Instructions: You must show supporting work to receive full and partial credits. No text book, notes, formula sheets allowed.

1. (27 points, 9 points each) Evaluate each of the following integrals (**No calculators allowed on this problem**).

   (a) $\displaystyle \int \frac{x^3}{\sqrt{x^2 + 3}} dx$

   (b) $\displaystyle \int \sin x (\cos x + 5)^{99} dx$

   (c) $\displaystyle \int_1^2 \frac{\ln x}{x} dx$

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2. (24 points, 8 points each) Let R be the region enclosed by $y = 4 - x^2$, $y = 2 - x$.

(a) Find **(but don't evaluate)** an integral whose value gives the exact area of the region R.

(b) Find **(but don't evaluate)** an integral whose value gives the volume of the solid obtained by revolving the region R about the line $y = -1$, **using the method of washers.**

(c) Find **(but don't evaluate)** an integral whose value gives the volume of the solid obtained by revolving the region R about the vertical line $x = 3$, **using the method of cylindrical shells.**

3. (14 points, 7 points each) A swimming pool has the shape of a rectangle 20 feet by 80 feet and the pool's sloppy bottom changes linearly from 4 feet at one end to 10 feet at the other end. Find a Riemann sum whose value approximates the total amount of work done in pumping out a pool full of water over the pool's top rim.

(b) Write down **but do not evaluate** an integral whose value is exactly the total amount of work done in pumping out the water.

4. (10 points) A dam is in the shape of a trapezoid with height 60 feet. The width at the top is 40 feet and the width at the bottom is 100 feet. Find the maximum hydrostatic force the wall would need to withstand.

5. (25 points, 5 points each) The following table gives some values of a function $y = f(x)$ on the interval $[1, 1.8]$:

x	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8
f(x)	1	1.3	1.4	1.2	1.1	0.9	0.8	0.9	0.95

Approximate the value of the integral $\int_1^{1.8} f(x)dx$ by the following Riemann sums:

(a) The left point sum L_4

(b) The right point sum R_4

(c) The midpoint sum M_4

(d) The trapezoid sum T_4

(e) The Simpson sum S_4

2 Bonus Points: Dr. Deng's new office is on the __th floor of _____ Hall.   (*... The End*)