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) \( \int (x + 2)\sqrt{x^2 + 4} \, dx \)

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

(f) \[ \int_0^1 e^{3x} \, dx \]
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.

\[ \int_{-3}^{3} \sqrt{9 - x^2} \, dx \]
4. Find the area of the region between the $x$-axis, the curve $y = \cos x$ over the interval $-\pi \leq x \leq \pi$.

(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 $f(x) = 3x^2 + 1$ over the interval $[0, 2]$.

(a) Estimate the area $A$ using four approximating rectangles, i.e., $n = 4$, and by taking the sample points to be right-most points. You don’t need to evaluate your estimate; you can leave your answer in a raw form such as $9/10(.5)^3 + 10/10(.7)^6$.

(b) Find the exact area $A$ using definite integrals.