1. Differentiate each of the following.
   a. \( F(x) = \arcsin (e^{x^2}) \)
   b. \( F(x) = \ln \left\{ 1 + \int_0^x \sqrt{t^3 + 5} \, dt \right\} \)
   c. \( F(x) = \frac{\tan (\ln x)}{\ln (\tan x)} \)
   d. \( F(x) = \int_0^x \cos x^2 \cdot \sin^2 x^2 \, dx \)
   e. \( F(x) = \int_1^3 e^{1-x} \, dt \)
   f. \( F(x) = \int_3^{x^3} \cos (t^2 + 1) \, dt \)
   g. \( F(x) = \int_{\sqrt{x-1}}^{x} \cos (t^2 + 1) \, dt \)
   h. \( F(x) = \int_x^{-1} (3 - t^5)^{100} \, dt \)
   i. \( F(x) = x^5 \cdot \int_0^x \frac{t^2}{t^2 + 1} \, dt \)

2. Find the x-value(s) for which each of the following functions has a global minimum value.
   a. \( F(x) = e^{x^2 - 7} \)
   b. \( F(x) = 9 + \int_0^x (t - 1) (2 - t)^6 \, dt \) for \( x \geq 0 \)

3. Evaluate the following definite integrals. Think carefully. Nothing sophisticated is needed to solve these problems.
   a. \( \int_1^2 \left( \frac{2}{x^2} + \frac{x^2}{2} \right) \, dx \)
   b. \( \int_{-1}^0 (1 + x)^2 \, dx \)
   c. \( \int_{-1}^0 (1 + x)^{200} \, dx \)
   d. \( \int_0^{\pi/6} \frac{\sin x}{\cos^2 x} \, dx \)
\[ \int_{\frac{\pi}{4}}^{\pi} (\sin x + \cos x)^2 \, dx \]
\[ \int_{0}^{\frac{\pi}{20}} x^2 (1 + x^3)^{1/10} \, dx \]
\[ \int_{0}^{\pi} \cos^2 x \, dx \]
\[ \int_{0}^{\frac{\pi}{2}} \sec^2 5x \, dx \]
\[ \int_{0}^{1} 2x \sec^2 (x^2) \, dx \]
\[ \int_{0}^{\frac{\pi}{4}} (x \cos x + \sin x) \, dx \]

4. a. Make a sketch of the region bounded by the graphs of \( y = \frac{1}{2} x \), \( y = 2 \), and \( x = 0 \).

b. Set up definite integrals which represent the volumes of the solids formed by revolving the region in part a. around

i. the x-axis

ii. the y-axis

5. A large bucket full of water weighing 100 lbs. is slowly lowered 25 feet by a rope and pulley.

a. How much work is done in lowering the bucket?

b. How much work is done in lowering the bucket if the bucket is leaking, losing 4 in.\(^3\) of water per foot lowered. (Assume that one cubic foot of water weighs 62.4 lbs.)

6. Find the average value of each function over the indicated interval.

a. \( f(x) = x^3 \) on \([0, 1]\)

b. \( f(x) = \sin x \) on \([0, \pi/2]\)

c. \( f(x) = 2x e^{x^2} \) on \([\sqrt{\ln 2}, \sqrt{\ln 5}]\)

d. \( f(x) = x \sec^2 x + \tan x \) on \([0, 1/2]\)