# Chapter 9

# Linear Programing

## Exercise 9.1

Q1. Solve following inequalities and graph the solution set in each case.

i). $x+3<7$

Sol: Given $x+3<7$

$x<7-3$

$x<4$


ii). $-3x-2\le 4$

Sol: Given $-3x-2\le 4$

$-3x\le 4+2$

$x\ge \frac{6}{-3}$

$x\ge -2$


iii). $2x+5\ge x-3$

Sol: Given $2x+5\ge x-3$

$2x-x\ge -3-5$

$x\ge -8$


Q2: Graph the following linear inequalities.

i). $x-2y\ge 4$

Sol: Given $x-2y\ge 4$

Consider associated equation $x-2y=4$

For y intercept put $x=0$

$0-2y=4$

$y=-2$

For x-intercept put $y=0$

$x-2(0)=4$

$x=4$

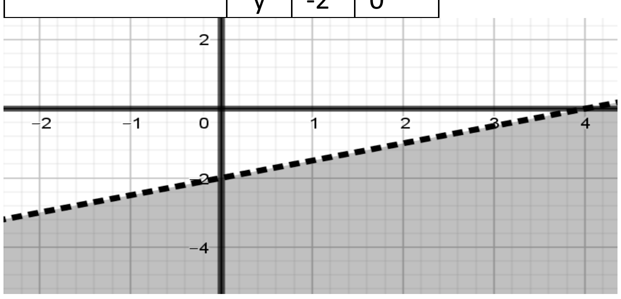
For shade inequality put Origin $(0,0)$ i.e. $x=0, y=0$

$(0)-2(0)\ge 4$

$0\ge 4$

False, so we shade the side of line that opposite origin

| And the table | X | 0 | 4 |
|---|---|---|---|
| | y | -2 | 0 |



ii). $x+y\le 2$

Sol: Given $x+y\le 2$

consider the associated equation $x+y=2$

For y intercept put $x=0$

$0+y=2$ $\Rightarrow$ $y=2$

For x-intercept put $y=0$

$x+0=2$ $\Rightarrow x=2$

For shade inequality put Origin $(0,0)$ i.e. $x=0, y=0$

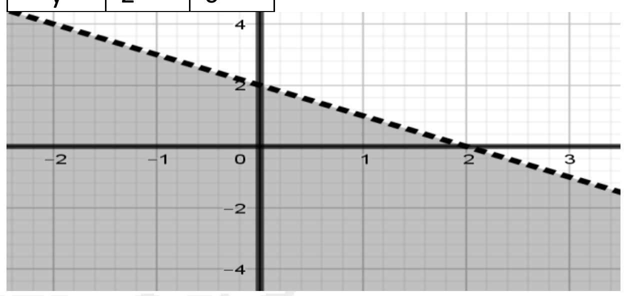
$0+0\le 2$

$0\le 2$

True, so we shade the side of line that have origin

And the table

| X | 0 | 2 |
|---|---|---|
| y | 2 | 0 |



iii). $2x-3y>6$

Sol: Given $2x-3y>6$

consider the associated equation $2x-3y=6$

For y intercept put $x=0$

$2(0)-3y=6$

$-3y=6$

$y=-2$

For x-intercept put $y=0$

$2x-3(0)=6$

$2x=6$

$x=3$

For shade the inequality put Origin $(0,0)$ i.e.

$x=0, y=0$

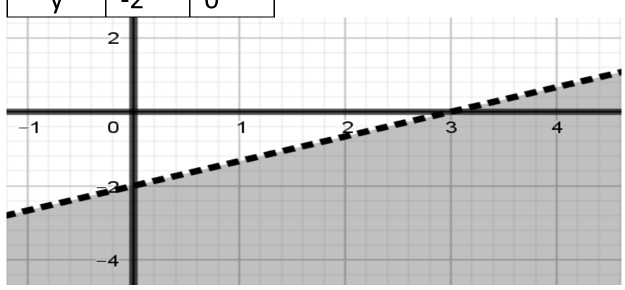
$2(0)-3(0)>6$

$0>6$

False, so we shade side of line that opposite the origin

And the table

| X | 0 | 3 |
|---|---|---|
| y | -2 | 0 |



Q3: Graph the following linear inequalities.

i). $2x-3y\le 12$ and $3x+2y\le 6$

Sol: Given $2x-3y\le 12$ and $3x+2y\le 6$

Consider associated equations

$2x-3y=12$ $\qquad$ $3x+2y=6$

For y intercept $\qquad$ put $x=0$

$2(0)-3y=12$ $\qquad$ $3(0)+2y=6$

$-3y=12$ $\qquad$ $2y=6$

$y=-4$ $\qquad$ $y=3$

For x-intercept $\qquad$ put $y=0$

$2x-3(0)=12$ $\qquad$ $3x+2(0)=6$

$2x=12$ $\qquad$ $3x=6$

$x=6$ $\qquad$ $x=2$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)-3(0)\le 12$ $\qquad$ $3(0)+2(0)\le 6$

$0\le 12$ $\qquad$ $0\le 6$

True $\qquad$ True

So we shade the side of line that

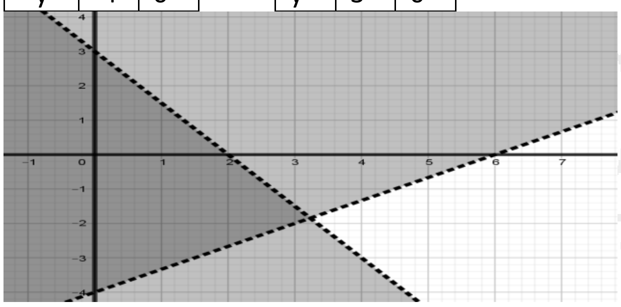
have origin $\qquad$ have origin

And the tables

| X | 0 | 6 |
|---|---|---|
| y | -4 | 0 |

And

| X | 0 | 2 |
|---|---|---|
| y | 3 | 0 |



ii). $\quad x+2y\ge 2$ and $4x-y\ge 4$

Sol: Given $x+2y\ge 2$ and $4x-y\ge 4$

Consider associated equations

$x+2y=2$ $\qquad$ $4x-y=4$

For y intercept $\qquad$ put $x=0$

$0+2y=2$ $\qquad$ $4(0)-y=4$

$2y=2$ $\qquad$ $-y=4$

$y=1$ $\qquad$ $y=-4$

For x-intercept $\qquad$ put $y=0$

$x+2(0)=2$ $\qquad$ $4x-0=4$

$x+0=2$ $\qquad$ $4x=4$

$x=2$ $\qquad$ $x=1$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+2(0)\ge 2$ $\qquad$ $4(0)-0\ge 4$

$0\ge 2$ $\qquad$ $0\ge 4$

False $\qquad$ False

So we shade the side of line that

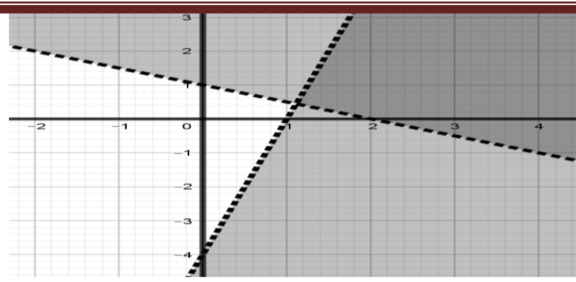
Opposite to origin $\qquad$ Opposite to origin

and the tables

| X | 0 | 2 |
|---|---|---|
| y | 1 | 0 |

And

| X | 0 | 1 |
|---|---|---|
| Y | -4 | 0 |



iii). $\quad x-y\le 1$ and $x+y\ge 4$

Sol: Given $x-y\le 1$ and $x+y\ge 4$

Consider associated equations

$x-y=1$ $\qquad$ $x+y=4$

For y intercept $\qquad$ put $x=0$

$0-y=1$ $\qquad$ $0+y=4$

$-y=1$ $\qquad$ $y=4$

$y=-1$

For x-intercept $\qquad$ put $y=0$

$x-0=1$ $\qquad$ $x+0=4$

$x=1$ $\qquad$ $x=4$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0-0\le 1$ $\qquad$ $0+0\ge 4$

$0\le 1$ $\qquad$ $0\ge 4$

True $\qquad$ False

So we shade the side of line that

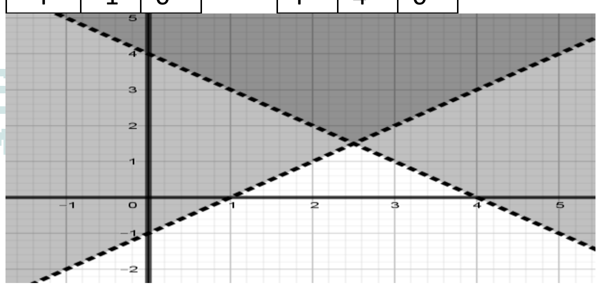
have origin $\qquad$ Opposite to origin

and the tables

| X | 0 | 1 |
|---|---|---|
| Y | -1 | 0 |

And

| X | 0 | 4 |
|---|---|---|
| Y | 4 | 0 |



Q4: Graph following system of linear inequalities.

i). $\quad 2x+y\ge 4$ , $x+y\ge 3$ and $x\ge 0$

Sol: we have $2x+y\ge 4$ , $x+y\ge 3$ and $x\ge 0$

Consider associated equations

$2x+y=4$ $\qquad$ $x+y=3$

For y intercept $\qquad$ put $x=0$

$2(0)+y=4$ $\qquad$ $0+y=3$

$y=4$ $\qquad$ $y=3$

For x-intercept $\qquad$ put $y=0$

$2x+0=4$ $\qquad$ $x+0=3$

$2x=4$ $\qquad$ $x=3$

$x=2$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)+0\ge 4$ $\qquad$ $0+0\ge 3$

$0\ge 4$ $\qquad$ $0\ge 3$

False $\qquad$ False

So we shade the side of line that

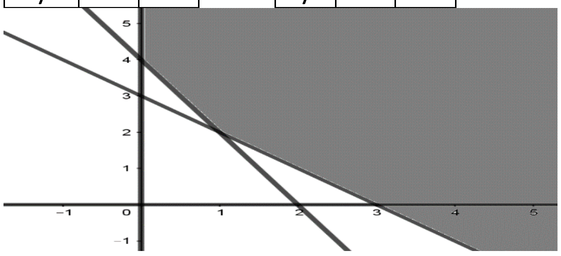
Opposite to origin Opposite to origin

and the tables

| X | 0 | 2 |
|---|---|---|
| y | 4 | 0 |

And

| X | 0 | 3 |
|---|---|---|
| y | 3 | 0 |



ii). $2x+y\le 8$ , $x+y\le 6$ and $y\ge 0$

Sol: we have $2x+y\le 8$ , $x+y\le 6$ and $y\ge 0$

Consider associated equations

$2x+y=8$ $x+y=6$

For y intercept put $x=0$

$2(0)+y=8$ $0+y=6$

$y=8$ $y=6$

For x-intercept put $y=0$

$2x+0=8$ $x+0=6$

$2x=8$ $x=6$

$x=4$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)+0\le 8$ $0+0\le 6$

$0\le 8$ $0\le 6$

True True

So we shade the side of line that

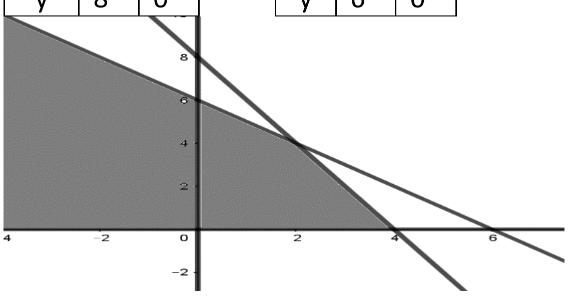
have origin have origin

and the tables

| X | 0 | 4 |
|---|---|---|
| y | 8 | 0 |

And

| X | 0 | 6 |
|---|---|---|
| y | 6 | 0 |



iii). $2x+y\ge 2$ , $x+2y\le 10$ and $x\ge 0$

Sol: we have $2x+y\ge 2$ , $x+2y\le 10$ and $x\ge 0$

Consider associated equations

$2x+y=2$ $x+2y=10$

For y intercept put $x=0$

$2(0)+y=2$ $0+2y=10$

$y=2$ $2y=10$

$y=5$

For x-intercept put $y=0$

$2x+0=2$ $x+2(0)=10$

$2x=2$ $x=10$

$x=1$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\ge 2$ $0+0\le 10$

$0\ge 2$ $0\le 10$

False True

So we shade the side of line that

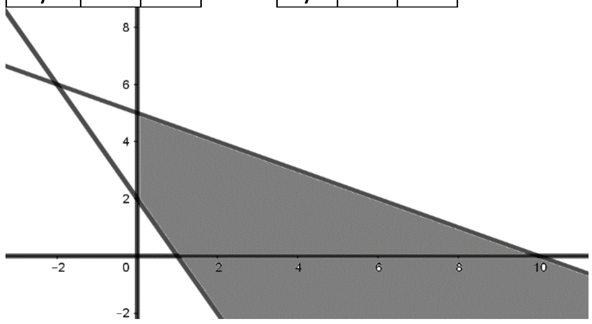
Opposite to origin have origin

and the tables

| X | 0 | 1 |
|---|---|---|
| y | 2 | 0 |

And

| X | 0 | 10 |
|---|---|---|
| y | 5 | 0 |



Q5:Graph the solution of the following system of linear inequalities and find the corner points in each case. Also tell where the graph is bounded or unbounded.

i). $2x+y\le 6$ , $x+2y\le 6$ and $x\ge 0$

Sol: we have $2x+y\le 6$ , $x+2y\le 6$ and $x\ge 0$

Consider associated equations

$2x+y=6$ $x+2y=6$

For y intercept put $x=0$

$2(0)+y=6$ $0+2y=6$

$y=6$ $2y=6$

$y=3$

For x-intercept put $y=0$

$2x+0=6$ $x+2(0)=6$

$2x=6$ $x=6$

$x=3$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)+0\le 6$ $0+2(0)\le 6$

$0\le 6$ $0\le 6$

True True

So we shade the side of line that

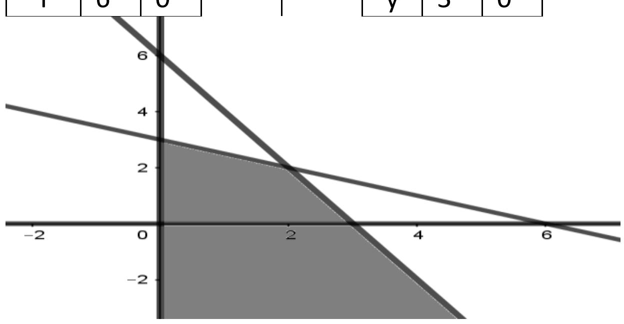
have origin have origin

and the tables

| X | 0 | 3 |
|---|---|---|
| Y | 6 | 0 |

now

| X | 0 | 6 |
|---|---|---|
| y | 3 | 0 |



The graph is unbounded and the corner points are A(3,0) , B(0,0) and C(2,2)

ii). $2x+3y\ge 6$ , $x+y\ge 4$ and $y\ge 0$

Sol: Given $2x+3y\geq 6$ , $x+y\geq 4$ and $y\geq 0$

Consider associated equations

$2x+3y=6$ $\qquad$ $x+y=4$

For y intercept $\qquad$ put $x=0$

$2(0)+3y=6$ $\qquad$ $0+y=4$

$3y=6$ $\qquad$ $y=4$

$y=2$

For x-intercept $\qquad$ put $y=0$

$2x+3(0)=6$ $\qquad$ $x+0=4$

$2x=6$ $\qquad$ $x=4$

$x=3$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)+3(0)\geq 6$ $\qquad$ $0+0\geq 4$

$0\geq 6$ $\qquad$ $0\geq 4$

False $\qquad$ False

So we shade the side of line that

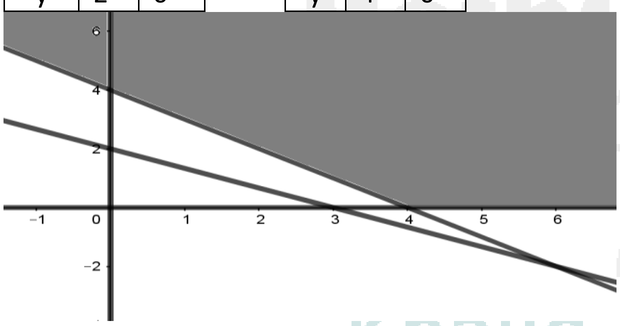
Opposite to origin $\qquad$ Opposite to origin

and the tables

| X | 0 | 3 |
|---|---|---|
| y | 2 | 0 |

now

| X | 0 | 4 |
|---|---|---|
| y | 4 | 0 |



Graph is unbounded and corner points are A(4,0) , B(0,4)

Q6: Graph the solution region of the following system of linear inequalities and find the corner points in each case. Also tell where the graph is bounded or unbounded.

i). $\qquad 2x+3y\leq 12$ , $3x+y\leq 12$ and $x+y\geq 2$

Sol: $2x+3y\leq 12$ , $3x+y\leq 12$ and $x+y\geq 2$

Consider associated equations

$2x+3y=12$ $\qquad$ $3x+y=12$ $\qquad$ $x+y=2$

For y intercept $\qquad$ put $x=0$

$2(0)+3y=12$ $\qquad$ $3(0)+y=12$ $\qquad$ $0+y=2$

$3y=12$ $\qquad$ $y=12$ $\qquad$ $y=2$

$y=4$

For x-intercept $\qquad$ put $y=0$

$2x+3(0)=12$ $\qquad$ $3x+0=12$ $\qquad$ $x+0=2$

$2x=12$ $\qquad$ $3x=12$ $\qquad$ $x=2$

$x=6$ $\qquad$ $x=4$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)+3(0)\leq 12$ $\qquad$ $3(0)+0\leq 12$ $\qquad$ $0+0\geq 2$

$0\leq 12$ $\qquad$ $0\leq 12$ $\qquad$ $0\geq 2$

True $\qquad$ True $\qquad$ False

So we shade the side of line that

have origin $\qquad$ have origin $\qquad$ Opposite to origin

and the tables

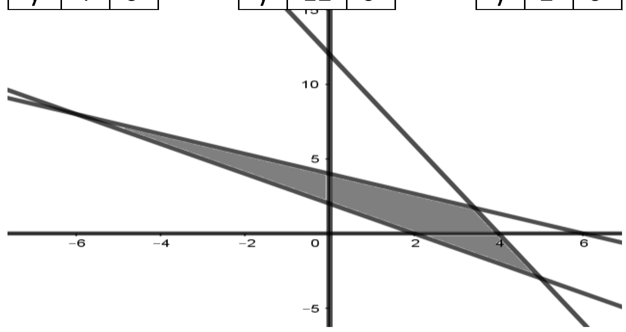
| X | 0 | 6 |
|---|---|---|
| y | 4 | 0 |

now

| X | 0 | 4 |
|---|---|---|
| y | 12 | 0 |

now

| X | 0 | 2 |
|---|---|---|
| y | 2 | 0 |



Graph is bounded & corner points are A(-6,8) , B(3.43,1.71) & C(5,-3)

ii). $\qquad 2x+y\geq 3$ , $x+y\leq 5$ and $x-y\geq 2$

Sol: $2x+y\geq 3$ , $x+y\leq 5$ and $x-y\geq 2$

Consider associated equations

$2x+y=3$ $\qquad$ $x+y=5$ $\qquad$ $x-y=2$

For y intercept $\qquad$ put $x=0$

$2(0)+y=3$ $\qquad$ $0+y=5$ $\qquad$ $0-y=2$

$y=3$ $\qquad$ $y=5$ $\qquad$ $y=-2$

For x-intercept $\qquad$ put $y=0$

$2x+0=3$ $\qquad$ $x+0=5$ $\qquad$ $x-0=2$

$x=\frac{3}{2}$ $\qquad$ $x=5$ $\qquad$ $x=2$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)+0\geq 3$ $\qquad$ $0+0\leq 5$ $\qquad$ $0-0\geq 2$

$0\geq 3$ $\qquad$ $0\leq 5$ $\qquad$ $0\geq 2$

False $\qquad$ True $\qquad$ False

So we shade the side of line that

Opposite to origin $\qquad$ have origin $\qquad$ Opposite to origin

and the tables

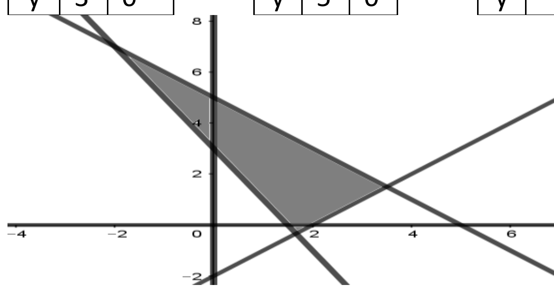
| X | 0 | 1.5 |
|---|---|---|
| y | 3 | 0 |

now

| X | 0 | 5 |
|---|---|---|
| y | 5 | 0 |

now

| X | 0 | 2 |
|---|---|---|
| y | -2 | 0 |



The graph is bounded and the corner points are D(-2,7) , B(1.67,-0.33) and C(3.5,1.5)

# Exercise 9.2

Q1: $\qquad$ Graph the feasible region of the following linear inequalities and also find the corner points.

i). $2x+y\leq 6$ and $4x+y\leq 8$ with $x\geq 0, y\geq 0$

Sol: $2x+y\leq 6$ and $4x+y\leq 8$ with $x\geq 0, y\geq 0$

Consider associated equations

$2x+y=6$ $\qquad$ $4x+y=8$

For y intercept $\qquad$ put $x=0$

$2(0)+y=6$ $\qquad$ $4(0)+y=8$

$y=6$ $\qquad$ $y=8$

For x-intercept put $y=0$

| $2x+0=6$ | $4x+0=8$ |
|---|---|
| $2x=6$ | $4x=8$ |
| $x=3$ | $x=2$ |

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)+0\le 6$ $\qquad$ $4(0)+0\le 8$

$0\le 6$ $\qquad$ $0\le 8$

True $\qquad$ True

So we shade the side of line that

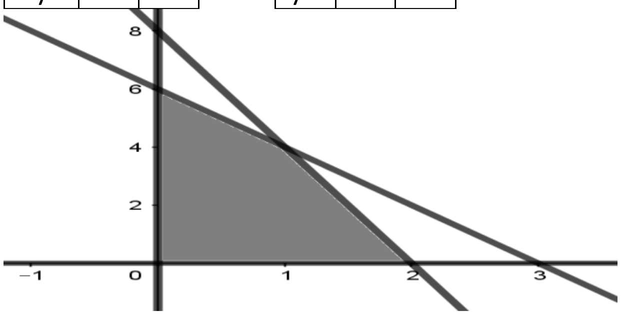
have origin $\qquad$ have origin

and the tables

| X | 0 | 3 |
|---|---|---|
| y | 6 | 0 |

And

| X | 0 | 2 |
|---|---|---|
| y | 8 | 0 |



The graph is bounded and the corner points are A(0,0) , B(2,0) , C(1,4) and D(0,6)

ii). $3x-y\ge -4$ and $x+y\le 5$ with $x\ge 0, y\ge 0$

Sol: $3x-y\ge -4$ and $x+y\le 5$ with $x\ge 0, y\ge 0$

Consider associated equations

$3x-y=-4$ $\qquad$ $x+y=5$

For y intercept put $x=0$

$3(0)-y=-4$ $\qquad$ $0+y=5$

$y=4$ $\qquad$ $y=5$

Put $y=1$ $\qquad$ For x-intercept put $y=0$

$3x-1=-4$

$3x=-4+1=-3$ $\qquad$ $x+0=5$

$x=-1$ $\qquad$ $x=5$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$3(0)-0\ge -4$ $\qquad$ $0+0\le 5$

$0\ge -4$ $\qquad$ $0\le 5$

True $\qquad$ True

So we shade the side of line that

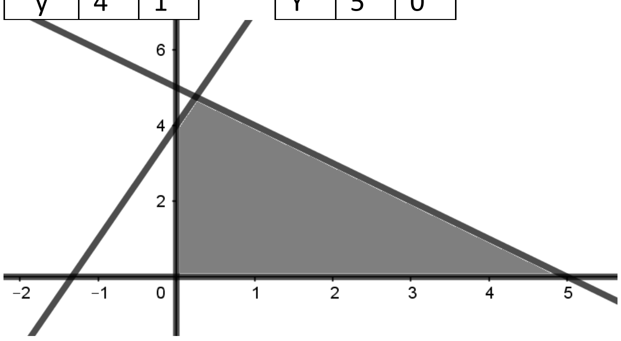
have origin $\qquad$ have origin

and the tables

| X | 0 | -1 |
|---|---|---|
| y | 4 | 1 |

And

| X | 0 | 5 |
|---|---|---|
| Y | 5 | 0 |



The graph is bounded and the corner points are A(0,0) , B(4,0) , C(0.25,4.75) and D(0,4)

iii). $x+2y\le 6$ and $2x+y\le 6$ with $x\ge 0, y\ge 0$

Sol: $x+2y\le 6$ and $2x+y\le 6$ with $x\ge 0, y\ge 0$

Consider associated equations

$x+2y=6$ $\qquad$ $2x+y=6$

For y intercept put $x=0$

| $0+2y=6$ | $2(0)+y=6$ |
|---|---|
| $2y=6$ | $0+y=6$ |
| $y=3$ | $y=6$ |

For x-intercept put $y=0$

| $x+2(0)=6$ | $2x+0=6$ |
|---|---|
| $x=6$ | $x=3$ |

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+2(0)\le 6$ $\qquad$ $2(0)+0\le 6$

$0\le 6$ $\qquad$ $0\le 6$

True $\qquad$ True

So we shade the side of line that

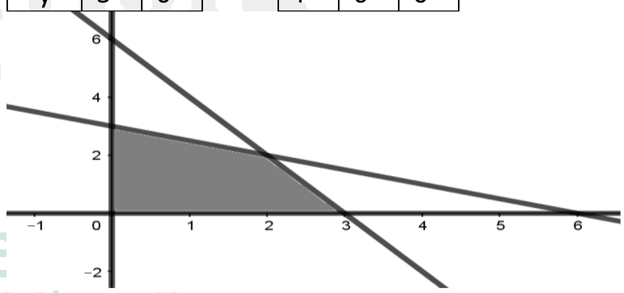
have origin $\qquad$ have origin

and the tables

| X | 0 | 6 |
|---|---|---|
| y | 3 | 0 |

And

| X | 0 | 3 |
|---|---|---|
| Y | 6 | 0 |



The graph is bounded and the corner points are A(0,3) , B(0,0) , C(3,0) and D(2,2)

Q2:Graph the feasible region subject to the following linear inequalities and also find the corner points.

i). $x+2y\le 8$, $x+y\le 5$ & $2x+y\le 8$ with $x\ge 0, y\ge 0$

Sol: Given $x+2y\le 8$ , $x+y\le 5$ and $2x+y\le 8$ with $x\ge 0, y\ge 0$

Consider associated equations

$x+2y=8$ $\qquad$ $x+y=5$ $\qquad$ $2x+y=8$

For y intercept put $x=0$

| $0+2y=8$ | $0+y=5$ | $2(0)+y=8$ |
|---|---|---|
| $2y=8$ | $y=5$ | $y=8$ |
| $y=4$ | | |

For x-intercept put $y=0$

| $x+2(0)=8$ | $x+0=5$ | $2x+0=8$ |
|---|---|---|
| $x=8$ | $x=5$ | $x=4$ |

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

| $0+2(0)\le 8$ | $0+0\le 5$ | $2(0)+0\le 8$ |
|---|---|---|
| $0\le 8$ | $0\le 5$ | $0\le 8$ |
| True | True | True |

So we shade the side of line that

have origin have origin have origin

and the tables

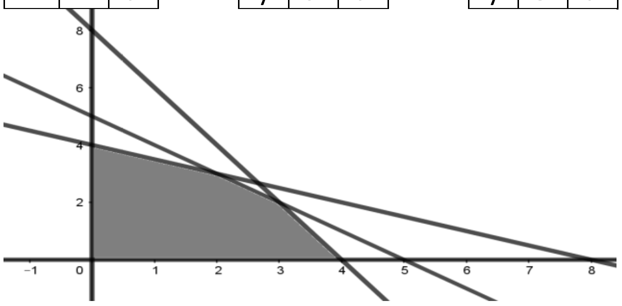
| X | 0 | 8 |
|---|---|---|
| Y | 4 | 0 |

now

| X | 0 | 5 |
|---|---|---|
| y | 5 | 0 |

now

| X | 0 | 4 |
|---|---|---|
| y | 8 | 0 |



The graph is bounded and the corner points are A(0,0) , B(4,0) , C(3,2) , D(2,3) and E(0,4)

ii). $2x+y\geq 6, 2x+3y\leq 12$ & $-x+y\leq 2$ with $x\geq 0, y\geq 0$

Sol: Given $2x+y\geq 6$ , $2x+3y\leq 12$ and $-x+y\leq 2$ with $x\geq 0, y\geq 0$

Consider associated equations

$2x+y=6$ $\quad 2x+3y=12$ $\quad -x+y=2$

For y intercept put $x=0$

$2(0)+y=6$ $\quad 2(0)+3y=12$ $\quad -0+y=2$

$y=6$ $\quad 3y=12$ $\quad y=2$

$y=4$

For x-intercept put $y=0$

$2x+0=6$ $\quad 2x+3(0)=12$ $\quad -x+0=2$

$2x=6$ $\quad 2x=12$ $\quad -x=2$

$x=3$ $\quad x=6$ $\quad x=-2$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$2(0)+0\geq 6$ $\quad 2(0)+3(0)\leq 12$ $\quad -0+0\leq 2$

$0\geq 6$ $\quad 0\leq 12$ $\quad 0\leq 2$

False True True

So we shade the side of line that

Opposite to origin have origin have origin

and the tables

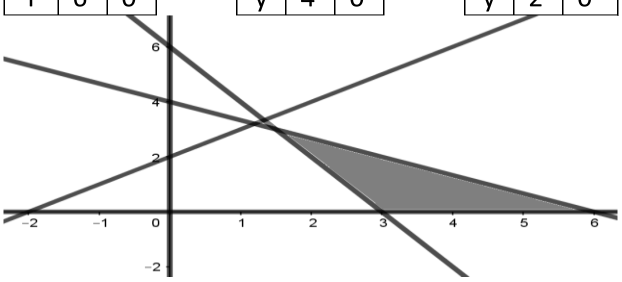
| X | 0 | 3 |
|---|---|---|
| Y | 6 | 0 |

now

| X | 0 | 6 |
|---|---|---|
| y | 4 | 0 |

now

| X | 0 | -2 |
|---|---|---|
| y | 2 | 0 |



Graph is bounded & corner points are A(3,0) , B(1.5,3) & C(6,0)

iii). $x+y\geq 3, 2x+3y\leq 12$ & $x-y\leq 12$ with $x\geq 0, y\geq 0$

Sol: Given $x+y\geq 3$ , $2x+3y\leq 12$ and $x-y\leq 12$ with $x\geq 0, y\geq 0$

Consider associated equations

$x+y=3$ $\quad 2x+3y=12$ $\quad x-y=12$

For y intercept put $x=0$

$0+y=3$ $\quad 0+3y=12$ $\quad 0-y=12$

$y=3$ $\quad y=4$ $\quad y=-12$

For x-intercept put $y=0$

$x+0=3$ $\quad 2x+0=12$ $\quad x-0=12$

$x=3$ $\quad x=6$ $\quad x=12$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\geq 3$ $\quad 0+0\leq 12$ $\quad 0-0\leq 12$

$0\geq 3$ $\quad 0\leq 12$ $\quad 0\leq 12$

False True True

So we shade the side of line that

Opposite to origin have origin have origin

and the tables

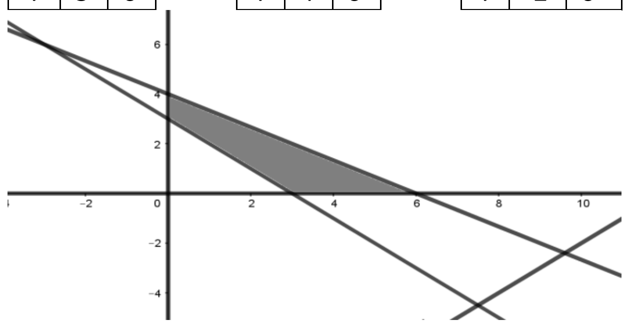
| X | 0 | 3 |
|---|---|---|
| Y | 3 | 0 |

now

| X | 0 | 6 |
|---|---|---|
| Y | 4 | 0 |

now

| X | 0 | 2 |
|---|---|---|
| Y | -2 | 0 |



The graph is bounded and the corner points are A(2.5,0.5) , B(18/5,8/5) , C(0,4) and D(0,3)

## Exercise 9.3

Q1: Maximize $f(x,y)=2x+y$ subject to constraints $x+y\leq 6$ and $x+y\geq 1$ with $x\geq 0, y\geq 0$

Sol: $x+y\leq 6$ and $x+y\geq 1$ with $x\geq 0, y\geq 0$

Consider associated equations

$x+y=6$ $\quad x+y=1$

For y intercept put $x=0$

$0+y=6$ $\quad 0+y=1$

$y=6$ $\quad y=1$

For x-intercept put $y=0$

$x+0=6$ $\quad x+0=1$

$x=6$ $\quad x=1$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\leq 6$ $\quad 0+0\geq 1$

$0\leq 6$ $\quad 0\geq 1$

True False

So we shade the side of line that

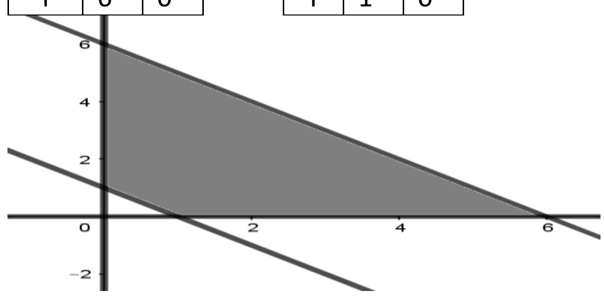
have origin Opposite to origin

and the tables

| X | 0 | 6 |
|---|---|---|
| Y | 6 | 0 |

and

| X | 0 | 1 |
|---|---|---|
| Y | 1 | 0 |



The graph is bounded and the corner points are A(0,1) , B(1,0) , C(6,0) and D(0,6)

| At $(x,y)$ | $f(x,y)=2x+y$ | |
|---|---|---|
| A(0,1) | 2.0+1 | 1 |
| B(1,0) | 2.1+0 | 2 |
| C(6,0) | 2.6+0 | 12 |
| D(0,6) | 2.0+6 | 6 |

Clearly f(x,y) is Maximize at C(6,0) and its value is 6

Q2: Maximize $f(x,y)=3x+5y$ subject to constraints $2x+3y\le 12$, $3x+2y\le 12$ & $x+y\ge 2$ with $x\ge 0, y\ge 0$

Sol: Given $2x+3y\le 12$, $3x+2y\le 12$ and $x+y\ge 2$ with $x\ge 0, y\ge 0$

Consider associated equations

$2x+3y=12$ $\quad$ $3x+2y=12$ $\quad$ $x+y=2$

For y intercept put $x=0$

$0+3y=12$ $\quad$ $0+2y=12$ $\quad$ $0+y=2$

$y=4$ $\quad$ $y=6$ $\quad$ $y=2$

For x-intercept put $y=0$

$2x+0=12$ $\quad$ $3x+0=12$ $\quad$ $x+0=2$

$x=6$ $\quad$ $x=4$ $\quad$ $x=2$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\le 12$ $\quad$ $0+0\le 12$ $\quad$ $0+0\ge 2$

$0\le 12$ $\quad$ $0\le 12$ $\quad$ $0\ge 2$

True $\quad$ True $\quad$ False

So we shade the side of line that

have origin $\quad$ have origin $\quad$ Opposite to Origin

and the tables

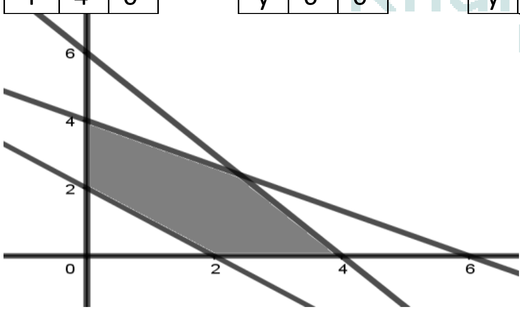
| X | 0 | 6 |
|---|---|---|
| Y | 4 | 0 |

now

| X | 0 | 4 |
|---|---|---|
| y | 6 | 0 |

now

| X | 0 | 2 |
|---|---|---|
| y | 2 | 0 |



Graph is bounded and the corner points are A(2,0) , B(4,0) , C(2.4,2.4) , D(0,6), E(0,2) and F(0,1.5)

| At $(x,y)$ | $f(x,y)=3x+5y$ | |
|---|---|---|
| A(2,0) | 3.2+0 | 6 |
| A(0,2) | 3.0+2.5 | 10 |
| B(4,0) | 3.4+0 | 12 |
| C(2.4,2.4) | 3x2.4+5x2.4 | 19.2 |
| D(0,6) | 3.0+6.5 | 30 |
| E(0,1.5) | 3.0+5.1.5 | 7.5 |
| F(0,4) | 3.0+5.4 | 20 |

Clearly f(x,y) is Maximize at D(0,4) & its value is 20

Q3:Minimize $f(x,y)=3x+4y$ subject to the constraints $2x+3y\ge 6$, $x+y\le 8$ with $x\ge 0, y\ge 0$

Sol: $2x+3y\ge 6$, $x+y\le 8$ with $x\ge 0, y\ge 0$

Consider associated equations

$2x+3y=6$ $\quad$ $x+y=8$

For y intercept put $x=0$

$0+3y=6$ $\quad$ $0+y=8$

$y=2$ $\quad$ $y=8$

For x-intercept put $y=0$

$2x+0=6$ $\quad$ $x+0=8$

$x=3$ $\quad$ $x=8$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\ge 6$ $\quad$ $0+0\le 8$

$0\ge 6$ $\quad$ $0\le 8$

False $\quad$ True

So we shade the side of line that

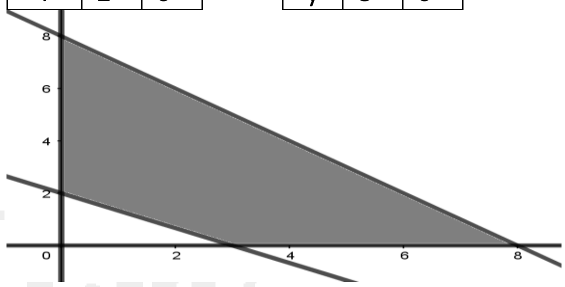
Opposite to origin $\quad$ have origin

and the tables

| X | 0 | 3 |
|---|---|---|
| Y | 2 | 0 |

now

| X | 0 | 8 |
|---|---|---|
| y | 8 | 0 |



graph is bounded & corner points are A(0,2) , B(3,0) , C(8,0) and D(0,8)

| At $(x,y)$ | $f(x,y)=3x+4y$ | |
|---|---|---|
| A(0,2) | 3.0+4.2 | 8 |
| B(3,0) | 3.3+4.0 | 9 |
| C(8,0) | 3.8+4.0 | 24 |
| D(0,8) | 3.0+4.8 | 32 |

Clearly f(x,y) is Minimize at D(0,2) and its value is 8

Q4.Find Maximum and Minimum values of function $f(x,y)=5x+2y$ subject to the constraints $2x+y\ge 2$, $x+2y\le 10$ with $x\ge 0, y\ge 0$

Sol: $2x+y\ge 2$, $x+2y\le 10$ with $x\ge 0, y\ge 0$

Consider associated equations

$2x+y=2$ $\quad$ $x+2y=10$

For y intercept put $x=0$

$0+y=2$ $\quad$ $0+2y=10$

$y=2$ $\quad$ $y=5$

For x-intercept put $y=0$

$2x+0=2$ $\quad$ $x+0=10$

$x=1$ $\quad$ $x=10$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\ge 2$ $\quad$ $0+0\le 10$

$0\ge 2$ $\quad$ $0\le 10$

False $\quad$ True

So we shade the side of line that

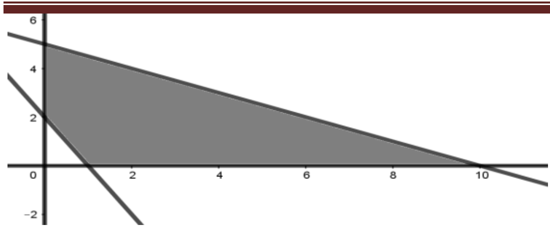
Opposite to origin $\quad$ have origin

and the tables

| X | 0 | 1 |
|---|---|---|
| Y | 2 | 0 |

now

| X | 0 | 10 |
|---|---|---|
| y | 5 | 0 |




The graph is bounded and the corner points are A(1,0) , B(10,0) , C(0,5) and D(0,2)

| At $(x,y)$ | $f(x,y)=5x+2y$ | |
|---|---|---|
| A(1,0) | 5.1+2.0 | 5 |
| B(10,0) | 5.10+2.0 | 50 |
| C(0,5) | 5.0+2.5 | 10 |
| D(0,2) | 5.0+2.2 | 4 |

Clearly f(x,y) is Maximize at D(10,0) & its value is 50
Minimize at D(0,2) and its value is 4

Q5.Find Maximum and Minimum values of the function $f(x,y)=7x+21y$ subject to constraints $2x+y\geq 2$, $2x+3y\leq 6$ and $x+2y\leq 8$ with $x\geq 0, y\geq 0$

Sol: Given $2x+y\geq 2$, $2x+3y\leq 6$ and $x+2y\leq 8$ with $x\geq 0, y\geq 0$

Consider associated equations

$2x+y=2$ $\quad$ $2x+3y=6$ $\quad$ $x+2y=8$

For y intercept put $x=0$

$0+y=2$ $\quad$ $0+3y=6$ $\quad$ $0+2y=8$

$y=2$ $\quad$ $y=2$ $\quad$ $y=4$

For x-intercept put $y=0$

$2x+0=2$ $\quad$ $2x+0=6$ $\quad$ $x+0=8$

$x=1$ $\quad$ $x=3$ $\quad$ $x=8$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\geq 2$ $\quad$ $0+0\leq 6$ $\quad$ $0+0\leq 8$

$0\geq 2$ $\quad$ $0\leq 6$ $\quad$ $0\leq 8$

False $\quad$ True $\quad$ True

So we shade the side of line that

Opposite to origin $\quad$ have origin $\quad$ have origin

and the tables

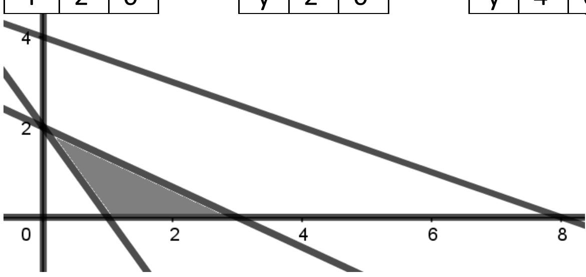
| X | 0 | 1 |
|---|---|---|
| Y | 2 | 0 |

now

| X | 0 | 3 |
|---|---|---|
| y | 2 | 0 |

now

| X | 0 | 8 |
|---|---|---|
| y | 4 | 0 |




The graph is bounded and the corner points are A(1,0) , B(3,0) and C(0,2)

| At $(x,y)$ | $f(x,y)=7x+21y$ | |
|---|---|---|
| A(1,0) | 7.1+21.0 | 7 |
| B(3,0) | 7.3+21.0 | 21 |
| C(0,2) | 7.0+21.2 | 42 |
| D(0,4) | 7.0+21.4 | 84 |

Clearly f(x,y) is Maximize at D(0,2) & its value is 84
Minimize at D(1,0) and its value is 7

Q6.Let manufactures of bicycle Model A=x manufactures of bicycle Model B=y

Sol: Suppose P(x,y) is Profit function, then P(x,y)=40x+50y and subject to constraints are $5x+4y\leq 120$, and $4x+8y\leq 144$ with $x\geq 0, y\geq 0$

Consider associated equations

$5x+4y=120$ $\quad$ $4x+8y=144$

For y intercept put $x=0$

$0+4y=120$ $\quad$ $0+8y=144$

$y=30$ $\quad$ $y=18$

For x-intercept put $y=0$

$5x+0=120$ $\quad$ $4x+0=144$

$x=24$ $\quad$ $x=36$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\leq 120$ $\quad$ $0+0\leq 144$

$0\leq 120$ $\quad$ $0\leq 144$

True $\quad$ True

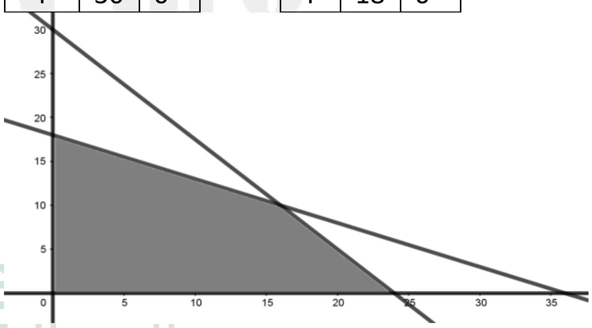
So we shade the side of line that

have origin $\quad$ have origin $\quad$ and the tables

| X | 0 | 24 |
|---|---|---|
| Y | 30 | 0 |

now

| X | 0 | 36 |
|---|---|---|
| Y | 18 | 0 |




The graph is bounded and the corner points are A(0,0) , B(24,0) ,C(16,10) and D(0,18)

| At $(x,y)$ | P(x,y)=40x+50y | |
|---|---|---|
| A(0,0) | 40.0+50.0 | 0 |
| B(24,0) | 40.24+50.0 | 960 |
| C(16,10) | 40.16+10.50 | 1140 |
| D(0,18) | 40.0+18.50 | 900 |

Clearly Maximum profit at C(16,10) and its value is 1140

Q7. Lamp L1 Model = x , Lamp L2 Model = y

Sol: Given P(x,y)=70x+50y be the profit function according to conditions And constrains are $2x+y\leq 40$, and $x+y\leq 32$ with $x\geq 0, y\geq 0$

Consider associated equations

$2x+y=40$ $\quad$ $x+y=32$

For y intercept put $x=0$

$0+y=40$ $\quad$ $0+y=32$

$y=40$ $\quad$ $y=32$

For x-intercept put $y=0$

$2x+0=40$ $\quad$ $x+0=32$

$x=20$ $\quad$ $x=32$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\le 40$ $\qquad$ $0+0\le 32$

$0\le 40$ $\qquad$ $0\le 32$

True $\qquad$ True

So we shade the side of line that

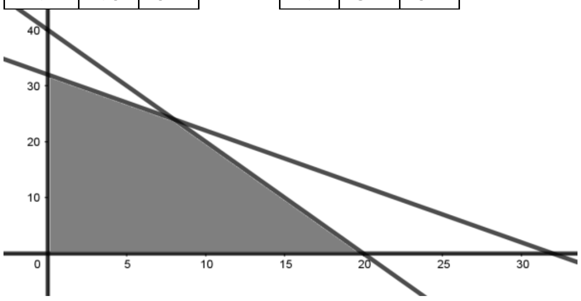
have origin $\qquad$ have origin

and the tables

| X | 0 | 20 |
|---|---|---|
| Y | 40 | 0 |

now

| X | 0 | 32 |
|---|---|---|
| Y | 32 | 0 |




The graph is bounded and the corner points are A(0,0) , B(20,0) ,C(8,24) and D(0,32)

| At $(x,y)$ | P(x,y)=70x+50y | |
|---|---|---|
| A(0,0) | 70.0+50.0 | 0 |
| B(20,0) | 70.20+50.0 | 1400 |
| C(8,24) | 70.8+50.24 | 1760 |
| D(0,32) | 70.0+50.32 | 1600 |

Clearly Maximum profit at C(8,24) & its value is 1760

Q8. Let for Achieving maximum profit

Product A=x, Product B=y

Sol: Given P(x,y) = 30x+20y with constrains

$2x+y\le 800,\quad x+2y\le 1000$ with $x\ge 0, y\ge 0$

Consider associated equations

$2x+y=800$ $\qquad$ $x+2y=1000$

For y intercept $\qquad$ put $x=0$

$0+y=800$ $\qquad$ $0+2y=1000$

$y=800$ $\qquad$ $y=500$

For x-intercept $\qquad$ put $y=0$

$2x+0=800$ $\qquad$ $x+0=1000$

$x=400$ $\qquad$ $x=1000$

For shade the inequalities put $(0,0)$ i.e. $x=0, y=0$

$0+0\le 800$ $\qquad$ $0+0\le 1000$

$0\le 800$ $\qquad$ $0\le 1000$

True $\qquad$ True

So we shade the side of line that

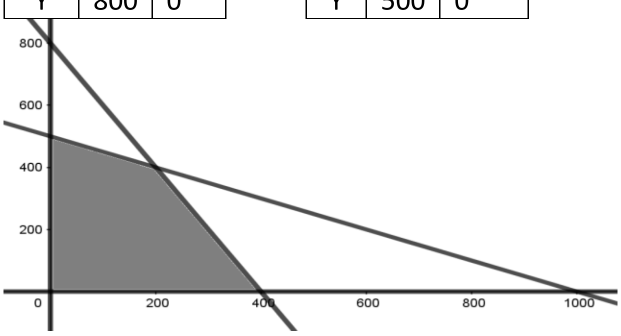
have origin $\qquad$ have origin

and the tables

| X | 0 | 400 |
|---|---|---|
| Y | 800 | 0 |

now

| X | 0 | 1000 |
|---|---|---|
| Y | 500 | 0 |




The graph is bounded and the corner points are A(0,0) , B(0,400) ,C(200,400) and D(0,500)

| At $(x,y)$ | P(x,y) = 30x+20y | |
|---|---|---|
| A(0,0) | 30.0+20.0 | 0 |
| B(400,0) | 30.400+20.0 | 12000 |
| C(200,400) | 30.200+20.400 | 14000 |
| D(0,500) | 30.0+20.500 | 10000 |

Clearly Maximum profit at C(200,400) & its value is 14000