Name (Print last name first): ................................................

Show all your work and justify your answer!
No partial credit will be given for the answer only!

PART I

You must simplify your answer when possible.
All problems in Part I are 8 points each.

1. Evaluate $\int \sqrt{x}(x^2 + 1) \, dx$.

2. Evaluate $\int \frac{x^2 + 1}{x^5} \, dx$.  


3. Evaluate $\int_0^1 x^3 \sin(2x^4 + 1) \, dx$

4. Evaluate $\int_{-2}^2 \frac{x}{x^4 + x^2 + 1} \, dx$.

5. Use the Fundamental Theorem of Calculus to define an anti-derivative of the function $f(x) = \sin(x^2 + 1)$.
6. Use a Riemann sum with $n = 3$ terms and the midpoint rule to approximate the value of $\int_1^2 \frac{1}{x} \, dx$.

7. Find the average value of the function $f(x) = x^2 - x$ on $[0, 1]$. 
PART II

1. [14 points] Evaluate \( \int \frac{(x + 1)^2}{(1 - x)^{30}} \, dx \)
2. **[16 points]** Suppose the graph of a function $y = f(x)$ is shown in the plot below.

(i) Find the value of its integral: $\int_0^3 f(x) \, dx$

(ii) Let $g(x) = \int_0^x f(t) \, dt$. What is the derivative $g'(1)$?

(iii) State the intervals where $g(x)$ is increasing and where it is decreasing. [As always you must explain your answer!]

The area of a triangle is $\frac{1}{2} \cdot \text{base} \cdot \text{height}$. 

![Graph showing the area of a triangle and the integral of a function.](image)
3. [14 points] If the velocity of a particle is given by \( v(t) = t^3 - t \) and the position \( S(0) = 3 \).

   (a) Find a formula for the position \( S(t) \) at time \( t \).
   (b) Find the displacement of the particle on \([0, 2]\).
   (c) Find the total distance traveled by the particle on \([0, 2]\).
Scratch paper