Topics in Calculus: Applications of Derivatives

Optimization

NCTM Principles and Standards

- **Content Standard:** Represent and analyze mathematical situations and structures using algebraic symbols
- **Process Standard**: Use representations to model and interpret physical, social, and mathematical phenomena

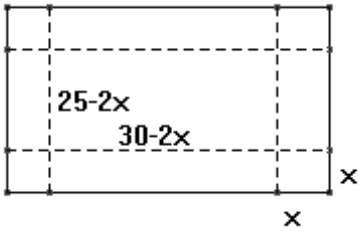
In business and industry the object is to find the optimal solution for a problem. This may mean finding the conditions that produce such situations as minimum cost, maximum profit, maximum volume, or minimum surface area.

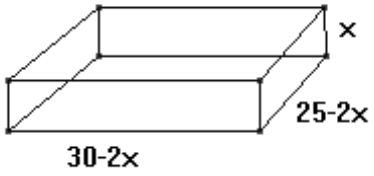
Strategies for Solving Problems:

1. Draw a picture.
2. Write a mathematical model.
3. Draw a graph of the function.
4. Draw a graph of the problem situation (that is select the domain values that make sense for that problem).
5. Find critical points.
6. Find the extreme (optimal) value.

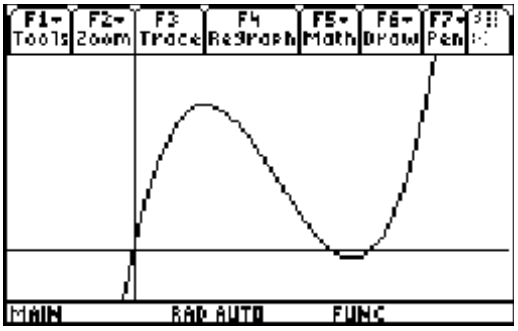
- A box with no top is to be created from a rectangle with dimensions 25cm by 30cm by cutting congruent squares of side length x from the corners. Determine the size square that will produce the box with maximum volume.

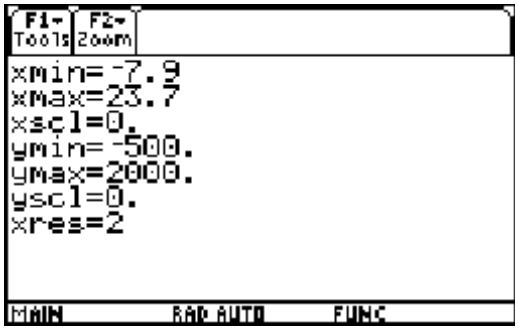
1. Picture



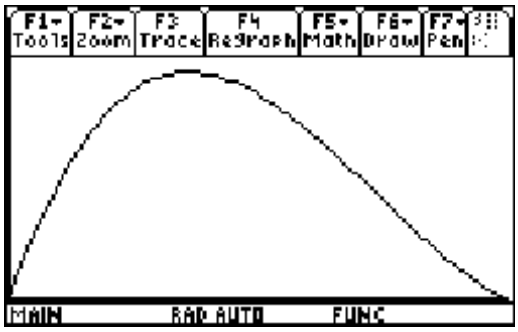


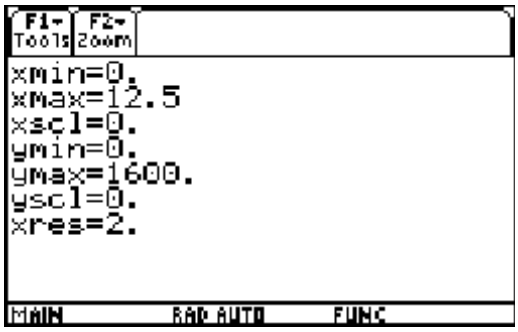
1. Mathematical model: V(x)=x(30-2x)(25-2x)
2. Graph the function:





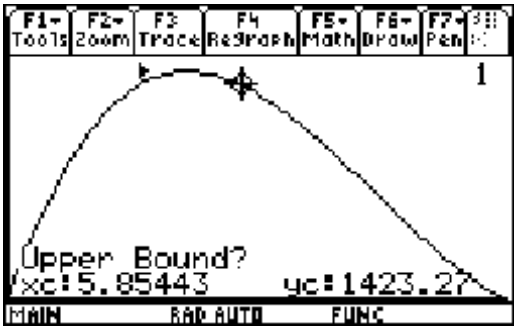
3. Draw a graph of the problem situation.



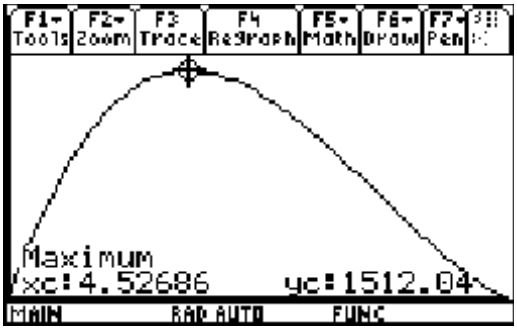


4. Find critical values.

   To find the maximum value press F5 4. Press ◄/► as necessary to move to a point to the left of the maximum and press ENTER. Press ► to move to the right of the maximum and press ENTER.

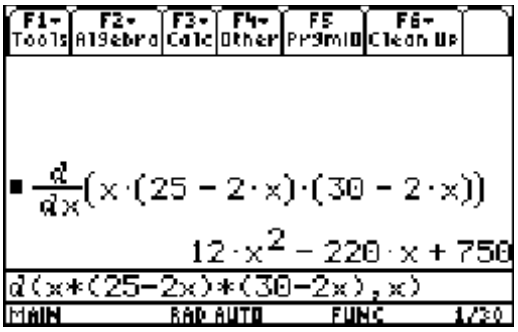


5. Find the extreme value.

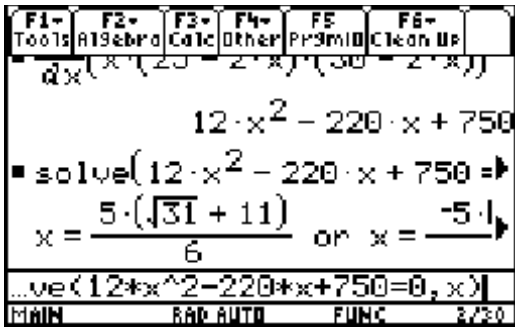


- Use the CAS features of the TI-89 to find the maximum value.

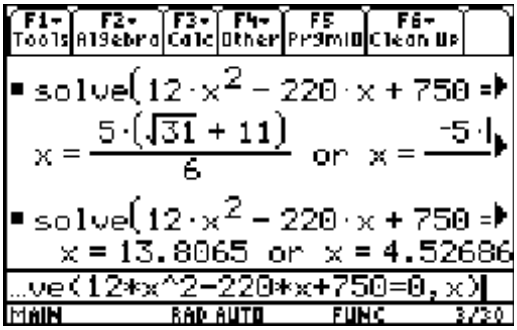
1. Find the derivative for f(x). Press F3 1 to select the differentiate command or press 2nd 8 (x*(25-2x)*(30-2x) , X).



2. Set the derivative equal to zero and solve for x. Press [F2][1] to paste the solve command in the entry line. Press ⊙ to arrow up to the derivative on the screen and press [ENTER] to paste it into the entry line. Type [=][0][,][X][)] and press [ENTER].



3. To see the approximate solutions press [◆][ENTER]. Notice that there are two solutions one of which is not reasonable for this problem.



3. To find the minimum, press [Y][1][(] ⊙ [ENTER] to paste the answer into the entry line. Press ⊙ to arrow to the left and delete x= and the unwanted answer. Press ⊙ to arrow back to the end of the statement and press [)] [ENTER]. Or simply type [Y][1][(][4][.][5][2][9][)].