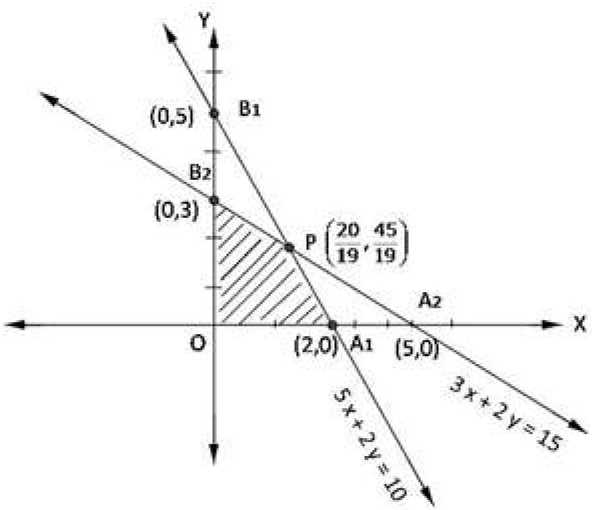
EXERCISE 30.2

Q1.
Solution:
Firstly let us convert the given Inequations into equations, we get
3x + 5y = 15,
5x + 2y = 10,
x = 0,
y = 0



Region represented by $3x + 5y \leq 15$:
The line meets the coordinate axes at $A_2(5,0)$ and $B_2(0,3)$. By joining these points we obtain the line 3x + 5y = 15.
So, (0,0) satisfies the inequation $3x + 5y \leq 15$. Hence, the region containing the origin represents the solution set of the inequation $3x + 5y \leq 15$.

Region represented by $5x + 2y \leq 10$:
The line meets the coordinate axes at $A_1(2,0)$ and $B_1(0,5)$. By joining these points we obtain the line 5x + 2y = 10.
So, (0,0) satisfies the inequation $5x + 2y \leq 10$. Hence, the region containing the origin represents the solution set of the inequation $5x + 2y \leq 10$.

Region represented by $x \geq 0, y \geq 0$:
Since, every point in the first quadrant satisfies these inequations. So, the first quadrant is the region represented by the inequations $x \geq 0, y \geq 0$.

The coordinates of the corner points of shaded region are O(0,0), A(2,0), P(20/19, 45/19),

$B_2(0,3)$

The value of $Z = 5x + 3y$ at

$O(0,0) \quad = 5 \times +3 \times 0$

$A(2,0) \quad = 5 \times 2 + 3 \times 0 = 10$

$P\left(\frac{20}{19}, \frac{45}{19}\right) \quad = 5\left(\frac{20}{19}\right) + 3\left(\frac{45}{19}\right) = \frac{235}{19}$

$B_2(0,3) \quad = 5 \times 0 + 3 \times 3 = 9$

Clearly, Z is maximum at $P\left(\frac{20}{19}, \frac{45}{19}\right)$

So, $x = \frac{20}{19}$, $y = \frac{45}{19}$, maximum $Z = \frac{235}{19}$

Q2.

Solution:

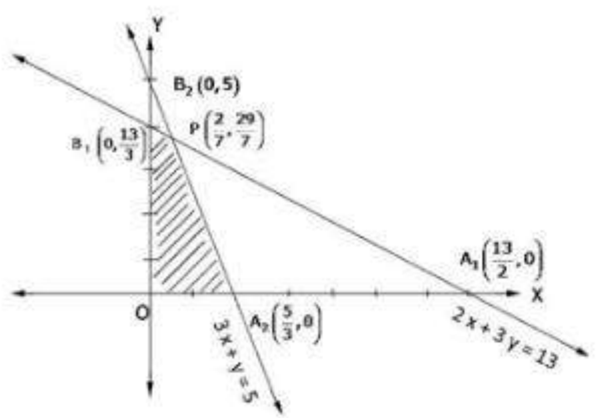
Firstly let us convert the given Inequations into equations, we get

2x + 3y = 13,

3x + y = 5,

x = 0,

y = 0



Region represented by $2x + 3y \leq 13$:

The line meets the coordinate axes at $A_1(13/2,0)$ and $B_1(0,13/3)$. By joining these points we obtain the line 2x + 3y = 13.

So, (0,0) satisfies the inequation $2x + 3y \leq 13$. Hence, the region containing the origin represents the solution set of the inequation $2x + 3y \leq 13$.

Region represented by $3x + y \leq 5$:

The line meets the coordinate axes at $A_2(5/3,0)$ and $B_2(0,5)$. By joining these points we obtain the line 3x + y = 5.

So, (0,0) satisfies the inequation $3x + y \leq 5$. Hence, the region containing the origin represents the solution set of the inequation $3x + y \leq 5$.

Region represented by $x \geq 0$, $y \geq 0$:
Since, every point in the first quadrant satisfies these inequations. So, the first quadrant is the region represented by the inequations $x \geq 0$, $y \geq 0$.

The coordinates of the corner points of shaded region are O(0,0), A(5/3,0), P(2/7, 29/7), B_2(0,13/3)

The value of $Z = 9x + 3y$ at

$O(0,0) \quad = 9(0) + 3(0) = 0$

$A_1\left(\frac{5}{3}, 0\right) \quad = 9\left(\frac{5}{3}\right) + 3(0) = 15$

$P\left(\frac{2}{7}, \frac{29}{7}\right) \quad = 9\left(\frac{2}{7}\right) + 3\left(\frac{29}{7}\right) = 15$

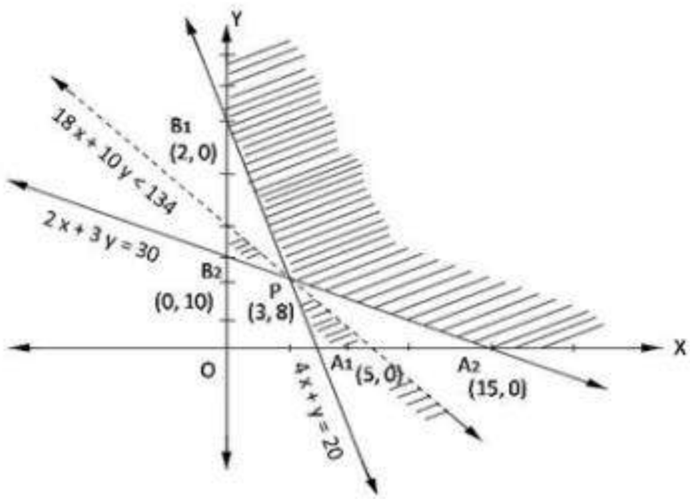
$B_2\left(0, \frac{13}{3}\right) \quad = 9(0) + 3\left(\frac{13}{3}\right) = 13$

Clearly, Z is maximum at at every point on the line joining A_1 and P, so

$x = \frac{5}{3}$ or $\frac{2}{7}$, $y = 0$ or $\frac{29}{7}$

and maximum $Z = 15$.

Q3.
Solution:
Firstly let us convert the given Inequations into equations, we get
$4x + y = 20$,
$2x + 3y = 30$,
$x = 0$,
$y = 0$



Region represented by $4x + y \geq 20$:
The line meets the coordinate axes at $A_1(5,0)$ and $B_1(0,20)$. By joining these points we obtain the line $4x + y = 20$.
So, (0,0) satisfies the inequation $4x + y \geq 20$. Hence, the region containing the origin represents the solution set of the inequation $4x + y \geq 20$.

Region represented by $2x + 3y \geq 30$:
The line meets the coordinate axes at $A_2(15,0)$ and $B_2(0,10)$. By joining these points we obtain the line $2x + 3y = 30$.
So, (0,0) satisfies the inequation $2x + 3y \geq 30$. Hence, the region containing the origin represents the solution set of the inequation $2x + 3y \geq 30$.

Region represented by $x \geq 0$, $y \geq 0$:
Since, every point in the first quadrant satisfies these inequations. So, the first quadrant is the region represented by the inequations $x \geq 0$, $y \geq 0$.

The coordinates of the corner points of shaded region are $A_2(15,0)$, P(3,8), $B_1(0,20)$

The value of $Z = 18x + 10y$ at

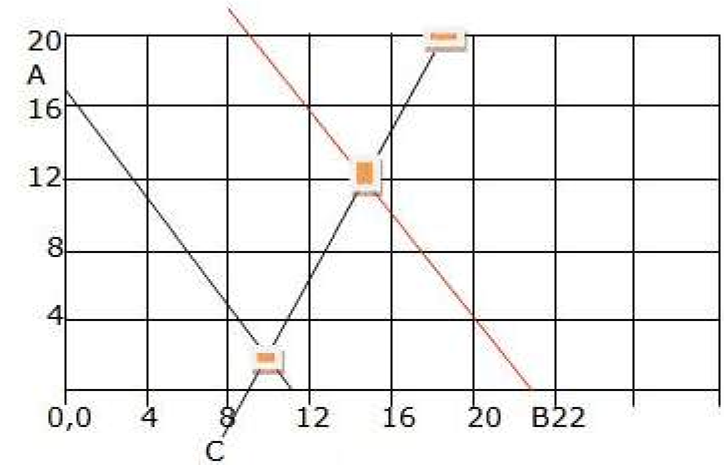
$A_2(15,0) \quad = 18(15) + 10(8) = 270$

$P(3,8) \quad = 18(3) + 10(8) = 134$

$B_1(0,20) \quad = 18(0) + 10(20) = 200$

It is clear that, x = 3 and y = 8 is optimal. Hence, Minimum value of Z is 134 at points (3,8).

Q4.
Solution:



2x-y ≥ 18 ; when x = 12, y = 6 & when y=0, x=9
3x+2y ≤ 34 ; when x = 0, y = 17 & when y=0, x=34/3

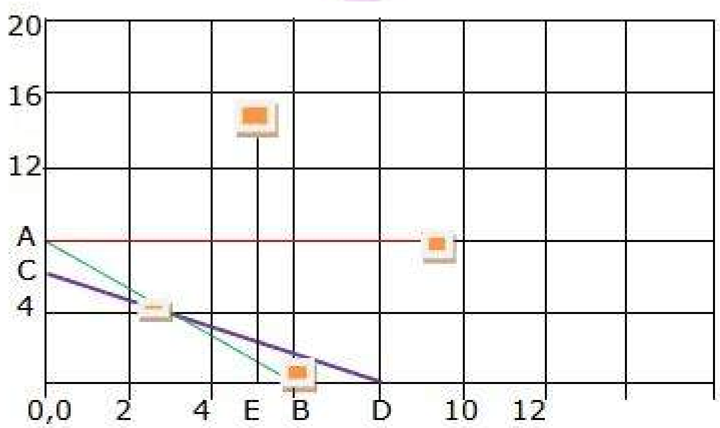
Let us plot these points, we get lines AB and CD.
We know that the feasible area is the unbounded area D-E-12

Corner point	Value of Z = 50x + 30y
10, 2	560
11.3, 17	1076.66

The maximum value of Z = 50x + 30y which occurs at x = 34/3, y = 17
Since we have an unbounded region as the feasible area plot 50x + 30y > 1076.66

The region D-F-B has common points with region D-E-12 the problem has no optimal maximum value.

Q5.
Solution:



$3x + 4y \leq 24$; when x = 0, y = 6 and when y = 0, x = 8, line AB.

$8x + 6y \leq 48$; when $x = 0$, $y = 8$ and when $y = 0$, $x = 6$, line CD.

Let us plot these points, $x \leq 5$ we get line EF and $y \leq 6$ we get line AG.
We know that the feasible area is the unbounded area O, O-C-H-G-E

Corner point	Value of Z = 4x + 3y
0,0	0
0,6	18
3.4, 3.4	24
5, 1	23
5, 0	20