PROBLEM 2: JEWELRY BOX CONSTRUCTION

The art teacher has assigned a jewelry box construction project. Each student receives two sheets of tin for this project, one sheet for the box and the other for the lid of the box. The sheets of tin you are given are both 24 centimeters by 17 centimeters. Give the dimensions of the box with the largest volume that you can construct from these pieces of tin.

A. Using centimeter graph paper, determine how you will form a rectangular prism from the sheet metal.
B. Write algebraic expressions to represent the length, width, and height of the box.
C. Write a formula to find the volume of the box
D. Determine the dimensions that will maximize the volume of the box.

MATERIALS

Casio CFX-9850Ga Plus or ALGEBRA FX2.0 Graphing Calculator Graphing Calculator:
Centimeter graph paper
Scissors
Tape

ONE SOLUTION TO PROBLEM 2: JEWELRY BOX CONSTRUCTION

A. Using centimeter graph paper, determine how you will form a rectangular prism from the sheet metal.

Cut squares of equal area from the four corners of the graph paper. Fold the graph paper to make a box without a top.

B. Write algebraic expressions to represent the length, width and height of the box.

Let x = the height of the box in centimeters.

$24 - 2x$ = the length of the box.

$17 - 2x$ = the width of the box.

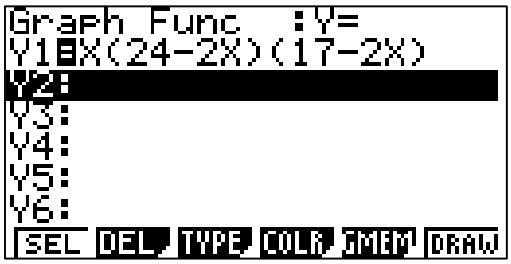
C. Write a formula to find the volume of the box

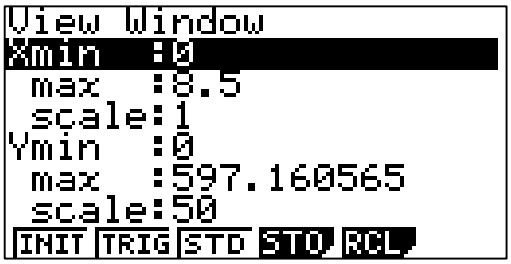
$V = x\,(\,24 - 2x\,)\,(\,17 - 2x\,)$

D. Determine the dimensions that will maximize the volume of the box.

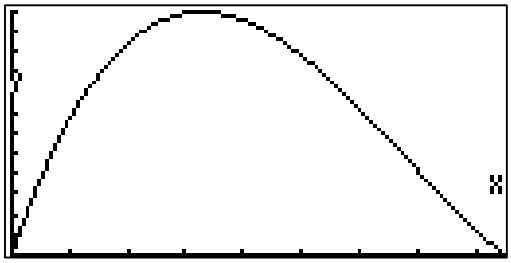
From the MAIN MENU, choose "Graph." Then,

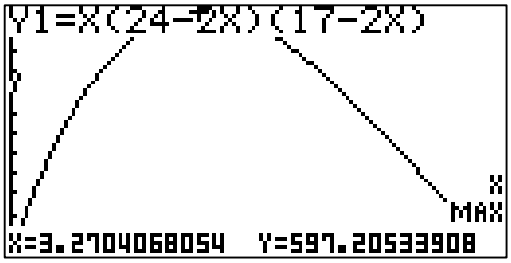
- Type the formula into Y1 and press [EXE] . See below left.
- Press [SHIFT] [F3] to set the window. Only positive values for x should be considered. If $x > 8.5$, the volume would be negative, so the domain should be restricted to $0 \le x < 8.5$. Type in the appropriate values for x, pressing [EXE] after each entry and [EXIT] when finished. This time we'll let the calculator set values for y.
- Press [F6] to draw the graph. Press [F2] followed by [F5] to set the window automatically for y. See below right to see the window that was set for us.





- To return to the graph, press EXIT F6 . See below left.
- To find the *x*-value that produces the maximum volume, press F5 for the graph solver and F2 for maximum. The screen below right tells us that to maximize the volume, we should cut squares from the corners with sides of 3.27 centimeters. This will form a box with a volume of 597.2 cubic centimeters.





If we were more interested in rounded values, we could have inspected a table to see how changing the sides of the squares we cut out affect the volume. From the MAIN MENU, choose "Table."

- Press F5 to set the range. Perhaps start at 0 and end at 6, using a pitch of perhaps .2. See below left.
- Press EXIT to leave the range screen and F6 to see the table. Use the down arrow key to find the greatest volume. See below right. This tells us that we most likely will obtain our maximum volume when we cut squares that have a length of somewhere between 3.2 and 3.4 centimeters.