$60-x\geq 0,\ 50-y\geq 0,$ and $x+y-60\geq 0$

$\Rightarrow x\leq 60,\ y\leq 50,$ and $x+y\geq 60$

Total transportation cost z is given by,

$$z=6x+3y+2.5(100-x-y)+4(60-x)+2(50-y)+3(x+y-60)$$
$$=6x+3y+250-2.5x-2.5y+240-4x+100-2y+3x+3y-180$$
$$=2.5x+1.5y+410$$

The given problem can be formulated as

Minimize $z = 2.5x + 1.5y + 410$ ... (1)

subject to the constraints,

$x+y\leq 100$ ...(2)

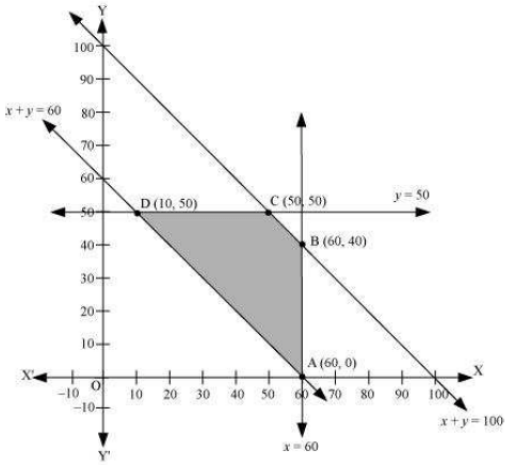
$x\leq 60$ ...(3)

$y\leq 50$ ...(4)

$x+y\geq 60$ ...(5)

$x,\ y\geq 0$ ...(6)

The feasible region determined by the system of constraints is as follows.



The corner points are A (60, 0), B (60, 40), C (50, 50), and D (10, 50).

The values of z at these corner points are as follows.

Corner point	$z = 2.5x + 1.5y + 410$	
A (60, 0)	560	
B (60, 40)	620	
C (50, 50)	610	
D (10, 50)	510	→ Minimum

The minimum value of z is 510 at (10, 50).

Thus, the amount of grain transported from A to D, E, and F is 10 quintals, 50 quintals, and 40 quintals respectively and from B to D, E, and F is 50 quintals, 0 quintals, and 0 quintals respectively.

Question 7:

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 distance (in km) between the depots and the petrol pumps is given in the following table:

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

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

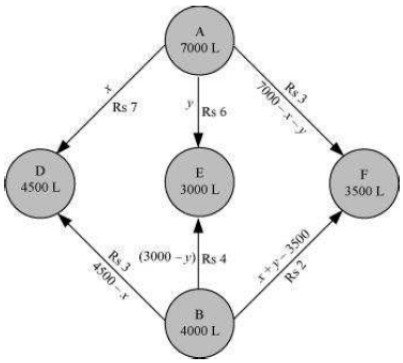
Answer

Let x and y litres of oil be supplied from A to the petrol pumps, D and E. Then, (7000 − x − y) will be supplied from A to petrol pump F.

The requirement at petrol pump D is 4500 L. Since x L are transported from depot A, the remaining (4500 −x) L will be transported from petrol pump B.

Similarly, (3000 − y) L and 3500 − (7000 − x − y) = (x + y − 3500) L will be transported from depot B to petrol pump E and F respectively.

The given problem can be represented diagrammatically as follows.



$x \geq 0,\ y \geq 0,\ \text{and}\ (7000 - x - y) \geq 0$

$\Rightarrow x \geq 0,\ y \geq 0,\ \text{and}\ x + y \leq 7000$

$4500 - x \geq 0,\ 3000 - y \geq 0,\ \text{and}\ x + y - 3500 \geq 0$

$\Rightarrow x \leq 4500,\ y \leq 3000,\ \text{and}\ x + y \geq 3500$

Cost of transporting 10 L of petrol = Re 1

Cost of transporting 1 L of petrol = $\text{Rs}\ \frac{1}{10}$

Therefore, total transportation cost is given by,

$$z = \frac{7}{10} \times x + \frac{6}{10} y + \frac{3}{10}(7000 - x - y) + \frac{3}{10}(4500 - x) + \frac{4}{10}(3000 - y) + \frac{2}{10}(x + y - 3500)$$
$$= 0.3x + 0.1y + 3950$$

The problem can be formulated as follows.

Minimize z = 0.3x + 0.1y + 3950 ... (1)

subject to the constraints,

$x + y \leq 7000$ ...(2)

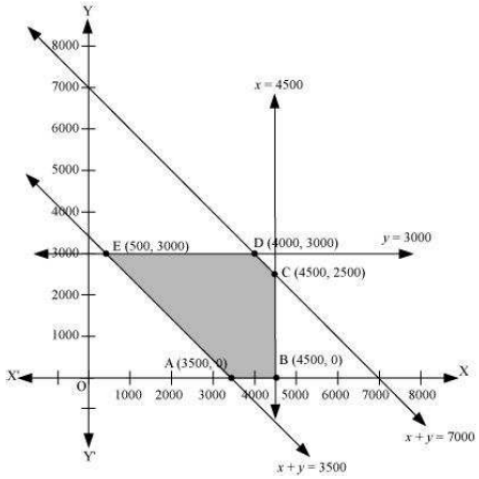
$x \leq 4500$ ...(3)

$y \leq 3000$ ...(4)

$x + y \geq 3500$ ...(5)

$x,\ y \geq 0$ ...(6)

The feasible region determined by the constraints is as follows.



The corner points of the feasible region are A (3500, 0), B (4500, 0), C (4500, 2500), D (4000, 3000), and E (500, 3000).

The values of z at these corner points are as follows.

Corner point	z = 0.3x + 0.1y + 3950	
A (3500, 0)	5000	
B (4500, 0)	5300	
C (4500, 2500)	5550	
D (4000, 3000)	5450	
E (500, 3000)	4400	→ Minimum

The minimum value of z is 4400 at (500, 3000).

The minimum value of Z is 4400 at (500, 3000).

Thus, the oil supplied from depot A is 500 L, 3000 L, and 3500 L and from depot B is 4000 L, 0 L, and 0 L to petrol pumps D, E, and F respectively.

The minimum transportation cost is Rs 4400.

Question 8:

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 minimize 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

********** END **********