MATH 127
MIDTERM II
April 5, 2006

NAME (please print legibly): ________________________________
Your University ID Number: ________________________________

- No calculators or notes are allowed on this exam.
- Please show all your work. You may use backs of pages if necessary. You may not receive full credit for a correct answer if there is no work shown.
- You do not need to simplify all the way.

Unacceptable answer: $4x^2 - x|_1^2$.
Acceptable answer: $(4(2^2) - 2) - (4 - 1)$.

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1. **(20 pts)** Set up an integral representing the length of the quarter circle shown below. You do not need to compute the integral.

(Bonus: compute!)

\[ y = \sqrt{9 - x^2} \]
2. (20 pts) Consider the region under the graph of $y = \sqrt{x}$ between $x = 0$ and $x = 4$:

A solid is formed by rotating this region around the horizontal line $y = -1$ (shown dotted).

(a) Using $dx$ to compute the volume will result in:  **Washers**  **Shells**  (circle one).

(b) Using $dy$ to compute the volume will result in:  **Washers**  **Shells**  (circle one).

(c) Compute the volume of the solid, using whichever method you prefer.
3. (20 pts) A well is 10m deep, and has a cylindrical shape, with radius 2m. The well contains water up to a height of 5m. Find the work done in pumping all of the water out the top of the well.
4. **(20 pts)** A block of radioactive kryptonite has radioactive decay. Let \( m(t) \) represent the mass of the block at time \( t \) (in hours). The rate of decay is twice the mass at any given time.

(a) Express the last sentence as a differential equation. (Hint: the rate of decay is \(-\frac{dm}{dt}\).)

(b) Solve the above differential equation.

(c) Suppose that at time \( t = 0 \) the block has a mass of 8 kg. What will the mass be after 2 hours?
5. **(20 pts)** The following series are geometric. Determine whether each series converges. If convergent, give the sum. If divergent, say why.

(a) \( \sum_{n=1}^{\infty} \frac{11^n}{10^n} \)

(b) \( \frac{2}{3} + \frac{6}{6} + \frac{18}{12} + \frac{54}{24} + \cdots \)

(c) \( \sum_{n=5}^{\infty} \left( -\frac{1}{2} \right)^n \)