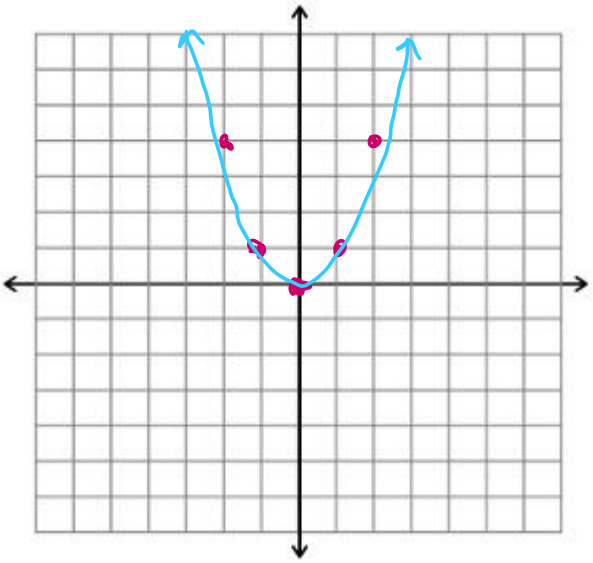
7/29/2023

Graphing Equations (non-linear)
Graphing Linear Inequalities (in two variables)

https://www.desmos.com/calculator

Last time we looked at graphing linear equations. For these we needed only two points to draw a straight line. None of the examples we'll look at today are straight lines. We will need to plot usually around 5 points or so to get a good sense of the graph. Point selection will also sometimes be an issue.

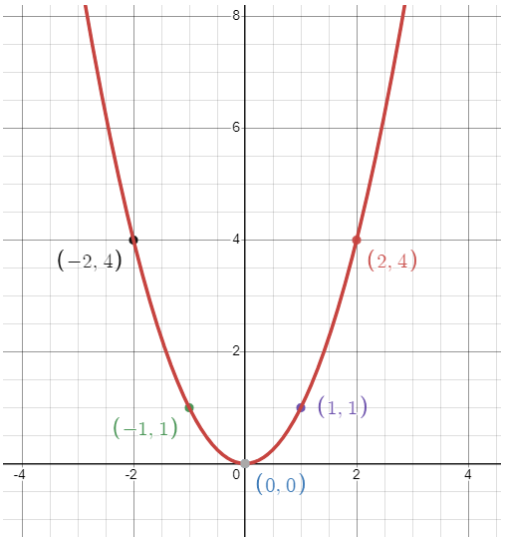
Graph the equation $y = x^2$



Can use a t-table to collect pairs of points.

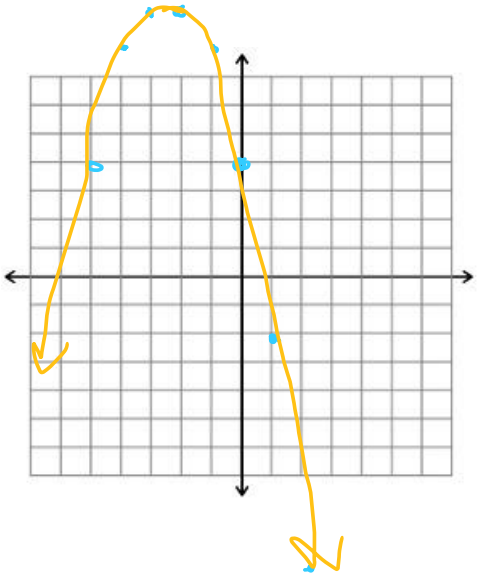
x	y
0	0
-1	1
1	1
-2	4
2	4

From desmos:



Every graph that has x^2 as the largest power, basically looks the same.

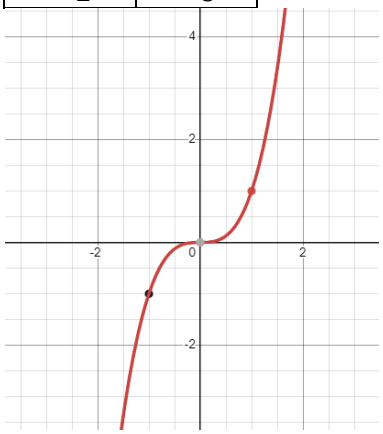
Graph $y = 4 - 5x - x^2$

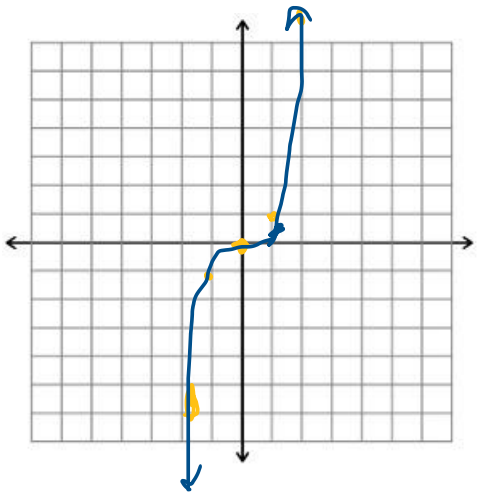


x	y	(x,y)
0	$y = 4 - 5(0) - 0^2 = 4$	(0,4)
1	$y = 4 - 5(1) - 1^2 = -2$	$(1,-2)$
-1	$y = 4 - 5(-1) - (-1)^2 = 8$	$(-1,8)$
2	$y = 4 - 5(2) - 2^2 = -10$	$(2,-10)$
-2	$y = 4 - 5(-2) - (-2)^2 = 10$	$(-2,10)$
-3	$y = 4 - 5(-3) - (-3)^2 = 10$	$(-3,10)$
-4	$y = 4 - 5(-4) - (-4)^2 = 8$	$(-4,8)$
-5	$y = 4 - 5(-5) - (-5)^2 = 4$	$(-5,4)$

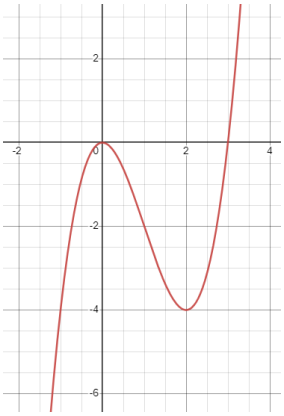
Graph $y = x^3$

x	y
0	0
1	1
-1	-1
2	8
-2	-8

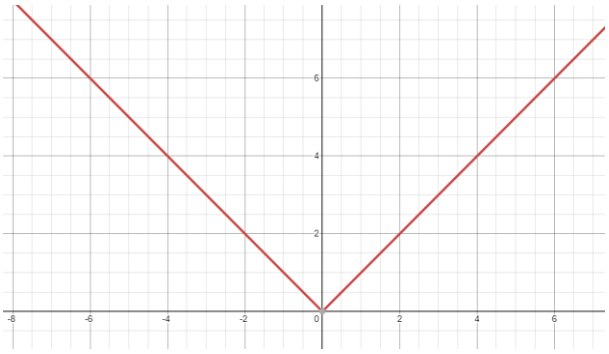




Graph $y = x^3 - x^2$



Graph $y = |x|$ in Desmos, write y=abs(x)

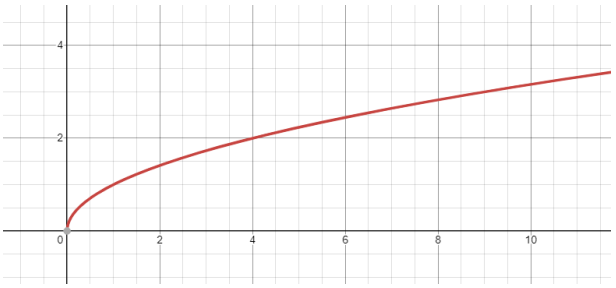


This is the only one with a sharp point in the graph. All the others curve smoothly.

x	y
0	$\|0\| = 0$
1	$\|1\| = 1$
-1	$\|-1\| = 1$
-2	$\|-2\| = 2$

The absolute value makes negative numbers into positive ones, and it leaves positive numbers alone.

Graph $y = \sqrt{x}$ in Desmos write y=sqrtx (sqrt will give you the square root)

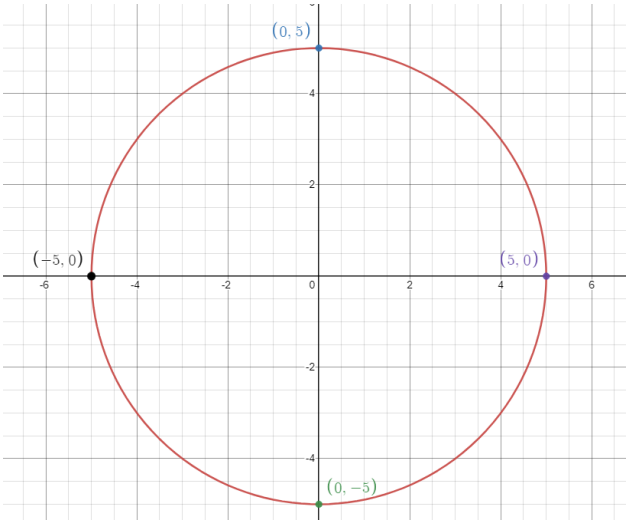


You want to locate the end of the graph. If you go beyond it, the number under the square root will be negative which isn't real and can't be plotted.

Sometimes things aren't solved for y.

$$x^2 + y^2 = 25$$

Plotting points still kinda works the same way, but if you put in $x = 0$, this equation reduces to $y^2 = 25$, which is either $y = 5$ or $y = -5$. You'll need to plot both points $(0,5)$ and $(0,-5)$. You can also pick $y = 0$, but then $x^2 = 25$ has a similar result, giving you two points $(5,0), (-5,0)$. This will give you an outline, but remember the graph is curved, not pointy… this is a circle.



These kinds of situations are uncommon, but they do come up from time-to-time.

Graphing Linear Inequalities in Two Variables

A linear inequality in two variables can be simplified to look like a linear equation except that the equal sign is replaced with an inequality.

Examples.

$$y \leq 3x + 4$$
$$2x + 3y > 12$$

And so on.

The first step in graphing a linear inequality is to plot the line.

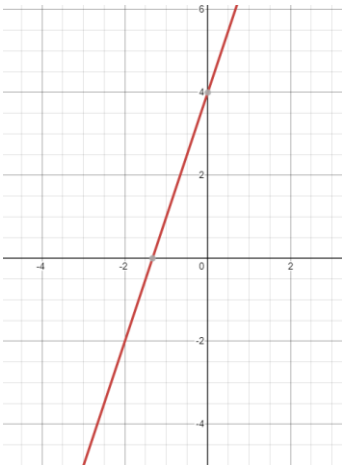
If the inequality is < or > draw the line as a dotted line (this means that the line itself is not included in the inequality… it's like a parentheses or open circle).

If the inequality is $\leq$ or $\geq$, then draw the line as a solid line (this means that the line is included in the inequality… it's like a square bracket or filled-in circle).

The inequality means that all points on one side of the line satisfy the inequality, and on the other side of the line, they don't. To determine which side that is, we select a test point. We can pick any point we want. Put the x and y values from that point into the inequality. If the inequality is true, shade on the side of the line that point is on. If the inequality is false, then shade on the other side of the line from the point.

Graph the inequality $y \leq 3x + 4$

First, graph the line. $y = 3x + 4$

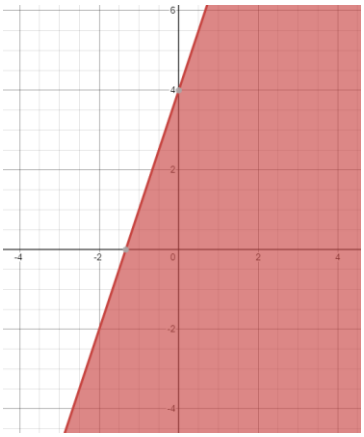


We graphed a similar line in the last lecture. Points in the line are (0,4), (-2,-2), etc.

I usually use the origin to test which side to shade on because the math is easier, but you can't use it if the line passes through the origin. Plug the point into the inequality.

$$0 \leq 3(0) + 4$$
$$0 \leq 4$$

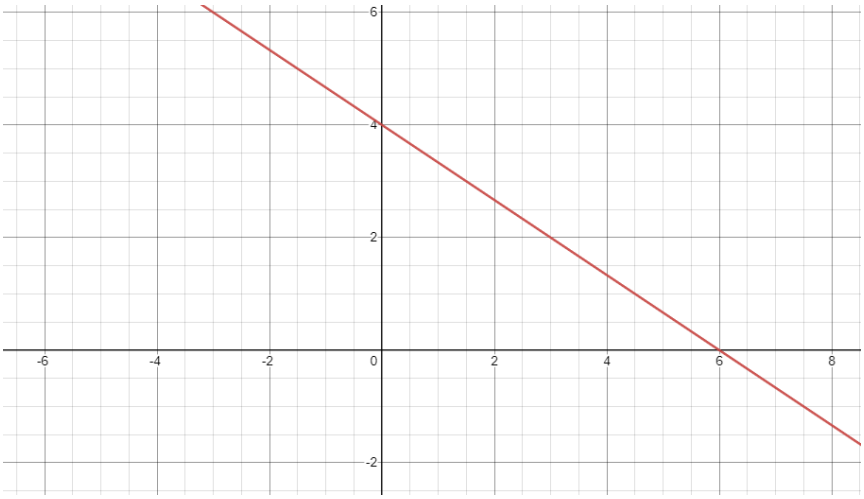
This inequality is true because 0 is less than (or equal to) 4. So, shade on the side of the line that contains this point.



This is the solution. Any point in that shaded region will satisfy the inequality.

Graph $2x + 3y > 12$

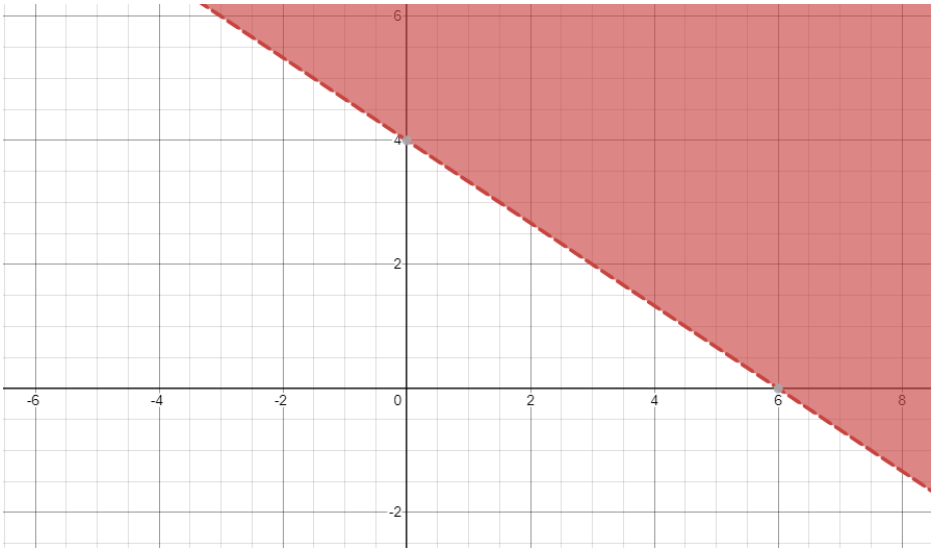
First, graph the line $2x + 3y = 12$.
Draw the line as a dotted line since the inequality does not include the line.



Again, choose a test point, like the origin.

$$2(0) + 3(0) > 12$$
$$0 > 12$$

This inequality is false since 0 is not greater than 12. So, shade on the side of the line that does not contain the origin.



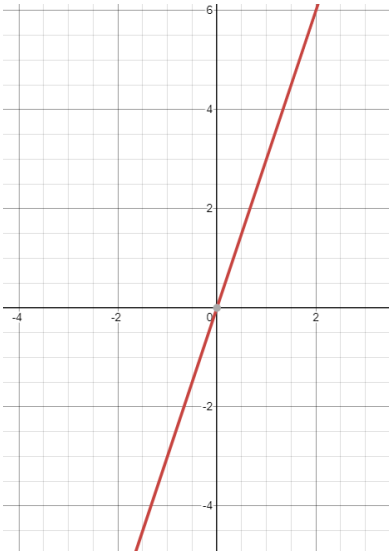
(note the dotted line)

To plot these in desmos, just write them as is.

Let's do one example where we can't use the origin.

Graph $3x - y < 0$

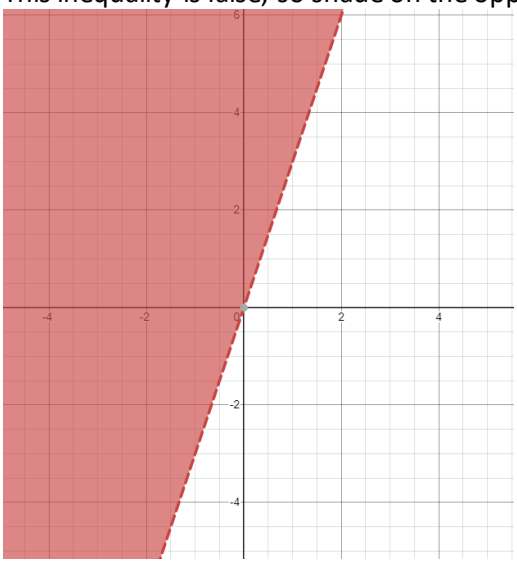
When we plot this line, $3x - y = 0$, we find that the line goes through (0,0).



In this case, we have to choose another point to test. Any point will do as long as it is NOT on the line. I like to pick something on one of the axes because (the math is easier and) it's easier to see that the point is not on the line even in a sketch. Let's try (2,0).

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

This inequality is false, so shade on the opposite side of the line.



Hopefully, this is clear. If not, we can go over another example during the review on Friday.