1. (8 points each) Evaluate the integral.
   
   (a) \[ \int x \cos(3x) \, dx \]
   
   (b) \[ \int \sec^4(5x) \, dx \]
   
   (c) \[ \int \frac{3 \cos^5 \alpha}{\sqrt{\sin \alpha}} \, d\alpha \]

2. (8 points each) Evaluate the integral.
   
   (a) \[ \int \frac{dx}{(25 + x^2)^{\frac{3}{2}}} \]
   
   (b) \[ \int \frac{x^2}{x^2 + 9} \]
   
   (c) \[ \int \frac{x + a}{x^2 - x} \, dx \]

3. (10 points) Determine whether the integral is convergent or divergent. If it is convergent, evaluate it.
   
   (a) \[ \int_{1}^{\infty} \frac{dx}{\sqrt{x}} \]
   
   (b) \[ \int_{0}^{1} \frac{dx}{\sqrt{x}} \]

4. (8 points)
   
   For any twice differentiable function \( f \) on \([a, b]\), \( P_{a}^{b}(f) \) will approximate \( \int_{a}^{b} f(x) \, dx \) to an error no more than \( K_{2} \frac{(b-a)^4}{32} \) when \( |f''(x)| \leq K_{2} \) for all \( x \) in \([a, b]\). You use \( P(f) \) to numerically approximate the integral \( \int_{1}^{3} \sqrt{1 + x^3} \, dx \) by subdividing the interval into 10 equal pieces and applying \( P(f) \) to each of the smaller intervals.
Using that the absolute value of the second derivative of $\sqrt{1 + x^3}$ is never more than 2 over $[1, 3]$, what is an upper bound for the error of your approximation (4 points) and why (6 points)?

5. (12 points, 8/4) Let $a > 0$. Evaluate the integrals.

(a) $\int \sin(x)e^{-ax} \, dx$

(b) $\int_0^\infty \sin(x)e^{-ax} \, dx$