Math 113 (Calculus 2)
Exam 1
25-29 January 2008

Instructions:

1. Work on scratch paper will not be graded.

2. Should you have need for more space than is allotted to answer a question, use the back of the page the problem is on and indicate this fact.

3. Simplify your answers. Expressions such as \( \ln(1) \), \( e^0 \), \( \sin(\pi/2) \), etc. must be simplified for full credit.

4. Calculators are not allowed.

For Instructor use only.

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</table>
1. (30%) Consider the region between the curves \( y = x^2 \) and \( y = 6x - x^3 \) in the first quadrant.

(a) Set up an integral for the area of the region bounded by the curves. DO NOT EVALUATE.

(b) Set up an integral for the volume when the region is rotated about the \( x \)-axis. DO NOT EVALUATE.

(c) Set up an integral for the volume when the region is rotated about the \( y \)-axis. DO NOT EVALUATE.

(d) Set up an integral for the volume when the region is rotated about the line \( x = -1 \). DO NOT EVALUATE.

(e) Set up an integral for the volume when the region is rotated about the line \( y = 6 \). DO NOT EVALUATE.
2. (10%) Use the disk method or the shell method to show that the volume $V$ of a sphere with radius $r$ is given by $V = \frac{4}{3}\pi r^3$.

3. (10%) A heavy rope, 100 ft long, weighs 0.5 lb/ft and hangs over the edge of a building 120 ft high. How much work is done in pulling the rope to the top of the building?
4. (10%) A spherical tank having radius 10 feet is filled with a fluid which weighs 100 pounds per cubic foot. This tank is half full. Find the work in foot pounds needed to pump the fluid out of a hole in the top of the tank.

5. (40%) Evaluate the following integrals:

(a) \( \int_0^{\pi} x \sin x \, dx \)

(b) \( \int_0^{\pi} \sin^2(2x) \, dx \)
(c) $\int (\ln x)^2 \, dx$

(d) $\int e^{3\theta} \cos(2\theta) \, d\theta$

(e) $\int \sin^4 x \cos^3 x \, dx$