

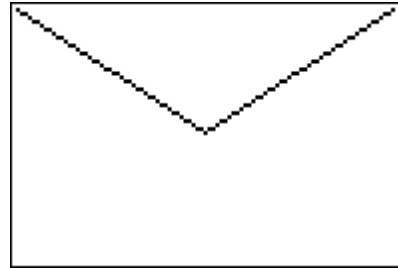
## MAKING VALENTINE'S MESSAGES ON A GRAPHING CALCULATOR

The document on the next page can be printed out and folded into a Valentine's Day card. Although the card can be given to our students just for a fun activity, devoid of any meaning, many mathematical concepts can be derived from this simple activity. You are welcome to copy and use the card in your math classes. I invite all of you, however, to take this activity to the next step and have your students explore the equations that are used to make the heart shape. The following questions can help lead an investigation into the Valentine's Day equations.

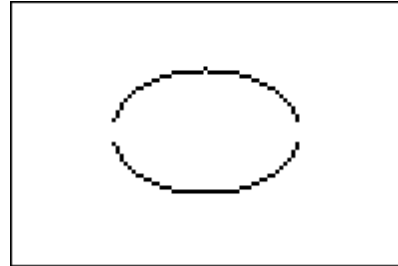
1. What is the graph of  $y = |x|$ ?
2. What is the graph of  $y = \pm\sqrt{1-x^2}$ ?
3. What is the domain of  $y = |x| \pm \sqrt{1-x^2}$ ?
4. Graph  $y = |x|$  and  $y = \pm\sqrt{1-x^2}$  on the same set of axes. Use these graphs to sketch a graph of  $y = |x| + \sqrt{1-x^2}$  and  $y = |x| - \sqrt{1-x^2}$ .
5. What equations would you graph to shift the heart three units up? You will need to adjust your graphing window to see this graph.
6. What equations would you graph to shift the original heart three units to the right? You will need to adjust your graphing window to see this graph.
7. What equation would you graph to flip the heart upside down?
8. What equation would you graph to make the heart five times bigger, both taller and wider? You will need to adjust your graphing window to see this graph.

## ANSWERS

1. The window of this graph, and the following two graphs, is from -2 to 2 on both the  $x$  and  $y$  axis.



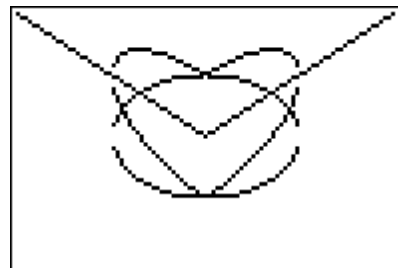
2. Notice, this equation is equivalent to  $x^2 + y^2 = 1$ , which is a circle centered at the origin with radius 1.



3.  $-1 \leq x \leq 1$

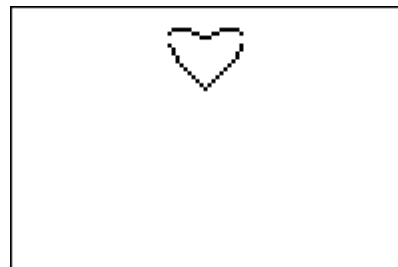
4. Another way to graph the sum of these two graphs is to graph  $y = y_1 + y_2$  and  $y = y_1 + y_3$ . On a TI calculator, the  $y$  variables can be accessed in the VARS menu.

```
Plot1 Plot2 Plot3
\Y1=abs(X)
\Y2=sqrt(1-X^2)
\Y3=-sqrt(1-X^2)
\Y4=Y1+Y2
\Y5=Y1+Y3
\Y6=
\Y7=
```

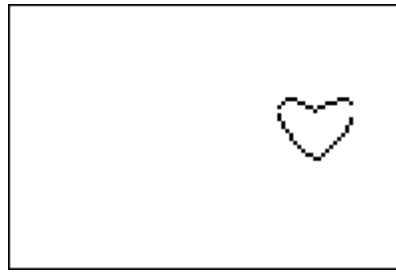


5.  $y = |x| \pm \sqrt{1-x^2} + 5$

The window of this graph, and the following graph, is from -5 to 5 on both the  $x$  and  $y$  axes.

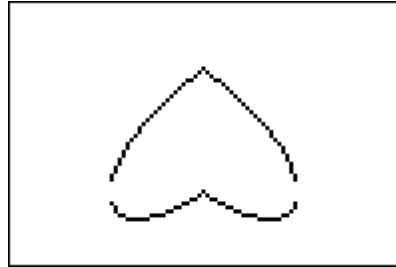


6.  $y = |x-5| \pm \sqrt{1-(x-5)^2}$



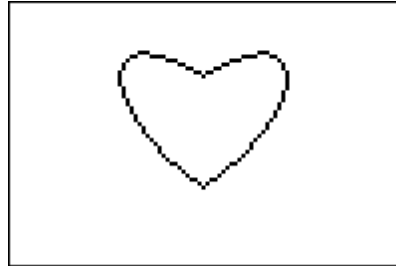
7.  $y = -|x| \pm \sqrt{1-x^2}$

The window of this graph is from -2 to 2 on both the  $x$  and  $y$  axes.



8.  $y = |x| \pm \sqrt{5-x^2}$

Notice, changing the radius of the circle changes the size of the heart. Notice also, with a bigger graph, the “broken” sides of the



heart appear to be fixed. We can tell our students that the bigger their heart, the less likely it is to be broken! The window of this graph is from -5 to 5 on both the  $x$  and  $y$  axes.