You must show all of your work to receive full credit. No calculators are allowed.

1. Find the area of the region between the two functions: $y = 4x^2$, $y = x^2 + 3$. 
2. Using the disk or shell method, find the volume of the solid generated by revolving the graphs of $y = x^2$, $y = 9$, about the $x$-axis from $x = 1$ to $x = 3$. 
3. Using the disk or shell method, find the volume of the solid generated by revolving the graph of \( f(x) = \sqrt{x} \) about the \( x \)-axis from \( x = 0 \) to \( x = 1 \).
4. Find the following using integration by parts:

$$\int \ln x \, dx$$
5. Find the following using integration by parts:

\[ \int (4x + 7) e^x \, dx \]
6. Use a partial fraction decomposition to find the integral:

\[
\int \frac{1}{x^2 - 4} \, dx
\]
7. Find the following limit using l’Hôpital’s Rule:

\[ \lim_{x \to \infty} \frac{\ln (x^4)}{x^3} \]
8. Find the following limit using l’Hôpital’s Rule:

\[
\lim_{x \to \infty} \frac{x^2}{e^{3x}}
\]
9. Determine the convergence or divergence of the series:

\[ \sum_{n=1}^{\infty} \frac{(-1)^n}{4n + 3} \]
10. Determine the convergence or divergence of the series:

\[
\sum_{n=1}^{\infty} \frac{1}{3^n + 5}
\]
11. Find the Maclaurin polynomial of degree \( n = 4 \) for the function \( f(x) = e^{2x} \) (centered at \( c = 0 \)).
12. Determine whether the improper integral diverges or converges. If it converges, evaluate.

\[
\int_{1}^{\infty} \frac{3}{\sqrt{x}} \, dx
\]