1. Evaluate the following integrals:
   (a) \[ \int \frac{\sin(\sqrt{x})}{\sqrt{x}} \, dx \]
   (b) \[ \int_{0}^{12} \frac{1}{5t + 4} \, dt \]
   (c) \[ \int \sec^3(x) \tan(x) \, dx \]
   (d) \[ \int_{0}^{1} x^2(1 + x^3)^5 \, dx \]
   (e) \[ \int_{-2}^{3} (x + 3)\sqrt{4 - x^2} \, dx \]
   (f) \[ \int_{-1}^{2} (x - 2|x|) \, dx \]
   (g) \[ 10 \int_{-1}^{0} (1 + x^5)^{3/2} x^9 \, dx \]
   (h) \[ \int_{0}^{1} 4x\sqrt{1 - x^4} \, dx \]

2. (a) If \( f \) is continuous and \( \int_{a}^{b} f(x) \, dx = 10 \), find \( \int_{0}^{2} f(2x) \, dx \).
   (b) If \( f' \) is continuous on \([a, b]\), show that \( 2 \int_{a}^{b} f(x)f'(x) \, dx = [f(b)]^2 - [f(a)]^2 \).

3. (a) Find the average value of \( f(t) = t\sqrt{1 + t^2} \) over the interval \([0, 5]\).
   (b) State the Mean Value Theorem for Integrals. Find a number \( c \) in \([2, 5]\) such that \( f_{ave} = f(c) \) where \( f(x) = (x - 3)^2 \).

4. Find the derivative of: (a) \( g(t) = \int_{1}^{\cos(t)} \sqrt{1 - x^2} \, dx \)
   (b) \( y = \int_{\sqrt{\pi}}^{x} \cos(t) \, dt \)

5. Find the intervals where the function \( f(x) = \int_{0}^{x} \frac{1}{1 + t + t^2} \, dt \) is concave up and concave down.

6. The velocity function (in meters per second) of a particle in motion is given by \( v(t) = 3t - 5 \), find (a) the displacement and (b) the total distance traveled by the particle in the first 3 seconds.

7. (a) Find an approximation to the integral \( \int_{0}^{2} (2 - x^2) \, dx \) using a Riemann sum with a regular partition with \( n = 5 \) using: (i) right endpoints, (ii) left endpoints, (iii) midpoints
   (b) Evaluate the lower sums (under estimate) for approximating the area of the region bounded by \( f(x) = x^2 - 4 \), \(-2 \leq x \leq 2\) and the \( x \)-axis using 4 approximating rectangles of equal width.

8. Given that: \( \sum_{i=1}^{n} i = \frac{n(n + 1)}{2} \), \( \sum_{i=1}^{n} i^2 = \frac{n(n + 1)(2n + 1)}{6} \), and \( \sum_{i=1}^{n} i^3 = \left[ \frac{n(n + 1)}{2} \right]^2 \).
   Use the limit definition of the integral, with right endpoints and a regular partition, to evaluate the following integrals, show all work: (a) \( \int_{0}^{2} (2 - x^2) \, dx \)  (b) \( \int_{0}^{1} x^3 + 3x \, dx \)

9. (a) Write the sum in expanded form \( \sum_{k=6}^{10} x^k \), (b) Evaluate the sum \( \sum_{i=3}^{99} \left( \frac{1}{i} - \frac{1}{i+1} \right) \)
   (c) Evaluate the limits: \( \lim_{n \to \infty} \sum_{j=1}^{n} \frac{1}{n} \left( \frac{j}{n} \right)^2 \), (d) \( \lim_{n \to \infty} \frac{1}{n} \left[ \left( \frac{1}{n} \right)^9 + \left( \frac{2}{n} \right)^9 + \cdots + \left( \frac{n}{n} \right)^9 \right] \)

10. (a) Set up a Newton’s method algorithm to approximate \( \sqrt{2} \).
    (b) Now, starting with \( x_1 = -1 \), find \( x_2 \), the second iteration approximation of \( \sqrt{2} \).

11. The Max-Min property of the definite integral states that if \( m \leq f(x) \leq M \) on \([a, b]\), then \( m(b - a) \leq \int_{a}^{b} f(x) \, dx \leq M(b - a) \). Use this property to estimate the value of \( \int_{-3}^{4} \sqrt{100 - 4x^2} \, dx \).
12. Let $g(t) = 3 - \frac{t}{2t + 1}$, $t \neq -1/2$.

(a) Show that $g$ is one-to-one.

(b) Let $a = \frac{2+2}{3}$. Calculate $(g^{-1})'(a)$ without finding $g^{-1}$.

(c) Now find $g^{-1}(t)$.

13. Let $h''(\theta) = \sec^2 \theta$, $h(0) = 1$, $h(\pi/4) = \frac{1}{2} \ln 2$. Find $h$.

14. Let $y = \sqrt[3]{\frac{3x - 1}{(x^2 + 5) \cos x}}$. Use logarithmic differentiation to find $dy/dx$. 