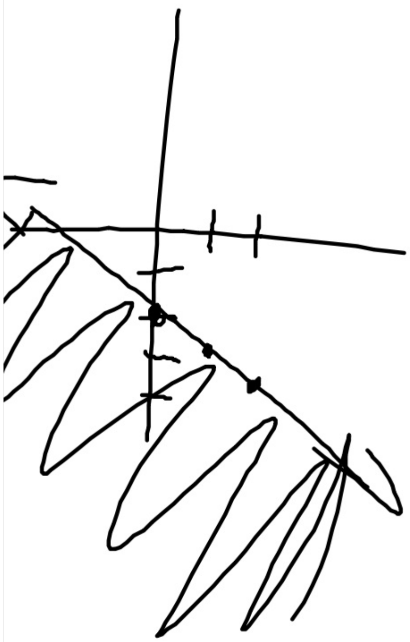
Warm Up 4/18

Graph the following inequalities.

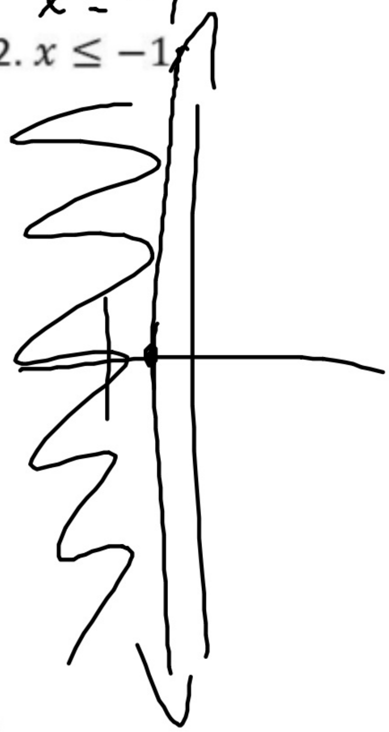
$y = -x - 2$

1. $y \le -x - 2$



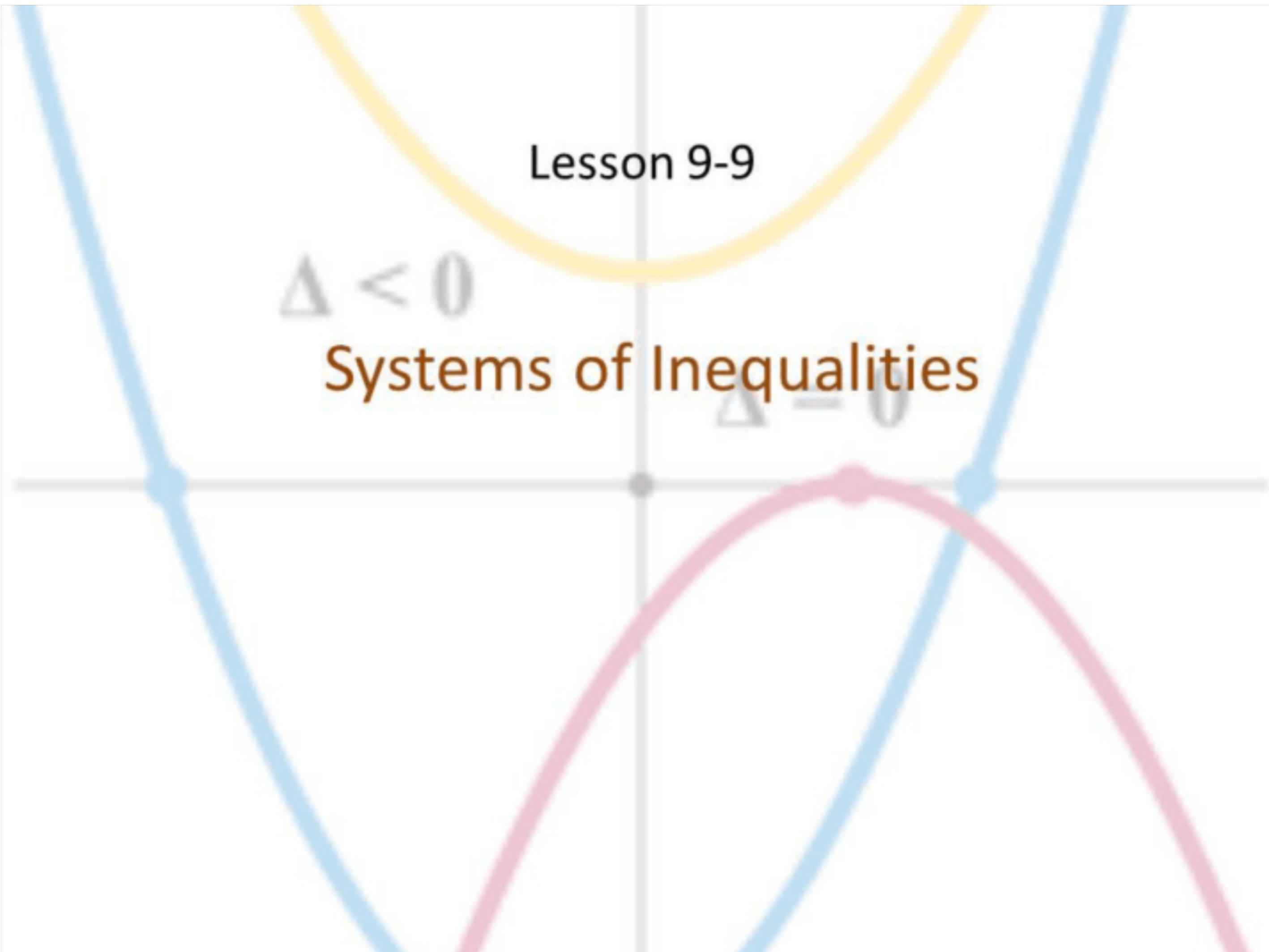
$x = -1$

2. $x \le -1$



$y = 5x + 2$

3. $y < 5x + 2$


Lesson 9-9
Δ < 0
Systems of Inequalities

Objective

Students will…

- Be able to sketch the graphs of any system of inequalities.
- Be able to define and determine whether the solution region is bounded or unbounded.

System of Inequalities

We have just refreshed our mind about graphing inequalities with **shaded regions** of possible solutions. We will now refresh our minds on **systems of inequalities**, which are sets of **multiple inequalities**.

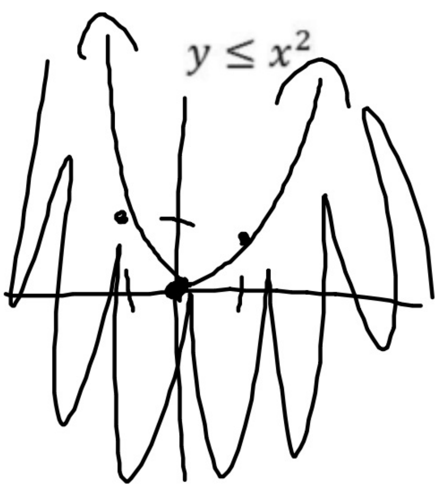
Ex. $$\left\{\begin{matrix} -\frac{1}{2}x^2 + y \geq -2 \\ x - y < 0 \\ x < -1 \\ y \geq 0 \end{matrix}\right\}$$

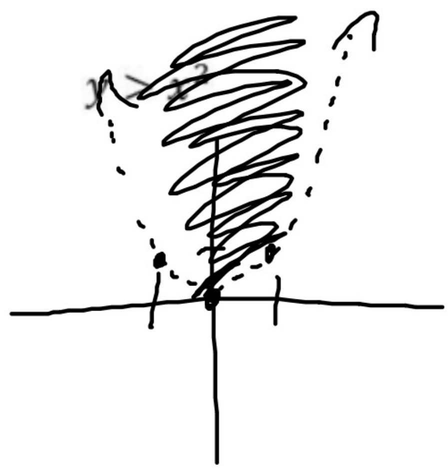
We will see that when dealing with a system of inequalities, we simply need to **sketch the graph** of each inequality **one-by-one**, and **analyze** them altogether **at the end**.

Non-linear Inequalities

First off, we need to know how to graph non-linear inequalities (power > 1). For example, consider…

$y \leq x^2$ and $y > x^2$





As you can see, when inequalities are involved, dotted line represents **<u>greater than</u>** or **<u>less than</u>**, while solid line represents the "**<u>or equal to</u>**."

Equation of a Circle

Another equation that we must familiarize ourselves with is the **equation of a circle**. We will study this much more in depth in the next chapter, so for now our goal is to being able to identify them and graphing them. For this unit, they will take the form: $x^2 + y^2 = r^2$, where r represents the **radius** of the circle.

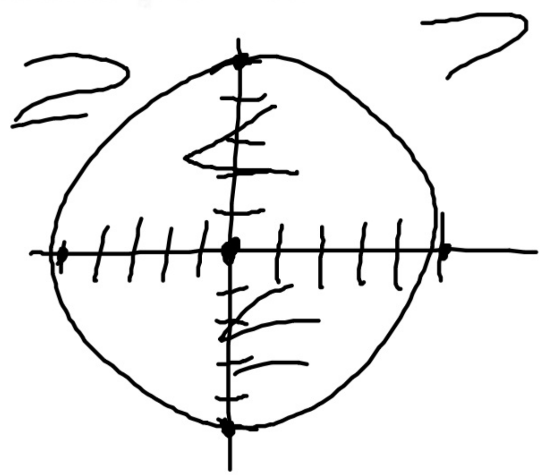
$(x-h)^2+(y-k)^2=r^2$

Ex. $x^2 + y^2 = 25$ is the equation of a circle centered at the origin, $(0,0)$, having the radius of $\sqrt{25} = 5$.

(h,k) cent

$r=$ ra

Let's graph this!



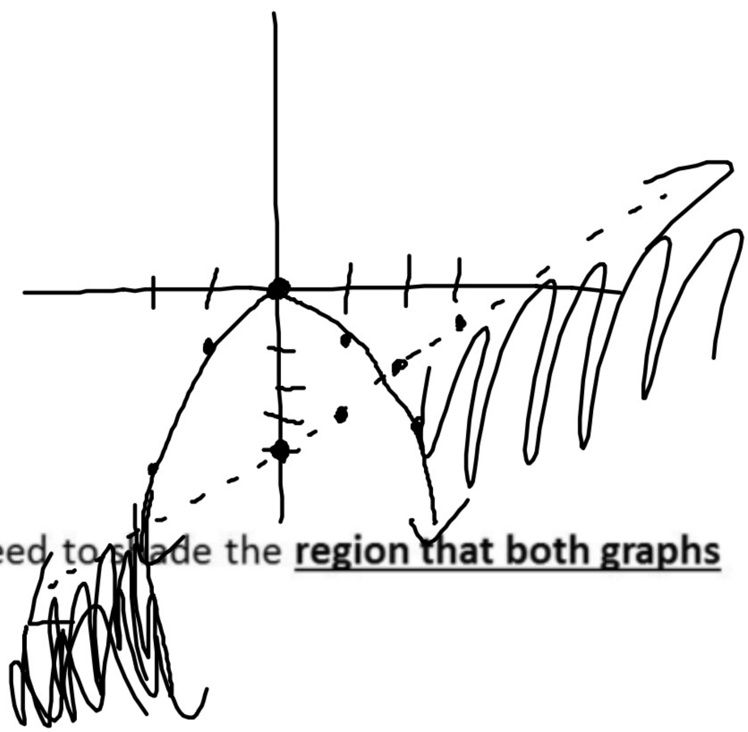
Example

So now let's graph a system of inequalities.

$$\begin{Bmatrix} y \geq -x^2 \\ x - y > 4 \end{Bmatrix}$$

$-y > -x + 4$

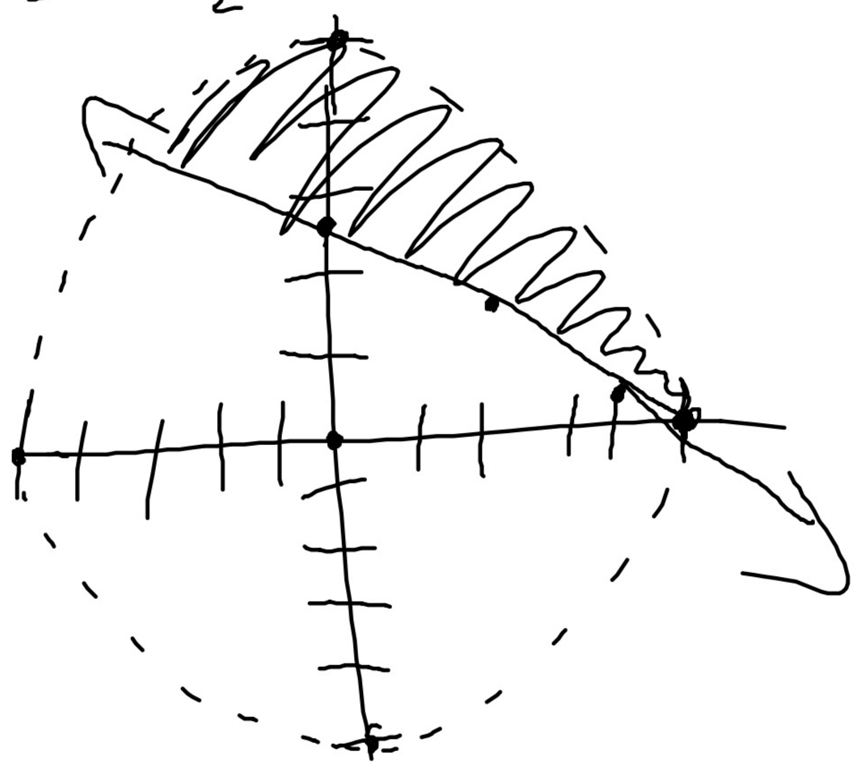
$y < x - 4$



As you can see, we simply need to shade the **region that both graphs share** as possible solutions.

Example

$$\begin{cases} x + 2y \geq 5 \\ x^2 + y^2 < 25 \end{cases} \Rightarrow y \geq -\frac{1}{2}x + \frac{5}{2}$$



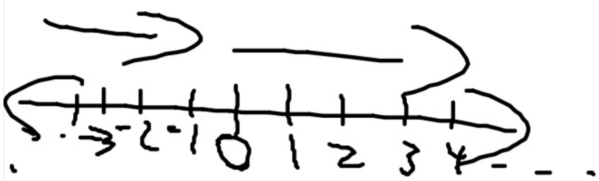
Example

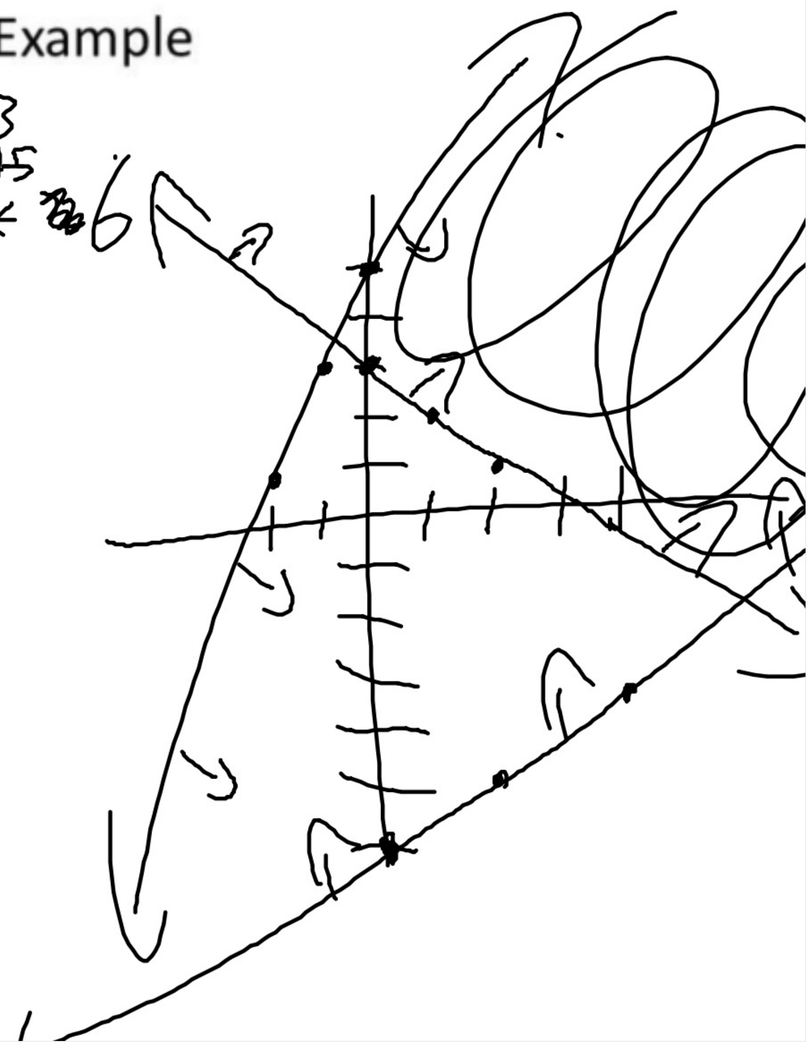
$$\begin{cases} x + y \geq 3 \\ -2x + y \leq 5 \\ x - 2y \leq 12 \end{cases}$$

$y \geq -x + 3$

$y \leq 2x + 5$

$y \geq \frac{1}{2}x - 6$



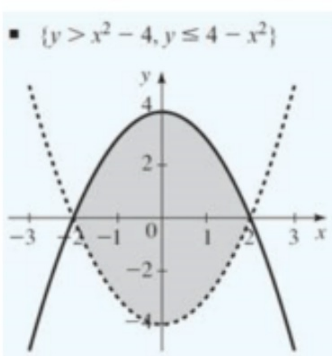


Bounded vs Unbounded

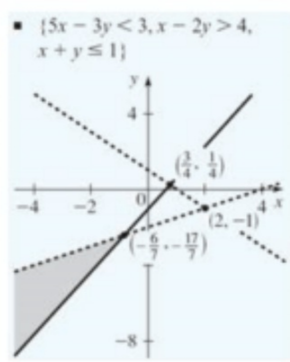
As you can see, the solution regions in the first and the last example seem to go on for **infinity**, i.e. there is no boundary, while the region in the second example appears to have a set of boundaries.

Regions that have no boundaries are said to be **unbounded** (first and third example), while regions that have boundaries are said to be **bounded** (second example).

Ex. **Bounded**



Unbounded



Homework Problems

Graph the solution of the system of inequalities. Determine whether the solution set is bounded or unbounded.

23. $\begin{cases} x \geq 0 \\ y \geq 0 \\ 3x + 5y \leq 15 \\ 3x + 2y \leq 9 \end{cases}$

37. $\begin{cases} x^2 + y^2 \leq 8 \\ x \geq 2 \\ y \geq 0 \end{cases}$

Homework 4/18

TB pg. 727 #19, 23, 25, 27, 29, 33, 37