Problem 1. Evaluate the integral
\[ \int_0^1 (x^2 + 2)e^x \, dx. \]

Problem 2. Evaluate the integral
\[ \int \frac{\sin(\ln x)}{x} \, dx. \]
Problem 3. Find the area between $y = \sin x$ and $y = -x$ for $x$ in $[0, \pi]$.

Problem 4. Find the average value of $f(x) = (x + 1) \ln x$ over $[1, 2e]$. 
Problem 5. Determine if the following given improper integral converges or diverges. If it converges, calculate its value.

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

Problem 6. Solve the differential equation

\[ xy \frac{dy}{dx} = 1 \]

with \( y(1) = 1 \).