Please read the following instructions carefully:

- There are **two problems** in this quiz.
- The point distribution is given in the table below.
- Please write each solution on a separate page.
- This is a group quiz. Feel free to discuss the problems with your teammates. **You must, however, write and turn in your own work.**
- Upload your work to Gradescope.

1. (5 points) Let R be the region between the graphs of $f(x) = 1 + \sqrt{x}$ and $g(x) = e^{-x}$ over the interval $[0, 1]$. Find the volume of the solid of revolution obtained by revolving the region R around the x-axis.

2. (5 points) Let $f(x) = \ln(x^2 - 1)$ for $2 \leq x \leq 5$. Set up the integral to compute the arc length. **Do NOT evaluate the integral.**

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1. (5 points) A hemispherical swimming pool has a radius of 9 feet. The surface of the water is at height 5 feet (from the bottom). Set up, **but DO NOT EVALUATE**, the integral for the work required to pump all but 3 feet of water (from the bottom) to a platform 1 foot above the top of the pool. **Place the origin at the BOTTOM of the tank**. Assume the weight of water is 62.5 pounds per cubic foot.

2. (5 points) Find the length L of the curve parameterized by $x(t) = 1 - t^2$ and $y(t) = 1 + t^3$ for t in the interval $[0, 1]$.

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1. (5 points) Solve the following questions:
   (a) Find dx/dy for the function $y = \ln(x^3 + 1)$. That is, compute the derivative of the inverse function of $y = \ln(x^3 + 1)$.
   (b) It can be shown that the function.

$$f(x) = \int_0^x \sqrt{1 + t^4}\, dt,$$

   has an inverse function. Letting $c = f(1)$, compute $(f^{-1})'(c)$, the derivative of the inverse function at c.

2. (5 points) Solve the following questions:
   (a) Compute the derivative of the function,

$$f(x) = 2^{x+2} + \sin^{-1}(x^3).$$

   (b) Evaluate the integral,

$$\int \frac{dx}{9x^2 + 16}.$$

Please read the following instructions carefully:

- There are **three** problems.
- Each problem has **two** parts.
- **In each problem, solve any ONE part of your choice**.
- The point distribution is given in the table below.
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1. (5 points) Compute **ONE** of the two integrals:

$$\int x^2 \sin(x)\, dx \quad \textbf{OR} \quad \int \tan^3(x) \sec(x)\, dx$$

2. (5 points) Compute **ONE** of the two integrals:

$$\int \frac{1}{(1-x^2)^{3/2}}\, dx. \quad \textbf{OR} \quad \int \frac{5x}{(x-2)(x-3)}\, dx$$

3. (5 points) Solve any **ONE** of the following two parts:
   (a) Write an approximation using the trapezoidal rule for the integral,

$$\int_0^2 \ln(x^3)\, dx,$$

   using $n = 4$ sub-intervals. **Do NOT find the final numerical answer.**
   (b) Determine whether the following improper integral converges or diverges:

$$\int_1^\infty \frac{1}{x}\sqrt{1+\frac{1}{x}}\, dx.$$

Hint: Use the comparison property and recall that,

$$\int_1^\infty \frac{dx}{x^p} \text{ is finite if } p > 1 \text{ and } \int_1^\infty \frac{dx}{x^p} \text{ is infinite if } 0 < p \leq 1.$$

NOTE: Due to limited time available during the quiz, I have asked you to solve only a limited number of problems. But please try and solve all problems either during the quiz or after solving the required number of problems during the quiz. All such problems are fair game on the exam on Friday!

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1. (5 points) Determine whether any **TWO** of the following series converge or diverge:

$$\sum_{n=1}^{\infty} \frac{\ln n}{n^3} \quad \textbf{OR} \quad \sum_{n=0}^{\infty} \frac{n(n+1)2^n}{3^n} \quad \textbf{OR} \quad \sum_{n=1}^{\infty} \frac{(\ln n)^n}{n^n}$$

2. (5 points) Find the radius of convergence of the power series:

$$\sum_{n=0}^{\infty} \frac{nx^n}{2^n(n+1)}$$

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