• 100 points for total.

• No calculator. Show all your work clearly.

• Presentation counts!!! Bad presentations are such as wrong notations or omitting $dx$, etc.

1. Evaluate indefinite integrals and definite integrals. Show your substitution clearly if you use any.

   (a) $\int \frac{x^2 + 1}{x^2} \, dx$

   (b) $\int \tan x \sec^2 x \, dx$
(c) \( \int (x + 2)\sqrt{x^2 + 4x} \, dx \)

(d) \( \int_1^2 \frac{1}{x} (x - 1) \, dx \) \quad \text{Simplify your answer as much as possible.}
(e) \[ \int_0^1 \frac{1}{\sqrt{4x + 1}} \, dx \]

2. Find \( \frac{d}{dx} \int_{100}^{x} \sqrt{t^5 - 1} \, dt. \)
3. Evaluate the integral by interpreting it in terms of area. **Sketch and shade** the appropriate area. **Show your work clearly. Simplify your answer as much as possible.**

\[
\int_{-2}^{2} \left(1 + \sqrt{4 - x^2}\right) dx
\]
4. Find the area of the region enclosed by the $x$-axis, the curve $y = 4 - x^2$.

(a) Sketch the curves and shade the region. Mark the intercepts of the curves clearly if there are any.

(b) Set up, but do NOT evaluate, the integral.

(c) Evaluate the integral in (b) to find the area. Simplify your answer as much as possible.
5. Consider the area $A$ of the region that lies under the graph $f(x) = \sin x$ over the interval $[0, \pi/2]$.

   (a) Estimate the area $A$ using two approximating rectangles, i.e., $n = 2$, and by taking the sample points to be right-most points.

   (b) Find the exact area $A$ using definite integrals.
6. For the given integrals $\int_{1}^{e} \frac{(\ln x)^2}{x} \, dx$, answer the followings.

(a) Evaluate the integral by substitution.

(b) Sketch the region that is represented by the definite integral in (a) after the $u$-substitution on the $uy$-plane.

(c) What is the area of the region that you draw in (b)?

(d) What is the area of the region that is represented by the given integral?