MATHS

BOOKS - ARIHANT PUBLICATION

LINEAR PROGRAMMING

Sample Question

1. Solve the inequality $y + 8 \geq 2x$ by graphical method.

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2. A company manufactures two types of sweaters type A and type B. It costs ₹ 360 to make a type A sweater and ₹ 120 to make a type B sweater. The company can make atmost 300 sweaters and spend atmost 72000 a day. The number of sweaters of type B cannot exceed the number of sweaters of type A by more than 100. The company makes a profit of ₹ 200 for each sweater of type A and ₹ 120 for every sweater of type B. Formulate this problem as a LPP to maximise the profit to the company.

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3. Reshma wishes to mix two types of food P and Q in such a way that the vitamin contents of the mixture contain

atleast 8 units of vitamin A and 11 units of vitamin B. Food P costs ₹ 60 per kg and food Q costs 80 per kg. Food P contains 3 units per kg of vitamin A and 5 units per kg of vitamin B while food Q contains 4 units per kg of vitamin A and 2 units per kg of vitamin B. Determine the minimum cost of the mixture.

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4. 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 ₹ 400 and each small van is ₹ 200. Not more than ₹ 3000 is to be spent on the job and the number of large vans cannot exceed the number of small vans.

Formulate this problem as a LPP given that the objective is to minimise cost.

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5. Find the feasible region of the following system

$2x + y \geq 6, x - y \leq 3, x \geq 0, y \geq 0$

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6. Solve the following LPP graphically Maximize $z = 5x_1 + 3x_2$

Subject to $3x_1 + 5x_2 \leq 15, 5x_1 + 2x_2 \leq 10, x_1, x_2 \geq 0.$

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7. A small firm manufactures shirts and trousers, Total number of shirts and trousers that it can handle per day is atmost 24. It takes 1 h to make a trouser and half an hour to make a shirt.

The maximum number of hours available per day is 16. If the profit on a shirt is ₹ 100 and that on a trouser is ₹ 300, then how many of each should be produced daily to maximise the profit? (Manufacturing problem)

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8. A dietician wishes to mix two types of foods f_1 and f_2 in such a way that the vitamin contents of the mixture contain atleast "6"units of vitamin A and "8"units of

vitamin B. Foof f_1 contains "2"units/kg of vitamin A and "3"units/kg of vitamin B while foof f_2 contains "3"units/kf of vitamin A and "2"units/kg of vitamin B. Food f_1 costs Rs "50"per kg and food f_2 costs Rs "75"per kg. Formulate the problem as an LPP to minimise the cost of mixture. (Diet Problem)

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9. A library has to accommodate two different types of books on a shelf. The books are 6 cm and 4 cm thick and weight $\frac{11}{2}$kg and 15 kg each respectively. The shelf is 96 cm long and atmost can support a weight of 21 kg. How should the shelf be filled with the books of two types in

order to include the greatest number of books? Make it as an LPP and solve it graphically. (Allocation problem)

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10. There is a factory located at each of the two places P and Q. From these locations, certain commodity is 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 factory at P and Q are respectively 8 and 6 units. The cost of transportation per unit is given below (Transportation problem)

From \ To	Cost (in ₹)		
	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 the transportation cost is minimum? Formulate the above LPP mathematically.

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Qustions For Practice Manufacturing Problems

1. Acompany is making two products A and B. The cost of producing one unit of product A and B are ₹ 60 and ₹ 80 respectively. As per the agreement, the company has to supply atleast 200 units of product B to its regular

customers. One unit of product Arequires one machine hour whereas product B has machine hours available abundantly within the company. Total machine hours available for product A are 400 h. One unit of each product A and B requires one labour hour each and total of 500 labour hours are available. The company wants to minimize the cost of production by satisfying the given requirements. Formulate the problem as a LPP.

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2. Arubber company is engaged in producing three types of tyres A, B and C. Each type requires processing in two plants, Plant I and Plant II. The capacities of the two plants, in number of tyres per day, are as follows

Plant	A	B	C
I	50	100	100
II	60	60	200

The monthly demand for tyre A, B and C is 2500, 3000 and 7000 respectively. If plant I costs ₹ 2500 per day, and plant II consts ₹ 3500 per day to operate, how many days should each be run per month to minimize cost while meeting the demand? Formulate the problem as LPP.

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Qustions For Practice Diet Problems

1. One kind of cake requires 200 g of flour and 25 g of fat and another kind of cake requires 100 g of flour and 50 g

of fat. 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 the other ingredients used in making the cakes, formulate the problem as LPP.

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2. 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 cholesterol 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 cholesterol. How many

packets of each .food should be used to maximize the amount of vitamin A in the diet? Formulate the Problem as LPP.

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Qustions For Practice Transportation Problems

1. A brick manufacturer has two depots, P and Q with stocks of 30000 and 20000 bricks respectively. He receives orders form three buildings A,B,C for 15000, 20000 and 15000 bricks respectively. The cost of transporting 1000 bricks to the buildings from the depots are given below

From \ To	Cost of transportation (in ₹ per 1000 bricks)		
	A	B	C
P	40	20	20
Q	20	60	40

The manufacturer wishes to find how to fulfil the order so that transportation cost is minimum. Formulate the problem as LPP.

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Qustions For Practice Allocation Problem

1. A dealer in rural area wishes to purchase a number of sewing machines. He has only ₹ 5760 to invest and has space for atmost 20 items for storage. An electronic

sewing machine cost him ₹ 360 and a manually operated sewing machine ₹ 240. He can sell an electronic sewing machine at a profit of ₹ 22 and a manually operated sewing machine at a profit of ₹ 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? Make it as an LPP.

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Qustions For Practice Very Short Answer Type Questions 1 Mark

1. Write the solution of the following LPP

Maximise $Z = x + y$

Subject to $3x + 4y \leq 12, x \geq 0, y \geq 0$

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2. Write the maximum value of x + y subject to

$2x + 3y \leq 6, x \geq 0, y \geq 0.$

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3. Shade the feasible region for the inequations

$2x + 3y \leq 6, x \geq 0, y \geq 0$ in a rough figure.

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4. Write the solution of the following LPP

Maximise $Z = 2x + 3y$

Subject to $x, y \geq 0, x + y \leq 1$.

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5. Show that feasible region for the following constarints in a graph $2x + y \leq 4, x \geq 0 y \geq 0$.

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6. Define the term solution.

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7. Shade the feasible region for the inequations

3x +2y 56, x $\geq$ 0, y $\geq$ 0.

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8. Mention the quadrant in which the solution of an LPP with two decision variables lies when the graphical method is adopted.

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9. Let an LPP be as follows: Maximize $Z = 3x_1 + 5x_2$ subject to $x_1 + 2x_2 \leq 12, 2x_1 + 5x_2 \leq 20$ and $x_1, x_2 \geq 0$

. Test whether the points (2,3) and (-3,4) are feasible solutions or not.

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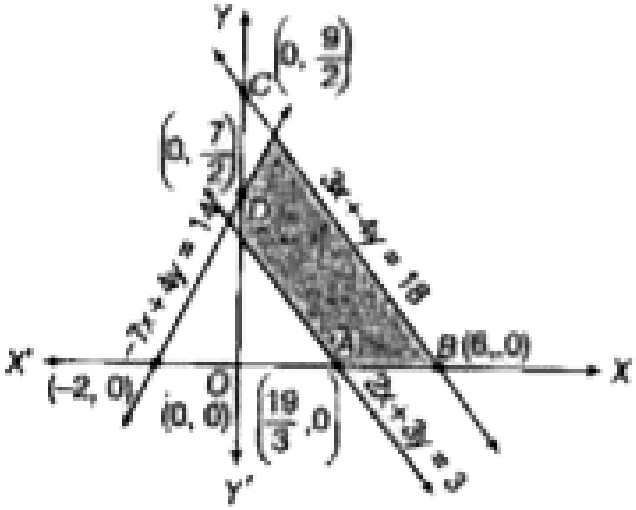
10. Find the linear constraints of the following:



For which the shaded area in the figure given above is the solution set.

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Qustions For Practice Short Answer Type Questions 4 Marks

1. Find the feasible region of the system

$2y - x \leq 0, 6y - 3x \leq 21, x \geq 0, y \geq 0$

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2. Solve the following LPP graphically

Maximize, $Z = 20x + 30y$

Subject to $3x + 5y \leq 15$

$x, y \geq 0.$

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3. Sole the following LPP graphically

Maximise $Z = 6x_1 + 7x_2$

Subject to $x_1 + 2x_2 \geq 2, x_1, x_2 \geq 0.$

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4. Find the feasible region the the following system of equations $2y - x \geq 0, 6y - 3x \leq 21, x \geq 0, y \geq 0.$

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5. Maximise Z =2x+3y,

subject to constraints

x+2y $\leq$ 10,2x + y $\leq$ 14, x $\geq$ 0, y $\geq$ 20

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6. Minimise Z=x + y,

subject to constraints

3x +2y $\geq$ 12 x+3y $\geq$ 11 x $\geq$ 0, y $\geq$ 0

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7. Show that the minimum of Z occurs at more than two points. Minimise and maximise 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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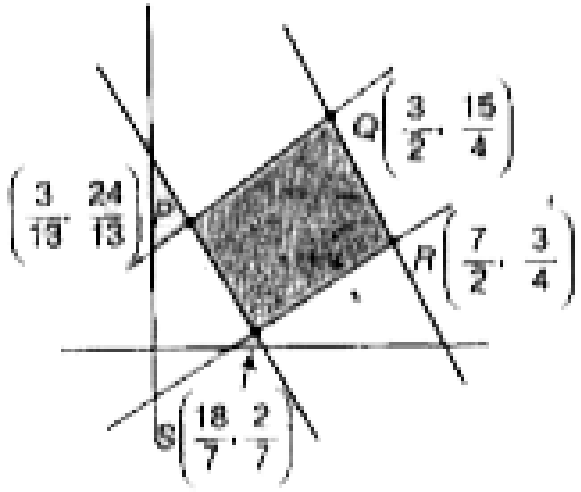
8. In the following figure, the feasible region for a LPP is shown.

Determine the maximum and minimum value of

$Z = x + 2y.$



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9. 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 $p, q > 0$.

Find the condition in p and q, so that the minimum of Z occurs at (3,0) and (1,1).

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Qustions For Practice Long Answer Type Questions 6 Marks

1. Solve the following LPP graphically.

Maximize $Z = 4x_1 + 3x_2$

Subject to $x_1 + x_2 \leq 50$

$x_1 2x_2 \leq 80$, $2x_1 + x_2 \geq 20$ and $x_1, x_2 \geq 0$

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2. Solve the following LPP

Maximise $Z = 20x + 10y$

Subject to $x + 2y \leq 40$,

$3x + y \geq 30$,

$4x + 3y \geq 60$,

$x, y \geq 0$.

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3. Solve the following LPP graphically.

Minimise $Z = 20x_1 + 40x_2$

Subject to $36x_1 + 6x_2 \geq 1083x_1 + 12x_2 \geq 36$

$2x_1 + x_2 \geq 10, x_1, x_2 \geq 0$

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4. Solve the following LPP graphically

Maximise $Z = 20x_1 + 10x_2$

Subject to $x_1 + 2x_2 \leq 40$

$3x_1 + x_2 \geq 30, 4x_1 + 3x_2 \geq 60, x_1 \geq 0, x_2 \geq 0$

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5. Solve the following LPP graphically Maximize

$z = 5x_1 + 3x_2$

Subject to $3x_1 + 5x_2 \leq 15, 5x_1 + 2x_2 \leq 10, x_1, x_2 \geq 0.$

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6. Solve the following LPP graphically.

Maximise Z = 2x + 3y

Subject to x+y $\leq$ 400

$2x + y \leq 600$

$x, y \geq 0$

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7. Solve the following LPP graphically :

Maximize $Z = 3x_1 + 2x_2$

subject to

$-2x_1 + x_2 \leq 1$

$x_1 \leq 2$

$x_1 + x_2 \leq 3$

$x_1, x_2 \geq 0$

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8. Maximise $Z = 5x + 11y$

Subject to $x + 4y \leq 30, 5x + 2y \geq 60$and $x \geq 0, y \geq 0.$

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9. Maximise $Z = -10x + 2y$

Subject to $-x + y \geq -1, x + y \leq 6, y \leq 5$and $x, y \geq 0$

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10. A manufacturing company makes two types of teaching aids A and B of Mathematics for Class XII. Each type of Arequires 9 labour hours of fabricating and 1 labour hour for finishing. Each type of B requires 12 labour hours for fabricating and 3 labour hours for finishing. For fabricating and finishing, the maximum labour hours available per week are 180 and 30, respectively. The company makes a profit of ₹ 80 on each piece of type A and 120 on each piece of type B. How many pieces of type A and type B should be manufactured per week to get a m

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11. A company manufactures three kinds of calculators: A, B and C in its two factories I and II. The company has got an order for manufacturing atleast 6400 calculators of kind A, 4000 of kind B and 4800 of kind C. The daily output of factory I is of 50 calculators of kind A 50 calculators of kind B and 30 calculators of kind C. The daily output of factory II is 40 calculators of kind 4, 20 of kind B and 40 of kind C. The cost per day to run factory I is ₹ 12000 and of factory II is ₹ 15000. How many days.do the two factories have to be in operation to produce the order with the minimum cost? Formulate this problem as an LPP and solve it graphically.

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12. Amanufacturer makes two types of toys A and B. Three machines are needed for this purpose and the time (in min) required for each toy on the machines is given below

Types	Machines		
	I	II	III
A	12	18	6
B	6	0	9

Each machine is available for a maximum of 6 h per day. If the profit on each toy of type Ais *7.50 and that the each toy of type B is 5, then show 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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13. 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% of phosphoric acid. After testing the soil conditions, a farmer finds that she needs atleast 14 kg of nitrogen and 14 kg of phosphoric acid for her crop. IfF_1 costs ₹ 6 per kg and F_2 costs ₹ 5 per 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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14. A housewife wishes to mix together two kinds of foods 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 1 kg of food is given below

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

1 kg of food X cost ₹ 6 and 1 kg of food Y cost ₹ 10. Then, find the least cost of the mixture which will produce the diet.

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15. A cooperative society of farmers has 50 hec of land to grow two crops A and B. The profits from crops A and B per hectare are estimated as ₹ 10500 and ₹ 9000, respectively. To control weeds, a liquid herbicide has to be

used for crops A and B at the rate of 20 L/hec and 10 L/hec, respectively. Further not more than 800 *L, herbicide should be used in order to protect fish and Wildlife 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 should be allocated to each crop so as to maximise the total profit? Formulate the above as an LPP and solve it graphically.

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16. A dealer wishes to purchase a number of fans and radios. He has only ₹ 5760 to invest and has a space for atmost 20 items. A fan costs him ₹ 360 and a radio ₹ 240. His expectation is that he can sell a fan at a profit of ₹ 22

and a radio at a profit of ₹ 18. Assuming that he can sell all the items that he buys, how should he invest his money for maximum profit? Translate the problem as an LPP and solve it graphically.

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17. Two godowns A and B have a grain storage capacity of 100 quintals and 50 quintals, respectively. They supply it to 3 ration shops D, E and F, whose requirements are 60,50 and 40 quintals, respectively. The cost of transportation per quintal from godowns to the shops are given in the following table

From \ To	Transportation cost per quintal (in ₹)	
	A	B
D	6.00	4.00
E	3.00	2.00
F	2.50	3.00

How should the supplies be transported in order that the transportation cost is minimum?

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18. An oil company requires 13000, 20000 and 15000 barrels of high grade, medium grade and low grade oil, respectively:Refinery A produces 100, 300 and arithmetic mean of 100 and 300 barrels per day and refinery B produces 200, 400 and 100 barrels per day of high, medium and low grade oil, respectively. If refinery A costs ₹ 400 per day and refinery B costs ₹ 300 per day to operate,

then how many days should each be run to minimise cost while satisfying requirements?

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19. If a young man rides his motorcycle at 25 km/h, he had to spend of ₹ 2 per km on petrol with very little pollution in the air. If he rides it at a faster speed of 40 km/h, the petrol cost increases to ₹ 5 per km and rate of pollution also increases. He has ₹ 100 to spend on petrol and wishes to find what is the maximum distance he can travel within one hour? Express this problem as an LPP and solve it graphically to find the distance to be covered with different speeds.

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Odisha Bureau S Textbook Solutions Exercise 3 A

1. A merchant sells two models X and Y of TV with cost price ₹ 25000 and ₹ 50000 Per set respectively. He gets a profit of ₹ 1500 on model X and ₹ 2000 on model Y . The sales connot exceed 20 sets in a month. If he cannot invest more than 6 lakh rupees, formulate the problem of determining the number of sets of each type he must keep in stock for maximum profit.

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2. A company manufactures and sells two models of lamps L_1 and L_2, the profit being ₹ 15 and ₹ 10 respectively. The process involves two workers W_1 and W_2 who are available for this kind of work 100 hours and 80 hours per month respectively, W_1 assembles,L_1 in 20 and L_2 in 30 minutes.W_2 [aomts L_1 in 20 and L-2 in 10 minutes. Assuming that all lamps made can be sold, formulate the LPP for determining the productions figures for maximum proft.

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3. A factory uses three different respurce for the manufacture of two different products, 20 units of the

resource A, 12 units of B and 16 unit of C being available. One unit of the first product requires 2,2 and 4 units of the resources and one unit of the second product requires 4,2 and 0 units of the resources taken in order. It is known that the first product gives a profit of ₹20 per unit and the second ₹ 30 prt uniy. Formulate the LPP so as to earn maximum profit.

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4. A man plans to start a poultry farm by investing at most ₹ 3000. He can buy old hens for ₹80 each and young ones for ₹ 140 each, but he cannot house more than 30 hens. Old hens lay 4 eggs per week ,each ell bing sold at ₹5. It costs ₹ 5 to feed an old hen and ₹8 to feed a young hen

per week. Formulate his problem determining the number of hens of each type he should buy so as to earn a proft of more than ₹ 300 per week.

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5. An agro-based company produces tomato souce and tomato jelly. The quantity of material, machine hour, labour (man hour) required to to produce one unit of each product and the avilability of raw material one given is the following table.

	souce	Jelly	availability
Man hour	3	2	10
Machinehour	1	2.5	7.5
Raw material	1	1.2	4.2

Assume that one unit of source and of unit of Jelly, yield a profit of

Rs 2 and Rs 4 respectively. Formulate the L.P.P so as to yield maximum profit.

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6. (Allocation Problem.)A farmer has 5 acres of land on which he wishes to grow two crops X and Y. He has to use 4 cart loads and 2cart loads of manure per acre for crops X and Y respectively. But not more than 18 cart loads of manure is available. Other expenses are ₹200 and ₹500 per acre for the crops X and Y respectively . He estimates profit from crops X and Y at the rates ₹1000 and ₹800 per acre respectively. Formulate the LPP as to how much land he should allocate to each crop for maximum profit.

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7. (Transportation Problem) A company has two factories at locations X and Y. He has to deliver the products from these factories to depots located at three places A, B and C. The production capacities at X and Y are respectiveiy, 12 and 10 units and the requirements at the depots are 8, 8 and 6 units, respectively. The cost of transportation from the factories to the depots per unit of the product is given below

To / From	Cost in ₹		
	A	B	C
X	210-	160	250
Y	170	180	140

The company has to determine how many units of product should be transported from each factory to each depot so

that the cost of transportation is minimum. Formulate this LPP.

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8. (Diet Problem) Two types of food X and Y are mixed to prepare a mixture in such a way that thrture contains atleast 10 units of vitamin A, 12 units of vitamin B and 8 units of vitamin C. These vitamins are available in one kg of food as per the table given below

Vitamins / Food	A	B	C
X	1	2	3
Y	2	2	1

One kg of food X cost ₹ 16 and one kg of food Y costs ₹ 20. Formulate the LPP so as to determine the least cost of the mixture containing the required amount of vitamins.

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9. Special purpose coins each weighing 10gms are to be manufactured using two basic metals $M_1$and $M_2$and a mix of other metals M_3. M_1, M_2andM_3 cost₹500,₹800 and ₹800 and ₹50 per gram respectively. The strength of a coin demands that not more than 7 gm. ofM_1 and a minimum of 3 gm of M_2should be used. The amount of M_3 in each coin is maintained at $25\,\%$ of that of M_1.Since the demand for that coin is related to its price,formulate the LPP to find the minimum cost of a coin.

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10. A company produces three types of cloth A,B and C. Three kinds of wool, say red, green and blue are required for the cloth needs 2 metres of red and 3 etres of blue wool, one unit length of type B cloth needs 3 metres of red, 2 metres of green and 2 metres of blue wool and one unit length of type C cloth needs 5 metres of green and 4 metres of blue wool. The firm has a stock of only 80 metres of red, 100 metres of green and 150 metres of blue wool. Assuming that income obtained from one unit length of cloth is ₹30, ₹50 and ₹ 40 of types . A, B and C respectively, formulate the LPP so as to maximize income.

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11. A person wants to decide the constituents of diet which will fulfil his daily requirements of proteins, fact and carbohydrates at minimum cost. The choice is to be made from three different types of food. The yields per unit of these foods are given in the following table

Food	Yield/unit			Cost/unit
	Protein	Fat	Carbohydrate	
f_1	3	2	6	45
f_2	4	2	3	40
f_3	8	7	7	85
Minimum requirement	1000	200	800	

Formulate the LPP.

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Odisha Bureau S Textbook Solutions Exercise 3 B

1. Solve the following LPPs graphically.

maximise $Z = 5x_1 + 6x_2$

Subject to $2x_1 + 3x_2 \leq 6$

$x_1, x_2 \geq 0$

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2. Sole the following LPP graphically

Maximise $Z = 6x_1 + 7x_2$

Subject to $x_1 + 2x_2 \geq 2, x_1, x_2 \geq 0.$

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3. Maximize : $Z = 20x_1 + 40x_2$

Subject to: $x_1 + x_2 \leq 1$

$x_1, x_2 \geq 0.$

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4. Solve the following LPP graphically. Minimize $z = 30x_1 + 45x_2$ subject to $2x_1 + 6x_2 \geq 4$, $5x_1 + 2x_2 \geq 5$ and $x_1, x_2 \geq 0$

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5. Solve the following LPP graphically :

Maximize $Z = 3x_1 + 2x_2$

subject to

$-2x_1 + x_2 \leq 1$

$x_1 \leq 2$

$x_1 + x_2 \leq 3$

$x_1, x_2 \geq 0$

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6. Solve the following LPPs graphically.

maximise $Z = 50x_1 + 60x_2$

Subject to $-2x_1 + x_2 \leq 5$

$x_1 + 2x_2 \geq 4$

$x_1, x_2 \geq 0$

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7. Solve the following LPPs graphically.

$Z = 5x_1 + 7x_2$

$x_1 + x_2 \leq 4$

$5x_1 + 8x_2 \leq 30$

$10x_1 + 7x_2 \leq 35$

$x_1, x_2 \geq 0$

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8. Solve the following LPPs graphically.

maximise $Z = 14x_1 - 4x_2$

Subject to $x_1 + 12x_2 \leq 65$

$7x_1 - 2x_2 \leq 25$

$2x_1 + 3x_2 \geq 10, x_1, x_2 \geq 0$

Also find the two other points which maximise Z.

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9. Solve the following LPPs graphically.

maximise $Z = 10x_1 + 12x_2 + 8x_3$

Subject to $x_1 + 2x_2 \leq 30$

$5x_1 - 7x_3 \geq 12$

$x_1 + x_2 + x_3 = 20, x_1 . x_2 \geq 0$

[Hint Eliminate Xz from all expressions using the given equation in the set of constraints, so that it becomes an LPP in two variables]

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10. Minimize: $Z = 20x_1 + 10x_2$

Subject to: $x_1 + 2x_2 \leq 40$

$3x_1 - x_2 \geq 30$

$4x_1 + 3x_2 \geq \ = 60$

$x_1, x_2 \geq 0$

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11. Maximize $Z = 4x_1 + 3x_2$

Subject to: $x_1 + x_2 \leq 50$

$x_1 + 2x_2 \leq 80$

$2x_1 + x_2 \geq 20, x_1, x_2 \geq 0$

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12. Solve the following LPP graphically Optimize $Z = 5x_1 + 25x_2$ subject to $-0.5x_1 + x_2 \leq 2, x_1 + x_2 \geq 2, -x_1 + 5x_2 \geq 5, x_1, x_2 \geq 0$

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13. Solve the following LPP graphically Optimize $Z = 5x_1 + 25x_2$ subject to $-0.5x_1 + x_2 \leq 2, x_1 + x_2 \geq 2, -x_1 + 5x_2 \geq 5, x_1, x_2 \geq 0$

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14. Solve the following LPPs graphically.

Optimize $Z = -10x_1 + 2x_2$

Subject to $-x_1 + x_2 \geq -1$

$x_1 + x_2 \leq 6$

$x_2 \leq 5, x_1, x_2 \geq 0$

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15. Solve the LPPs obtained in Exercise 3(a) Q1 to Q8 by graphical method.

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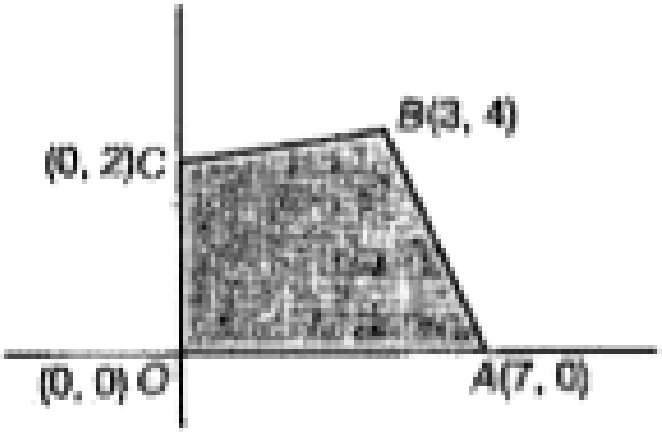
Chapter Practice Short Answer Type Questions 4 Marks

1. Feasible region (shaded) for an LPP is shown in the following figure, Maximise Z = 5x + 7y



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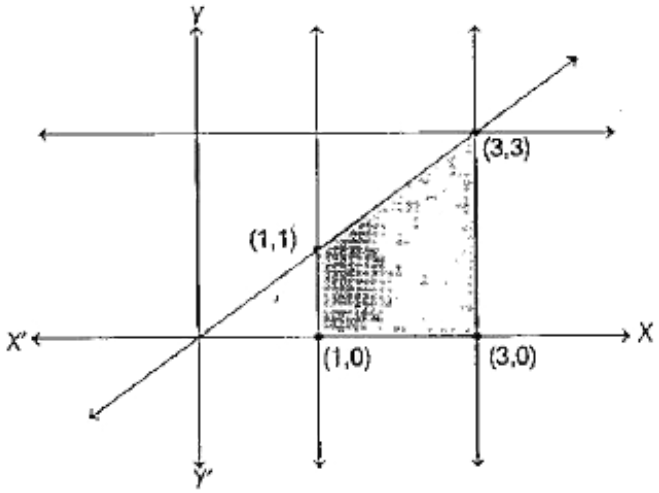
2. Find the minimum value of $Z = 2x + y$ in the following region.



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3. Minimise Z=X-7y + 190, subject to constraints are $x + y \leq 8, x \leq 5, x + y \geq 4$ and $x, y \geq 0$

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4. Maximise Z=x + y, subject to constraints are

$x - y \leq -1, -x + y \leq 0$ and $x, y \geq 0$

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5. Maximise Z = 3x+4y, subject to constraints are

$x + y \leq 1, x \geq 0$ and $x, y \geq 0$

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6. Maximise Z=10x + 6y, subject to constraints are

$3x + y \leq 12, 2x + 5y \leq 34$ and $x, y \geq 0$

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7. Minimise Z =2x + 4y, subject to constraints are $x + y \geq 8, x + 4y \geq 12, x \geq 3, y \geq 2$ and $x, y \geq 0$

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8. Maximise $Z = 3x_1 + 4x_2$, if possible, subject to constraints are $x_1 - x_2 \leq -1, -x_1 + x_2 \leq 0$ and $x_1, x_2 \geq 0$

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9. Maximise and minimise Z=3x-4y, subject to -constraints are $x - 2y \leq 0, -3x + y \leq 4, x - y \leq 6$ and $x, y \geq 0.$

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10. Aman rides his motorcycle at the speed of 50 km/h. He has to spend ₹ 2 per km on petrol. If he rides it at a faster speed of 80 km/h, the petrol cost increases to ₹ 3 per km. He has atmost ₹ 120 to spend on petrol and one hour time. He wishes to find the maximum distance that he can travel. Express this problem as à linear programming problem.

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11. Two tailors A and B earn ₹ 150 and ₹ 200 per day, respectively. Acan stitch 6 shirts and 4 pants while B can stitch 10 shirts and 4. pants per day. Form a linear

programming problem to minimise the labour cost to produce atleast 60 shirts and 32 pants.

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Chapter Practice Long Answer Type Questions 6 Marks

1. Find the maximum and minimum value of 2x + y subjects to the constraints are

$x + 3y \geq 6, x - 3y \leq 3, 3x + 4y \leq 24$

$-3x + 2y \leq 6, 5x + y \geq 5$ and $x, y \geq 0$

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2. Anil wants to invests atmost ₹ 12000 in bonds A and B. According to the rules, he has to invests atleast ₹ 2000 in bond A and atleast ₹ 4000 in bond B. If the rate of interest on bond Ais 8% per annum and on bond B is 10% per annum, then how should he invests his money for maximum interest? Solve the problem graphically.

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3. A firm deals with two kinds of fruit juice. These are mixed and two mixtures are sold as soft drink Aand B. 1 tin of Arequires 4 of pineapple and 1 of orange juice. 1 tin of B requires-2 of pineapple and 3 of orange juice.

The firm has only 46 of pineapple juice and 24 of orange

juice. Each tin of A and B are sold at a profit of ₹ 4 and ₹ 3, respectively. How many tins of each type should the firm produce to maximise the profit? Solve the problem graphically.

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4. A diet for a sick person must contain at least 4000 units of vitamins, 50 units of minerals and 1400 units of calories. Two foods A and B, are available at a cost of Rs.4 and Rs. 3 per unit respectively. If one unit of A contains 200, units of vitamin, 1 unit of mineral and 40 calories and one units of B contains 100 units of vitamins, 2 units of minerals and 40 calories. Formulate the LPP to minimize the cost of foods.

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5. One kind of cake requires 200 g 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 it.graphically.

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6. 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 cholesterol and 3 units of vitamin A. The diet requires atleast 240 units of calcium, atleast 460 units of iron and atmost 300 units of cholesterol. 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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7. Acarpenter has 20 and 15 sqm of plywood and sunmica, respectively. He produces products A and B. Product Arequires 2 and 1 sq m and product Brequires 1 and 3 sq m of plywood and sunmica, respectively. If the profit on one

piece of product A is ₹ 30 and on one piece of product B is ₹ 20, then how many pieces of products A and B should he make to maximise his profit?

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8. A company manufactures two types of screws Å and B. All the screws have to pass through a threading machine and a slotting machine. Abox of type A screw require 2 min on the threading machine and 3 min on the slotting machine. A box of type B screws requires 8 min on the threading machine and 2 min on the slotting machine. In a week, each machine is available for both.

On selling these screws, the company gets a profits of ₹ 100 per box on type A screws and ₹ 170 per box on type B

screws. Formulate this problemi as an LPP given that the objective is to miamise profit. Solve the linear programming problem and determine the maximum profit to the manufacturer.

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9. Amanufacturer of patient medicines is preparing plan on medicines A and B. There are sufficient raw materials available to make 20000 bottles of A and 40000 bottles of B, but there are only 45000 bottles into which either of the medicines can be put. Further, it takes 3 h to prepare enough material to fill 1000 bottles of A, it takes 1 h to prepare enough material to fill 1000 bottles of B and there are 66 h available for this operation. The profit is ₹ 8 per

bottle for A and ₹ 7 per bottle for B. How should the manufacturer schedule his production in order to maximise his profit?

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10. An aeroplane can carry a maximum of 200 passengers. A profit of ₹ 400 is made on each first class ticket and a profit of ₹ 300 is made on each economy class ticket. The airline reserves atleast 20 seats for first class. However, atleast 4 times as many passengers prefer to travel by economy class to the first class. Determine, how many each type of tickets must be sold in order to maximise the profit for the airline. What is the maximum profit?

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11. A manufacturer produces nuts and bolts. It takes 1 h of work on machine A and 3 h on machine B to produce package of nuts. It takes 3 h on machine A and I h on machine B to produce a package of bolts. He 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 maximise his profits, if he operates his machines for atmost 12 h a day. Formulate above as an linear programming problem and solve it graphically.

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12. A dietician wishes to mix together two kinds of foods 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 1 kg food is given below

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

1 kg of food X costs of ₹ 16 and 1 kg of food Y costs ₹ 20. Find the least cost of the mixture, . which will produce the required diet?

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13. A dietician wishes to mix two types of foods in such a way that the vitamin contents of mixture contains atleast 8 units of vitamin A and 10 units of vitamin C. Food I contains 2 units per kg of vitamin A and 1 unit per kg of vitamin C while food II contains 1 unit per kg of vitamin A and 2 units per kg of vitamin C. It costs ₹ 5 per kg to purchase food I and ₹ 7 per kg to purchase food II. Find the minimum cost of such a mixture. Formulate above as an LPP and solve it graphically.

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14. Amerchant 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 lakh and his profit on the desktop model is 4500 and on the portable model is ₹ 5000. Make an LPP and solve it graphically.

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15. A farmer mixes two brands P and Q of cattle feed. Brand P, costing ₹ 250 per bag, contains 3 units of nutritional element A, 2.5 units of elements B and 2 units of element C.

Brand Q, costing ₹ 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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16. A company manufactures two types of stickers, A: "SAVE ENVIRONMENT" and B: “BE COURTEOUS". Type Arequires 5 min each for cutting and 10 min each for assembling. Type B requires 8 min each for cutting and 8 min each for

assembling. There are 3 h and 20 min available for cutting and 4 h available for assembling in a day. He earns a profit of 50 on each type A and ₹ 60 on each type B. How many stickers of each type should the company manufacture in a day to maximise profit?

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17. A small firm manufactures gold rings and chains. The total number of rings and chains manufactured per day is atmost 24. It takes 1h to make a ring and 30 min to make a chain. The maximum number of hours available per day is 16. If the profit on a ring is ₹ 300 and that on a chain is ₹ 190, then find the number of rings and chains that should

be manufactured per day, so as to earn the maximum profit, make it as an LPP and solve it graphically.

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

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