Technology used: Write only on one side of each page. Show all of your work. Calculators may be used for numerical calculations and answer checking only.

1. [15 points] Without using a calculator, evaluate the following indefinite integral
\[ \int \left( \frac{1}{|x|\sqrt{x^2 - 1}} + \frac{2}{x^2 + 1} - \frac{3}{\sqrt{1-x^2}} + \frac{4}{x} - e^x + \sin(x) - \sec^2(x) + \sec(x)\tan(x) - x^{-5/3} \right) \, dx \]

2. [15 points] If we use the partition points \( x_0 < x_1 < x_2 < \cdots < x_n \) to partition the interval \([2, 5]\) into \( n \) subintervals of equal length
   
   (a) What is the value of \( \Delta x \) in terms of the letter \( n \)?
   
   (b) Write the values of \( x_0, x_1, x_2, x_k, \) and \( x_n \) in terms of the letter \( n \).
   
   (c) Use sigma notation to write, in terms of the letter \( n \), the Riemann sum for the function \( f(x) = 2\pi\sqrt{x} \) that uses the left endpoint of each subinterval as the value of \( c_k \).

3. [15 points] Do ONE (1) of the following.
   
   (a) If we partition the interval \([0, 2]\) into \( n \) subintervals of equal width and select \( c_k \) as the right endpoint of each subinterval, then the corresponding Riemann sum for the function \( f(x) = 8 - x^3 \) is \( \sum_{k=1}^{n} \left( 8 - \left( \frac{2k}{n} \right)^3 \right) \frac{2}{n} \).

   Use the fact that \( f(x) = 8 - x^3 \) is monotone decreasing over the interval \([0, 2]\) to find an error bound for this estimate. Include any pertinent figures and write your answer as a function of \( n \) (the number of subintervals).

   (b) Express the following limit as a definite integral. Do not evaluate the limit. [Note that \( \Delta x = \frac{5}{n} \).]

\[ \lim_{\|P\| \to 0} \sum_{k=1}^{n} \left[ 9 \left( 2 + \frac{5k}{n} \right)^5 - \left( 2 + \frac{5k}{n} \right)^2 + 15 \right] \frac{5}{n} \]

4. [10 points] Do ONE (1) of the following.
   
   (a) Find the derivative of \( F(x) = \int_{2}^{x} \sqrt{\cos(4t)} \, dt \).
   
   (b) Find a function \( f \) that satisfies the equation

\[ \sec(x) = \int_{2}^{x} \sqrt{4 + f(t)} \, dt. \]

5. [15 points each] Use substitution to evaluate TWO (2) of the following indefinite integrals.
(a)
\[ \int \frac{4x \sqrt{\arcsin (x^2)}}{\sqrt{1 - (x^2)^2}} \, dx \]

(b)
\[ \int_0^{\ln(9)} e^\theta (e^\theta - 1)^{1/2} \, d\theta \]

(c)
\[ \int \frac{3 \sin (x) \cos (x)}{\sqrt{1 + 3 \sin^2 (x)}} \, dx \]

6. [15 points] Solve the initial value problem
\[ \frac{d^2 y}{dx^2} = \frac{1}{(x - 2)^2}, \quad y'(3) = 0, \quad y(3) = 5 \]