MATHS

BOOKS - BODY BOOKS PUBLICATION

LINEAR PROGRAMMING

Example

1. Food X contains 6 units of vitamins A and 7 units of vitamins B per gram and it costs 12 paise per gram.Food Y contains 8 units of

vitamin A and 12 units of vitamins B per gram and it costs 20 paise per gram.Daily minimum requiremrnts of vitamin A and vitamin B are 100 units and 120 units respectively.Formulate the LPP mathematically so that the cost is to be minimized.

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2. Manu has Rs.36000 for purchases of rice and wheat cost Rs.180 and Rs.120 respectively.He has storage capacity for 250

bags only.He earns a profit of Rs.11 and Rs.9 per bag of rice and wheat respectively.(i) Formulate an LPP to maximize the profit.

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3. Manu has Rs.36000 for purchases of rice and wheat cost Rs.180 and Rs.120 respectively.He has storage capacity for 250 bags only.He earns a profit of Rs.11 and Rs.9 per bag of rice and wheat respectively.Slove the LPP.

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4. Draw the graph of 5x+10y=50,x+y=1,y=4,x,y=0.

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5. Solve graphically, the linear programming problem: Minimize Z=2x+y subject to $5x + 10y \leq 50, x + y \geq 1, y \leq 4, x, y \geq 0$

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6. A manufacture make two types of furniture,chairs and tables.Both the products are processed on three machines A_1, A_2 and A_3.Machine A_1 requires 3 hours for a chair and 3 hours for a table,machine A_2 requires 5 hours for a chair and 2 hours for a table and machine A_3 requires 2hours for a chair and 6 hours for a table.Maximum time available on machine A_1, A_2 and A_3 is 36 hours,50 hours and 60 hours respectively.Profits are Rs.20 per chair and Rs.30 per table.Formulate the above as a linear programming problem to maximize the profit.

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7. Solve the following problem graphically :Minimize,Z=3x+3y Subject to constraints: $x + y \geq 8, 3x + 5y \leq 15 x \geq 0, y \geq 0$

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8. The region other than the feasible region is called_____

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9. If the feasible region of a linear programming is bounded,then it is always a _____

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10. Who invented Linear programming problem?

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11. A person deals only two items,Cycles and scooters.He has Rs.1,20,000 to invest and a space to store at most 38 pieces.One scooter costs him Rs.12000 and a cycle costs him Rs.800.He can sell a scooter at a profit of Rs.1500 and a cycle at a profit of Rs.200.Assuming that he can sell all the items he buys,how should he invest his money in order that he may maximum his profit.Formulate the problem mathematically.

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12. The corner points of the feasible region determined by the following system of 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)$q = 3p$

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13. A firm manufactures 3 products A,B and C.The profit are Rs.3,Rs.2 and Rs.4 respectively.The firm has 2 machines and below is the required processing time in minutes for each machine on each product:Machine M_1 and M_2 have 2000 and 2500 machine minutes respectively.The firm must manufacture 100A's,200B's and 50C's but not more than 150A's.Set up a LPP to maximize

the profit.

Machine	Products		
	A	B	C
M_1	4	3	5
M_2	2	2	4

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14. Determine graphically the minimum value of the objective function $Z = -50x + 20y$ subject to the constraints: $2x - y \geq -5$, $3x + y \geq 3, 2x - 3y \leq 12, x \geq 0, y \geq 0$

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15. A company products two aricles X and Y.There are two different departments through which the articles are processed namely assembly and finishing.The potential capacity of the assembly department is 60 hours,a week and that of finishing department is 48 hours a week.Production of one unit of X requires 4 hours of assembly and 2 hours of finishing.Each of the unit Y requires 2 hours in assembly and 4 hours in finishing.If profit is

Rs.8 for each unit of X and Rs.6 for each unit of y,(i) formulate an LPP to maximize the profit

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16. A company produces two types of goods, A and B, that require gold and silver. Each unit of type A requires $3gm$ of silver and $1gm$ of gold while that of type B requires $1gm$ of silver and $2gm$ of gold. The company can use $9gm$ of silver and $8gm$ of gold. If each unit of type A brings a profit of Rs. 40 and that of

type B Rs. 50, find the number of units of each type that the company should produce to maximise the profit. What is the maximum profit.

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17. Solve the following problem graphically.

Minimise and Maximise $Z = 3x + 9y$

subject to the constraints: $x + 3y \leq 60$, $x + y \geq 10, x \leq y, x \geq 0, y \geq 0$

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18. An aeroplane can carry a maximum of 200 passengers. A profit of Rs 1000 made on each executive class ticket and a profit of Rs 600 is made on economy class ticket. The airline reserves atleast 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 sold in order to maximise the profit for the airline. What is the maximum profit?

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19. Choose the correct answer from the bracket.If an LPP is consistent,then its feasible region is always

A. Bounded

B. Unbounded

C. Convex region

D. Concave region

Answer:

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20. Maximise $Z = 2x + 3y$ subject to the constraints x+y<4, x>0, y>0`

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21. A manufacturer makes two types of tea cups, say A and B. Three machines are needed for the manufacturing and the time in minutes required for each cup on the machine is given below:

	Machine		
	I	II	III
A	12	18	6
B	6	0	9

Each machine is available for a maximum of 6 hrs per day. If the profit on each cup A is 75 paise and that on each cup B is 50 paise. Show that 15 tea cups of type A and 30 tea cups of type B should be manufactured in a day to get the maximum profit.

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

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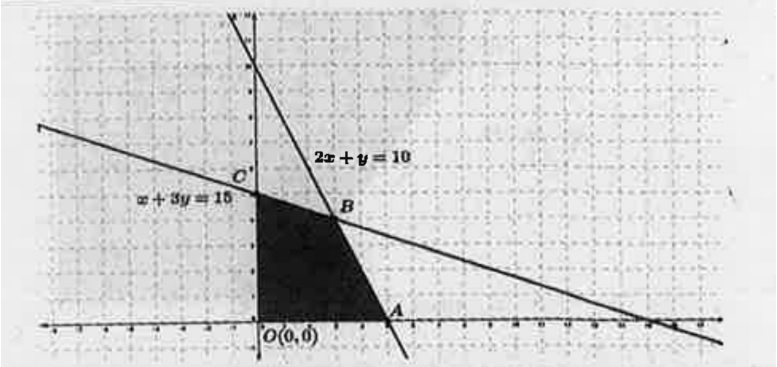
23. The graph of linear programing problem is given below.The shaded region is the feasible region.The objective function is

$Z = px + qy$

What are the co ordinates of the corners of the feasible region.



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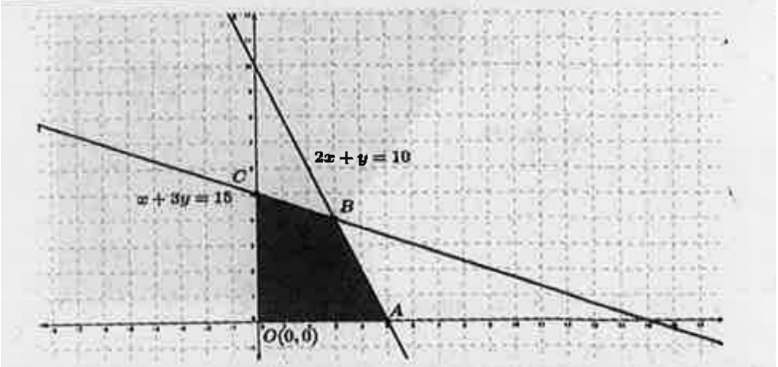
24. The graph of linear programing problem is given below.The shaded region is the feasible region.The objective function is

$Z = px + qy$

Write the constraints.



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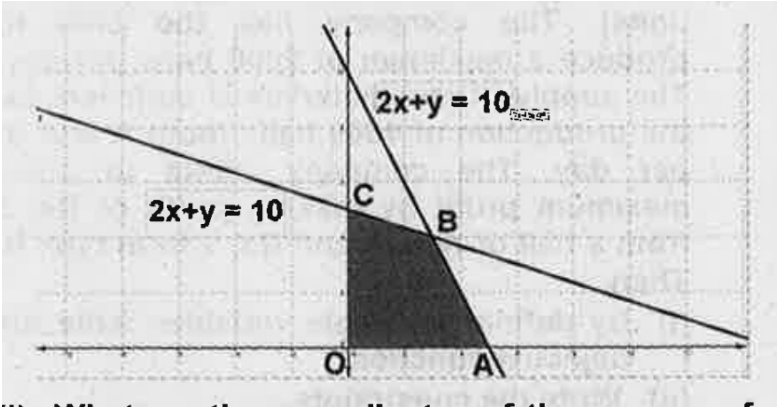
25. The graph of linear programming problem is given below.The shaded region is the feasible region.The objective function is Maximise, $Z = px + qy$

` If the Max,Z occurs at A and B,what is the relation between pand q?



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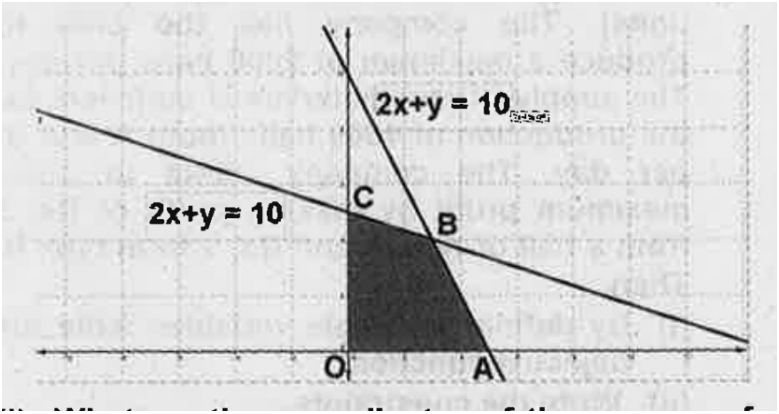
26. The graph of linear programming problem is given below.The shaded region is the feasible region.The objective function is Maximise, $Z = px + qy$

If q=1, write the objective function when maximum of Z occures at A and B.`



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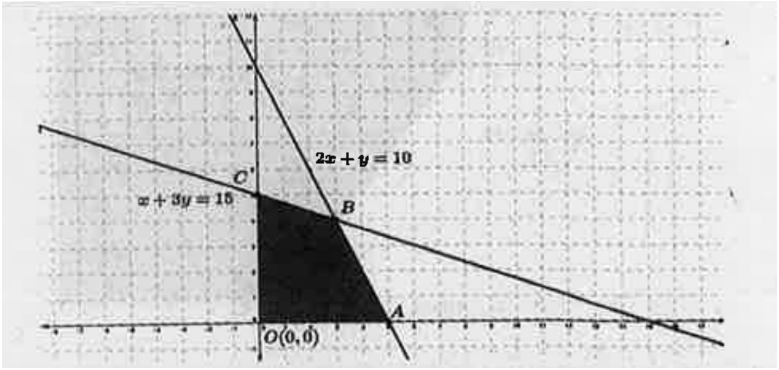
27. The graph of linear programing problem is given below.The shaded region is the feasible region.The objective function is

$Z = 3x + 2y$

Find the Max Z.



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28. A dietician wishes to mix two type of foods in such a way that vitamin contents of the mixture contain at least 8 units of vitamin A and the 10 units of vitamin C. Food I contains 2 $\frac{unit}{kg}$ of vitamin A and 1$\frac{unit}{kg}$ of vitamin C. Food II contains 1 $\frac{unit}{kg}$ of vitamin A and 2 $\frac{unit}{kg}$ of vitamin C. It costs Rs.$\frac{50}{kg}$ to purchase food I and Rs. $\frac{70}{kg}$ to purchase food II. Formulate this problem as a linear programming problem to minimise the cost of such a mixture ?

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29. Reshma wishes to mix two types of food P and Q in such a way that the vitamin contents of the mixture contain atleast of 8 units of the vitamine A and 11 units of vitamine B. Food P costs Rs . $\frac{60}{kg}$ and Food Q costs Rs. $\frac{80}{kg}$. Food P contains $3\frac{units}{kg}$ of vitamine A and $5\frac{units}{kg}$ of vitamine B. While food Q contains $4\frac{unit}{kg}$ of vitamine A and $2\frac{unit}{kg}$ of vitamine B. Determine the minimum cost of the mixture.

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30. Draw the graph of x+3y=3,x+y=2,x,y=0.

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31. Solve the following LPP Graphically,

Minimise, $Z = 3x + 5y$

Subject to constraints,

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

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32. A fruit grower can use two types of fertilizers in his garden , brand P and 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 atleast 240 kg of phosphoric acid , atleast 270 kg of potash and atmost 310 kg of chlorine. If the grower wants to minimise the amount of nitrogen added to the garden, how many bags of each brand should 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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33. Solve the linear programming problem graphically:

Max: $z = 3x + 2y$

Subject to:

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

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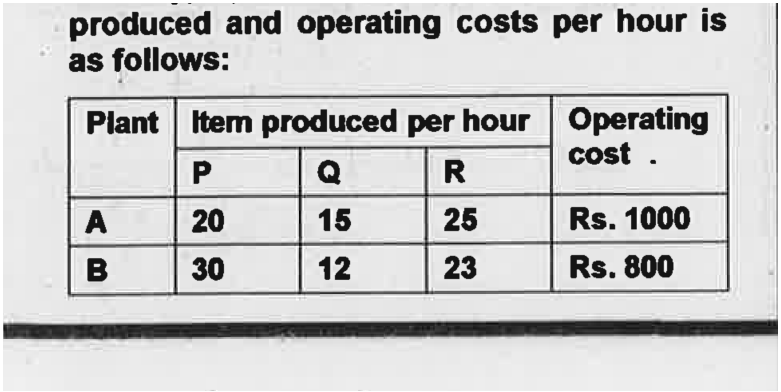
34. A factory produces three items P,Q and R at two plants A and B . The number of items produced and operating costs per hour is as follows:

It is desired to produce at least 500 items of type P , at least 400 items of type Q and 300 items of type R per day.

Write the objective function and constraints.



produced and operating costs per hour is as follows:

Plant	Item produced per hour			Operating cost .
	P	Q	R	
A	20	15	25	Rs. 1000
B	30	12	23	Rs. 800

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35. 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 profit of Rs. 17.50 per package on nuts and Rs. 7.00 per package on bolts. Formulate the above LPP if the machine operates for at most 12 hours a day

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36. Solve the LPP:

Maximize Z=-3x+4y

Subject to

$x + 2y \leq 8,$

$3x + 2y \leq 12,$

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

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37. Consider the linear programming problem:

Maximize Z=50x+40y

Subject to the constraints

$x + 2y \geq 10$

$3x + 4y \leq 24$

$x \geq 0, y \geq 0$

Find the maximum value of Z.

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38. Consider the linear programming problem:

Maximize Z=50x+40y

Subject to the constraints

$x + 2y \geq 10$

$3x + 4y \leq 24$

$x \geq 0, y \geq 0$

Find the corner points of the feasible region.

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39. Consider the linear programming problem:

Maximize Z=50x+40y

Subject to the constraints

$x + 2y \geq 10$

$3x + 4y \leq 24$

$x \geq 0, y \geq 0$

Find the maximum value of Z.

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40. Consider the following L.P.P.Maximize Z=3x+2y subject to the constraints $x + 2y \leq 10$,$3x + y \leq 15$,$x, y \geq 0$.a.Draw its feasible region.

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41. Consider the LPP

Maximise $z = 3x + 2y$

Subject to the constraints

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

Find the corner points of the feasible region.

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42. Consider the LPP

Maximise $z = 3x + 2y$

Subject to the constraints

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

Find the maximum value of Z.

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43. Consider the linear inequalities

$2x + 3y \leq 6,2x + y \leq 4,x, y \geq 0$

Mark the feasible region.

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44. Consider the linear inequalities

$2x + 3y \leq 6,2x + y \leq 4,x, y \geq 0$

Maximise the function $z = 4x + 5y$ subject to

the given constraints.

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45. In factory there are two machines A and B producing toys.They respectively produce 60 and 80 units in one hour.A can run a maximum of 10 hours and B a maximum of 7 hours a day .The cost of their running per hour respectively amount to 2,000 and 2,500 rupee.The total duration of working these machines cannot exceed 12 hours a day.If the total cost cannot exceed Rs. 25,000 per day and the total daily production is atleast 800 units,then formulate the problem mathematically.

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46. Consider the LPP

Maximise, $Z = 5x + 3y$

Subject to, $3x + 5y \leq 15, 5x + 2y \leq 10,$

$x, y \geq 0$

Draw the feasible region.

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47. Consider the LPP

Maximise, $Z = 5x + 3y$

Subject to, $3x + 5y \leq 15, 5x + 2y \leq 10,$

$x, y \geq 0$

Find the corner points of the feasible region.

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48. Consider the LPP

Maximise, $Z = 5x + 3y$

Subject to, $3x + 5y \leq 15, 5x + 2y \leq 10,$

$x, y \geq 0$

Find the corner at which Z attains its maximum.

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49. Consider the LPP

Minimise,Z=200x+500y

$x + 2y \geq 10, 3x + 4y \leq 24, x \geq 0, y \geq 0$

Draw the feasible region.

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50. Consider the LPP

Minimise,Z=200x+500y

$x + 2y \geq 10, 3x + 4y \leq 24, x \geq 0, y \geq 0$

Find the co-ordinates of the corner points of the feasible region.

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51. Consider the LPP

Minimize,Z=200x+500y

$x + 2y \geq 10, 3x + 4y \leq 24, x \geq 0, y \geq 0$

Solve the LPP.

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52. Consider the linear programming problem,

Maximise, $Z = x + y, 2x + y - 3 \leq 0,$

$x - 2y + 1 \leq 0, y \leq 3, x \geq 0, y \geq 0$

Draw its feasible region.

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53. Consider the linear programming problem,

Maximize, $Z = x + y$, subject to constraints

$2x + y - 3 \leq 0, x - 2y + 1 \leq 0, y \leq 3, x \geq 0,$

$y \geq 0$

Find the corner points of the feasible region.

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54. Consider the linear programming problem,

Maximise, $Z = x + y,$ subject to the constraints $2x + y - 3 \leq 0, x - 2y + 1 \leq 0,$

$y \leq 3, x \geq 0, y \geq 0$

Find the corner at which Z attains its maximum.

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55. A manufacturur 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 per package on bolts.How many package of each should be produced each day so as to maximise the profit,if he operates his machine for at the most 12 hours a days?

By suitable defining the variables write the objective function of the problem.

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56. A manufacturur 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 per package on bolts.How many

package of each should be produced each day so as to maximise the profit,if he operates his machine for at the most 12 hours a days? Formulate the problem as a linear programming problem.

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57. A manufacturur 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 per package on bolts.How many package of each should be produced each day so as to maximise the profit,if he operates his machine for at the most 12 hours a days?

Solve the LPP graphically and find the number of packages of nuts and bolts to be manufactured.

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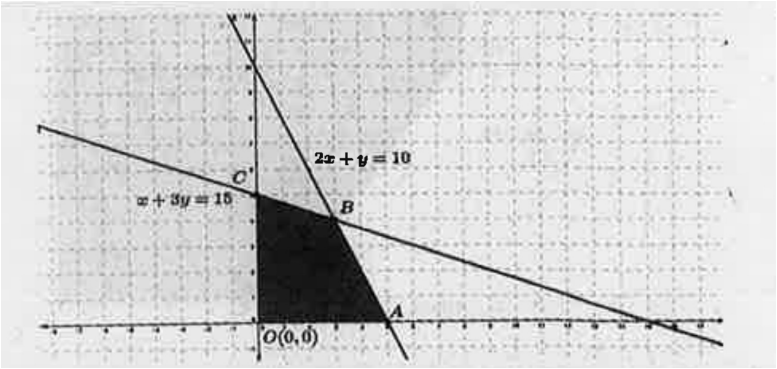
58. The graph of linear programing problem is given below.The shaded region is the feasible region.The objective function is

$Z = px + qy$

What are the co ordinates of the corners of the feasible region.



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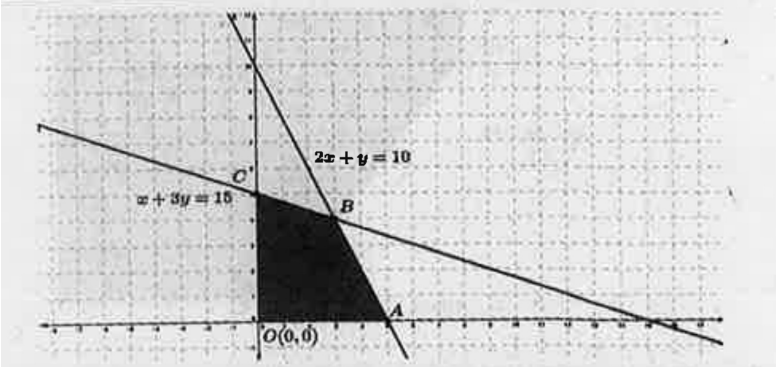
59. The graph of linear programing problem is given below.The shaded region is the feasible region.The objective function is

$Z = px + qy$

Write the constraints.



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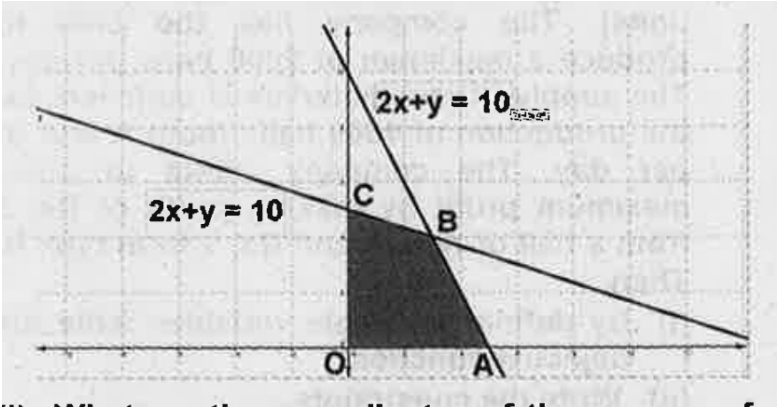
60. The graph of linear programming problem is given below.The shaded region is the feasible region.The objective function is Maximise, $Z = px + qy$

` If the Max,Z occurs at A and B,what is the relation between pand q?



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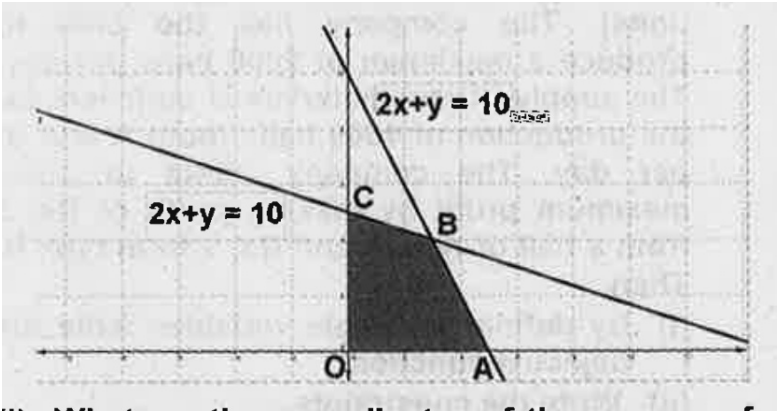
61. The graph of linear programming problem is given below.The shaded region is the feasible region.The objective function is Maximise, $Z = px + qy$

If q=1, write the objective function when maximum of Z occures at A and B.`



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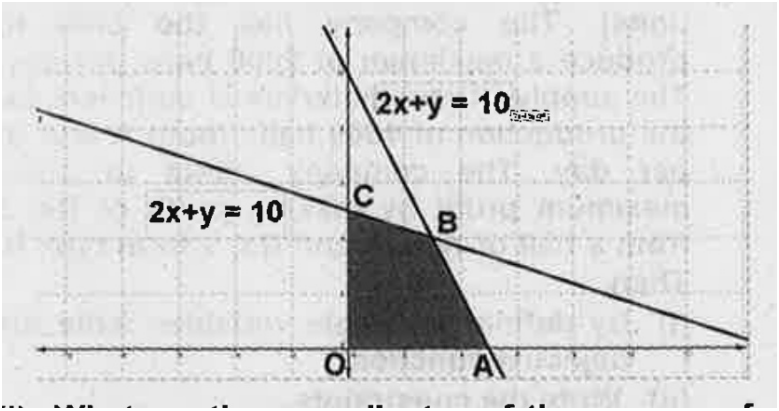
62. The graph of linear programming problem is given below.The shaded region is the feasible region.The objective function is Maximise, $Z = px + qy$

` If the Max,Z occurs at A and B,what is the relation between pand q?



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Exercise

1. Consider the LPP

Maximise $z = 3x + 2y$

Subject to the constraints

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

Find the maximum value of Z.

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2. A fruit grower can use two types of fertilizers in his garden , brand P and 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 atleast 240 kg of phosphoric acid , atleast 270 kg of potash and atmost 310 kg of chlorine. If the grower wants to minimise the amount of nitrogen added to the garden, how many bags of each brand should be used ? What is the minimum amount of nitrogen

added in the garden ?

kg per bag		
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Potash	3	1.5
Chlorine	1:5	2

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