- **Summation formulas identities:**

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

- $$1 - \sin^2 x = \cos^2 x,\ 1 + \tan^2 x = \sec^2 x,\ \sec^2 x - 1 = \tan^2 x$$

- **Trigonometric Half-angle formulas:**

$$\cos^2 x = \frac{1+\cos(2x)}{2}, \quad \sin^2 x = \frac{1-\cos(2x)}{2}, \quad \sin(2x) = 2\sin x \cos x$$

- **Indefinite integrals:**

$$\int \sec x\, dx = \ln|\sec x + \tan x| + C, \int \csc x\, dx = -\ln|\csc x + \cot x| + C$$

- **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 Trapeziod 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:

$$\begin{aligned} M(n) &= \sum_{k=1}^{n} f\left(a + (k - \tfrac{1}{2}\Delta x\right)\Delta x, \\ T(n) &= \left(\tfrac{1}{2}f(x_0) + \sum_{k=1}^{n-1} f(a + k\Delta x) + \tfrac{1}{2}f(x_n)\right)\Delta x, \\ S(n) &= \left(f(x_0) + 4f(x_1) + 2f(x_2) + 4f(x_3) + \ldots + 4f(x_{n-1}) + f(x_n)\right)\tfrac{\Delta x}{3}, \end{aligned}$$

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

$$E_M \le \frac{k(b-a)}{24}(\Delta x)^2 \text{ and } E_T \le \frac{k(b-a)}{12}(\Delta x)^2,$$

where k is a real number such that $|f''(x)| \le k$ 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

$$E_S \le \frac{K(b-a)}{180}(\Delta x)^4$$

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

Equivalently, the error bounds can also be written as:

$$\begin{aligned} E_M &\le \tfrac{k(b-a)^3}{24n^2}, \\ E_T &\le \tfrac{k(b-a)^3}{12n^2}, \\ E_S &\le \tfrac{K(b-a)^5}{180n^4}. \end{aligned}$$

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