0. (1 pt) Follow the instructions on this exam and any additional instructions given during the exam.

(5 pt) 1. If $F$ is an antiderivative of $f$ and $F(x) = e^{\sin(x)}$, then compute $\int_{0}^{x} f(s) \, ds$. 

2. The shaded region below is the region in the first quadrant bounded by $y = e^{-\sqrt{x}}$ and $x = 4$.

(a) Set up, but do not evaluate, an integral that will give the average value of $f(x) = e^{-\sqrt{x}}$ over the interval $[0, 4]$.

(b) Write down a function $F$ that is an antiderivative of $f$ with the property that $F(1) = 5$. Your answer may be written in terms of an integral.
(6 pt) 3. Below is the graph of the function $f$:

(a) Compute $\int_{0}^{9} f(x) \, dx$.

(b) What is the average value of $f$ over the interval $[0, 9]$?

(c) Compute $\int_{0}^{9} \frac{f(\sqrt{x})}{\sqrt{x}} \, dx$. 
4. The following is a graph of the function \( f \). Assume the area of region \( A \) is 5 and the area of region \( B \) is 6.

Let \( F(x) = \int_a^x f(t) \, dt \).

(a) Give the values of \( F(a) \), \( F(c) \), and \( F(b) \).

(b) Is \( F(d) \) a positive number, a negative number, or zero?

(c) Compute \( \int_b^a |f(t)| \, dt \).

(d) Is \( F \) concave up, concave down, or does it have a point of inflection at \( x = c \)?
5. Evaluate the integral: \[ \int_{0}^{2} \sqrt{4-x^2} \, dx \]
(6 pt)  6. Evaluate the integral: \( \int 3x^2 \ln(x) \, dx \)
7. Evaluate the improper integral or show that it diverges: \[ \int_{0}^{\infty} xe^{x^2} \, dx \]
8. Find the general solution to the differential equation:

\[
\frac{dy}{dt} = -4 \sin(2t) + 6t
\]
9. (6 pt) Find an explicit solution \( y = f(x) \) to the initial value problem:

\[
\frac{dy}{dx} = \frac{6xy}{\ln(y)}, \quad y(0) = e^2
\]
(6 pt) 10. Find the second degree Taylor polynomial for the function $\ln(x)$ centered at $a = 3$. 