1. (30 pts) Evaluate the following integrals.
   
   i. \( \int \frac{x^2 + 4x + 1}{x^3 + x^2} \, dx \)
   
   ii. \( \int_{3}^{0} \frac{\sqrt{x}}{(1 - t^2)^{3/2}} \, dt \)
   
   iii. \( \int_{4}^{9} \frac{\sqrt{x}}{x - 1} \, dx \)
   
   iv. \( \int (\tan^4 x - \sec^4 x) \, dx \)
   
   v. \( \int \frac{x^2}{\sqrt{2x - x^2}} \, dx \)

2. (25 pts) Consider the function \( f(x) = x \sin x \).
   
   (a) Approximate the net area between the graph of \( f(x) \) and the \( x \)-axis from \( x = 0 \) to \( x = 2\pi \) using the Trapezoidal Rule with \( n = 4 \).
   
   (b) Estimate the error in the calculation from part (a).
   
   (c) Find the exact net area between the graph of \( f(x) \) and the \( x \)-axis from \( x = 0 \) to \( x = 2\pi \).

3. (25 pts) Consider the region bounded above by \( y = \sqrt{x} \) and below by \( y = x - 2 \) and the \( x \)-axis.
   
   (a) Sketch the region. Be sure to label all axes, curves, and intersection points.
   
   (b) Set up the integral(s) with respect to \( x \) which, if evaluated, would give the area of the region.
   
   (c) Set up the integral(s) with respect to \( y \) which, if evaluated, would give the area of the region.
   
   (d) Find the area of the region using your answer to either part (b) or part (c).

4. (20 pts) Determine if the following integrals converge or diverge. If the integral in part (a) converges, find its value.
   
   a. \( \int_{0}^{1} x \ln x^4 \, dx \)
   
   b. \( \int_{1}^{\infty} \frac{2e^{-x} \cos^2 x}{\tan^{-1} x} \, dx \)

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**Midpoint Rule**

\[ M_n = \Delta x \left[ f(\bar{x}_1) + f(\bar{x}_2) + \cdots + f(\bar{x}_n) \right] \]

where \( \Delta x = \frac{b - a}{n} \) and \( \bar{x}_i = \frac{1}{2} (x_{i-1} + x_i) \)

\[ |E_M| \leq \frac{K(b - a)^3}{24n^2} \]

**Trapezoidal Rule**

\[ T_n = \frac{\Delta x}{2} \left[ f(x_0) + 2f(x_1) + 2f(x_2) + \cdots + 2f(x_{n-1}) + f(x_n) \right] \]

where \( \Delta x = \frac{b - a}{n} \)

\[ |E_T| \leq \frac{K(b - a)^3}{12n^2} \]