1. Compute $f'(x)$ for

$$(a)\ f(x) = \int_x^{\sin(x)} e^{t^2}\, dt \quad \text{and} \quad (b)\ f(x) = x^x, x > 0.$$

(*Simplify as much as possible.*)

2. Evaluate the following integrals. (*Simplify as much as possible*).

$$(a)\ \int_0^{\pi/2} \frac{\sin(x)\cos(x)}{1+\sin^2(x)}\, dx \text{ and } (b)\ \int_e^{e^2} \frac{1}{x \ln x}\, dx$$

3. Let Ω be the region inside the triangle with vertices at the points $(0,0)$, $(1,1)$, and $(1,-1)$. Find the volume obtained by revolving Ω about the y-axis.

4. Find all points of inflection of the function $f : \mathbb{R} \to \mathbb{R}$ defined by the formula

$$f(x) = \int_0^x e^{-(t-3)^4}\, dt$$

(If there are no points of inflection, explain why; if there are points of inflection explain why they are points of inflection.)

5. Let $f : [0,1] \to \mathbb{R}$ be an increasing function. For each positive integer n, let

$$P_n = \left\{0, \frac{1}{n}, \frac{2}{n}, \ldots, \frac{n}{n}\right\},$$

(the uniform partition of the interval $[0,1]$ into n subintervals).

Show that $U_f(P_n) - L_f(P_n) \leq \dfrac{f(1)-f(0)}{n}$.