1. (5 points) Compute the following integral:

\[ \int x e^{x^2/2} \, dx \]

\[ = 2x e^{x^2/2} - \int 2e^{x^2/2} \, dx \]

\[ = 2x e^{x^2/2} - 4e^{x^2/2} + C \]

\[ f(x) = x \quad f'(x) = 1 \]

\[ g(x) = e^{x^2/2} \quad g'(x) = 2e^{x^2/2} \]

2. (5 points) Use partial fractions to simplify the given integral. Do NOT compute the integral or the values of constants A, B, C, etc.

\[ \int \frac{1}{x^4(x - 3)(x + 1)(x^2 + 1)(x^2 + 5)} \, dx \]

\[ = \int \frac{A}{x} + \frac{B}{x^2} + \frac{C}{x^3} + \frac{D}{x^4} + \frac{E}{x - 3} + \frac{F}{x + 1} + \frac{Gx + H}{x^2 + 1} + \frac{Jx + K}{x^2 + 5} \, dx \]

(extra credit) Explain how the answer of question 2 would look if you actually found the constants and computed the integral. (You may show how it would look by computing the above integral in terms of A, B, C, etc.)

You would get \( \ln(x) \), \( \arctan(x) \), and \( x^{-n} \) terms.

Eg:

\[ A \ln(x) + \frac{-B}{x^2} - \frac{C}{2x^2} - \frac{D}{3x^3} + E \ln(x - 3) + F \ln(x + 1) \]

\[ + = \ln(x^2 + 1) + = \arctan(x) \]

\[ + = \ln(x^2 + 5) + = \arctan(\frac{x}{\sqrt{5}}) + C \]