Series Theorems for Analytic Functions

**Theorem: (Taylor Series)**
If $w(z)$ is analytic in a region, then it has derivatives of all orders and can be expanded in a Taylor series about any point in that region. The Taylor series will converge inside a circle which extends to the nearest singular point in the complex plane.

**Theorem: (Laurent Series)**
Let $C_1$ and $C_2$ be two circles in the complex plane with center at $z_0$. If $w(z)$ is analytic in the region between the circles, then it can be expanded in a *Laurent series* of the form:

$$w(z) = a_0 + a_1(z - z_0) + a_2(z - z_0)^2 + \ldots$$

$$+ \frac{b_1}{z - z_0} + \frac{b_2}{(z - z_0)^2} + \ldots$$