Please answer the following questions. Your answers will be evaluated on their correctness, completeness, and use of mathematical concepts we have covered. Please show all work and write out your work neatly. Answers without supporting work will receive no credit. The point values of the problems are listed in parentheses.

1. (12 points) Evaluate the following indefinite integral.

\[ \int x^4 \ln x \, dx \]
2. (13 points) Evaluate the following indefinite integral.

\[ \int \frac{1}{x^3 + x} \, dx \]
3. (12 points) Evaluate the following indefinite integral.

\[ \int \sin^2 x \cos^5 x \, dx \]
4. (13 points) Evaluate the following indefinite integral.

\[ \int \frac{x^2}{(1 - x^2)^{3/2}} \, dx \]
5. (12 points) Find the exact value (no decimal approximations) of the following integral if it converges.

\[ \int_{0}^{\infty} \frac{1}{(2x + 1)^3} \, dx \]
6. (12 points) Use the Comparison Test to determine whether the following integral converges or diverges. You do not need to evaluate the integral if it converges.

\[ \int_{1}^{\infty} \frac{x^3}{x^5 + 1} \, dx \]
7. (13 points) Determine the area between the graphs of $y = \cos x$ and $y = \sin 2x$ for $0 \leq x \leq \pi/2$. *Hint:* $\sin 2x = 2 \sin x \cos x$. 
8. (13 points) A pyramid has a square base with edges of length 20. The height of the pyramid is 15. Find the volume of the pyramid.