1. Use the method of substitution to find the **definite** integral.

\[
\int_{6}^{8} (x - 3) \sqrt{x^2 - 6x} \, dx
\]

Please note, you must state the \( u \) and \( du \) which will allow \( u \)-substitution to perform the integral.
2. Use integration by parts to find the definite integral.

\[ \int_{0}^{\pi/3} \frac{\sin(x) \ln(\cos x)}{\cos^2 x} \, dx \]

Please note, you must state the \( u, dv, du, \) and \( v \) which will allow integration by parts to perform the integral.
3. Use trigonometric substitution to find the definite integral. \[
\int_{2}^{2\sqrt{3}} \frac{1}{x^2\sqrt{x^2 + 4}} \, dx
\]
4. Determine if the Improper Integral converges or diverges. If it converges, find its value. Show your work.

\[ \int_{2}^{\infty} \frac{1}{x (\ln x)^2} \, dx \]
5. Compute the area of the finite region enclosed by the curves.

\[ y = |x| \]

\[ y = 6 - x^2 \]

Find the points of intersection and integrate over the finite interval.
6. Use the Comparison Test to show whether the following converges or diverges.

\[ \int_{1}^{\infty} \frac{1}{x + e^{2x}} \, dx \]
7. Answer each question on this page in reference to the function $f$ shown in Figure 1; you may simply supply the requested values in the provided blanks no explanations necessary. The “areas” of the three shaded regions are, from left to right, 9.3, 0.7, and 1.2. Assume that $F$ is in reference to the specific antiderivative of $f$ that passes through the point $(0,3)$.

\[ a. \int_{-4}^{4} f(x) \, dx = \]  
\[ b. \int_{0}^{-4} f(x) \, dx = \]  
\[ c. \int_{2}^{4} f'(x) \, dx = \]  
\[ d. F(4) = \]  
\[ e. F(-4) = \]  
\[ f. \int_{0}^{4} f\left(\frac{x}{2}\right) \, dx = \]  
\[ g. \int_{-4}^{4} |f(x)| \, dx = \]  
\[ h. \text{If } g(t) = \int_{-4}^{t} F(x) \, dx \text{ then } g'(0) = \]
8. Suppose \( f(x) = e^x \) over the interval \([0, 3]\), with \( n = 6 \).

For the Trapezoidal sum get the value for \( \Delta x \). State the \( x \)-values that determine the subintervals of \([0, 3]\).

Use the Trapezoidal Rule to compute the Trapezoidal sum, \( T_6 \).
(Give answer to 6 decimal places.)
9. For the following integral consider the error for \([1, 4]\) and \(n = 16\)

\[
\int_1^4 \frac{1}{\sqrt{x}} \, dx
\]

Use the error bound formulas to estimate \(|E_T|\) and \(|E_M|\) for \(n = 16\).

Formulas: \(|E_T| \leq \frac{K (b - a)^3}{12 n^2}\), \(|E_M| \leq \frac{K (b - a)^3}{24 n^2}\)

Using the error bound formula, determine the number of terms, \(n\), needed for \(T_n\) to have an accuracy within 0.0001.