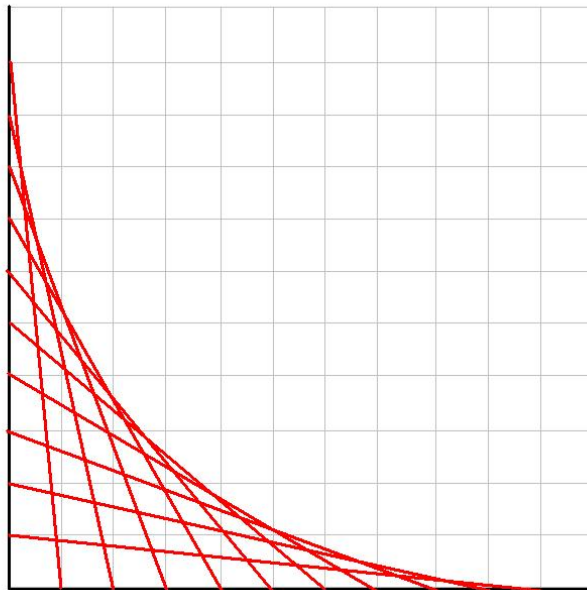


Mathematics of Doodles



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Kinser

Goal: Use creative and easy to construct drawings to explain properties of lines such as slope, y-intercept, and their interactions.

Grade and Course: 9th grade Algebra or Pre-Algebra

Objectives: At the end of this lesson the students should be more comfortable with translating equations of lines into corresponding lines on graph paper and vice versa. This lesson emphasizes using the slope-intercept form of linear equations.

Resources/materials needed:

- Graph Paper for students
- Chalk Board/Smart Board
- Straight Edges or rulers for students (optional)
- Colored Pencils/Chalk (optional)
- Graphing Calculators

Lesson Source: Original lesson (as far as I know)

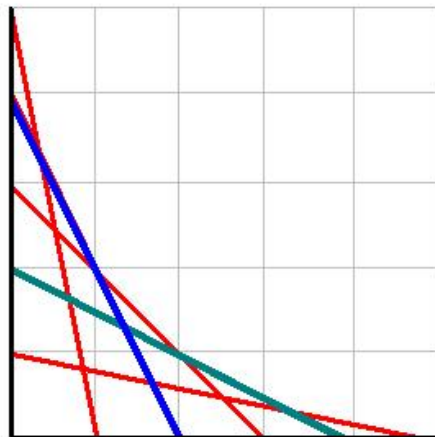
Description of Plan: The idea of this lesson and the extension is to give an easy example of the differences between positive and negative slope and positive and negative y intercepts. The use of the designs gives the students something to relate these values to. Before this lesson students should have been introduced to the idea of slope as 'rise/run' and be familiar with the coordinate plane.

Instructional Mode: Draw or display the above graphic on the chalk/smart board. Hand out graph paper to the students and ask them to draw their own version using exactly 5 lines. Students should be familiar with this design, but if they are not you may instruct them as follows:

- Start at your highest point on the y axis (5, if you are using 5 lines) and draw a line using the straight edge that goes to the right exactly 1 space.
- Go to the next highest point on the y axis (4) and draw a straight line that goes to the right exactly 2 spaces.
- Repeat this until you are at the lowest point on the y axis (1) and then draw a straight line that goes to the right 5 spaces.

This should take about 3 minutes and will familiarize the students with the graphic (if they were not already). Please take this time to emphasize that real lines would actually go on forever in both directions, but to keep a neat paper, we are keeping all of these lines in the first quadrant.

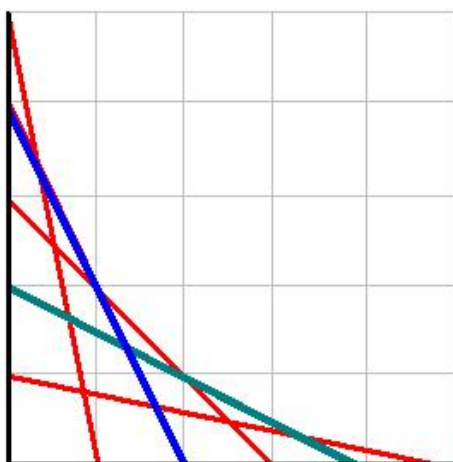
Pick 2 of the lines at random. Have the students write down the value of where each of the 2 lines cross the y axis. Then ask the students to find the slope of each line. Break down the question into asking how far each line goes 'down' and how far each line goes 'over'. Or 'rise' and 'run'. This should come quickly to the students because they just drew these lines using a fairly simple set of rules that used all of these values. Example:



This line crosses at $y = 4$
This line goes down 4
and over 2

This line crosses at $y = 2$
This line goes down 2
and over 4

Have the students use the information on their pages to form the slope-intercept equations of the 2 lines. Emphasize that these lines all "go down" and therefore their 'rise' is actually negative.



This line crosses at $y = 4$

This line goes down 4
and over 2

This line crosses at $y = 2$

This line goes down 2
and over 4

$$y = \frac{\text{rise}}{\text{run}}x + \text{axis crossing point}$$

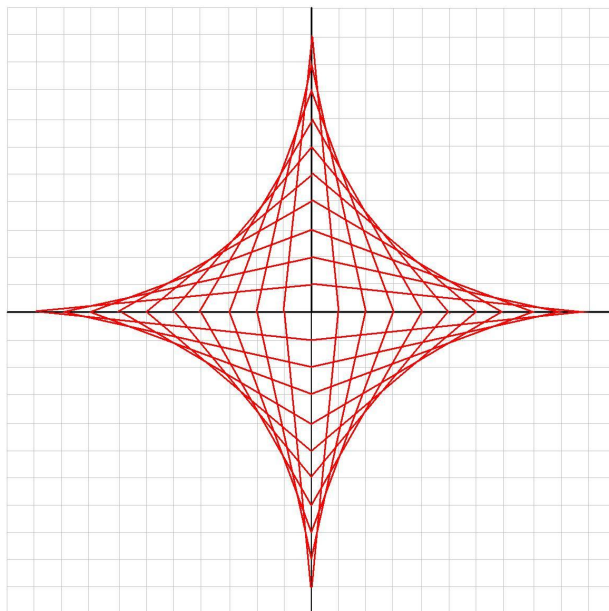
$$y = \frac{-4}{2}x + 4$$

$$y = \frac{-2}{4}x + 2$$

After this period of supervised work, have the students find all 5 equations for the 5 lines that make up their picture.

(Optional) At this time, if the students have access to graphing calculators (or smartboard with the appropriate software) you may graph these equations and get a similar picture on the calculator. Note that the calculator will draw the full lines and it may look odd until you properly adjust your window.

Extension #1 The Other Quadrants



Description of Plan: The obvious extension of this lesson is to continue into the other quadrants. Again, emphasize to the students that actual lines continue forever in each direction and that we are working with line segments contained in each quadrant. Finding the equations of these lines may look really intimidating, but after we understand how the first quadrant equations are formed the others follow rather easily. This extension is for students/classes who are more experience with slope-intercept equations and are ready to begin working with shifts and translations.

From Quadrant I to Quadrant II:

the y intercepts actually don't change, and neither do the 'run' values. In fact the only thing different is that now the lines go up (positive slope). These 5 equations are the same as the first quadrant with the sign of the slope changed.

From Quadrant I to Quadrant III:

The signs of the slope now stay the same (both negative), we can form the 3rd quadrant equations by simply changing the sign of the y intercept.

From Quadrant I to Quadrant IV:

In this final case, we need to change both the sign of the slopes and the y intercepts.

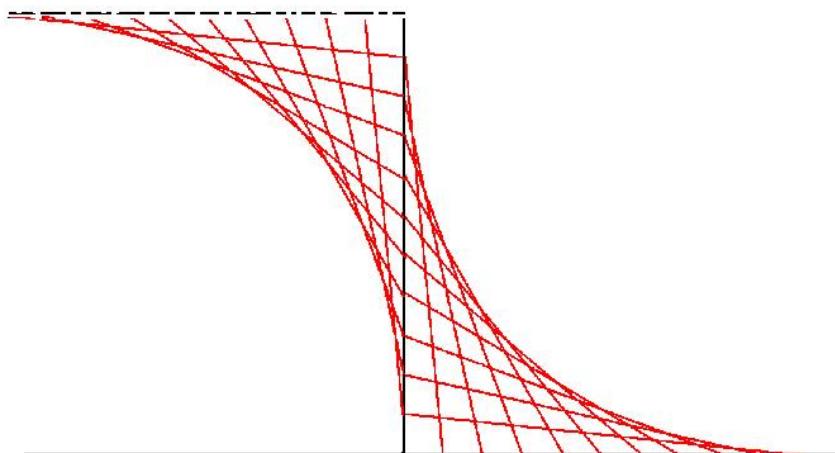
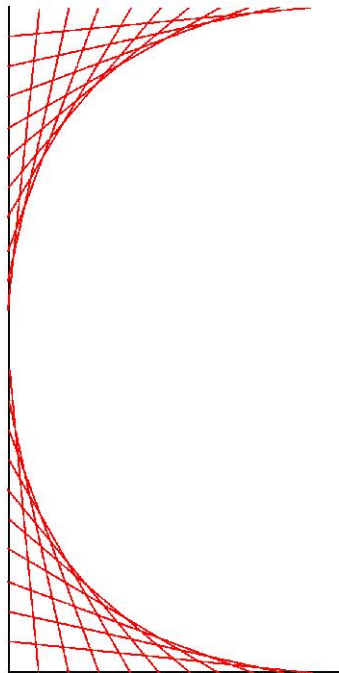
Instructional Mode:

Draw the first quadrant graphic or present it on the smart board. Make sure to leave room for the other 3 quadrants. Ask the students to complete the second quadrant on their papers or perhaps on the chalkboard. Ask them to point out the y intercepts of these new lines and how they compare with the first quadrant's lines intercepts. Ask questions to encourage the students to realize that the only difference between these

new equations is that now the slope is positive (the lines go up instead of down). Repeat this for the other quadrants encouraging the students to find out what is different from the first quadrant and then explain why (see description of plan).

Assignment or in-class work:

Ask the students to find the equations of lines that form these images.



Ask students to make their own pictures and find the corresponding set of equations. Encourage them to use the patterns they discovered when making the original drawings in the different quadrants.

Estimated Time: 1 class period. 2 including extension.