Problem 1) Find the derivative of the function

\[ g(x) = \int_{x^2}^{e^x} \ln(t) dt \]

Problem 2) Evaluate the following integrals. When there are no bounds, you have to find an indefinite integral.

(a) \[ \int_{0}^{\pi/4} \cos(\theta) (\sec^3(\theta) + \sec^2(\theta) \tan(\theta)) \, d\theta. \]

(b) \[ \int |x - 2| dx. \] Hint: express |x - 2| and your answer as piecewise-defined functions.

Problem 3) Let \( t \) be the time in seconds and suppose that an object moves along a straight line with velocity \( v(t) \) (in meters per seconds). We know that \( \int_{t_1}^{t_2} v(t) \, dt \) is the displacement of the object in the time interval \([t_1, t_2]\).

(a) Give an expression (formula) for the distance traveled in the time interval \([t_1, t_2]\). You cannot assume that \( v(t) \geq 0 \).

(b) Suppose that \( v(t) = t^2 - 4t + 3 \). What is the distance traveled in the time interval \([0, 4]\).

Problem 4) In this problem, we will find the value of the following limit:

\[ (*) : \lim_{n \to \infty} \left( \frac{1}{n + 1} + \frac{1}{n + 2} + \frac{1}{n + 3} + \cdots + \frac{1}{n + n - 1} + \frac{1}{2n} \right). \]

(a) Consider \( a_i = \frac{1}{1 + i/n} \). What do you get if you write \( a_i \) as a simplified fraction? In other words, simplify the expression for \( a_i \).

(b) Let \( b_i \) be the \( i \)-th term of the sum in (*). Express \( b_i \) in terms of \( a_i \).

(c) Using (a) and (b), write \( \left( \frac{1}{n+1} + \frac{1}{n+2} + \frac{1}{n+3} + \cdots + \frac{1}{n+n-1} + \frac{1}{2n} \right) \) as a Riemann sum for some function \( f \) on \([1, 2]\).

(d) Transform the limit into a definite integral and evaluate it.

Don’t forget to do the WebAssign Homework, due September 17th at 11:59 pm.