1. (36 pts) Evaluate the integral.
   (a) \( \int \left( \tan \theta + \frac{1}{\cos \theta} \right)^2 d\theta \)
   (b) \( \int \frac{11}{(2x - 1)(3x + 4)} \, dx \)
   (c) \( \int \frac{3x^3 + 18x - 1}{x^2 + 6} \, dx \)

2. (26 pts) Consider the integral \( \int_{0}^{\pi/2} x \cos(2x) \, dx \).
   (a) Estimate the integral using the trapezoidal approximation \( T_3 \). Fully simplify your answer.
   (b) Find error estimate \( |E_T| \) for the approximation \( T_3 \). You may leave your answer unsimplified. (Hint: The first derivative of \( x \cos(2x) \) is \( \cos(2x) - 2x \sin(2x) \).)
   (c) Find the exact value of the integral.

3. (16 pts) The shaded region shown below is bounded by \( y = x \cos(2x) \) and \( y = x \sin(2x) \). The region is composed of two smaller regions \( R_1 \) above the \( x \)-axis and \( R_2 \) below the \( x \)-axis. Set up (but do not evaluate) integrals to find the following quantities.
   (a) The area of shaded region \( R_1 \) which lies above the \( x \)-axis
   (b) The volume of the solid generated by rotating the entire shaded region (both \( R_1 \) and \( R_2 \)) about the line \( y = -2 \)

\[ \text{TURN OVER—More problems on the next page} \]
4. (12 pts) Determine whether \( \int_{1}^{\infty} \frac{e^{-x^3}}{\cosh(1)} \, dx \) is convergent or divergent. Justify your answer.

5. (10 pts) Let \( f(x) = \frac{b - a}{(x - a)(x - b)} \) where \( a \) and \( b \) are constants, \( 0 < a < b \).

Is \( \int_{b+1}^{\infty} f(x) \, dx \) convergent or divergent? If convergent, find the value of the integral. If divergent, explain why. (Hint: Let \( g(x) = \ln |x - b| - \ln |x - a| \). Then \( g'(x) = f(x) \).)

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**Trigonometric identities**

\[
\begin{align*}
\sin(2x) &= 2 \sin(x) \cos(x) \\
\cos(2x) &= \cos^2(x) - \sin^2(x) \\
\sin^2(x) &= \frac{1}{2} (1 - \cos(2x)) \\
\cos^2(x) &= \frac{1}{2} (1 + \cos(2x))
\end{align*}
\]

**Inverse Trigonometric Integral Identities**

\[
\begin{align*}
\int \frac{du}{\sqrt{a^2 - u^2}} &= \sin^{-1}(u/a) + C \\
\int \frac{du}{a^2 + u^2} &= \frac{1}{a} \tan^{-1}(u/a) + C \\
\int \frac{du}{u\sqrt{u^2 - a^2}} &= \frac{1}{a} \sec^{-1}(u/a) + C
\end{align*}
\]

**Error Bounds for Trapezoidal and Midpoint Rules**

\[
|E_T| \leq \frac{K(b - a)^3}{12n^2} \quad |E_M| \leq \frac{K(b - a)^3}{24n^2}
\]