Math. 301-01
Fall, 1999
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Second Examination, Part 2
Monday, October 25, 1999

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 open book, open notes, and computer-on. You may leave after handing in your exam paper, but be sure to check your answers carefully. Each entire problem is worth 33 points, and 1 point is "free".

1. A certain parabolic radio telescope is 1000 feet across at the top, and 250 feet deep, so that a cross-section obeys the equation $y = x^2/1000$. Suppose that, after a hurricane, the bottom of the telescope fills with water to a depth of 20 feet. If water weighs 62.4 pounds per cubic foot, then how much work (in ft.-lb.) would be required to pump the water out over the top (assuming the telescope was not engineered to drain the water out)? (See Figure 1.)

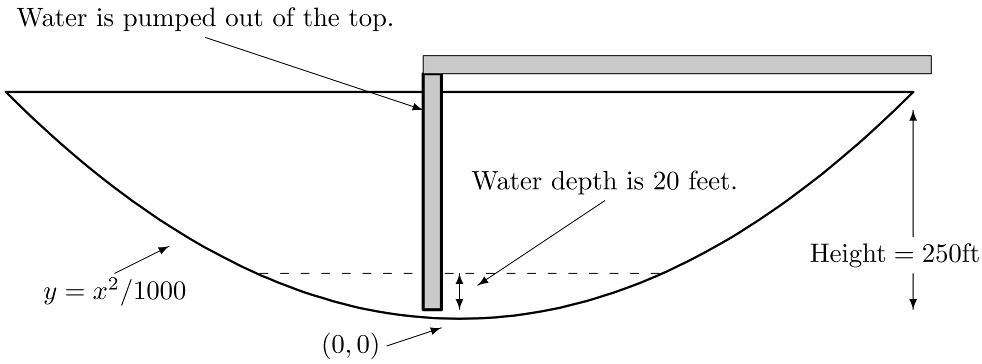

Figure 1: The radio telescope for Problem 1

2. Find the volume of the solid obtained by rotating the region between curve $y = x^3$, $0 \le x \le 1$, and $0 \le y \le 1$ about the y-axis. (*Hint: Draw a picture of the region and the solid to use as a guide.*)

3. Suppose a line is stretched from one edge of the radio telescope in Problem 1 to the bottom of the telescope. How long is the line? (*Hint: Give an exact answer if you can. Otherwise, you may use the "`N`" function in Mathematica to get an approximation. In any case, explain carefully what you did, showing all relevant equations. You may print your Mathematica notebook.*)