 1 kg of fat assuming that there is no shortage of the other ingredients used in making the cakes.

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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 and 1 hour or 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 to 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.

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4. 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 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 maximise his profit, if he operates his machines for at the most 12 hours a day ?

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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 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 Rs. 10. 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 maximise his profit ? Determine the maximum profit.

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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 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 maximise his profit ?

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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 many souvenirs of each type should the company manufacture in order to maximise the profit ?

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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.

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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 F_1 costs Rs. 4 per unit food and F_2 costs Rs. 6 per unit. One

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 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.

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10. There are two types of fertilisers 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 oil conditions, a farmer finds that she needs atleast 14 kg of nitrogen and 14 kg of phosphoric acid for her crop. If F_1 costs Rs. 6/kg and F_2 costs Rs. 5/kg, determine how much of each type of fertiliser should be

used so that nutrient requirements are met at a minimum cost. What is the minimum cost ?

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11. The correct 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 .....

A. p = q

B. p = 2q

C. p = 3q

D. q = 3p

Answer: D

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Miscellaneous Exercise 12

1. Maximize the function $z = 6x + 3y$, subject to the constraints :

$4x + y \geq 80, x + 5y \geq 115, 3x + 2y \leq 150, x \geq 0, y \geq 0$

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2. 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 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 ?

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3. 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 is given below :

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

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 ?

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4. A manufacturer makes two type 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 :

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

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, whow that 15 toys of type A and 30 of type B should be manufactured in a day to get maximum profit.

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5. 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 ?

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6. An oil company has two depots A and B with capacities of 7000 L and 4000 L respectively. The company is to supply oil to three petrol pumps, D, E and F whose requirements are 4500L, 3000L and 3500L respectively. The distances (in km) between the depots and the petrol pumps is given in the following table :

From / To	Distance in (km.)	
	A	B
D	7	3
E	6	4
F	3	2

Assuming that the transportation cost of 10 litres of oil is Rs. 1 per km, how should the delivery be scheduled in order that the transportation cost is minimum ? What is the minimum cost ?

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7. A fruit grower can use two types of fertilizer in his garden, brand P and brand Q. The amounts (in kg) of nitrogen, phosphoric acid, potash, and chlorine in a bag of each brand are given in the table. Tests indicate that the

garden needs at least 240 kg of phosphoric acid, at least 270 kg of potash and at most 310 kg of chlorine.

If the grower wants to minimise the amount of nitrogen added to the garden, how many bags of each brand be used ? What is the minimum amount of nitrogen added in the garden ?

kg per bag		
	Brand P	Brand Q
Nitrogen	3	3.5
Phosphoric acid	1	2
Potash	3	1.5
Chlorine	1.5	2

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8. Refer to Question 8. If the grower wants to maximise the amount of nitrogen added to the garden, how many bags

of each brand should be added ? What is the maximum amount of nitrogen added ?

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9. A toy company manufactures two types of dolls, A and B. Market research 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 ?

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Textbook Illustrations For Practice Work

1. Solve the following linear programming problem graphically :

Maximise Z = 4x + y $\quad \ldots(1)$

subject to the constraints :

$x + y \leq 50 \quad \ldots(2)$

$3x + y \leq 90 \ldots(3)$"

$x \geq 0, y \geq 0 \quad \ldots(4)$

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2. Solve the following linear programming problem graphically :

Minimise Z = 200 x + 500 y $\quad \ldots(1)$

subject to the constraints :

$x + 2y \geq 10 \quad \ldots(2)$

$3x + 4y \leq 24 \quad \ldots(3)$

$x \geq 0, y \geq 0 \quad \ldots(4)$

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3. Solve the following problem graphically :

Minimise and Maximise Z = 3x + 9y $\quad \ldots(1)$

subject to the constraints : $x + 3y \leq 60 \quad \ldots(2)$

$x + y \geq 10 \quad \ldots(3)$

$x \leq y \quad \ldots(4)$

$x \geq 0, y \geq 0 \quad \ldots(5)$

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4. Determine graphically the maximize value of the subjective function $Z = 10x + 25y \quad \ldots(1)$

subject to the constraints :

$x \leq 3, y \leq 3 \quad \ldots(2)$

$x + y \leq 5 \quad \ldots(3)$

$x \geq 0, y \geq 0 \quad \ldots(4)$

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5. Minimise Z = 3x + 2y

subject to the constraints :

$x + y \geq 8 \quad \ldots(1)$

$3x + 5y \leq 15 \quad \ldots(2)$

$x \geq 0, y \geq 0 \quad \ldots(3)$

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6. (Diet problem): A dietician wishes to mix two types of foods in such a way that vitamin contents of the mixture contain atleast 8 units of vitamin A and 10 units of vitamin C. Food 'I' contains 2 units/kg. of vitamin A and 1 unit/kg. of vitamin C. Food 'II' contains 1 unit/kg. of vitamin A and 2 units/kg of vitamin C. It costs Rs. 50 per kg. to purchase Food 'I' and Rs. 70 per kg. to purchase Food 'II'. Formulate

this problem as a linear programming problem to minimise the cost of such a mixture.

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7. (Allocation problem) A cooperative society of farmers has 50 hectare of land to grow two crops X and Y. The profit from crops X and Y per hectare are estimated as Rs. 10,500 and Rs. 9000 respectively. To control weeds, a liquid herbicide has to be used for crops X and Y at rates 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. How much land should be allocated to each crop so as to to maximise the total profit of the society ?

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8. (Manufacturing problem) A manufacturing company makes two models A and B of product. Each piece of Model A requires 9 labour hours for fabricating and 1 labour hour for finishing. Each piece of Model B requires 12 labour hours for fabricating and 3 labour hours for finishing. For fabricating and finishing, the maximum labour hours available are 180 and 30 respectively. The company makes a profit of Rs. 8000 on each piece of model A and Rs. 12000 on each piece of Model B. How many pieces of model A and model B should be manufactured per week to realise a maximum profit ? What is the maximum profit per week ?

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9. (Diet problem) A dietician has to develop a special diet using two foods P and Q. Each packet (containing 30 g) of food P contains 12 units of calcium, 4 units of iron, 6 units of cholesterol and 6 units of vitamin A. Each packet of the same quantity of food Q contains 3 units of calcium, 20 units of iron, 4 units of cholestrol and 3 units of vitamin A. The diet requires atleast 240 units of calcium, atleast 460 units of iron and at most 300 units of cholestrol. How many packets of each food should be used to minimise the amount of vitamin A in the diet ? What is the minimum amount of vitamin A ?

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10. (Manufacturing problem) A manufacturer has three machines I, II and III installed in his factory. Machines I and II are capable of being operated for at most 12 hours whereas machine III must be operated for atleast 5 hours a day. She produces only two items M and N each requiring the use of all the three machines. The number of hours required for producing 1 unit of each of M and N on the three machines are given in the following table :

Items	Number of hours required on machines		
	I	II	III
M	1	2	1
N	2	1	1.25

She makes a profit of Rs. 600 and Rs. 400 on items M and N respectively. How many of each should she produce so as to maximise her profit assuming that she can sell all the items that she produced? What will be the maximum profit ?

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11. (Transportation problem) There are two factories located one place at place P and the other at place Q. From these locations, a certain commodity is to be delivered to each of the 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 (in ₹)		
	A	B	C
P	160	100	150
Q	100	120	100

How many units should be transported from each factory to

each depot in order that the transportation cost is minimum. What will be the minimum transportation cost ?

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Solutions Of Ncert Exemplar Problems

1. Determine the maximum value of z = 11x + 7y subject to the constraints :

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

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

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3. Maximize the function $z = 11x + 7y$, subject to the constraints : $x \leq 3, y \leq 2, x \geq 0, y \geq 0$

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4. Minimise z = 13x - 15y subject to the constraints : $x + y \leq 7, 2x - 3y + 6 \geq 0, x \geq 0, y \geq 0$

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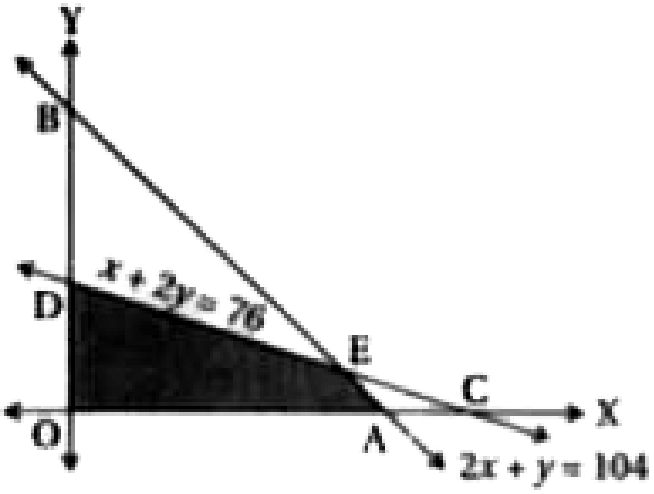
5. Determine the maximum value of z = 3x + 4y if the feasible region (shaded) for a LPP is shown in Figure.



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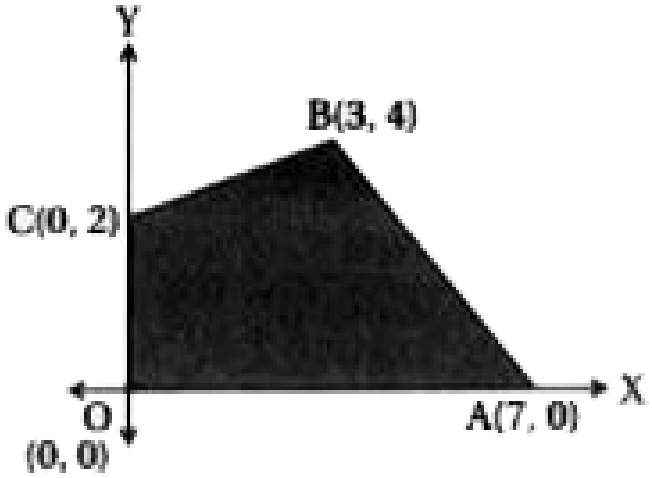
6. Feasible region (shaded) for a LPP is shown in Figure

Maximise z = 5x + 7y.



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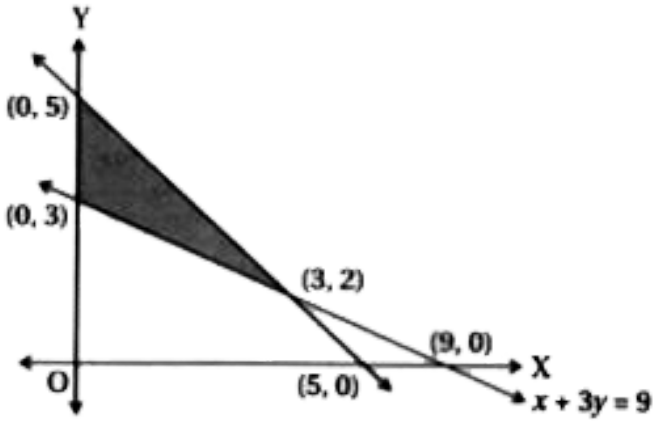
7. The feasible region for a LPP is shown in Figure. Find the minimum value of $z = 11x + 7y$.



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8. Find the maximum value of $Z = 4x + y$ subject to the constraints $2x + y \leq 23, x \geq 0, y \geq 0$ is .....

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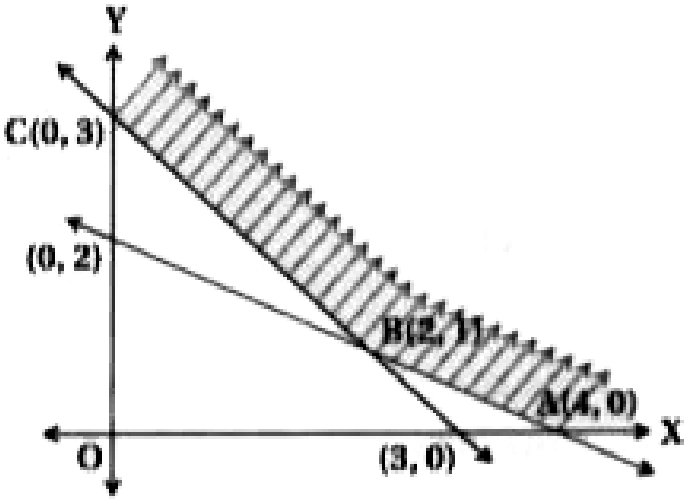
9. The feasible region for a LPP is shown in Figure. Evaluate z = 4x + y at each of the corner points at this region. Find

the minimum value of z, if exists.



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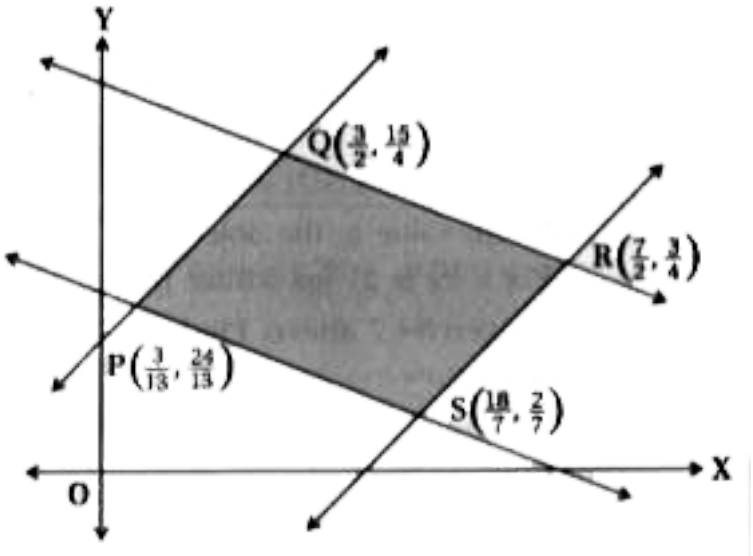
10. In Figure, the feasible region (shaded) for a LPP is shown.

Determine the maximum and minimum value of z = x + 2y.



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11. A manufacturer of electronic circuits has a stock of 200 resistors, 120 transistors and 150 capacitors and is required to produce two types of circuits A and B. Type A requires 20 resistors, 10 transistors and 10 capacitors. Type B requires 10 resistors, 20 transistors and 30 capacitors. If the profit on type A circuit is Rs. 50 and that on type B circuit is Rs. 60,

formulate this problem as a LPP so that the manufacturer can maximize his profit.

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12. A firm has to transport 1200 packages using large vans which can carry 200 packages each and small vans which can take 80 packages each. The cost for engaging each large van is Rs. 400 and each small van is Rs. 200. Not more than Rs. 3000 is to be spent on the job and the number of large vans can not exceed the number of small vans. Formulate this problem as a LPP given that the objective is to minimize cost.

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13. A company manufactures two types of screws A and B. All the screws have to pass through a threading machine and a slotting machine. A box of Type A screws requires 2 minutes on the threading machine and 3 minutes on the slotting machine. A box of type B screws requires 8 minutes of threading on the threading machine and 2 minutes on the slotting machine. In a week, each machine is available for 60 hours.

On selling these screws, the company gets a profit of Rs. 100 per box on type A screws and Rs. 170 per box on type B screws.

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14. A man rides his motorcycle at the speed of 50 km/hour. He has to spend Rs. 2 per km on petrol. If he rides it at a faster speed of 80 km/hour, the petrol cost increases to Rs. 3 per km. He has atmost Rs. 120 to spend on petrol and one hour's time. He wishes to find the maximum distance that he can travel.

Express this problem as a linear programming problem.

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15. Refer to question 11. How many of circuits of Type A and of Type B, should be produced by the manufacturer so as to maximise his profit? Determine the maximum profit.

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16. Find the minimum value of $Z = x + y$ subject to the constraints $2x + 3y \leq 6, x \geq 0, y \geq 0$ is .....

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17. Solve the following linear programming problems graphically :

Maximize : $Z = 100x + 170y$ subject to the constraints $3x + 2y \leq 3600, x + 4y \leq 1800, x, y \geq 0.$

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18. Solve the following linear programming problems graphically :

Maximize : $Z = x + 170y$ subject to the constraints $3x + 2y \leq 6, x + 4y \leq 16, x, y \geq 0.$

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19. Refer to question 15. Determine the maximum distance that the man can travel.

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20. Maximise z = x + y subject ot $x + 4y \leq 8, 2x + 3y \leq 12, 3x + y \leq 9, x \geq 0, y \geq 0.$

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21. A manufacturer produces two models of bikes model X and model Y. Model X takes a 6 man hours to make per unit, while Model Y takes 10 man-hours per unit. There is a total of 450 man-hour available per week. Handling and Marketing costs are Rs. 2000 and Rs. 1000 per unit for Models X and Y respectively. The total funds available for these purposes are Rs. 80,000 per week. Profits per unit for Models X and Y are Rs. 1000 and Rs. 500, respectively. How many bikes of each model should the manufacturer produce, so as to yield a maximum profit ? Find the maximum profit.

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22. In order to supplement daily diet, a person wishes to take some of x and some wishes y tablets. The contents of iron, calcium and vitamins in x and y (in milligrams per tablet) are given as below :

Tablets	Iron	Calcium	Vitamin
x	6	3	2
y	2	3	4

The person needs atleast 18 milligrams of iron, 21 milligrams of calcium and 16 milligram of vitamins. The price of each tablet of X and Y is Rs. 2 and Rs. 1 respectively. How many tablets of each should the person take in order to satisfy the above requirement at the minimum cost ?

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23. A company makes 3 model of calculators : A, B and C at factory (I) and factory (II). The company has orders for atleast 6400 calculators of model A, 4000 calculator of model B and 4800 calculators of model C. At factory (I), 50 calculators of model A, 50 of model B and 30 of model C are made everyday, at factory (II), 40 calculators of model A, 20 of model B and 40 of model C are made everyday. It costs Rs. 12000 and Rs. 15000 each day to operate factory (I) and (II), respectively. Find the number of days each factory should operate to minimise the opertaing costs and still meet the demand.

A. 24

B. KPK_AIO_MAT_XII_P2_C12_E04_024

C. SOLUTIONS OF NCERT EXEMPLAR PROBLEMS

D. 24

Answer: Number of days factory (I) should work 80 days and factory (II) should work 60 days.

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24. Maximise $Z = 10x + 7y$

subject to $2x + 2y \geq 16$,

$$6x + 10y \leq 30,$$

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

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25. The corner points of the feasible region determined by the system of linear constraints are (0, 0), (0, 40), (20, 40), (60, 20), (60, 0). The objective function is $z = 4x + 3y$.

Compare the quantity in Column A and Column B

Column	Maximum of z
A	300
B	325

A. The quantity in column (A) is greater

B. The quantity in column (B) is greater

C. Both quantities are equal

D. The relation can't be determined on basis of given information

Answer: B

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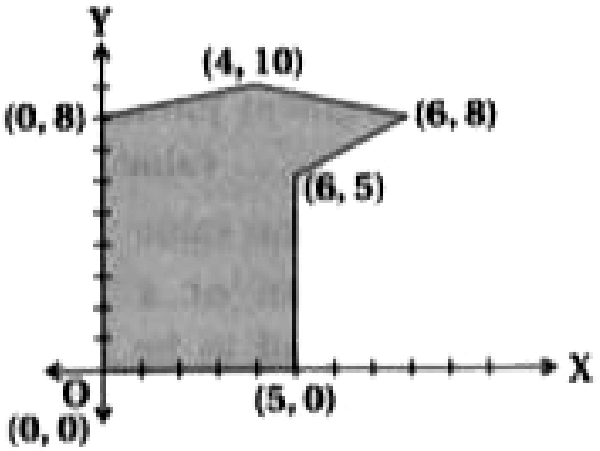
26. The feasible solution for a LPP is shown in Figure

Let z = -3x - 4y



objective function. Minimum of Z occurs at

A. (0, 0)

B. (0, 8)

C. (5, 0)

D. (4, 10)

Answer: B

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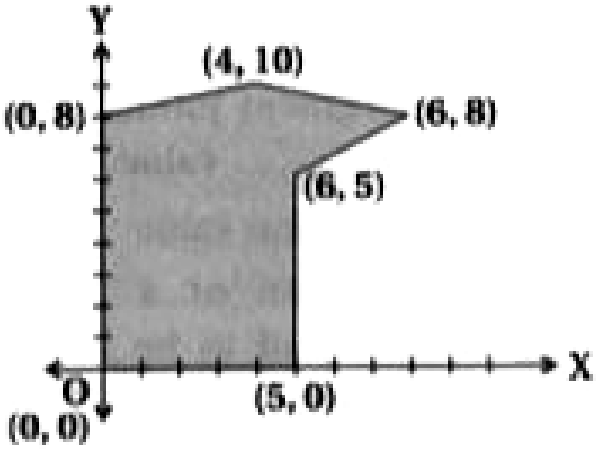
27. The feasible solution for a LPP is shown in Figure

Let z = -3x - 4y



objective function. Maximum of Z occurs at

A. (5, 0)

B. (6, 5)

C. (6, 8)

D. (4, 10)

Answer: A

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28. The corner points of the bounded feasible region are $(0, 0), (0, 8), (4, 10), (6, 8), (6, 5)$ and $(5, 0)$. For the objective function $z = 3x - 4y$. . . . . (Maximum value of z + Minimum value of z) is equal to

A. 13

B. 1

C. -13

D. -17

Answer: D

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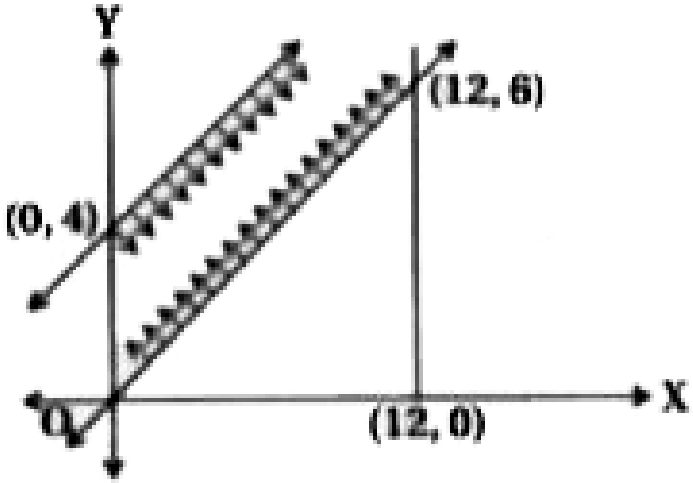
29. The feasible region for an LLP is shown in the Figure. Let $z = 3x - 4y$ be the objective function. Maximum value of z is



A. 0

B. 8

C. 12

D. -18

Answer: C

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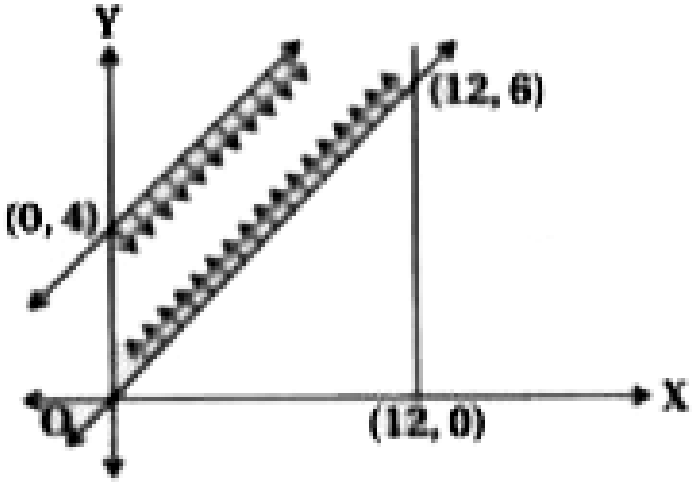
30. The feasible region for an LLP is shown in the Figure. Let $z = 3x - 4y$ be the objective function. Minimum value of z is



A. 0

B. -16

C. 12

D. does not exist

Answer: B

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31. Corner points of the feasible region for an LPP are (0, 2), (3, 0), (6, 0), (6, 8) and (0, 5).

Let F = 4x + 6y be the objective function. The Minimum value of F occurs at .....

A. only (0, 2)

B. only (3, 0)

C. the mid-point of the line segment joining the points (0, 2) and (3, 0) only

D. any point on the line segment joining the point (0, 2) and (3, 0)

Answer: D

Watch Video Solution

32. Corner points of the feasible region for an LPP are (0, 2), (3, 0), (6, 0), (6, 8) and (0, 5).

Let F = 4x + 6y be the objective function. (Maximum of F)- (Minimum of F) =

A. 60

B. 48

C. 42

D. 18

Answer: A

Watch Video Solution

33. Corner points of the feasible region determined by the system of linear constraints are (0, 3), (1, 1) and (3, 0). Let Z = px + qy, where $p, q > 0$. Condition on p and q, so that the maximum of Z occurs at (3, 0) and (1, 1) is .....

A. p = 2q

B. $p = \frac{q}{2}$

C. p = 3q

D. p = q

Answer: B

Watch Video Solution

34. In a LPP, the linear inequalities or restrictions on the variables are called ..... .

Watch Video Solution

35. In a LPP, the objective function is always .....

Watch Video Solution

36. If the feasible region for a LPP is ....., then the optimal value of the objective function z = ax + by may or may not exist.

Watch Video Solution

37. In a LPP if the objective function z = ax + by has the same maximum value on two corner points of the feasible region, then every point on the line segment joining these two points give the same ..... Value.

Watch Video Solution

38. A feasible region of a system of linear inequalities is said to be ..... if it can be enclosed within a circle.

Watch Video Solution

39. A corner point of a feasible region is a point in the region which is the ..... of two boundary lines.

Watch Video Solution

40. The feasible region for an LLP is always a ..... polygon.

Watch Video Solution

41. If the feasible region for a LPP is unbounded, maximum or minimum of the objective function $Z = ax + by$ may or may not exist.

Watch Video Solution

42. Maximum value of the objective function $Z = ax + by$ in a LPP always occurs at only one corner point of the feasible region.

Watch Video Solution

43. In a LPP, the minimum value of the objective function Z = ax + by is always 0, if origin is one of the corner point of the feasible region.

Watch Video Solution

44. In a LPP, the maximum value of the objective function z = ax + by is always finite.

Watch Video Solution

Multiple Choice Questions

1. Solution set of the inequality $2x + y > 5$ is .....

A. The half plane containing origin

B. The open half plane not containing origin

C. xy - plane excepts the points on the line 2x + y = 5

D. None of these

Answer: B

Watch Video Solution

2. The optimal value of the objective function is attained at the points .....

A. given by intersection of inequations with the axes only

B. given by intersection of inequations with X - axis only

C. given by corner points of the feasible region

D. None of these

Answer: C

Watch Video Solution

3. The region formed by the inequalities $x, y \geq 0, y \leq 6, x + y \leq 3$ is .....

A. unbounded in first quadrant

B. unbounded in first and second quadrants

C. bounded in first quadrant

D. none of these

Answer: C

Watch Video Solution

4. The corner points of the feasible region are (0, 0), (16, 0), (8, 12), (0, 20). The maximum and minimum values of Z = 22x + 18y are m and n respectively then m + n = ...

A. 352

B. 0

C. 360

D. 392

Answer: D

Watch Video Solution

5. For linear programming $x + 2y \geq 10, 3x + 4y \leq 24$ and $x \geq 0, y \geq 0 \ldots\ldots\ldots$ is not the corner point of feasible region.

A. (0, 6)

B. (4, 3)

C. (3, 4)

D. (0, 5)

Answer: C

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6. The region represented by the inequation $x - y \leq -1, x - y \leq 0, x \leq 0, y \leq 0$ is .....

A. bounded

B. unbounded

C. do not exist

D. triangular region

Answer: C

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7. Let x and y are optimal solution of a LPP, then ...

A. $Z = \lambda x + (1 - \lambda)y, \lambda \in R$ is also an optimal solution

B. $Z = \lambda x + (1 - \lambda)y, 0 \leq \lambda \leq 1$ gives an optimal solution

C. $Z = \lambda x + (1 + \lambda)y, 0 \leq \lambda \leq 1$ gives an optimal solution

D. $Z = \lambda x + (1 + \lambda)y, \lambda \in R$ gives an optimal solution

Answer: B

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8. The feasible solution of LPP .....

A. satisfy all the constraints

B. satisfy some of the constraints

C. always corner points of feasible solution

D. always optimal value of objective function

Answer: A

Watch Video Solution

9. Which of the following statement is correct ?

A. Every LPP admits an optimal solution

B. A LPP admits an optimal solution

C. If a LPP admits two optimal solutions it has an infinite number of optimal solution.

D. The set of all feasible solutions of a LPP is not a converse set.

Answer: C

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10. Consider a LPP given by minimise Z = 6x + 10y. Subject to $x \geq 6, y \geq 2, 2x + y \geq 10, x \geq 0, y \geq 0.$ Redundant constraints in this LPP are .....

A. $x \geq 6, y \geq 2$

B. $2x + y \geq 10, x \geq 0, y \geq 0$

C. $x \geq 6$

D. $x \geq 6, y \geq 0$

Answer: B

Watch Video Solution

11. Objective function of a LPP is .....

A. constant graph

B. a function to be optimized

C. inequality

D. quadratic equation

Answer: B

Watch Video Solution

12. The maximum value of Z = x + 4y subject to the constraints $3x + 6y \leq 6, 4x + 8y \geq 16, x \geq 0, y \geq 0$ is .....

A. 4

B. 8

C. unbounded feasible region

D. Does not exist feasible region

Answer: D

Watch Video Solution

13. The corner points of the feasible region determined by some inequality are (0, 10), (5, 5), (15, 15), (0, 20). Let Z = px + qy, where $p, q > 0$ condition on p and q so that the maximum of Z occurs at both (15, 15) and (0, 20) is .....

A. p = q

B. p = 2q

C. q = 2p

D. q = 3p

Answer: D

Watch Video Solution

14. Objective function of a LPP is .....

A. a constraint

B. a function to be optimized

C. a relation between the variables

D. None of these

Answer: B

Watch Video Solution

15. The corner points of the feasible region are A(3, 3), B(20, 3), C(20, 10), D(18, 12) and E(12, 12). The maximum value of Z = 2x + 3y is .....

A. 72

B. 80

C. 82

D. 70

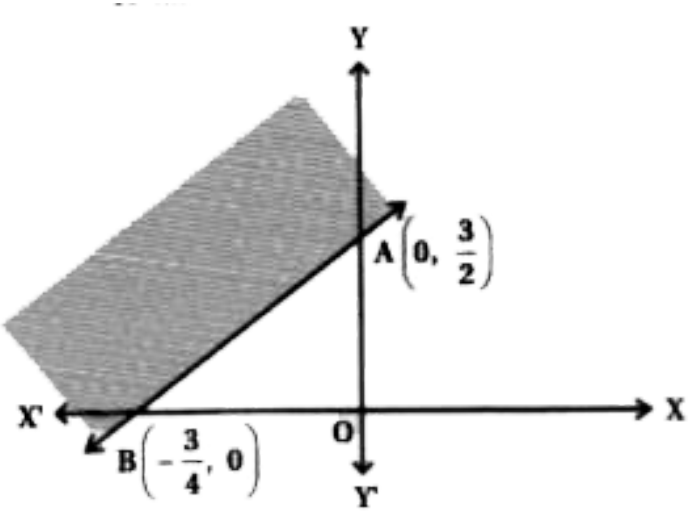
Answer: A

Watch Video Solution

16. Cake-A requires 200g of flour and 25g of fat Cake-B 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. The mathematical form of this LPP is .....

Watch Video Solution

17. The shaded region in the given figure is a graph of .....



A. $4x - 2y \leq 3$

B. $4x - 2y \leq -3$

C. $2x - 4y \geq 3$

D. $2x - 4y \leq -3$

Answer: B

Watch Video Solution

18. The point at which the maximum value of Z = 3x + 2y subject to the constraints $x + 2y \leq 2, x \geq 0, y \geq 0$ is .....

A. (0, 0)

B. (1.5, -1.5)

C. (2, 0)

D. (0, 2)

Answer: C

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19. The solution of linear programming problem, maximize $Z = 3x_1 + 5x_2$ subject to $3x_1 + 2x_2 \leq 18, x_1 \leq 4, x_2 \leq 6, x_1 \geq 0, x_2 \geq 0$ is .....

A. $x_1 = 2, x_2 = 0, z = 6$

B. $x_1 = 2, x_2 = 6, z = 36$

C. $x_1 = 4, x_2 = 3, z = 27$

D. $x_1 = 4, x_2 = 6, z = 42$

Answer: B

Watch Video Solution

20. The maximum value of Z = x + 3y subject to the constraints $2x + y \leq 20, x + 2y \leq 20, x \geq 0, y \geq 0$ is

.....

A. 10

B. 60

C. 40

D. 30

Answer: D

Watch Video Solution

21. The solution set of the constraints $x + 2y \geq 11, 3x + 4y \leq 30, 2x + 5y \leq 30, x \geq 0, y \geq 0$ includes the point.

A. (2, 3)

B. (3, 2)

C. (3, 4)

D. (4, 3)

Answer: C

Watch Video Solution

22. The feasible region of the inequality $x + y \leq 1$ and $x - y \leq 1$ lies in ..... quadrants.

A. Only I and II

B. Only I and III

C. Only II and III

D. All the these

Answer: D

Watch Video Solution

23. The following five inequalities form the feasible region.

$2x - y \leq 8, x + y \leq 20, \ -x + y \geq \ -10, x \geq 0, y \geq 0.$

Redundant constraints is ...

A. $x \geq 0$

B. $2x - y \leq 8$

C. $-x + y \geq \ -10$

D. $x + y \leq 20$

Answer: C

Watch Video Solution

24. The position of the points $O(0, 0)$ and $P(2, -1)$ is ....., in the region of the inequality $2y - 3x < 5$.

A. O is inside the region and P is outside the region

B. O and P both are inside the region

C. O and P both are outside the region

D. O is outside the region and P is inside the region

Answer: B

Watch Video Solution

25. The constraints $x + y \leq 4, 3x + 3y \geq 18, x \geq 0, y \geq 0$ defines on .....

A. bounded feasible region

B. unbounded feasible region

C. feasible region in first and second quadrants

D. does not exist

Answer: D

Watch Video Solution

26. The solution set of the constraints $x + 2y \leq 2000, x + y \leq 1500, y \leq 600$ and $x \geq 0$ does not include the point .....

A. (1000, 0)

B. (0, 500)

C. (2, 0)

D. (2000, 0)

Answer: D

Watch Video Solution

27. Out of the following points, how many points are satisfied the inequality $2x - 3y > -5$?

$(1, -1), (-1, 1), (1, -1), (-1, -1), (-2, 1), (2, -1),$ $(-1, 2)$ and $(-2, -1)$.

A. 3

B. 5

C. 6

D. 4

Answer: B

Watch Video Solution

28. How many points having integer co-ordinates are there in the feasible region of the inequality $3x + 4y \leq 12, x \geq 0$ and $y \geq 1$?

A. 7

B. 6

C. 5

D. 8

Answer: C

Watch Video Solution

29. z = 30x - 30y + 1800 is a objective function. The corner points of the feasible region are (15, 0), (15, 15), (10, 20), (0, 20) and (0, 15). z has the minimum value at ..... point.

A. (0, 20)

B. (0, 15)

C. (15, 0)

D. (10, 20)

Answer: A

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30. The corner points of the bounded feasible region are (0, 1), (0, 7), (2, 7), (6, 3) (6, 0) (1, 0). For the objective function Z = 3x - y .....

At which point, Z is minimum ?

(ii) At which point, Z is maximum ?

(iii) The maximum value of Z is .....

(iv) The minimum value of Z is .....

A. (i) (2, 7) (ii) (6, 3) (iii) 20 (iv) -1

B. (i) (0, 7) (ii) (6, 0) (iii) 18 (iv) -7

C. (i) (0, 1) (ii) (6, 3) (iii) 18 (iv) -1

D. (i) (0, 7) (ii) (6, 0) (iii) 15 (iv) -7

Answer: B

Watch Video Solution

31. The constraints $-x + y \leq 1, \ -x + 3y \leq 9, x \geq 0, y \geq 0$ defines on .....

A. bounded feasible space

B. unbounded feasible space

C. Does not get feasible space

D. Feasible space is a square

Answer: B

Watch Video Solution

32. The solution set of the constraints $2x + 3y \leq 6, 5x + 3y \leq 15$ and $x \geq 0, y \geq 0$ does not include ..... point.

A. (0, 2)

B. (0, 0)

C. (3, 0)

D. (0, 5)

Answer: D

Watch Video Solution

33. The solution set of the constraints $2x + 3y \leq 6, x + 4y \leq 4$ and $x \geq 0, y \geq 0$ includes the

point ..... As corner point.

A. (1, 0)

B. (1, 1)

C. $\left(\frac{12}{5}, \frac{2}{5}\right)$

D. $\left(\frac{2}{5}, \frac{12}{5}\right)$

Answer: C

Watch Video Solution

34. The region formed by the inequalities $2x + 3y - 5 \leq 0, 4x - 3y + 2 \leq 0$ and $x \geq 0$ .....

A. does not lie in first quadrant

B. lies in first quadrant and bounded

C. lies in first quadrant and unbounded

D. lies in first and second quadrant

Answer: D

Watch Video Solution

35. A wholesale dealer wants to starts the business with Rs. 2,40,000. The cost price of a quintal wheat is Rs. 2000 and the cost price of a quintal rice is Rs. 3000. He has the space capacity for 200 quintals grain. The profit from the sale of one quintal wheat is Rs. 125 and that from one quintal rice is Rs. 200. If he has x quintal rice and y quintal wheat then the objective function for the maximum profit is .....

A. 125x + 200y

B. 200x + 125y

C. 2000x + 3000y

D. $\frac{2000}{200}x + \frac{3000}{125}y$

Answer: B

Watch Video Solution

36. The corner points of the bounded feasible region are (0, 0), (2, 0), (4, 2), (2, 4) and $\left(0, \frac{10}{3}\right)$. Then for the objective function z = -x + 2y.

(i) Maximum value of z has at .....

(ii) Minimum value of z has at .....

(iii) The maximum value of z is .....

(iv) The minimum value of z is .....

A. (i) (2, 4) (ii) (0, 0) (iii) 6 (iv) 0

B. (i) $\left(0, \frac{10}{3}\right)$ (ii) (4, 2) (iii) 6 (iv) 0

C. (i) (2, 4) (ii) (2, 0) (iii) 6 (iv) -2

D. (i) (0, 10/3) (ii) (2, 0) (iii) $\frac{20}{3}$ (iv) -2

Answer: D

Watch Video Solution

37. The production of item A is x and the production of item B is y. If the corner points of the bounded feasible region

are (1, 0), (2, 0), (0, 2) and (0, 1) then the maximum profit z = 2000x + 5000y is .....

A. 20000

B. 5000

C. 4000

D. 10000

Answer: D

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38. The corner points of the bounded feasible region are (60, 0), (120, 0), (60, 40), (40, 20) and (20, 30). For the objective function z = 5x + 10y .....

(i) Maximum value of z.

(ii) Minimum value of z.

(iii) Maximum value of z has at .....

(iv) Minimum value of z has at .....

A. 700, 600, (60, 40), (120, 0)

B. 600, 400, (120, 0), (40, 20)

C. 600, 300, (120, 0), (60, 0)

D. 700, 300, (60, 40), (60, 0)

Answer: D

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39. The minimum value of z = 2x + 4y subject to constraints $x + 2y \geq 10, 3x + y \geq 10, x \geq 0, y \geq 0$ is .....

A. 20

B. 40

C. Not exists

D. 30

Answer: A

Watch Video Solution

40. Objective function of a LPP is .....

A. a function to be optimized.

B. a quadratic equation.

C. a constant.

D. an inequality.

Answer: A

Watch Video Solution

41. The vertices of the feasible region determined by some linear constraints are (0, 2), (1, 1), (3, 3), (1, 5). Let Z = px + qy where p, q gt 0. The condition on p and q so that the maximum of Z occurs at both the points (3, 3) and (1, 5) is .....

A. p = q

B. $p = 2q$

C. $q = 2p$

D. $p = 3q$

Answer: A

Watch Video Solution

42. If the vertices of a feasible region are O(0, 0), A(10, 0), B(0, 20), C(15, 15), then minimum value of a objective function $Z = 10x - 20y + 30$ is .....

A. -120

B. 130

C. 30

D. -370

Answer: D

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Practice Paper 12

1. The correct 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 .....

A. q = 3p

B. $p = 3q$

C. $p = q$

D. $q = 2p$

Answer:

Watch Video Solution

2. The optimal value of the objective function is attained at the points .....

A. given by intersection of inequations with the axes only

B. given by intersection of inequations with X - axis only

C. given by corner points of the feasible region

D. None of these

Answer:

Watch Video Solution

3. The corner points of the feasible region are (0, 0), (16, 0), (8, 12), (0, 20). The maximum value of the objective function $Z = 22x + 18y$ is .....

A. 309

B. 399

C. 329

D. 392

Answer:

Watch Video Solution

4. The region represented by the inequation system $x + y \leq 4, 4x + 4y \geq 24, x \geq 0, y \geq 0$ is .....

A. bounded

B. unbounded

C. does not exist

D. bounded in first and fourth quadrants

Answer:

Watch Video Solution

5. The feasible region of the inequality $x + y \leq 1$ and $x - y \leq 1$ lies in ..... quadrants.

A. First and second

B. First and fourth

C. Second and third

D. All the four

Answer:

Watch Video Solution

6. The solution set of the constraints $2x + 3y \leq 6, x + 4y \leq 4$ and $x \geq 0, y \geq 0$ includes the point ..... As corner point.

A. (1, 0)

B. (1, 1)

C. $\left(\frac{12}{5}, \frac{2}{5}\right)$

D. $\left(\frac{2}{5}, \frac{12}{5}\right)$

Answer:

Watch Video Solution

7. Find the minimum value of Z = -3x + 4y, subject to the constraints $x + 2y \leq 8, 3x + 2y \leq 12, x \geq 0, y \geq 0.$

Watch Video Solution

8. Find the maximum value of Z = x + y, subject to the constraints $x - y \leq -1, -x + y \leq 0, x, y \geq 0.$

Watch Video Solution

9. Solve the following linear programming problem graphically :

Maximise Z = 4x + y $\ldots(1)$

subject to the constraints :

$x + y \leq 50 \quad \ldots(2)$

$3x + y \leq 90 \ldots(3)$"

$x \geq 0, y \geq 0 \quad \ldots(4)$

Watch Video Solution

10. One kind of cake requires 400g of flour and 50g of fat, and another kind of cake requires 200g of flour and 75g of fat. Find the number of cakes which can be made from 8kg of flour and 2 kg of fat. Write the mathematical formulation of this problem.

Watch Video Solution

11. Find the maximum and minimum value of Z = x + 2y, subject to the constraints $x + 2y \geq 100, 2x - y \leq 0, 2x + y \leq 200, x, y \geq 0.$

Watch Video Solution

12. 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 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 maximise his profit, if he operates his machines for at the most 12 hours a day ?

Watch Video Solution

13. (Diet problem): A dietician wishes to mix two types of foods in such a way that vitamin contents of the mixture contain atleast 8 units of vitamin A and 10 units of vitamin C. Food 'I' contains 2 units/kg. of vitamin A and 1 unit/kg. of

vitamin C. Food 'II' contains 1 unit/kg. of vitamin A and 2 units/kg of vitamin C. It costs Rs. 50 per kg. to purchase Food 'I' and Rs. 70 per kg. to purchase Food 'II'. Formulate this problem as a linear programming problem to minimise the cost of such a mixture.

Watch Video Solution

14. 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 ?

Watch Video Solution

Practice Work

1. Solve the following linear programming problems graphically :

Minimise : Z = 3x + 2y subject to the constraints

$x + y \leq 8, 3x + 5y \geq 15, x \geq 0, y \geq 0$

Watch Video Solution

2. Solve the following linear programming problems graphically :

Minimise : Z = 20x + 10y subject to the constraints $x + 2y \leq 40, 3x + y \geq 30, 4x + 3y \geq 60, x, y \geq 0.$

Watch Video Solution

3. Solve the following linear programming problems graphically :

Maximise : Z = 10x + 6y subject to constraints $3x + y \leq 12, 2x + 5y \leq 34, x, y \geq 0$

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4. Solve the following linear programming problems graphically :

Minimise : Z = 18x +10y subject to constraints $4x + y \geq 20, 2x + 3y \geq 30, x, y \geq 0.$

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5. Solve the following linear programming problems graphically :

Maximise Z = 50x + 15y subject to constraints $5x + y \leq 100, x + y \leq 60, x, y \geq 0.$

Watch Video Solution

6. Solve the following linear programming problems graphically :

Maximise : Z = 5x +7y subject to constraints

$x + y \leq 4, 3x + 8y \leq 24, 10x + 7y \leq 35, x, y \geq 0.$

Watch Video Solution

7. Solve the following linear programming problems graphically :

Minimise : Z = 3x + 5y subject to constraints

$-2x + y \leq 4, x + y \geq 3, x - 2y \leq 2, x, y \geq 0.$

Watch Video Solution

8. A dealer wants to purchase 5 litres oil tin and 1 kg ghee tin. He has only Rs. 5760 to invest and has a space for atmost 20 tins. 5 l oil tin costs him Rs. 360 and 1 kg ghee tin costs him Rs. 240. He can sell oil tin at a profit of Rs. 22 and ghee tin at a profit of Rs. 18. Assuming that he can sell all the items that he buys, how should he invest his money for maximum profit ?

Watch Video Solution

9. 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 ?

Watch Video Solution

10. A housewife wishes to mix together two kinds of food X and Y 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 food is given below.

Item	Vitamin A (unit)	Vitamin B (unit)	Vitamin C (unit)
Food x	1	2	3
Food y	2	2	1

One kg of food x costs Rs. 60 and one kg of food y costs Rs.

100. Find the least cost of the mixture which will product the diet.

Watch Video Solution

11. One kind of cake requires 300 gr of flour and 15 gr of fat and another kind of cake requires 150 gr. of flour and 30 gr of fat. Find the maximum number of cakes which can be made from 7.5 kg of flour and 600 gr. of fat assuming that there is no shortage of the other ingredients used in making the cake.

Watch Video Solution

12. A factory owner purchase two types of machines A and B for his factory. The requirements and limitations for the machines are as follows.

Type of Machines	Area occupied by the machines	Labour force for each machine	Daily out-put in units
A	1000 m^2	12 persons	60
B	1200 m^2	8 persons	40

He has an area of 9000 m^2 available and 72 skilled persons who can operate the machines. How many machines of each types should he buy to maximise the daily output ?

Watch Video Solution

13. 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 him Rs. 360 and a sewing machine Rs. 240. His expectation is that he can sell a fan at pofit 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 ?

Watch Video Solution

14. Two tailors, A and B earn Rs. 15 and Rs. 20 per day respectively. 'A' can stitch 6 shirts and 4 pants while B can stitch to 10 shirts and 4 pants per day. How many days shall each work if it is desired to produces (at least) 60 shirts and 32 pants at a minimum labour cost ?

Watch Video Solution

15. A publisher sells a hard cover edition of a text book for Rs. 72 and a paperback edition of the same text for Rs. 40. Costs to the publisher are Rs. 56 and Rs. 28 per book respectively in addition to weekly costs of Rs. 9600. Both types require 5 minutes of priniting time, although hard cover requires 10 minutes binding time and the paper back requires only 2 minutes. Both the printing and binding operations have 4800 minutes available each week. How many of each types of book should be produced in order to maximise profit ?

View Text Solution

16. Every gram of wheat provides 0.1 gm of proteins and 0.25 gm of carbohydrates. The corresponding values of rice are 0.05 gm and 0.5 gm respectively. Wheat costs Rs. 4 per kg and rice Rs. 6. The minimum daily requirements of proteins and carbohydrates for an average child are 50 gm and 200 gms respectively. In what quantities should wheat and rice be mixed in the daily diet to provide minimum daily requirements of proteins and carbohydrates at minimum cost ?

Watch Video Solution

17. A manufacturer maks two types A and B of tea cups. Three machines are needed for the manufacture and the time in minutes required for each cup on the machines is

given below.

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

Each machine is available for a maximum of 6 hours per day. If the profit on each cup A is 75 paise and that on each cup B is 50 paise. How many both type of tea cups should be manufactured in a day to get the maximum profit ?

Watch Video Solution

18. A medical company has factories at two places, A and B from these places, supply is made to each of its three agencies situated at P, Q and R. The monthly requirements of the agencies are respectively 40, 40 and 50 packets of the medicines, while the production capacity of the

factories, A and B are 60 and 70 packets respectively. The transportation cost per packet from the factories to the agencies are given below.

From / To	Transportation cost per packet in (	
	A	B
P	5	4
Q	4	2
R	3	5

How many packets from each factory be transported to each agency so that the cost of transportation is minimum ? Also find the minimum cost ?

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19. Kellogg is a new cereal formed of a mixture of bran and rice that contains at least 88 grams of protein and at least 36 milligrams of iron. Knowing that bran contains 80 grams

of protein and 40 milligrams of iron per kilogram and that rice contains 100 grams of protein and 30 milligrams of iron per kilogram, find the minimum cost of producing this new cereal if bran costs Rs. 5 per kg and rice costs Rs. 4 per kg.

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20. The brick manufacturer has two depot A and B with stocks of 30,000 and 20,000 bricks respectively. He receives order from three builders P, Q and R for 15,000, 20,000 and 15,000 respectively. The cost in Rs. Transporting 1000 bricks to the builders from the depots are given below.

From / To	P	Q	R
A	₹ 80	₹ 40	₹ 60
B	₹ 40	₹ 120	₹ 80

How should the manufacturer fulfil the orders so as to keep the cost of transportation minimum ?

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21. A small firm manufacturers Golden chains and rings. The total number of chains and rings that it can manufacture in a day is at the most 24. The ring takes 30 minutes. The maximum time available per day is 16 hours. If the profit on the ring be Rs. 300 and one chain be Rs. 190. How many of rings and chains be produced to maximize the profit ?

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22. A company manufactures two articles x and y. There are three departments through which these articles are processed. (i) welding (ii) assembly and (iii) colouring. The production of each article X requires 2 hours in welding, 3 hours in assembly and 1 hour in colouring and that of each unit of Y requires 3 hours in welding, 2 hours in assembling and 1 hours in colouring. The maximum capacity of welding department is 1500 hours, assembly department is 1500 hours and colouring department is 550 hours in each month. IF the profit is Rs. 1000 for each unit of x and Rs. 1200 for each unit of y, machines. How many machines of each type should be buy to maximise the daily out put ?

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23. A man owns a field of area 1000 sq.m. He wants to plant fruit trees in it. He has a sum of Rs. 1400 to purchase young trees. He has the choice of two types of trees. Type A requires 10 sq.m. of ground per tree and costs Rs. 20 per tree and type B requires 20 sq.m. of ground per tree and costs Rs. 25 per tree. When fully grown type A produces an average of 20 kg. of fruit which can be sold at a profit of Rs. 2/ - per kg and type B produces an average of 40 kg of fruit which can be sold at a profit of Rs. 1.50/ - per kg. How many of each type should be planted to achieve maximum profit when the trees are fully grown ?

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24. A factory owner purchase two types of machines, A and B, for his factory. The requirements and limitations for the machines are as follows :

	Area occupied by the machine	Labour forces for each machine	Daily Output in units
Machine A	1000 sq.m.	12 men	50
Machine B	1200 sq.m.	8 men	40

He has an area of 7600 sq.m. available and 72 skilled men who can operate the machines. How many machines of each type should be buy to maximise the daily output ?

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25. A company manufactures the bicycle with gears and without gears in two different factories. The factory A

produces 16 bicycles without gears and 20 bicycles with gears in a day. The factory B produces 12 bicycles without gears and 20 bicycles with gears in a day. The expenditure of factory A is Rs. 50,000 daily and the expenditure of factory B is Rs. 40,000 daily. A company has ordered for 96 bicycles without gears and 140 bicycles with gears. To complete these order, how many days the factories will work so that there is minimum expenditure ?

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