Final Project
Honors Calculus I
Math 2554H
Fall 2018

The final project consists of two optimization problems. For each problems, you are expected to do the following:

(a) Carefully sketch the situation described. Clearly label on your picture any known distances with numbers, and label any distances you may choose with variables (letters).
(b) Find a formula for the total cost in terms of your variables.
(c) Using the techniques you have learned this semester, find an equation or equations that are satisfied by the variables that give you the lowest cost.
(d) In part (b), you should have found a polynomial or trigonometric equation. Find the roots of this polynomial using Newton's method. Use the intermediate value theorem to be sure that your roots are correct to at least 6 significant figures.
(e) Test all of your roots (and any necessary boundary values) to find a local minimum. Explain why you may be sure that this is indeed a global minimum.
(f) Carefully write up your solutions, explaining your work at every step.

Problem 1. A pipeline must be laid from a small island in a lake to a treatment plant on shore. The island is 24 miles to the west of the shore. The treatment plant is 18 miles east of the shore and 45 miles north of the island. You may assume that the shoreline is a straight line running from north to south. The cost of laying the pipeline under water is twice as much per mile as it is on land. The pipeline starts at the island and goes under water in a straight line to a point on land and then from this point in a straight line to the treatment plant. At what point on the straight shoreline should the pipeline meet the shore in order to minimize the cost? Assuming the cost of building the pipeline on land is \$65,750.94 per mile, how much will the whole project cost? Write a report that your boss must use to submit a bid to the city government to bid on this job. You want your boss to feel confident that when she follows your advice she is selecting the cheapest possible path for the pipeline.

Problem 2. A firm must build a cylindrical storage tank that holds 2600π cubic feet of water. The top is to be made of inexpensive sheet steel costing \$25 per square foot. The sides must be made of steel costing \$42 per square foot. Because the tank must sit on corrosive soil, the bottom must be made of a special alloy costing \$45 per square foot. The contractor orders the top, bottom and cylindrical sides from a supplier, but must weld the base and top to the prefabricated sides. With all overhead included, it costs \$28 per foot to do the welding at both the top and at the bottom. What should be the dimensions of the storage tank to ensure the the lowest cost? What is this lowest cost? Suppose you are doing this report for the use of the construction company owner. You want to explain exactly how you arrived at your numbers in such a way that the owner of the construction company will feel confident that he is making the lowest possible bid.