Math 150, ***Lecture Notes- Bonds*** **Name____________**

Section 3.7 *Optimization Problems*

Applied Minimum and Maximum Problems

One of the most common applications of calculus involves the determination of minimum and maximum values. Consider how frequently you hear or read terms such as greatest profit, least cost, least time, greatest voltage, optimum size, least size, greatest strength, and greatest distance. Before outlining a general problem-solving strategy for such problems, let's look at an example.

Guidelines for Solving Applied Minimum and Maximum Problems

1. Identify all *given* quantities and quantities *to be determined*. If possible, make a sketch.
2. Write a **primary equation** for the quantity that is to be maximized or minimized. (A review of several useful formulas from geometry is presented inside the front cover.)
3. Reduce the primary equation to one having a *single independent variable*. This may involve the use of **secondary equations** relating the independent variables of the primary equation.
4. Determine the feasible domain of the primary equation. That is, determine the values for which the stated problem makes sense.
5. Determine the desired maximum or minimum value by the calculus techniques discussed in Sections 3.1 through 3.4.

When you take a test that covers this material, I will ask you to show me the following:

(i) draw a diagram of the situation and label the diagram

(ii) define your variables

(iii) create a function

(iv) use agraphing utility to graph this function over the appropriate domain

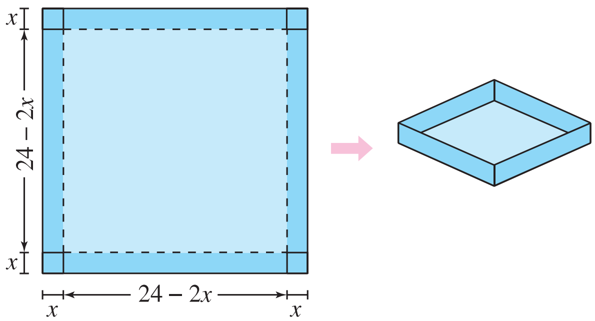
(v) use calculus and algebra to **prove** your result-
that is, differentiate, find critical numbers, use a 1^{st}, or 2^{nd} derivative test

and

(vi) state your answer in a sentence, using correct units

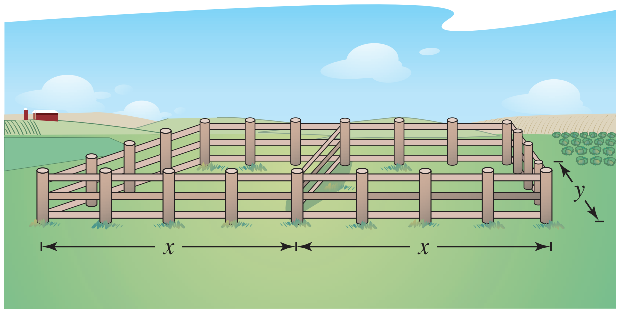
Ex.1

Numerical, Graphical, and Analytic Analysis An open box of maximum volume is to be made from a square piece of material, 24 inches on a side, by cutting equal squares from the corners and turning up the sides (see figure).



Ex.2

Maximum Area A rancher has 400 feet of fencing with which to enclose two adjacent rectangular corrals (see figure). What dimensions should be used so that the enclosed area will be a maximum?



Ex.3

Which points on the graph of $y = 4 - x^2$ are closest to the point $(0, 2)$?

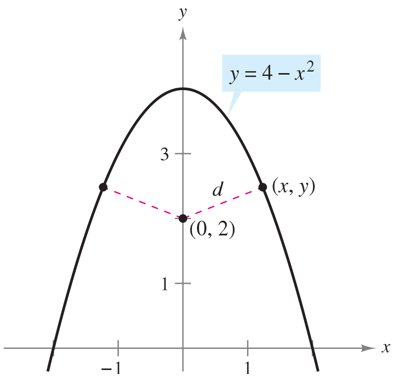


Figure 3.55

Ex.4

A rectangular page is to contain 24 square inches of print. The margins at the top and bottom of the page are to be $1\frac{1}{2}$ inches, and the margins on the left and right are to be 1 inch (see Figure 3.56). What should the dimensions of the page be so that the least amount of paper is used?

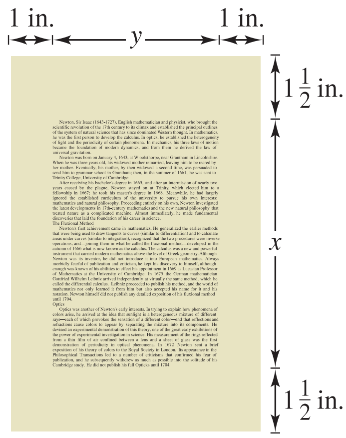


Figure 3.56

Ex.5

Two posts, one 12 feet high and the other 28 feet high, stand 30 feet apart. They are to be stayed by two wires, attached to a single stake, running from ground level to the top of each post. Where should the stake be placed to use the least amount of wire?

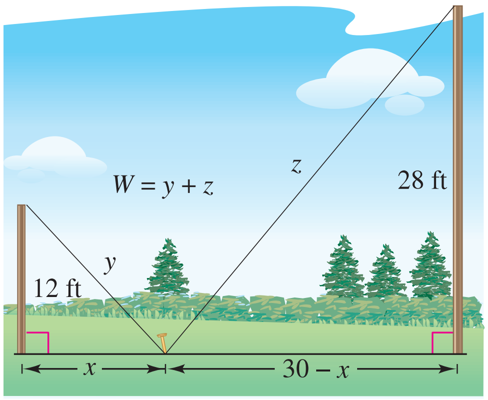


Figure 3.57

Ex.6

Four feet of wire is to be used to form a square and a circle. How much of the wire should be used for the square and how much should be used for the circle to enclose the maximum total area?

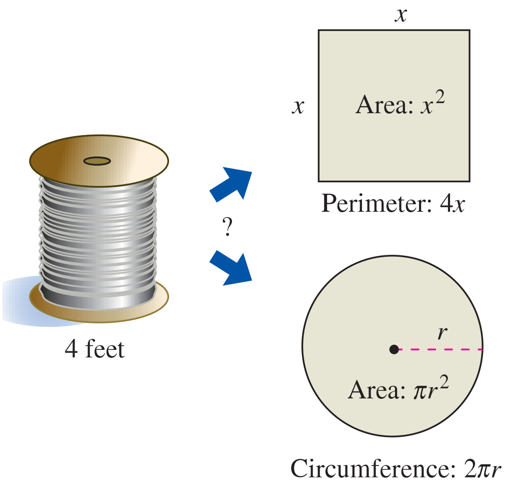


Figure 3.59