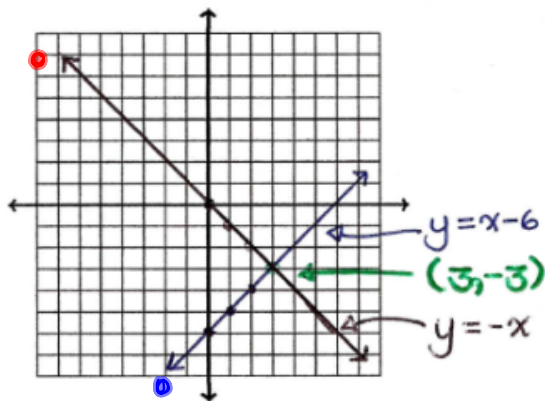


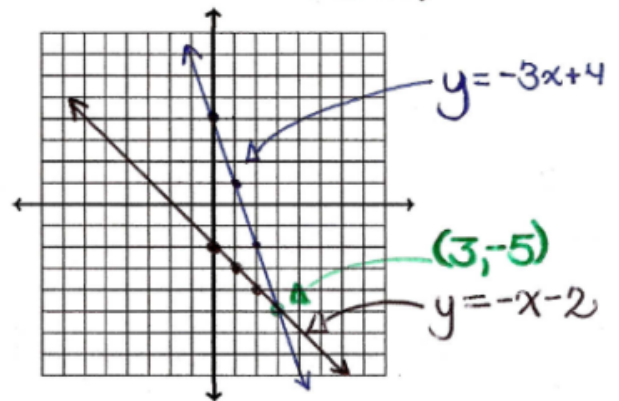
Math 112 Geo & Apps
Systems of Equations

Part I. Solve by graphing.

1. $y = -x$ $m = \frac{-1 \text{ (down)}}{1 \text{ (over)}} b = 0$
 $y = x - 6$ $m = \frac{1 \text{ (up)}}{1 \text{ (over)}} b = -6$



2. $y = -x - 2$ $m = \frac{-1 \text{ (down)}}{1 \text{ (over)}} b = -2$
 $y = -3x + 4$ $m = \frac{-3 \text{ (down)}}{1 \text{ (over)}} b = 4$



Solve by graphing

② • $y = -x - 2$

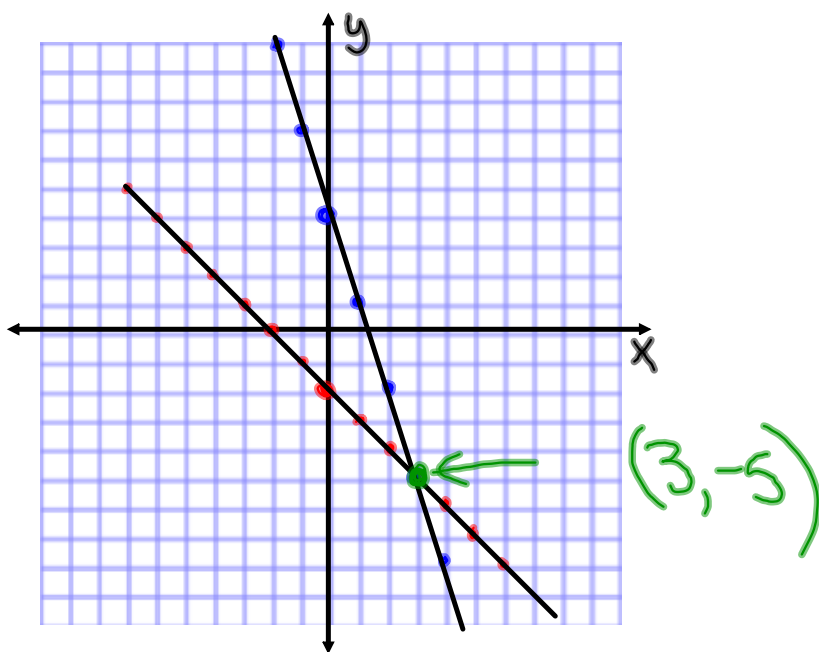
$m = -\frac{1}{1}$

$b = -2$

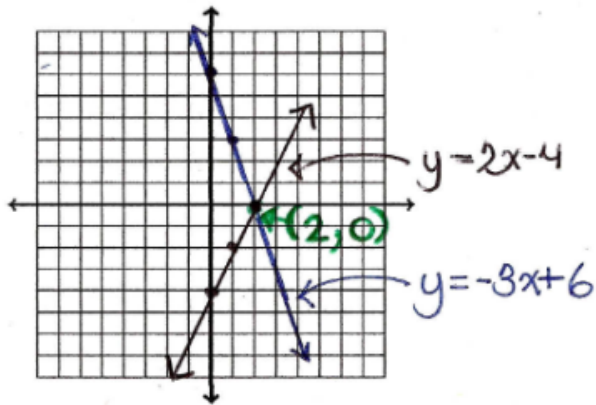
• $y = -3x + 4$

$m = -\frac{3}{1}$

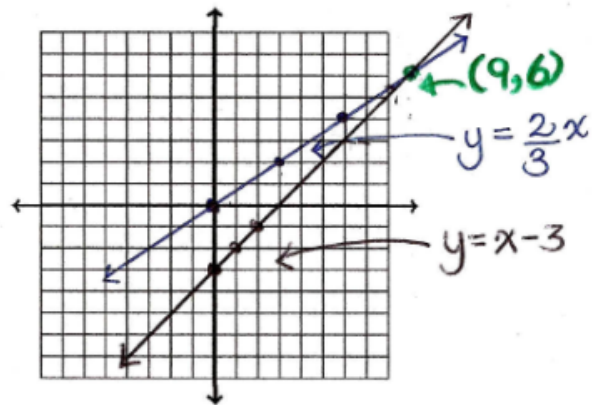
$b = 4$



3. $y = 2x - 4$ $m = \frac{2 \text{ (up)}}{1 \text{ (over)}} b = -4$
 $y = -3x + 6$ $m = \frac{-3 \text{ (down)}}{1 \text{ (over)}} b = 6$



4. $y = x - 3$ $m = \frac{1 \text{ (up)}}{1 \text{ (over)}} b = -3$
 $y = \frac{2}{3}x$ $m = \frac{2 \text{ (up)}}{3 \text{ (over)}} b = 0$



Ex: $x + 6y = 9$
 $x - 3y = 6$

$$x - 3y = 6$$

$$x = 3y + 6$$

$$x = 3\left(\frac{1}{3}\right) + 6$$

$$x = 1 + 6$$

$$x = 7$$

$$x + 6y = 9$$

$$(3y + 6) + 6y = 9$$

$$3y + 6 + 6y = 9$$

$$9y = 3$$

$$y = \frac{3}{9}$$

$$y = \frac{1}{3}$$

$$\textcircled{1} -2x + 2y = 6$$

$$\textcircled{2} 3x - y = 3$$

$$(3, 6)$$

$$\textcircled{2} 3x - y = 3$$

$$-y = -3x + 3$$

$$y = 3x - 3$$

$$y = 3(3) - 3$$

$$y = 9 - 3$$

$$y = 6$$

$$\textcircled{1} -2x + 2y = 6$$

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

$$-2x + 6x - 6 = 6$$

$$4x = 12$$

$$x = 3$$

PART II

$$5. \begin{cases} x+3y=0 & \textcircled{1} \\ x+y=4 & \textcircled{2} \end{cases}$$

$$\textcircled{2} \begin{cases} x+y=4 \\ y=-x+4 \text{ sub in } \textcircled{1} \end{cases}$$

$$\textcircled{1} \begin{cases} x+3y=0 \\ x+3(-x+4)=0 \\ x-3x+12=0 \\ -2x+12=0 \\ -\frac{2x}{-2} = \frac{-12}{-2} \end{cases}$$

$$x=6 \text{ sub in } \textcircled{2}$$

$$\textcircled{2} \begin{cases} x+y=4 \\ 6+y=4 \\ y=4-6 \\ y=-2 \end{cases}$$

$$\text{Solution} \Rightarrow (6, -2)$$

$$6. \begin{cases} -2x+3y+22=0 & \textcircled{1} \\ x+4y=0 & \textcircled{2} \end{cases}$$

$$\textcircled{2} \begin{cases} x+4y=0 \\ x=-4y \text{ sub in } \textcircled{1} \end{cases}$$

$$\textcircled{1} \begin{cases} -2x+3y+22=0 \\ -2(-4y)+3y+22=0 \\ 8y+3y+22=0 \\ 11y+22=0 \\ \frac{11y}{11} = \frac{-22}{11} \end{cases}$$

$$y=-2 \text{ sub in } \textcircled{2}$$

$$\textcircled{2} \begin{cases} x+4y=0 \\ x+4(-2)=0 \\ x-8=0 \\ x=8 \end{cases}$$

$$\text{Solution} \Rightarrow (8, -2)$$

$$7. \begin{cases} -x + y = -6 & \textcircled{1} \\ 3x + y = 2 & \textcircled{2} \end{cases}$$

$$\textcircled{1} \begin{cases} -x + y = -6 \\ y = x - 6 \text{ sub in } \textcircled{2} \end{cases}$$

$$\textcircled{2} \begin{cases} 3x + y = 2 \\ 3x + (x - 6) = 2 \\ 4x - 6 = 2 \\ 4x = 2 + 6 \\ \frac{4x}{4} = \frac{8}{4} \\ x = 2 \text{ sub in } \textcircled{1} \end{cases}$$

$$\textcircled{1} \begin{cases} -x + y = -6 \\ -2 + y = -6 \\ y = -6 + 2 \\ y = -4 \end{cases}$$

Solution $\Rightarrow (2, -4)$

$$8. \begin{cases} -6x - 2y = 2 & \textcircled{1} \\ 4x + y = 1 & \textcircled{2} \end{cases}$$

$$\textcircled{2} \begin{cases} 4x + y = 1 \\ y = -4x + 1 \text{ sub in } \textcircled{1} \end{cases}$$

$$\textcircled{1} \begin{cases} -6x - 2y = 2 \\ -6x - 2(-4x + 1) = 2 \\ -6x + 8x - 2 = 2 \\ 2x - 2 = 2 \\ 2x = 2 + 2 \\ \frac{2x}{2} = \frac{4}{2} \\ x = 2 \text{ sub in } \textcircled{2} \end{cases}$$

$$\textcircled{2} \begin{cases} 4x + y = 1 \\ 4(2) + y = 1 \\ 8 + y = 1 \\ y = 1 - 8 \\ y = -7 \end{cases}$$

Solution $\Rightarrow (2, -7)$

$$9. \begin{cases} -x + 4y = 8 & \textcircled{1} \\ 2x - 3y = -16 & \textcircled{2} \end{cases}$$

$$\textcircled{1} \begin{cases} -x + 4y = 8 \\ 4y - 8 = x \text{ sub in } \textcircled{2} \end{cases}$$

$$\textcircled{2} \begin{cases} 2x - 3y = -16 \\ 2(4y - 8) - 3y = -16 \\ 8y - 16 - 3y = -16 \\ 5y - 16 = -16 \\ 5y = -16 + 16 \\ 5y = 0 \\ \frac{5y}{5} = \frac{0}{5} \\ y = 0 \text{ sub in } \textcircled{1} \end{cases}$$

$$\textcircled{1} \begin{cases} -x + 4y = 8 \\ -x + 4(0) = 8 \\ -x + 0 = 8 \\ -x = 8 \\ \frac{-x}{-1} = \frac{8}{-1} \\ x = -8 \end{cases}$$

Solution $\Rightarrow (-8, 0)$

$$10. \begin{cases} 2x - 2y + 1 = 0 & \textcircled{1} \\ x + y + 1 = 0 & \textcircled{2} \end{cases}$$

$$\textcircled{2} \begin{cases} x + y + 1 = 0 \\ x = -y - 1 \text{ sub in } \textcircled{1} \end{cases}$$

$$\textcircled{1} \begin{cases} 2x - 2y + 1 = 0 \\ 2(-y - 1) - 2y + 1 = 0 \\ -2y - 2 - 2y + 1 = 0 \\ -4y - 1 = 0 \\ -4y = 1 \\ \frac{-4y}{-4} = \frac{1}{-4} \\ y = -\frac{1}{4} \text{ sub in } \textcircled{2} \end{cases}$$

$$\textcircled{2} \begin{cases} x + y + 1 = 0 \\ x - \frac{1}{4} + 1 = 0 \\ x - \frac{1}{4} + \frac{4}{4} = 0 \\ x + \frac{3}{4} = 0 \\ x = -\frac{3}{4} \end{cases}$$

Solution $\Rightarrow (-\frac{3}{4}, -\frac{1}{4})$

$$11. \begin{cases} x+6y = -9 & \textcircled{1} \\ x-3y = 6 & \textcircled{2} \end{cases}$$

$$\textcircled{2} \quad x-3y=6 \\ x = 3y+6 \text{ sub in } \textcircled{1}$$

$$\textcircled{1} \quad x+6y = -9 \\ (3y+6)+6y = -9 \\ 9y+6 = -9 \\ 9y = -9-6 \\ 9y = -15 \\ \frac{9y}{9} = \frac{-15}{9}$$

$$y = -\frac{15}{9} \\ y = -\frac{5}{3} \text{ sub in } \textcircled{2}$$

$$\textcircled{2} \quad x-3y=6 \\ x-3\left(-\frac{5}{3}\right)=6 \\ x+1\frac{5}{3}=6$$

$$x+5=6 \\ x=6-5 \\ x=1$$

$$\text{Solution} \Rightarrow (1, -5/3)$$

$$12. \begin{cases} -2x+2y = 6 & \textcircled{1} \\ 3x-y = 3 & \textcircled{2} \end{cases}$$

$$\textcircled{2} \quad 3x-y=3 \\ 3x-3 = y \text{ sub in } \textcircled{1}$$

$$\textcircled{1} \quad -2x+2y=6 \\ -2x+2(3x-3)=6 \\ -2x+6x-6=6 \\ 4x-6=6 \\ 4x=6+6 \\ \frac{4x}{4} = \frac{12}{4} \\ x=3 \text{ sub in } \textcircled{2}$$

$$\textcircled{2} \quad 3x-y=3 \\ 3(3)-y=3 \\ 9-y=3 \\ 9-3=y \\ 6=y$$

$$\text{Solution} \Rightarrow (3, 6)$$

Elimination:

$$\begin{array}{r} \textcircled{15} \quad -x - 6y = -3 \\ \textcircled{+} \quad \underline{x - 2y = 11} \\ \hline \quad -8y = 8 \\ \quad \underline{-8} \quad \underline{-8} \\ \quad \quad y = -1 \end{array}$$

$$\begin{array}{r} x - 2y = 11 \\ x - 2(-1) = 11 \\ x + 2 = 11 \\ \underline{x = 9} \end{array}$$

$$\boxed{(9, -1)}$$

Graphing:

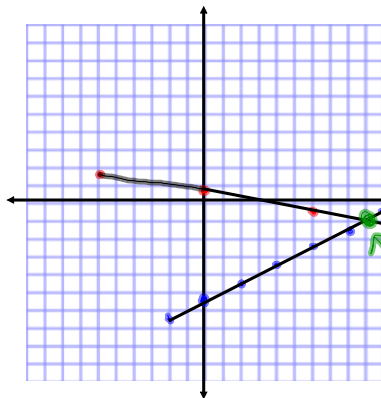
$$\begin{array}{l} \textcircled{15} \quad \textcircled{1} \quad -x - 6y = -3 \\ \quad \quad \textcircled{2} \quad x - 2y = 11 \end{array}$$

$$\textcircled{1} \quad \underline{-6y = x - 3} \\ \bullet \quad y = -\frac{1}{6}x + \frac{1}{2}$$

$$\textcircled{2} \quad \underline{-2y = -x + 11} \\ \bullet \quad y = \frac{1}{2}x - \frac{11}{2}$$

$$m = -\frac{1}{6} \quad b = \frac{1}{2} \text{ or } 0.5$$

$$m = \frac{1}{2} \quad b = -\frac{11}{2} \text{ or } -5.5$$



$$\boxed{(9, -1)}$$

Substitution:

$$\begin{array}{l} \textcircled{15} \quad \textcircled{1} \quad -x - 6y = -3 \\ \quad \quad \textcircled{2} \quad x - 2y = 11 \end{array}$$

$$\begin{array}{l} \textcircled{2} \quad x = 2y + 11 \\ x = 2(-1) + 11 \\ x = -2 + 11 \\ \underline{x = 9} \end{array}$$

$$\begin{array}{l} \textcircled{1} \quad -x - 6y = -3 \\ \quad \underline{-(2y + 11)} - 6y = -3 \\ \quad \quad -2y - 11 - 6y = -3 \\ \quad \quad \quad -8y - 11 = -3 \\ \quad \quad \quad \underline{-8y = 8} \\ \quad \quad \quad \underline{y = -1} \end{array}$$

$$\boxed{(9, -1)}$$

PART III

$$\begin{aligned} 13. \quad x+y &= 0 \quad \textcircled{1} \\ x-y &= -14 \quad \textcircled{2} \end{aligned}$$

$$\begin{aligned} \textcircled{1} - \textcircled{2} \quad 2y &= 14 \\ \frac{2y}{2} &= \frac{14}{2} \\ y &= 7 \text{ sub in } \textcircled{1} \end{aligned}$$

$$\begin{aligned} \textcircled{1} \quad x+y &= 0 \\ x+7 &= 0 \\ x &= -7. \end{aligned}$$

Solution $\Rightarrow (-7, 7)$

$$\begin{aligned} 14. \quad x-3y &= 7 \quad \textcircled{1} \\ x+3y &= 7 \quad \textcircled{2} \end{aligned}$$

$$\begin{aligned} \textcircled{1} - \textcircled{2} \quad -6y &= 0 \\ \frac{-6y}{-6} &= \frac{0}{-6} \\ y &= 0 \text{ sub in } \textcircled{1} \end{aligned}$$

$$\begin{aligned} \textcircled{1} \quad x-3y &= 7 \\ x-3(0) &= 7 \\ x-0 &= 7 \\ x &= 7 \end{aligned}$$

Solution $(7, 0)$

$$15. \begin{aligned} -x - 6y &= -3 \text{ ①} \\ x - 2y &= 11 \text{ ②} \end{aligned}$$

$$\begin{aligned} \text{①} + \text{②} \quad -8y &= 8 \\ \frac{-8y}{-8} &= \frac{8}{-8} \\ y &= -1 \text{ sub in ①} \end{aligned}$$

$$\begin{aligned} \text{①} \quad -x - 6y &= -3 \\ -x - 6(-1) &= -3 \\ -x + 6 &= -3 \\ -x &= -3 - 6 \\ \frac{-x}{-1} &= \frac{-9}{-1} \\ x &= 9 \end{aligned}$$

Solution $\Rightarrow (9, -1)$

$$16. \begin{aligned} -3x - 9y + 6 &= 0 \text{ ①} \\ 3x + 5y - 14 &= 0 \text{ ②} \end{aligned}$$

$$\begin{aligned} \text{①} + \text{②} \quad -4y - 8 &= 0 \\ \frac{-4y}{-4} &= \frac{8}{-4} \\ y &= -2 \text{ sub in ①} \end{aligned}$$

$$\begin{aligned} \text{①} \quad -3x - 9y + 6 &= 0 \\ -3x - 9(-2) + 6 &= 0 \\ -3x + 18 + 6 &= 0 \\ -3x + 24 &= 0 \\ \frac{-3x}{-3} &= \frac{-24}{-3} \\ x &= 8 \end{aligned}$$

Solution $\Rightarrow (8, -2)$

$$17. \begin{cases} 2x + 4y = 14 & \textcircled{1} \\ 3x - y = 14 & \textcircled{2} \end{cases}$$

$$4 \times \textcircled{2} \quad 12x - 4y = 56 \textcircled{3}$$

$$\begin{cases} 2x + 4y = 14 & \textcircled{1} \\ 12x - 4y = 56 & \textcircled{3} \end{cases}$$

$$\textcircled{1} + \textcircled{3} \quad 14x = 70$$

$$\frac{14x}{14} = \frac{70}{14}$$

$$x = 5 \text{ sub in } \textcircled{2}$$

$$\textcircled{2} \quad 3x - y = 14$$

$$3(5) - y = 14$$

$$15 - y = 14$$

$$-y = 14 - 15$$

$$\frac{-y}{-1} = \frac{-1}{-1}$$

$$y = 1$$

$$\text{Solution} \Rightarrow (5, 1)$$

$$18. \begin{cases} y - x = -4 & \textcircled{1} \\ y + x = 0 & \textcircled{2} \end{cases}$$

$$\textcircled{1} - \textcircled{2} \quad \frac{-2x}{-2} = \frac{-4}{-2}$$

$$x = 2 \text{ sub in } \textcircled{1}$$

$$\textcircled{1} \quad y - x = -4$$

$$y - 2 = -4$$

$$y = -4 + 2$$

$$y = -2$$

$$\text{Solution} \Rightarrow (2, -2)$$

$$19. \begin{aligned} -5x + 2y - 9 &= 0 \quad (1) \\ 12x - 3y &= 0 \quad (2) \end{aligned}$$

$$\begin{aligned} 3 \times (1) \quad -15x + 6y &= 27 \quad (3) \\ 2 \times (2) \quad 24x - 6y &= 0 \quad (4) \end{aligned}$$

$$\begin{aligned} (3) + (4) \quad 9x &= 27 \\ \frac{9x}{9} &= \frac{27}{9} \\ x &= 3 \text{ sub in } (2) \end{aligned}$$

$$\begin{aligned} (2) \quad 12x - 3y &= 0 \\ 12(3) - 3y &= 0 \\ 36 - 3y &= 0 \\ \frac{36}{3} &= \frac{3y}{3} \\ 12 &= y \end{aligned}$$

Solution $\Rightarrow (3, 12)$

$$20. \begin{aligned} 2x - 3y - 35 &= 0 \quad (1) \\ 9x + 4y &= 0 \quad (2) \end{aligned}$$

$$\begin{aligned} 4 \times (1) \quad 8x - 12y &= 140 \quad (3) \\ 3 \times (2) \quad 27x + 12y &= 0 \quad (4) \end{aligned}$$

$$\begin{aligned} (3) + (4) \quad 35x &= 140 \\ \frac{35x}{35} &= \frac{140}{35} \\ x &= 4 \text{ sub in } (2) \end{aligned}$$

$$\begin{aligned} (2) \quad 9x + 4y &= 0 \\ 9(4) + 4y &= 0 \\ 36 + 4y &= 0 \\ \frac{4y}{4} &= \frac{-36}{4} \\ y &= -9 \end{aligned}$$

Solution $\Rightarrow (4, -9)$

Review Sheet

① b) ① $4x + y - 4 = 0$
 $y = -4x + \underline{4}$
 $b = 4$

$2x + ky + 5 = 0$
 $\frac{ky}{k} = -\frac{2x}{k} - \frac{5}{k}$
 $y = -\frac{2x}{k} - \frac{5}{k}$
 $b = -\frac{5}{k}$

$$-\frac{5}{k} \Rightarrow \frac{4}{1}$$

$$4k = -5$$
$$k = -\frac{5}{4}$$