

Functions: Domain, range, shape, etc...

Group activity using TI-83.

(Alternative name: Valentine on TI-83)

(based on “**Creating Valentine’s message on a graphing calculator**”, by David Ebert, *Mathematics Teacher*, Feb. 2009, pp 404-405)



Overview

This activity uses a graphic calculator to draw different functions. The nice twist is that the functions produce a fun drawing, and are suggested by the students! For example, for Valentine day, we can draw a heart-shape with a text added as a finishing touch.

This lesson can be given as a teacher directed activity, in which case it is a short activity (~20 minutes), that can still touch on a few basic concepts (function, domain, etc), and encourage work with the graphic calculator.

It can also be given as a problem-solving lesson, where the students work in groups, and find their own way to draw a heart, other shapes, and then present their drawing(s) and method(s) to the class.

→ For BOTH options there is a guiding sheet attached at the end.

Learning Objectives

- Familiarity with TI-83.
- Functions: Definition, domain, range, and plot.
- Fun before Valentine day! Side benefits include review of functions, plotting, and the use of TI-83.

Prior Knowledge needed

Basic familiarity with the drawing capability of graphing calculator.

Knowledge of ‘what is a function(vertical line test)?’, drawing, even-odd functions, and so on.

Following the above, this lesson is aimed at pre-calculus and above.

In the simple, teacher directed, minimal format, it can also be conveyed to advanced Algebra-II students.

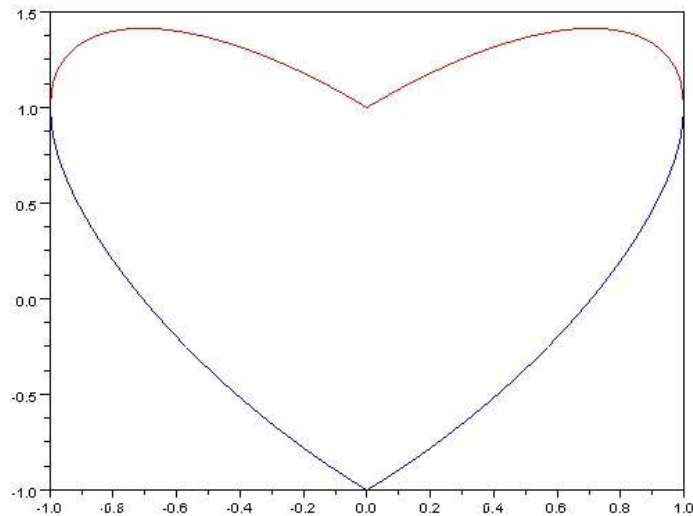
Instruction and activity

I. Teacher led activity for Valentine Day

It is a very open activity, so I will just point to possible subjects to discuss as you go through.

Background of activity for the students:

The problem: We are trying to draw something similar to the picture depicted below, on your calculator.



Some guiding questions:

1. Does this plot describe a function? **No** – multiple 'y' values for one 'x' value.
2. How many functions would you use to plot the heart?
3. What is the domain of the function? NOTE: on the TI-83 screen there are no loose ends!!

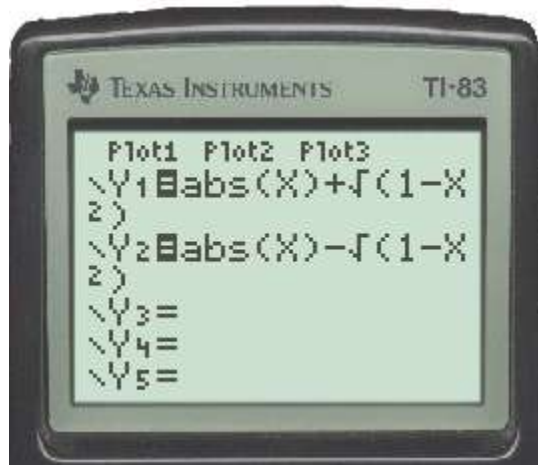


4. What is the graph of $y_1 = |x|$? What is its domain over the real numbers?
5. What is the graph of $y_2 = \pm\sqrt{1-x^2}$? What is its domain over the real numbers?
6. Graph y_1 and y_2 on the same set of axis.
7. Use these to graph the two functions

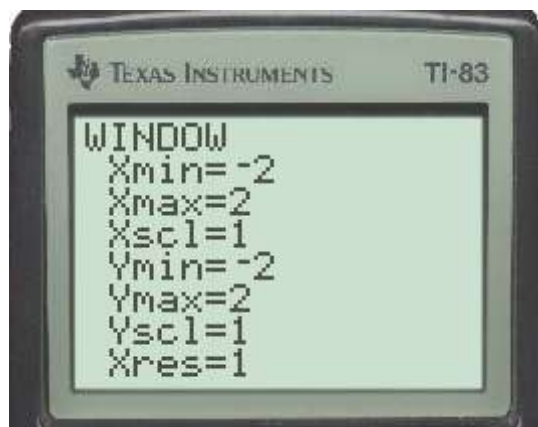
$$y = |x| \pm \sqrt{1-x^2}$$

Here are some helping notes to make it work on your TI: (See also the Student's sheet, with 'direction' only).

- a. Plot the equations:
(the ABS function is under MATH -> NUM menu)



- b. Set the limits in the WINDOW:



- c. Press 2nd+ZOOM (which will get you to the FORMAT menu), to turn off the axes.



- d. Press GRAPH to see the heart !!
- e. To add text, while in GRAPH mode, press 2nd+PRGM, and choose the 10th option (TEXT) to place a text on your graph.

Some further exploration:

- 8. What equations would you graph to (you will need to adjust the graphing window to see those right):
 - a. Shift the heart three units up?
 - b. Shift the heart three units to the right?
 - c. Flip the heart upside down?
 - d. Make it five-times bigger?

HAPPY

VALENTINE

Day !!



Valentine on your Graphing calculator!



Student page: Just the directions!

Student Name: _____ Date: _____

Step #	Description	Hint	On your TI screen
1	Plot the equations.	ABS() function is under MATH -> NUM menu .	
2	Set the limits in the WINDOW.		
3	Turn off the axes.	Press 2 nd +ZOOM (which will get you to the FORMAT menu), and select the AxesOff option.	
4	Press GRAPH to see the heart !!		
5	Add text.	While in GRAPH mode, press 2 nd +PRGM, and choose the 10 th option (TEXT) to place a text on your graph.	



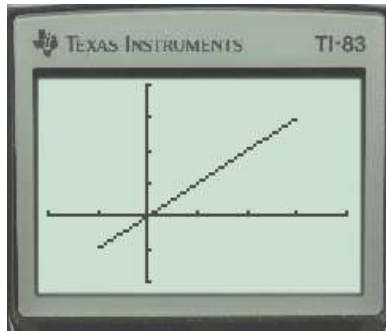
II. Student led exploration (for any day)

For this activity, one can divide the students into groups, and give the sheet below to the students. At the end, each group should present to the class their solution: The function(s) they used to graph the heart and their own creative drawings.

It seems that only one-item in that sheet might need a solution as it is not that obvious, so here it is:

Can you create a graph like the following?

It is a graph of the function $Y=x$, but it extends ONLY from $x=-1$ to $x=3$.



Remember, you are allowed to use only the simple $Y=...$ function and drawing utility for this (and there is no smoke-and-mirrors magic involved).

What is the function you drew to get this picture (please write it below):

Answer (there are other options as well of course):



Other than this, all the items on the worksheet are pretty open, and students will come up with their own insights and ideas.

====End====

Valentine (and more!) on your Graphing calculator!

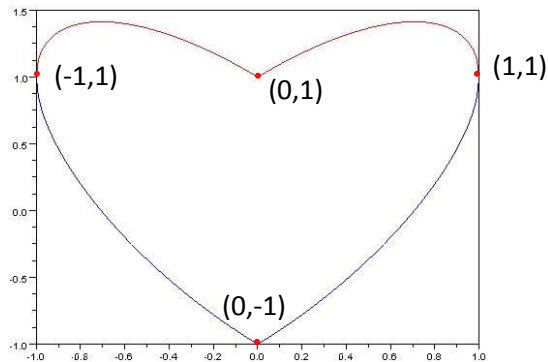


Student page: Group work directions

Student Name: _____ Date: _____

Problem 1:

Your task is to draw the following picture on your calculator:



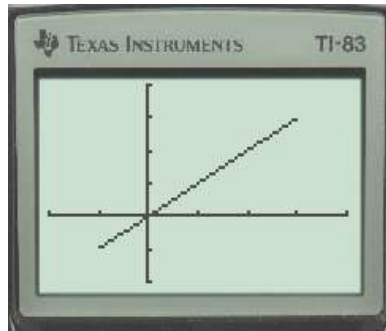
- You are allowed to use only the simple function plotting capabilities. No Programming, Stats, etc.... : Just the simple $Y = \dots$ and plot.
- You are allowed to use multiply $Y = \dots$ (That was a hint!!).
- The coordinates of a few key-points are given specifically. Your drawing should go through these points.

Some helping (guiding) questions:

- Does this plot describe a single function? _____
- How many functions (one or more) would you use to plot the heart? _____
- What should the domain of these functions be? Range? Write those below
- As a (very relevant!) warm up, plot the following functions on you TI.
 - $y_1 = |x|$
 - $y_2 = +\sqrt{0.5^2 - (x - 0.5)^2}$
 - Do you see any connection to the one we are seeking? You can bring it to good use now.
- Now you are all set to try plotting the desired heart-shape graph: Give it a shot... Write the functions you drew below.

Problem 2:

Can you create a graph like the following? It is a graph of the function $Y=x$, but it extends ONLY from $x=-1$ to $x=3$.



Remember, you are allowed to use only the simple $Y=...$ function and drawing utility for this (and there is no smoke-and-mirrors magic involved).

What is the function you drew to get this picture (please write it below):

- Can you now find a better drawing for Problem-1? Describe your new solution here:

Problem 3:

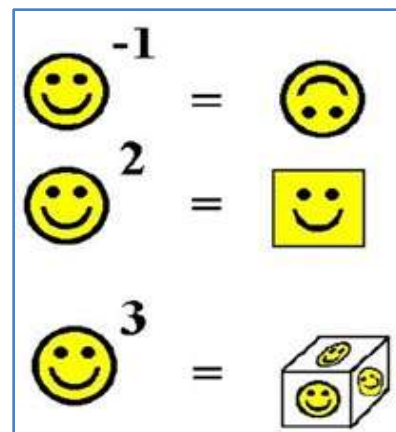
Using your favorite answer from the previous sections, what equations would you graph to (you will need to adjust the graphing window to see those right):

- Shift the heart three units up?
- Shift the heart three units to the right?
- Flip the heart upside down?
- Make it five-times bigger?

Problem 4:

Think of a shape you would like to create on your TI-83. Say (for example) a Smiley face, a House, Dog, or any other item.

Draw it freehand below, and then write the functions to draw it on the calculator. Be creative and have fun!



Extra-Credit:

So far we talked only of function drawing. Can you use parametric drawing to get a similar drawing?!? How?

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