1. Find the following limits. Clearly show all steps and indicate where you use L'Hopital's Rule.

(a). $\lim_{x\to 0} \frac{\sin 4x}{2x}$ **(b).** $\lim_{x\to\infty} (1+x)^{\frac{1}{x}}$ **(c).** $\lim_{x\to 2} \frac{x-2}{x^2-3x+2}$ **(d).** $\lim_{x\to 2} \frac{x-2}{x^2-3x-2}$

2. Evaluate the following integrals

(a). $\int_0^{\pi/2} \sin(9x)\cos(x)\,dx$

(b). $\int \frac{-1}{\sqrt{x^2-2x-3}}\,dx$

(c). $\int \tan^3 x \sec^4 x\,dx$

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

(e). $\int x^3(\ln 2x)\,dx$

(f). $\int \sqrt{9-x^2}\,dx$

(g). $\int \sin^{-1} x\,dx$

(h). $\int \frac{4x}{(x^2-1)(x^2+1)}\,dx$

3. Integrate: $\int e^x \sin 2x \, dx$

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

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

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

5. Evaluate the following improper integral: $\int_0^\infty (7x - 3)e^x \, dx$

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

(a). $\int_0^1 \frac{1}{4 - 2x} \, dx$ **(b).** $\int_0^4 \frac{1}{4 - 2x} \, dx$ **(c).** $\int_{-\infty}^\infty 2x^2 e^{-x^3} \, dx$

7. Find the area bounded by $f(x) = \sin^2 x \cos^2 x$ on the interval $[0, \pi/2]$.

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

$$\frac{3x - 4}{x^2(x - 2)(x^2 + 9)^3}$$

9. Use the Comparison Theorem for integrals to determine whether the following integral converges or diverges.

$$\int_1^\infty \frac{\arctan x}{x^{3/2}} \, dx$$

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

(a). $a_n = \frac{1}{n} + (-1)^n$ **(b).** $a_n = \frac{1}{5^n}$ **(c).** $b_n = \frac{\cos n}{n}$ **(d).** $\left\{ \frac{5n^2 + n}{3 - 2n^2} \right\}_{n=1}^\infty$