1. Evaluate the following integrals

(a). $\displaystyle\int_0^{\pi/2} \sin(9x)\cos(x)\,dx = \frac{1}{10}$

(b). $\displaystyle\int \frac{-1}{\sqrt{x^2-2x-3}}\,dx = -\ln\left|\tfrac{x-1}{2} + \tfrac{\sqrt{(x-1)^2-4}}{2}\right| + C$

(c). $\displaystyle\int \tan^3 x \sec^4 x\,dx = \frac{1}{4}\tan^4 x + \frac{1}{6}\tan^6 x + C$

(d). $\displaystyle\int \frac{1}{x^3-4x^2+4x}\,dx = \frac{1}{4}\ln|x| - \frac{1}{4}\ln|x-2| - \frac{1}{2}\frac{1}{x-2} + C$

(e). $\displaystyle\int x^3(\ln 2x)\,dx = \frac{1}{4}x^4\ln(2x) - \frac{1}{16}x^4 + C$

(f). $\displaystyle\int \sqrt{9-x^2}\,dx = \frac{9}{2}\sin^{-1}\left(\frac{x}{3}\right) + \frac{x\sqrt{9-x^2}}{2} + C$

(g). $\displaystyle\int \sin^{-1} x\,dx = x\sin^{-1} x + \sqrt{1-x^2} + C$

(h). $\displaystyle\int \frac{4x}{(x^2-1)(x^2+1)}\,dx = \ln|x-1| + \ln|x+1| - \ln|x^2+1| + C$

2. Use a rationalizing substitution to evaluate $\displaystyle\int \frac{x}{\sqrt{x+9}}\,dx$ $= \frac{2}{3}(x+9)^{3/2} - 18\sqrt{x+9} + C$ using $u = \sqrt{x+9}$

3. Approximate the integral $\displaystyle\int_4^6 \frac{1}{x^2}\,dx$, using [Do **NOT** simplify.]

(a). Simpson's Rule with $n = 4$

$$\int_4^6 \frac{1}{x^2}\,dx \approx \frac{1}{6}\left[\frac{1}{16} + 4\cdot\frac{4}{81} + 2\cdot\frac{1}{25} + 4\cdot\frac{4}{121} + \frac{1}{36}\right]$$

(b). The Trapezoid Rule with $n = 6$

$$\int_4^6 \frac{1}{x^2}\,dx \approx \frac{1}{6}\left[\frac{1}{16} + 2\cdot\frac{9}{169} + 2\cdot\frac{9}{196} + 2\cdot\frac{1}{25} + 2\cdot\frac{9}{256} + 2\cdot\frac{9}{289} + \frac{1}{36}\right]$$

4. Evaluate the following improper integral: $\displaystyle\int_0^\infty (7x-3)e^x\,dx$ Diverges to $+\infty$.

5. Evaluate the following integrals or show that it is a divergent improper integral.

(a). $\displaystyle\int_0^1 \frac{1}{4-2x}\,dx = \frac{1}{2}\ln 2$

(b). $\displaystyle\int_0^4 \frac{1}{4-2x}\,dx$ Diverges

(c). $\displaystyle\int_{-\infty}^\infty 2x^2 e^{-x^3}\,dx$ Diverges

6. Integrate: $\displaystyle\int e^x \sin 2x\,dx = \frac{1}{5}\left(e^x \sin 2x - 2e^x \cos 2x\right) + C$

7. Find the area bounded by $f(x) = \sin^2 x \cos^2 x$ on the interval $[0, \pi/2]$. $\displaystyle A = \frac{1}{8}x - \frac{1}{32}\sin 4x\Big|_0^{\pi/2} = \frac{\pi}{16}$

8. Write out the ***form*** of the partial fraction decomposition for the following function. Do **NOT** determine the values of the coefficients.

$$\frac{3x-4}{x^2(x-2)(x^2+9)^3} = \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x-2} + \frac{Dx+E}{x^2+9} + \frac{Fx+G}{(x^2+9)^2} + \frac{Hx+I}{(x^2+9)^3}$$

9. Determine whether the following **sequences** converge or diverge. Find the limit if it converges.

(a). $a_n = \frac{1}{n} + (-1)^n$ Div./DNE

(b). $a_n = \frac{1}{5^n} \to 0$

(c). $b_n = \frac{\cos n}{n} \to 0$

(d). $\displaystyle\left\{\frac{5n^2+n}{3-2n^2}\right\}_{n=1}^\infty \to -\frac{5}{2}$