Last time, we worked w/

$$\begin{cases} x' = x-3 \\ y' = x+5y+2 \end{cases}$$

and found the critical point at $(3,-1)$ and found the equilibrium solution.

This is also known as the equilibrium solution.

Remember $\dfrac{dy}{dx} = \dfrac{dy/dt}{dx/dt} = \dfrac{y'}{x'}$

since that's how we defined y' and x' last time.

So $\dfrac{dy}{dx} = \dfrac{y'}{x'} = \dfrac{x+5y+2}{x-3}$

Why slope? Cause I want to draw a slope field.

We want to calculate the slope in a range of spots on the graph so let's create a table with x-values as the rows from -5 to 5, y-values as the columns from -5 to 5

The intersection of the x- and y-values will be our slope $\dfrac{dy}{dx} = \dfrac{x+5y+2}{x-3}$

Y

X	-5	-4	-3	-2	-1	0	1	2	3	4	5
-5	3.5	2.875	2.25	1.625	1	0.375	-0.25	-0.875	-1.5	-2.125	-2.75
-4	3.857142857	3.142857143	2.428571429	1.714285714	1	0.285714286	-0.428571429	-1.142857143	-1.857142857	-2.571428571	-3.285714286
-3	4.333333333	3.5	2.666666667	1.833333333	1	0.166666667	-0.666666667	-1.5	-2.333333333	-3.166666667	-4
-2	5	4	3	2	1	0	-1	-2	-3	-4	-5
-1	6	4.75	3.5	2.25	1	-0.25	-1.5	-2.75	-4	-5.25	-6.5
0	7.666666667	6	4.333333333	2.666666667	1	-0.666666667	-2.333333333	-4	-5.666666667	-7.333333333	-9
1	11	8.5	6	3.5	1	-1.5	-4	-6.5	-9	-11.5	-14
2	21	16	11	6	1	-4	-9	-14	-19	-24	-29
3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
4	-19	-14	-9	-4	1	6	11	16	21	26	31
5	-9	-6.5	-4	-1.5	1	3.5	6	8.5	11	13.5	16

Using this table, we can generate the slope field. When generating the slope field we don't "care" about the exact value, we care if it is positive, negative, or 0.

Using Desmos,

1 Let g(x,y)=dy/dx

2 $g(x,y) = \frac{(x+5y+2)}{(x-3)}$

3 Slope Grid

26 Moveable Point

27 (a,b)

$= (3,-1)$

28 $g(a,b)(x-a)+b\left\{|x-a| \le \frac{.5}{\sqrt{1+(g(a,b))}}\right.$

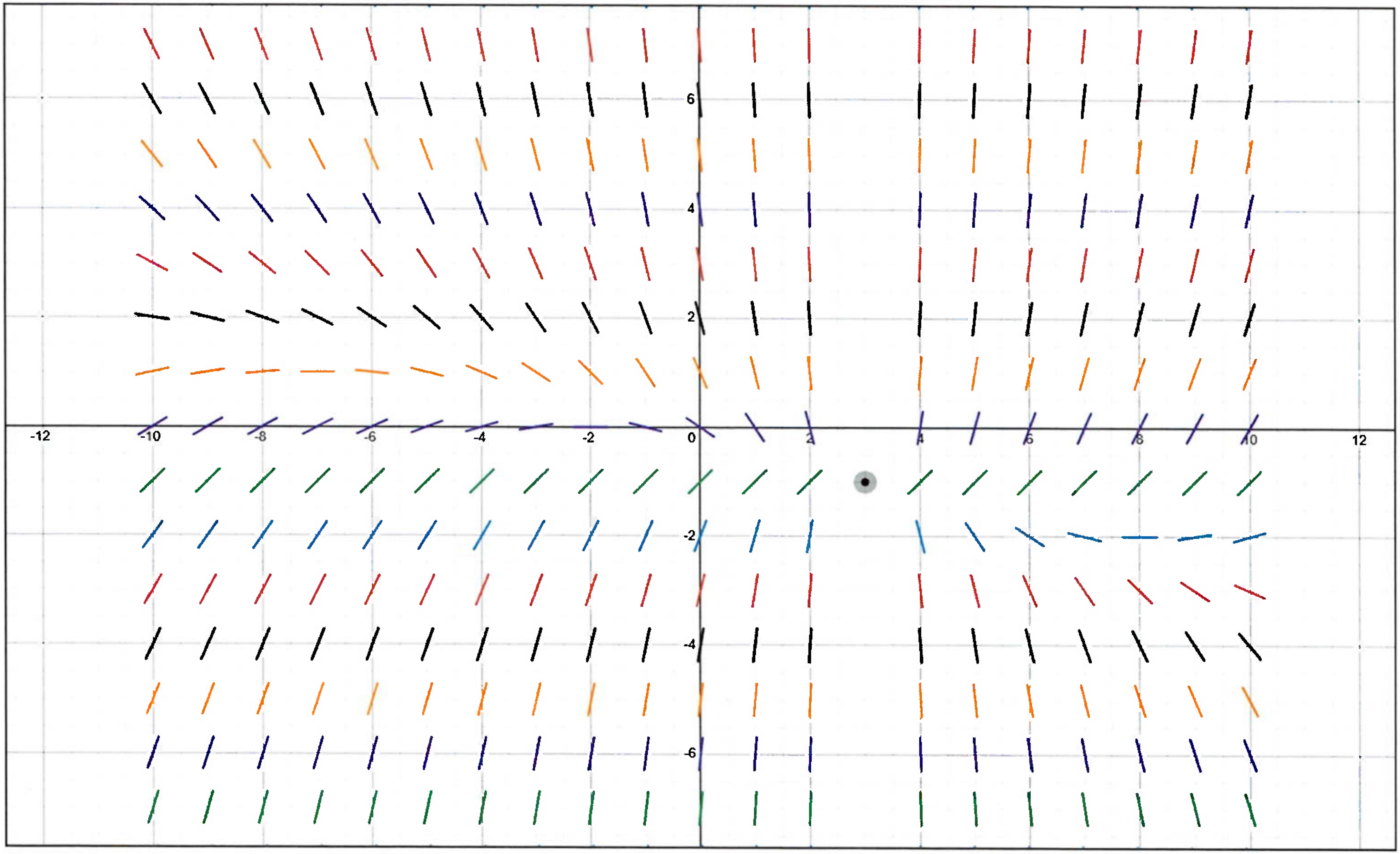
29 $a = 3$

30 $b = -1$

$\left.\begin{array}{l} a=3 \\ b=-1 \end{array}\right\}$ Critical Pt

31

(Graph on the next page)



So we can see why the graph looks that way from last class notes.

Phase portrait for $x' = x - 3,\ y' = x + 5y + 2$