**Geometric Series**: $\sum_{n=1}^{\infty} ar^{n-1}$ converges to $\frac{a}{1-r}$ if $|r| < 1$.

**Divergence Test**: If $\lim_{n\to\infty} a_n$ does not exist or if $\lim_{n\to\infty} a_n \neq 0$, then the series $\sum_{n=1}^{\infty} a_n$ is divergent.

**Integral Test**: Suppose $f$ is a continuous, positive, decreasing function on $[1, \infty)$ and let $a_n = f(n)$. Then the series $\sum_{n=1}^{\infty} a_n$ is convergent if and only if the improper integral $\int_1^{\infty} f(x)dx$ is convergent.

**P series Test**: The $p$-series $\sum_{n=1}^{\infty} \frac{1}{n^p}$ is convergent if $p > 1$ and divergent if $p \leq 1$.

**Comparison Test**: Suppose that $\sum a_n$ and $\sum b_n$ are series with positive terms.
If $\sum b_n$ is convergent and $a_n \leq b_n$ for all $n$, then $\sum a_n$ also converges.
If $\sum a_n$ is divergent and $a_n \leq b_n$ for all $n$, then $\sum b_n$ also diverges.

**Limit Comparison Test**: Suppose that $\sum a_n$ and $\sum b_n$ are series with positive terms. If $\lim_{n\to\infty} \frac{a_n}{b_n} = c$ where $c$ is a finite number and $c > 0$, then either both series converge or both series diverge.

**Alternating Series Test**: If the alternating series $\sum_{n=1}^{\infty}(-1)^{n-1}b_n$ satisfies

1) $b_{n+1} \le b_n$ for all $n$ and
2) $\lim_{n\to\infty} b_n = 0$ then the series converges.

**Ratio Test**: Suppose that $\sum a_n$ is a series with positive terms. If $\lim_{n\to\infty}\frac{a_{n+1}}{a_n} = L < 1$ then the series converges. If $\lim_{n\to\infty}\frac{a_{n+1}}{a_n} = L > 1$ then the series diverges.

**Root Test**: Suppose that $\sum a_n$ is a series with positive terms. If $\lim_{n\to\infty}\sqrt[n]{a_n} = L < 1$ then the series converges. If $\lim_{n\to\infty}\sqrt[n]{a_n} = L > 1$ then the series diverges.

If a series $\sum a_n$ converges and $\sum |a_n|$ converges, then $\sum a_n$ is **absolutely convergent.**

If a series $\sum a_n$ converges and $\sum |a_n|$ diverges, then $\sum a_n$ is **conditionally convergent.**

**MacLaurin Series**: $f(x) = \sum_{n=0}^{\infty}\frac{f^{(n)}(0)}{n!}x^n$

**Taylor Series:** $f(x) = \sum_{n=0}^{\infty}\frac{f^{(n)}(a)}{n!}(x-a)^n$

$$\frac{1}{1-x} = \sum_{n=0}^{\infty} x^n$$

$$e^x = \sum_{n=0}^{\infty}\frac{x^n}{n!}$$

$$\sin x = \sum_{n=0}^{\infty}(-1)^n\frac{x^{2n+1}}{(2n+1)!}$$

$$\cos x = \sum_{n=0}^{\infty}(-1)^n\frac{x^{2n}}{(2n)!}$$

$$\tan^{-1} x = \sum_{n=0}^{\infty}(-1)^n\frac{x^{2n+1}}{2n+1}$$