According to the Standards:
Instructional programs from preK-grade 12 should enable students to:

- Recognize and use connections among mathematical ideas
- Use the language of mathematics to express mathematical ideas precisely
- Select, apply and translate among mathematical representations to solve problems

In grades 9-12 students should

1. Students should develop an increased capacity to link mathematical ideas and a deeper understanding of how more than one approach to the same problem can lead to equivalent results.

Calculus Scope and Sequence: Applications of Derivatives
Keywords: optimization, maximum, minimum, applications
Description: This activity will illustrate the idea of using the derivative to find a solution to an optimization problem

A farmer wishes to fence in a rectangular field of 10,000 square feet. The north-south fences will cost $1.50 per foot, while the east-west fences will cost $6.00 per foot. Find the dimensions of the fence that will minimize the cost.

- Set up the cost function in terms of one variable
- Find the derivative of the cost function
- Find the critical points on the derivative, check for max, min using the second derivative
- Confirm the point graphically.

The Derivative is found from the Homescreen in F3-Calc-#1
Syntax: *d*(function, variable)
The Solve function is found from the Homescreen in F2-Algebra-#1
Syntax: solve(expression = expression, variable)

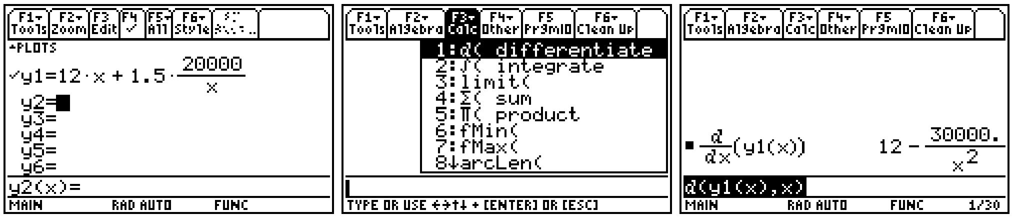
User Tips:

1. **You can store the function in the Y= screen to make it easier to use**
2. **You can copy and paste a result from the homescreen by using the Up Arrow to highlight it and then pressing ENTER to paste it into the edit line. (You can also use the copy & paste functions in the F1-Tools menu)**

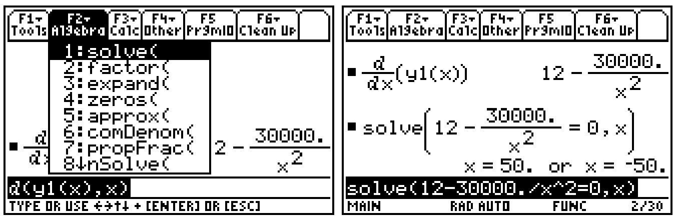
In this problem we let x = east-west dimension and y = north-south dimension

- Therefore $xy = 10{,}000$
- $y = 10{,}000/x$
- *Cost = 6(east-west) + 1.5(north-south)*
- *Cost = 6(2x) + 1.5(2y)*
- *Cost = 12x + 1.5(20,000/x)*

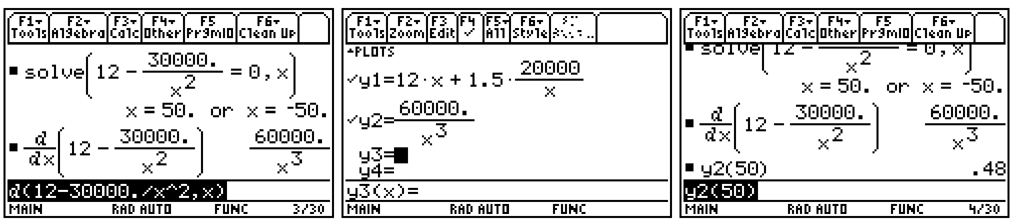
Finding the Derivative:



Setting the Derivative equal to zero to find the critical points:



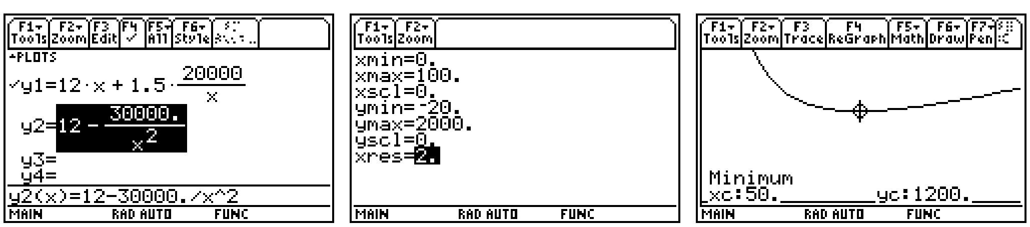
Disregard –50 (outside the domain of the problem) and check in the second derivative:



The second derivative is positive, therefore the function has a minimum at x=50 in the domain x > 0 which is appropriate for the problem.

The answer to the question asked then is 50 feet of east-west fence and 200 feet of north-south fence.

You can use the graph to visually confirm these dimensions:
Note: Make sure only the cost equation is active, and that you find a reasonable window to see the problem develop.



Extension:
You can show the graphs of the original cost function and the first derivative and compare. However, the window setting required to show both does make it hard to see.