\[ 1 - \sin^2 x = \cos^2 x, \quad 1 + \tan^2 x = \sec^2 x, \quad \sec^2 x - 1 = \tan^2 x \]

**Half-angle formulas:**

\[ \cos^2 x = \frac{1 + \cos 2x}{2}, \quad \sin^2 x = \frac{1 - \cos 2x}{2} \]

**Double-angle formulas:**

\[ \sin 2x = 2 \sin x \cos x, \quad \cos 2x = \cos^2 x - \sin^2 x = 2 \cos^2 x - 1 = 1 - 2 \sin^2 x \]

**Indefinite integrals:**

\[ \int \sec x \, dx = \ln |\sec x + \tan x| + C, \quad \int \csc x \, dx = -\ln |\csc x + \cot x| + C \]

**Summation identities:**

\[ \sum_{k=1}^{n} k = \frac{n(n+1)}{2}, \quad \sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}, \quad \sum_{k=1}^{n} k^3 = \frac{n^2(n+1)^2}{4} = \left( \frac{n(n+1)}{2} \right)^2. \]

**Approximation’s Rules and their error bound:** Let \( y = f(x) \) be a continuous function defined on the interval \([a, b]\) such that its derivatives \( f'' \) and \( f^{(4)} \) are continuous. The midpoint Rule approximation \( M(n) \), the Trapezoid Rule approximation \( T(n) \) and the Simpson’s Rule approximation \( S(n) \) to \( \int_{a}^{b} f(x) \, dx \) using \( n \) equally spaced subintervals on \([a, b]\) are given by the following formulas:

\[ M(n) = \sum_{k=1}^{n} f \left( a + (k - \frac{1}{2}) \Delta x \right) \Delta x, \]

\[ T(n) = \left( \frac{1}{2} f(x_0) + \sum_{k=1}^{n-1} f(a + k \Delta x) + \frac{1}{2} f(x_n) \right) \Delta x, \]

\[ S(n) = \left( f(x_0) + 4 f(x_1) + 2 f(x_2) + 4 f(x_3) + ... + 4 f(x_{n-1}) + f(x_n) \right) \frac{\Delta x}{3}, \]

where \( \Delta x = \frac{b-a}{n} \). The absolute errors in approximating the integral \( \int_{a}^{b} f(x) \, dx \) by the Midpoint Rule, Trapezoid Rule satisfy the inequalities

\[ E_M \leq \frac{k(b-a)}{24} (\Delta x)^2 \quad \text{and} \quad E_T \leq \frac{k(b-a)}{12} (\Delta x)^2, \]

where \( k \) is a real number such that \( |f''(x)| \leq k \) for all \( x \) in \([a, b]\).
The absolute errors in approximating the integral \( \int_a^b f(x)dx \) by the Simpson’s Rule satisfies the inequalities

\[
E_S \leq \frac{K(b - a)}{180} (\Delta x)^4
\]

where \( K \) is a real number such that \(|f^{(4)}(x)| \leq K\) for all \( x \) in \([a, b]\).

Equivalently, the error bounds can also be written as:

\[
E_M \leq \frac{k(b - a)^3}{24n^2},
\]

\[
E_T \leq \frac{k(b - a)^3}{12n^2},
\]

\[
E_S \leq \frac{K(b - a)^5}{180n^4}.
\]

(you can use any of these two versions for error bounds, as they give the same result.)