1. Find the following indefinite integrals.

\[ \int \frac{(x+3)^2}{\sqrt{x}} \, dx \quad \int \frac{8}{x (\ln 5x)^3} \, dx \quad \int \frac{x^3 + 6x + 4}{x + 2} \, dx \]

\[ \int \frac{30x}{x^4 + 9} \, dx \quad \int \frac{18 \sin x}{\sqrt{4 - \cos^2 x}} \, dx \]

2. Differentiate the following functions.

\[ a) \ F(x) = \int_{x}^{0} \cos (\pi t + 1) \, dt \]

\[ b) \ F(x) = \int_{0}^{1} \frac{t^4}{t^4 + 9} \, dt \]

3. Evaluate the following definite integrals.

\[ a) \ \int_{1}^{3} \frac{q x + 5}{\sqrt{x}} \, dx \]

\[ b) \ \int_{1}^{3} \frac{(5x + 6)^2}{x^2} \, dx \]

4. Use Part I of the Fundamental Theorem of Calculus to define an antiderivative \( G \) for \( f(x) = \cos (x^4) + e^{-x^2} \) with \( G(4) = 11 \).

5. Use the definition of the definite integral to evaluate \( \int_{1}^{4} \frac{1}{x^2} \, dx \), using an arbitrary partition \( P = \{ x_0, x_1, x_2, \ldots, x_n \} \) of \([1, 4]\) and sampling numbers \( c_i \) given by \( c_i = \sqrt{x_{i-1}x_i} \) for \( 1 \leq i \leq n \).

6. Calculate the following limits by finding a definite integral which is represented by each limit, and then evaluating the integral:

\[ a) \ \lim_{n \to \infty} \sum_{i=1}^{n} \frac{n}{n^2 + i^2} \]

\[ b) \ \lim_{n \to \infty} \sum_{i=1}^{n} \frac{1}{i - 1 + n} \]

\[ c) \ \lim_{n \to \infty} \sum_{i=1}^{n} \frac{(n + 2i - 1)^2}{n^2} \]