**Activity 3.1.4 The Open Box Problem**

A local cookie company is creating a box for their cookies that will be an open box made out of cardboard and a lid made out of plastic. The design of the box is to cut out squares from the corners of an 18 inch x 24 inch sheet of cardboard, then fold up the sides to create an open box. (See the figures below) The company wants to determine what effect the size of the cut-out square will have on the volume of the open box.

24 in.

x in.

18 in.

The class will examine the changes in the volume by cutting out squares starting with 1x1 inch squares and increasing the length of the square being cut out by increments of 1 inch. Fill in the table below with the data gathered in class and then answer the questions that follow to make that determination.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Square Cut Out | Length of Box | Width of Box | Height of Box | Volume of Box |
| 1 in. by 1 in. |  |  |  |  |
| 2 in. by 2 in. |  |  |  |  |
| 3 in. by 3 in. |  |  |  |  |
| 4 in. by 4 in. |  |  |  |  |
| 5 in. by 5 in. |  |  |  |  |
| 6 in. by 6 in. |  |  |  |  |
| 7 in. by 7 in. |  |  |  |  |
| 8 in. by 8 in. |  |  |  |  |
| 9 in. by 9 in. |  |  |  |  |
| **x in. by x in.** |  |  |  |  |

Questions

1. What is the function that gives the volume, V(x), of the open box as a function of the side of the square, x, that is cut out from the corner of the sheet?

2. Graph the function from question 1 on your calculator in a window that shows all the significant behavior of the function, i.e., end behavior, x-intercepts, relative maxima and minima.

3. For what values of x is the volume of the box positive based on the graph?

4. Do all values of x that make the volume positive make sense in the context of the problem?

5. What is significance of the x-intercepts of the graph of the function?

6. Do all the x-intercepts make sense in the context of the problem?

7. What connection is there between the factors of the volume, V(x), and the significant features of the graph?