1 Integration Methods, 3B

In addition to the integration “rules,” you must also recall several techniques of integration.

1. \textit{u-substitution}

\begin{align*}
\text{a)} & \quad \int x \sin(x^2 - 3) \, dx \\
\text{b)} & \quad \int e^4 \frac{1}{x \sqrt{\ln(x)}} \, dx \\
\text{c)} & \quad \int \sec^3(y) \tan(y) \, dy
\end{align*}

\[ u = \quad du = \]
2. Integration by Parts

\[ a) \int x \sin(x - 3) \, dx \quad b) \int \arctan(y) \, dy \]

\[ u = \quad du = \quad dv = \quad v = \]

c) \int e^{\cos t} \, dt \] This is a tricky, but classic problem.
3. **Partial Fractions** Factor the denominator and rewrite the expression \( \frac{1}{x^2+5x+6} \) as the sum of constants over the linear factors of the denominator.

Calculate the following two integrals:

a) \( \int \frac{1}{x^2+5x+6} \, dx \)

b) \( \int \frac{1}{1-y} \, dy \)
2 Differential Equations, 3C

Are the following are solutions to the given differential equations:

\[ 9y'' + 4y = 0 \]
\[ y = 2 \cos \left( \frac{2}{3} t - \frac{\pi}{2} \right) \]

\[ y'' = 25y \]
\[ y = 5 \sin (3t) \]

\[ y'' - 2y' + y = 0 \]
\[ y = 2e^{-t} - te^{-t} \]