Third Examination
Tuesday, October 25, 2011

Instructions: This exam should be done on your own paper. Your name should be on each sheet and on the back of the last sheet; the answers should appear written carefully and in order. If in doubt, show intermediate steps: Full credit may not be given, even for correct answers, unless work is arranged clearly and explained. This exam is closed book. You may leave after handing in your exam paper, but be sure to check your answers carefully. Each entire problem is worth 25 points. You may keep this exam sheet.

1. A satellite dish is in the shape of a parabola 2 meters across and 1 meter deep at its deepest. (That is, it is a paraboloid of revolution.) If it fills with water, how many liters will it hold, and how heavy is the water in it?

   Hint: 1 cubic meter is 1000 liters, and 1 liter of water weighs 1 kilogram, under specific conditions.

2. An electrical cable is hung between two towers spaced 1 unit apart. The cable sags about 0.1276 units midway between the towers. It is well-known that such hanging cables follow a *catenary* curve, in the shape of the cosh function. If we say the cable stretches between $x = 0$ and $x = 1$, suppose the shape of this particular catenary curve is
$$y = \cosh(x - 0.5).$$

   Find the total length of cable between the two towers.

3. Circle City has a population, in people per square mile, given approximately by
$$\delta(r) = 5000 * (6 - r),$$

   where r is the distance from the center of the city, $0 \leq r \leq 6$. Based on $\delta(r)$, what is the total population of the city?

4. Water weighs about 62.4 pounds per cubic foot. What is the total force (in pounds) on a glass window 8 feet high and 20 feet long at the bottom of an aquarium that is 20 feet deep?