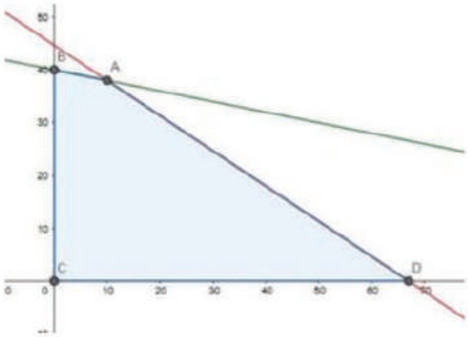


The corner points of feasible region are A(10,38) ,B(0,40) ,C(0,0), D(67,0) . The values of Z at the following points is

Corner Point	Z = 4x + 9y	
A(10,38)	382	Maximum
B(0,40)	360	
C(0,0)	0	
D(67,0)	268	

The maximum value of Z is 382 at point A(10,38) .

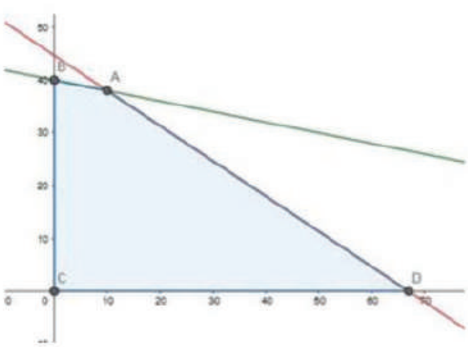
2. Question

Maximize Z = 4x + 9y, subject to the constraints

$x \geq 0$, $y \geq 0$, $x + 5y \leq 200$, $2x + 3y \leq 134$.

Answer

The feasible region determined by the constraints $x \geq 0$, $y \geq 0$, $x + 5y \leq 200$, $2x + 3y \leq 134$ is given by



The corner points of feasible region are A(10,38) ,B(0,40) ,C(0,0), D(67,0) . The values of Z at the following points is

Corner Point	$Z = 4x + 9y$	
A(10,38)	382	Maximum
B(0,40)	360	
C(0,0)	0	
D(67,0)	268	

The maximum value of Z is 382 at point A(10,38) .

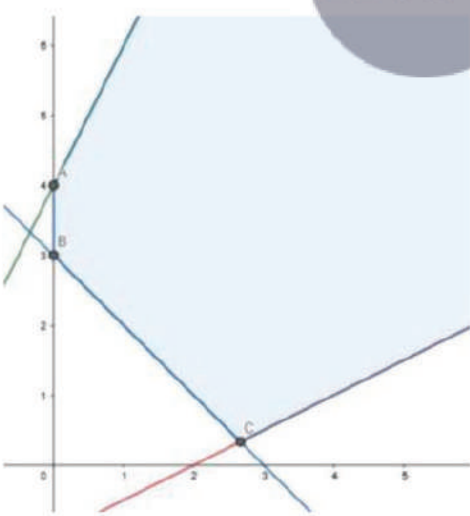
3. Question

Find the minimum value of $Z = 3x + 5y$, subject to the constraints

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

Answer

The feasible region determined by the $-2x + y \leq 4$, $x + y \geq 3$, $x - 2y \leq 2$, $x \geq 0$ and $y \geq 0$ is given by



Here the feasible region is unbounded. The vertices of the region are A(0,4) ,B(0,3) ,C$(\frac{8}{3}, \frac{1}{3})$. The values of Z at the following points is

Corner Point	Z = 3x + 5y	
A(0,4)	20	
B(0,3)	15	
$C(\frac{8}{3},\frac{1}{3})$	$\frac{29}{3}$	Minimum

The minimum value of Z is $\frac{29}{3}$ at point $C(\frac{8}{3},\frac{1}{3})$.

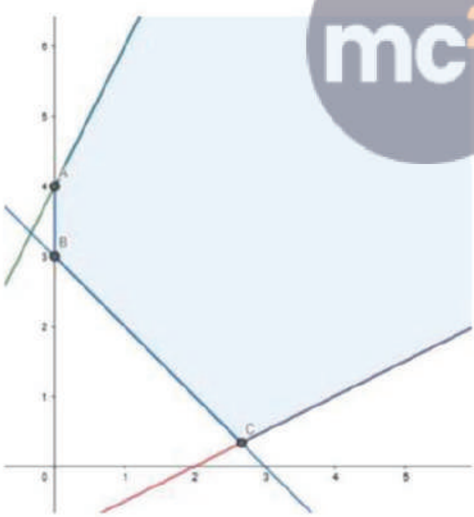
3. Question

Find the minimum value of Z = 3x + 5y, subject to the constraints

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

Answer

The feasible region determined by the $-2x + y \leq 4,\ x + y \geq 3,\ x - 2y \leq 2,\ x \geq 0$ and $y \geq 0$ is given by



Here the feasible region is unbounded. The vertices of the region are A(0,4) ,B(0,3) ,$C(\frac{8}{3},\frac{1}{3})$. The values of Z at the following points is

Corner Point	$Z = 3x + 5y$	
A(0,4)	20	
B(0,3)	15	
$C(\frac{8}{3},\frac{1}{3})$	$\frac{29}{3}$	Minimum

The minimum value of Z is $\frac{29}{3}$ at point $C(\frac{8}{3},\frac{1}{3})$.

4. Question

Minimize $Z = 2x + 3y$, subject to the constraints

$x \geq 0$, $y \geq 0$, $x + 2y \geq 1$ and $x + 2y \leq 10$.

Answer

The feasible region determined by the $x \geq 0$, $y \geq 0$, $x + 2y \geq 1$ and $x + 2y \leq 10$ is given by

The corner points of the feasible region is $A(0,\frac{1}{2})$, B(0,5), C(10,0), D(1,0).The value of Z at corner points are

Corner Points	Z = 2x + 3y	
$A(0,\frac{1}{2})$	$\frac{3}{2}$	Minimum
B(0,5)	15	
C(10,0)	20	
D(1,0)	2	

The minimum value of Z is $\frac{3}{2}$ at point $A(0,\frac{1}{2})$.

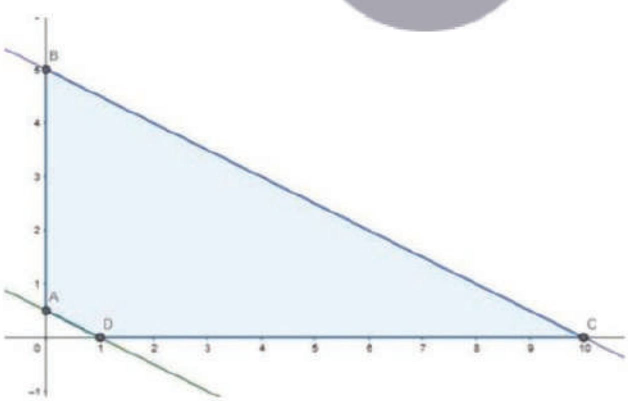
4. Question

Minimize Z = 2x + 3y, subject to the constraints

$x \geq 0$, $y \geq 0$, $x + 2y \geq 1$ and $x + 2y \leq 10$.

Answer

The feasible region determined by the $x \geq 0$, $y \geq 0$, $x + 2y \geq 1$ and $x + 2y \leq 10$ is given by



The corner points of the feasible region is $A(0,\frac{1}{2})$, B(0,5), C(10,0), D(1,0).The value of Z at corner points are

Corner Points	Z = 2x + 3y	
$A(0,\frac{1}{2})$	$\frac{3}{2}$	Minimum
B(0,5)	15	
C(10,0)	20	
D(1,0)	2	

The minimum value of Z is $\frac{3}{2}$ at point $A(0,\frac{1}{2})$.

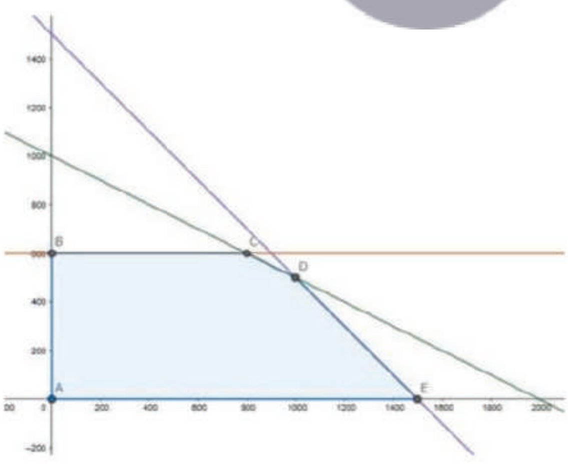
5. Question

Maximize Z = 3x + 5y, subject to the constraints

X + 2y $\leq$ 2000, x + y $\leq$ 1500, y $\leq$ 00, y $\leq$ 600, x $\geq$ 0 and y $\geq$ 0.

Answer

The feasible region determined by the X + 2y $\leq$ 2000, x + y $\leq$ 1500, y $\leq$ 600, x $\geq$ 0 and y $\geq$ 0 is given by



The corner points of the feasible region are A(0,0), B(0,600), C(800,600), D(1000,500), E(1500,0).The value of Z at the corner points are

Corner Point	Z = 3x + 5y	
A(0,0)	0	
B(0,600)	3000	
C(800,600)	5400	
D(1000,500)	5500	Maximum
E(1500,0)	4500	

The maximum value of Z is 5500 at point D(1000,500).

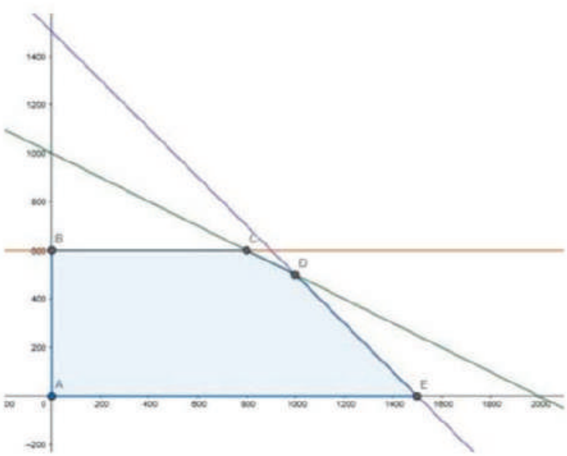
5. Question

Maximize Z = 3x + 5y, subject to the constraints

X + 2y $\leq$ 2000, x + y $\leq$ 1500, y $\leq$ 00, y $\leq$ 600, x $\geq$ 0 and y $\geq$ 0.

Answer

The feasible region determined by the X + 2y $\leq$ 2000, x + y $\leq$ 1500, y $\leq$ 600, x $\geq$ 0 and y $\geq$ 0 is given by



The corner points of the feasible region are A(0,0), B(0,600), C(800,600), D(1000,500), E(1500,0).The value of Z at the corner points are

Corner Point	Z = 3x + 5y	
A(0,0)	0	
B(0,600)	3000	
C(800,600)	5400	
D(1000,500)	5500	Maximum
E(1500,0)	4500	

The maximum value of Z is 5500 at point D(1000,500).

6. Question

Find the maximum and minimum values of $Z = 2x + y$, subject to the constraints

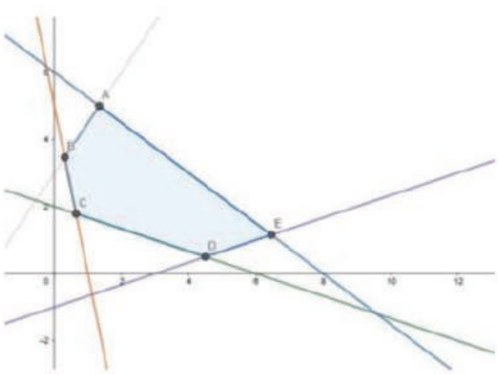
$X + 3y \geq 6$, $x - 3y \leq 3$, $3x + 4y \leq 24$,

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

Answer

The feasible region determined by $X + 3y \geq 6$, $x - 3y \leq 3$, $3x + 4y \leq 24$,

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



The corner points of the feasible region are A(4/3,5) , B(4/13,45/13), C(9/14,25/14) , D(9/2,1/2) , E(84/13,15/13).The value of Z at corner points are

Corner Point	Z = 2x + y	
A(4/3,5)	23/3	
B(4/13,45/13)	53/13	
C(9/14,25/14)	43/14	Minimum
D(9/2,1/2)	19/2	
E(84/13,15/13)	183/13	Maximum

The maximum and minimum value of Z is 183/13 and 43/14 at points E(84/13,15/13) and C(9/14,25/14).

6. Question

Find the maximum and minimum values of $Z = 2x + y$, subject to the constraints

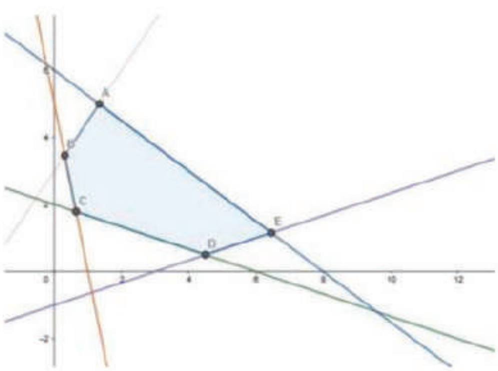
$X + 3y \geq 6$, $x - 3y \leq 3$, $3x + 4y \leq 24$,

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

Answer

The feasible region determined by $X + 3y \geq 6$, $x - 3y \leq 3$, $3x + 4y \leq 24$,

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



The corner points of the feasible region are A(4/3,5) , B(4/13,45/13), C(9/14,25/14) , D(9/2,1/2) , E(84/13,15/13).The value of Z at corner points are

Corner Point	$Z = 2x + y$	
A(4/3,5)	23/3	
B(4/13,45/13)	53/13	
C(9/14,25/14)	43/14	Minimum
D(9/2,1/2)	19/2	
E(84/13,15/13)	183/13	Maximum

The maximum and minimum value of Z is 183/13 and 43/14 at points E(84/13,15/13) and C(9/14,25/14).

7. Question

Mr.Dass wants to invest ₹12000 in public provident fund (PPF) and in national bonds. He has to invest at least ₹1000 in PPF and at least ₹2000 in bonds. If the rate of interest on PPF is 12% per annum and that on bonds is 15% per annum, how should he invest the money to earn maximum annual income? Also find the maximum annual income.

Answer

Let the invested money in PPF be x and in national bonds be y.

∴According to the question,

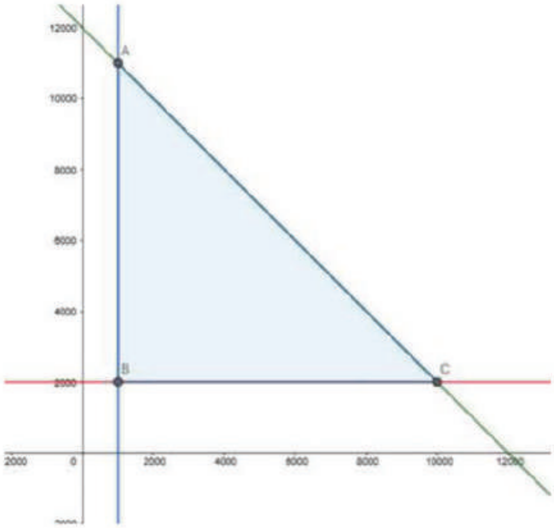
$X + y \leq 12000$

$x \geq 1000$, $y \geq 2000$

Maximize $Z = 0.12x + 0.15y$

The feasible region determined by $X + y \leq 12000$, $x \geq 1000$,

$y \geq 2000$ is given by



The corner points of the feasible region are A(1000,11000) , B(1000,2000) and C(10000,2000) . The value of Z at the corner point are

Corner Point	Z = 0.12x + 0.15y	
A(1000,11000)	1770	Maximum
B(1000,2000)	420	
C(10000,2000)	1500	

The maximum value of Z is 1770 at point A(1000,11000).

So, he must invest Rs.1000 in PPF and Rs.11000 in national bonds.

The maximum annual income is Rs.1770 .

7. Question

Mr.Dass wants to invest ₹12000 in public provident fund (PPF) and in national bonds. He has to invest at least ₹1000 in PPF and at least ₹2000 in bonds. If the rate of interest on PPF is 12% per annum and that on bonds is 15% per annum, how should he invest the money to earn maximum annual income? Also find the maximum annual income.

Answer

Let the invested money in PPF be x and in national bonds be y.

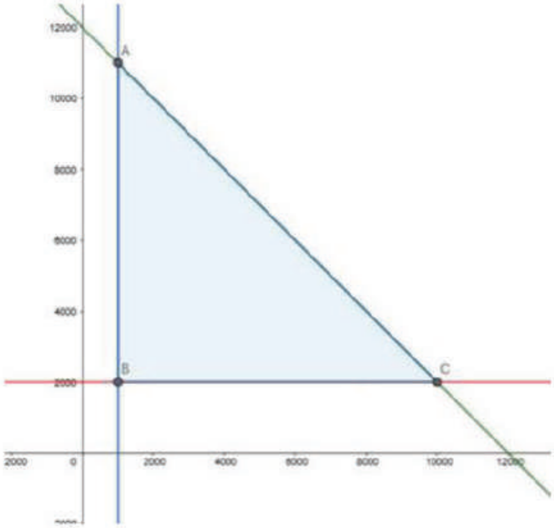
∴According to the question,

$X + y \leq 12000$

$x \geq 1000$, $y \geq 2000$

Maximize Z = 0.12x + 0.15y

The feasible region determined by $X + y \leq 12000$, $x \geq 1000$, y $\geq$ 2000 is given by



The corner points of the feasible region are A(1000,11000) , B(1000,2000) and C(10000,2000) . The value of Z at the corner point are

Corner Point	Z = 0.12x + 0.15y	
A(1000,11000)	1770	Maximum
B(1000,2000)	420	
C(10000,2000)	1500	

The maximum value of Z is 1770 at point A(1000,11000).

So, he must invest Rs.1000 in PPF and Rs.11000 in national bonds.

The maximum annual income is Rs.1770 .

8. Question

A small firm manufactures necklace and bracelets. The total number of necklace and bracelet that it can handle per day is at most 24. It takes 1 hour to make a bracelet and half an hour to make a necklace. The maximum number of hours available per day is 16. If the profit on a necklace is ₹100 and that on a bracelet is ₹300, how many of each should be produced daily to maximize the profit? It is being given that at least one of each must be produced.

Answer

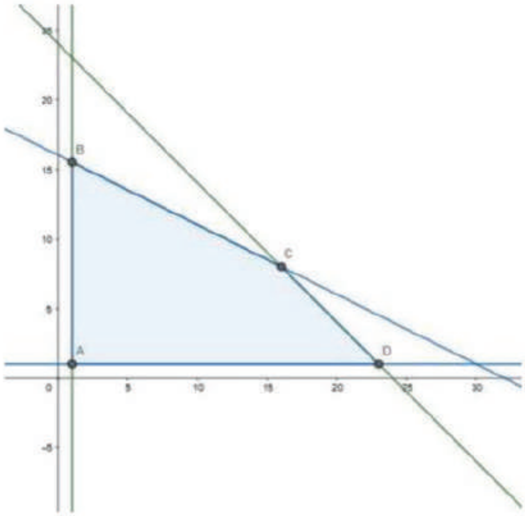
Let the firm manufacture x number of necklaces and y number of bracelets a day.

∴According to the question,

X + y ≤ 24 , 0.5x + y ≤ 16 x $\geq 1, y \geq 1$

Maximize Z = 100x + 300y

The feasible region determined by X + y ≤ 24 , 0.5x + y ≤ 16, x $\geq 1, y \geq 1$ is given by



The corner points of the feasible region are A(1,1) , B(1,15.5) , C(16,8) , D(23,1).The number of bracelets should be whole number. Therefore, considering point (2,15). The value of Z at corner point is

Corner Point	Z = 100x + 300y	
A(1,1)	400	
(2,15)	4700	Maximum
C(16,8)	4000	
D(23,1)	2600	

The maximum value of Z is 4700 at point B(2,15).

∴ The firm should make 2 necklaces and 15 bracelets.

8. Question

A small firm manufactures necklace and bracelets. The total number of necklace and bracelet that it can handle per day is at most 24. It takes 1 hour to make a bracelet and half an hour to make a necklace. The maximum number of hours available per day is 16. If the profit on a necklace is ₹100 and that on a bracelet is ₹300, how many of each should be produced daily to maximize the profit? It is being given that at least one of each must be produced.

Answer

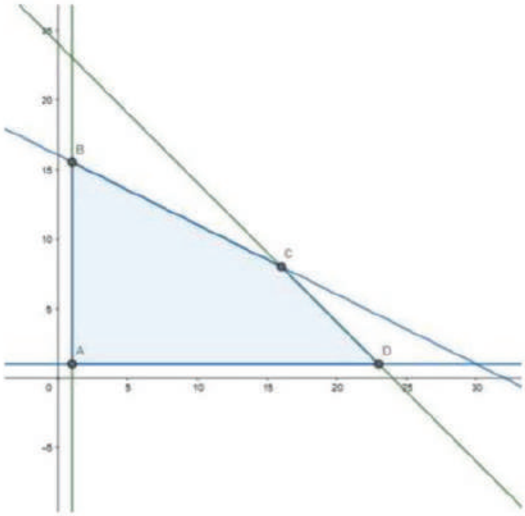
Let the firm manufacture x number of necklaces and y number of bracelets a day.

∴According to the question,

$X + y \leq 24$, $0.5x + y \leq 16$ $x \geq 1, y \geq 1$

Maximize Z = 100x + 300y

The feasible region determined by $X + y \leq 24$, $0.5x + y \leq 16$, $x \geq 1, y \geq 1$ is given by



The corner points of the feasible region are A(1,1) , B(1,15.5) , C(16,8) , D(23,1).The number of bracelets should be whole number. Therefore, considering point (2,15). The value of Z at corner point is

Corner Point	Z = 100x + 300y	
A(1,1)	400	
(2,15)	4700	Maximum
C(16,8)	4000	
D(23,1)	2600	

The maximum value of Z is 4700 at point B(2,15).

∴ The firm should make 2 necklaces and 15 bracelets.

9. Question

A man has ₹1500 to purchase rice and wheat. A bag of rice and a bag of wheat cost ₹180 and 120 respectively. He has storage capacity of 10 bags only. He earns a profit of ₹11 and ₹8 per bag of rice and wheat respectively. How many bags of each must he buy to make maximum profit?

Answer

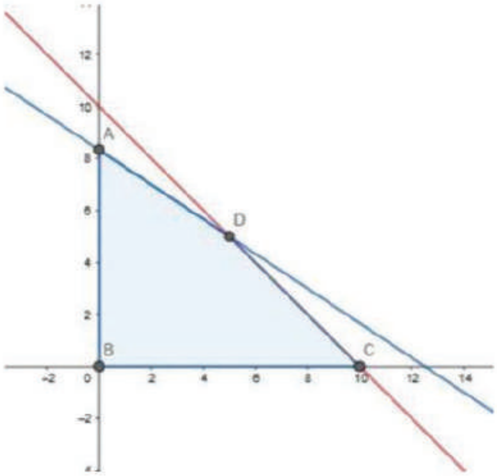
Let the number of wheat and rice bags be x and y.

∴According to the question,

$120x + 180y \leq 1500, x + y \leq 10, x \geq 0, y \geq 0$

Maximize Z = 8x + 11y

The feasible region determined by $120x + 180y \leq 1500, x + y \leq 10, x \geq 0, y \geq 0$ is given by



The corner points of feasible region are A(0,8), B(0,0), C(10,0), D(5,5) .

The value of Z at corner point is

Corner Point	Z = 8x + 11y	
A(0,8)	88	
B(0,0)	0	
C(10,0)	80	
D(5,5)	95	Maximum

The maximum value of Z is 95 at point (5,5).

Hence, the man should 5 bags each of wheat and rice to earn maximum profit.

9. Question

A man has ₹1500 to purchase rice and wheat. A bag of rice and a bag of wheat cost ₹180 and 120 respectively. He has storage capacity of 10 bags only. He earns a profit of ₹11 and ₹8 per bag of rice and wheat respectively. How many bags of each must he buy to make maximum profit?

Answer

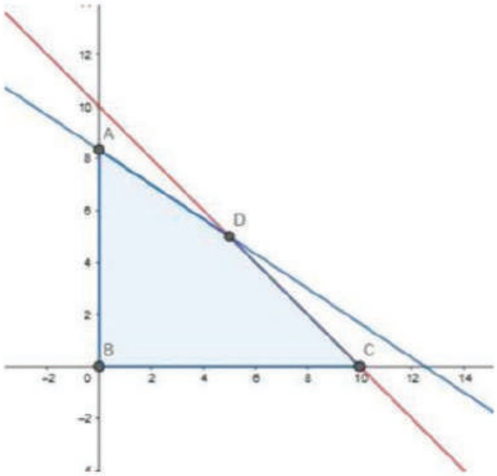
Let the number of wheat and rice bags be x and y.

∴According to the question,

$120x + 180y \leq 1500$, $x + y \leq 10$, $x \geq 0, y \geq 0$

Maximize Z = 8x + 11y

The feasible region determined by $120x + 180y \leq 1500$, $x + y \leq 10$, $x \geq 0, y \geq 0$ is given by



The corner points of feasible region are A(0,8), B(0,0), C(10,0), D(5,5) .

The value of Z at corner point is

Corner Point	Z = 8x + 11y	
A(0,8)	88	
B(0,0)	0	
C(10,0)	80	
D(5,5)	95	Maximum

The maximum value of Z is 95 at point (5,5).

Hence, the man should 5 bags each of wheat and rice to earn maximum profit.

10. Question

A manufacture produces nuts and bolts for industrial machinery. It takes 1 hour of work on machine A and 3 hours on machine B to produces a packet of nuts while it takes 3 hours on machine A and 1 hours on machine B to produce a packet of bolts. He earns a profit ₹17.50 per packet on nuts and ₹7 per packet on bolts. How many packets of each should be produced each day so as to maximize his profit if he operates each machine for at the most 12 hours a day? Also find the maximum profit.

Answer

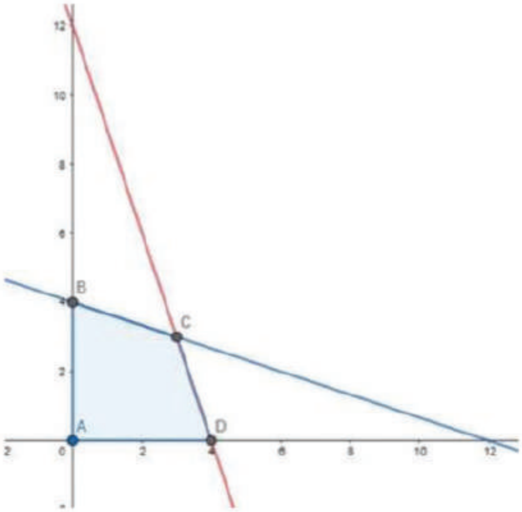
Let the number of packets of nuts and bolts be x and y respectively.

∴According to the question,

X + 3y $\leq 12, 3x + y \leq 12, x \geq 0, y \geq 0$

Maximize Z = 17.50x + 7y

The feasible region determined by X + 3y $\leq 12, 3x + y \leq 12, x \geq 0, y \geq 0$ is given by



The corner points of the feasible region are A(0,0), B(0,4), C(3,3)), D(4,0).The value of Z at the corner point is

Corner Point	Z = 17.50x + 7y	
A(0,0)	0	
B(0,4)	28	
C(3,3)	73.50	Maximum
D(4,0)	70	

The maximum value of Z is 73.50 at (3,3).

The manufacturer should make 3 packets each of nuts and bolts to make maximum profit of Rs.73.50.

10. Question

A manufacture produces nuts and bolts for industrial machinery. It takes 1 hour of work on machine A and 3 hours on machine B to produces a packet of nuts while it takes 3 hours on machine A and 1 hours on machine B to produce a packet of bolts. He earns a profit ₹17.50 per packet on nuts and ₹7 per packet on bolts. How many packets of each should be produced each day so as to maximize his profit if he operates each machine for at the most 12 hours a day? Also find the maximum profit.

Answer

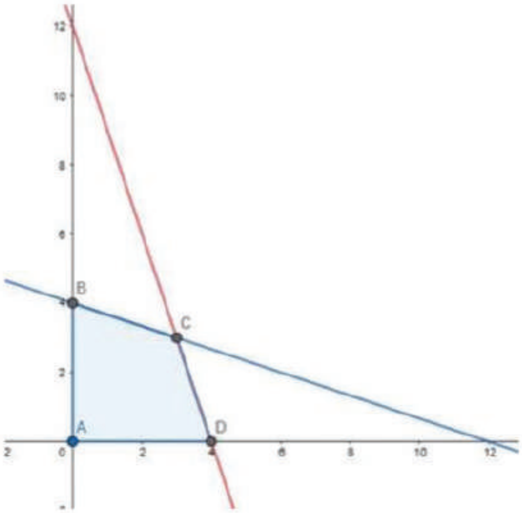
Let the number of packets of nuts and bolts be x and y respectively.

∴According to the question,

X + 3y $\leq 12, 3x + y \leq 12, x \geq 0, y \geq 0$

Maximize Z = 17.50x + 7y

The feasible region determined by X + 3y $\leq 12, 3x + y \leq 12, x \geq 0, y \geq 0$ is given by



The corner points of the feasible region are A(0,0), B(0,4), C(3,3)), D(4,0).The value of Z at the corner point is

Corner Point	Z = 17.50x + 7y	
A(0,0)	0	
B(0,4)	28	
C(3,3)	73.50	Maximum
D(4,0)	70	

The maximum value of Z is 73.50 at (3,3).

The manufacturer should make 3 packets each of nuts and bolts to make maximum profit of Rs.73.50.

11. Question

Two tailors, A and B, earn ₹300 and ₹400 per day respectively. A can stitch 6 shirts and 4 pair of trousers while B can stitch 10 shirts and 4 pairs of trousers per day. How many days should each of them work if it is desired to produce at least 60 shirts and 32 pairs of trousers at a minimum labor cost?

Answer

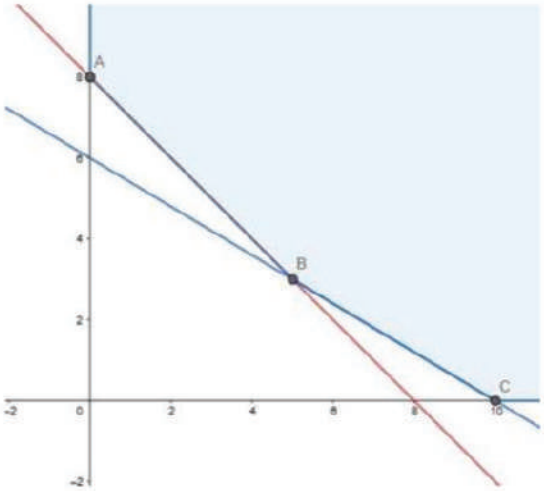
Let the total number of days tailor A work be x and tailor B be y.

∴According to the question,

$6x + 10y \geq 60, 4x + 4y \geq 32, x \geq 0, y \geq 0$

Minimize Z = 300x + 400y

The feasible region determined by $6x + 10y \geq 60, 4x + 4y \geq 32, x \geq 0, y \geq 0$ is given by



The feasible region is unbounded. The corner points of feasible region are A(0,8),B(5,3),C(10,0) .The value of Z at corner point is

Corner Point	Z = 300x + 400y	
A(0,8)	3200	
B(5,3)	2700	Minimum
C(10,0)	3000	

The minimum value of Z is 2700 at point (5,3).

∴Tailor A must work for 5 days and tailor B must work for 3 days for minimum expenses.

11. Question

Two tailors, A and B, earn ₹300 and ₹400 per day respectively. A can stitch 6 shirts and 4 pair of trousers while B can stitch 10 shirts and 4 pairs of trousers per day. How many days should each of them work if it is desired to produce at least 60 shirts and 32 pairs of trousers at a minimum labor cost?

Answer

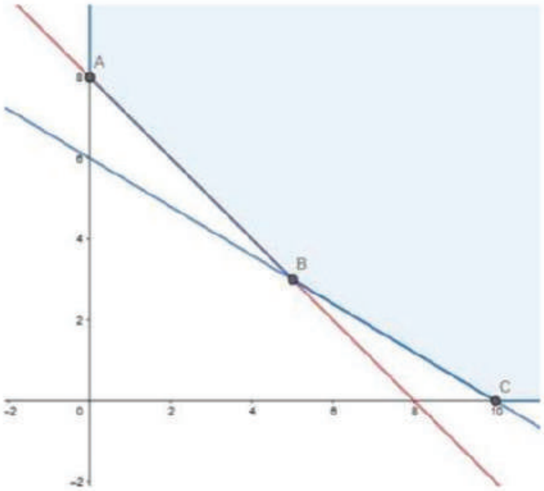
Let the total number of days tailor A work be x and tailor B be y.

∴According to the question,

$6x + 10y \geq 60, 4x + 4y \geq 32, x \geq 0, y \geq 0$

Minimize Z = 300x + 400y

The feasible region determined by $6x + 10y \geq 60, 4x + 4y \geq 32, x \geq 0, y \geq 0$ is given by



The feasible region is unbounded. The corner points of feasible region are A(0,8),B(5,3),C(10,0) .The value of Z at corner point is

Corner Point	Z = 300x + 400y	
A(0,8)	3200	
B(5,3)	2700	Minimum
C(10,0)	3000	

The minimum value of Z is 2700 at point (5,3).

∴Tailor A must work for 5 days and tailor B must work for 3 days for minimum expenses.

12. Question

A dealer wishes to purchase a number of fans and sewing machines. He has only ₹5760 to invest and space for at most 20 items. A fan costs him ₹360 and a sewing machine, ₹240. He expects to gain ₹22 on a fan and ₹18 on a sewing machine. Assuming that he can sell all the items he can buy, how should he invest the money in order to maximize the profit?

Answer

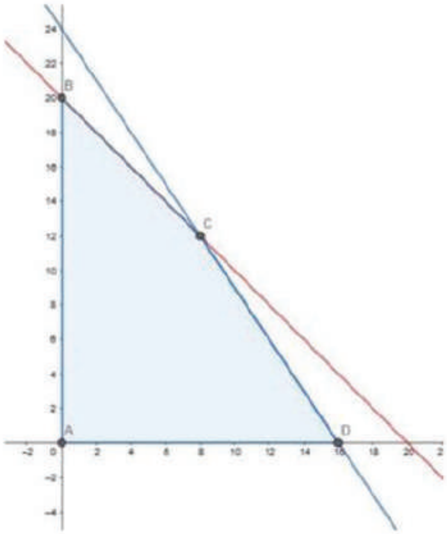
Let the number of fans bought be x and sewing machines bought be y.

∴According to the question,

$360x + 240y \leq 5760, x + y \leq 20, x \geq 0, y \geq 0$

Maximize $Z = 22x + 18y$

The feasible region determined by $360x + 240y \leq 5760, x + y \leq 20, x \geq 0, y \geq 0$ is given by



The corner points of the feasible region are A(0,0) , B(0,20),C(8,12) , D(16,0).The value of Z at corner points is

Corner Point	Z = 22x + 18y	
A(0,0)	0	
B(0,20)	360	
C(8,12)	392	Maximum
D(16,0)	352	

The maximum value of Z is 392 at point (8,12).

The dealer must buy 8 fans and 12 sewing machines to make the maximum profit.

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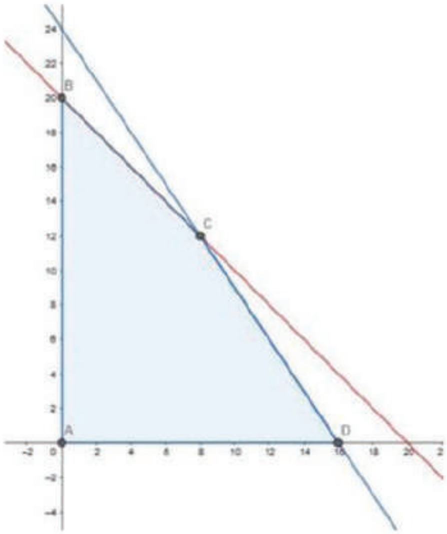

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13. Question

A firm manufactures two types of products, A and B, and sells them at a profit of₹2 on type A and ₹2 on type B. Each product is processed on two machines, M_1 and M_2. Type A requires one minute of processing time on M_1 and two minutes on M_2. Type B requires one minute on M_1 and one minute on M_2 is available for not more than 6 hours 40 minutes while M_2 is available for at most 10 hours a day.

Find how many products of each type the firm should produce each day in order to get maximum profit.

Answer

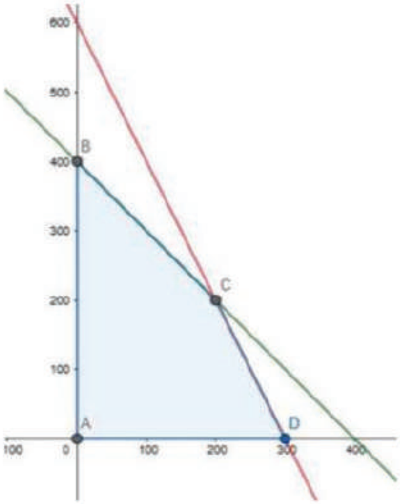
Let the firm manufacture x number of Aand y number of B products.

∴According to the question,

X + y $\leq 400, 2x + y \leq 600, x \geq 0, y \geq 0$

Maximize Z = 2x + 2y

The feasible region determined by X + y $\leq 400, 2x + y \leq 600, x \geq 0, y \geq 0$ is given by



The corner points of feasible region are A(0,0) , B(0,400) , C(200,200) , D(300,0).The value of Z at corner point is

Corner Point	Z = 2x + 2y	
A(0,0)	0	
B(0,400)	800	Maximum
C(200,200)	800	Maximum
D(300,0)	600	

The maximum value of Z is 800 and occurs at two points. Hence the line BC is a feasible solution.

The firm should produce 200 number of Aproducts and 200 number of B products.

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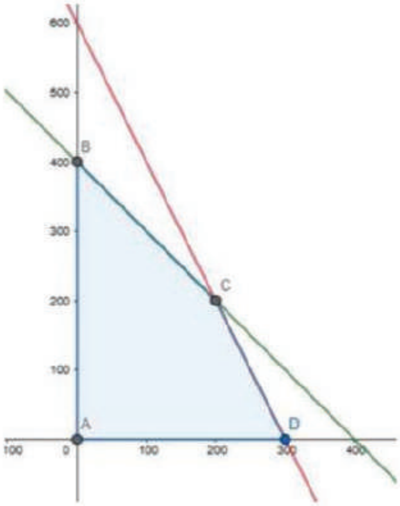

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The firm should produce 200 number of Aproducts and 200 number of B products.

14. Question

A manufactures produces two types of soap bars using two machines, A and B. A is operated for 2 minutes and B for 3 minutes to manufacture the first type, while it takes 3 minutes on machine A and 5 minutes on machine B to manufacture the second type. Each machine can be operated at the most for 8 hours per day. The two types of soap bars are sold at a profit of ₹0.25 and ₹0.50 each. Assuming that the manufacture can sell all the soap bars he can manufacture, how many bars of soap of each type should be manufactured per day so as to maximize his profit?

Answer

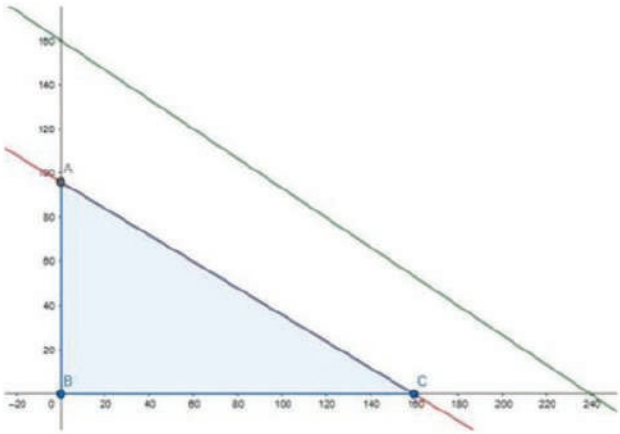
Let x and y be number of soaps be manufactured of 1^{st} and 2^{nd} type.

∴According to the question,

$2x + 3y \leq 480$, $3x + 5y \leq 480$, $x \geq 0$, $y \geq 0$

Maximize $Z = 0.25x + 0.50y$

The feasible region determined by $2x + 3y \leq 480$, $3x + 5y \leq 480$, $x \geq 0$, $y \geq 0$ is given by



The corner points of feasible region are A(0,96) , B(0,0) , C(160,0).

The value of Z at corner points are

Corner Point	Z = 0.25x + 0.50y	
A(0,96)	48	Maximum
B(0,0)	0	
C(160,0)	40	

The maximum value of Z is 48 at point (0,96).

Hence, the manufacturer should make 96 soaps of the 2nd type to make maximum profit.

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Maximize $Z = 0.25x + 0.50y$