Math 196L **PROBLEM SET 4** **NAME:**

Instructions: Read each problem. Write a sentence or two about the approach you might take to solve each problem. Draw a picture to illustrate the scenario. Write a formula that might be needed to help set up or solve the problem.

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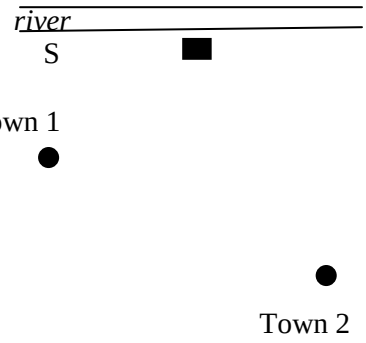
1. On the same side of a straight river are two towns and the townspeople wants to build a pumping station. The pumping station is to be at the river's edge with pipes extending straight to the two towns. Town 1 is 1 mile south of the river and Town 2 is 4 miles south of the river. Town 2 is 6 miles east of Town 1. They can put the pumping station anywhere along the river bank; the pipe cost $55 per foot. How much must they spend for the pipe to connect both towns to the pumping station?



2. A suspension bridge is a type of bridge in which the deck (the roadway) is hung below suspension cables on vertical suspenders. Consider a bridge with 2 suspension cables, each of which form a curve that can be approximated by a parabola, its lowest point 10 feet above the horizontal roadway. The suspension cables are attached to twin towers on the roadway that rise 98.2 feet from the roadway and 420 feet apart. Between the towers, equally spaced vertical suspenders lines are used to hang the deck from the suspension cables. On each suspension cable, you can use six stronger vertical suspenders lines which cost $120 per foot or nine cheaper (but weaker) vertical suspenders lines costing $72 per foot. Which should you use, and what is the cost of the suspender lines?

3. A firework can be created in the following way. Load a spherical shell with burst stars (a chemical mixture that when ignited produces the colorful bursts of light) and run a wick into a mortar, an object similar to a small cannon. Black powder is loaded below the shell and once ignited, will propel the shell with some initial velocity. Once the shell is airborne, the wick burns and is timed so the explosion of the shell and contents is delayed.

Suppose we plan on shooting such a firework from a rudimentary mortar which points straight up from the roof of a 30 foot building. The shell is fired with an initial velocity of 112 feet per second.

It may be helpful to use the following equation for the height in feet, p, as a function of time, t, in seconds:

$$p(t) = -16t^2 + v_0 t + s_0$$

where v_0 represents initial velocity, and s_0 represents initial position.

A) Find the vertex of the height equation for this particular scenario. What is the practical interpretation?

B) Determine and simplify the average rate of change of position between t=1 and t=1+h. What is the practical interpretation of this value? How might we use this to determine the exact speed at t=1?