Method (Power series solutions for $P_0(x)y'' + P_1(x)y' + P_2(x)y = 0$)**.** If $P_0(x_0) \neq 0$, then we'll say that x_0 is an **ordinary point** of the differential equation. We seek a power series solution centered at x_0:

$$\boxed{y = \sum_{n=0}^{\infty} a_n(x - x_0)^n = a_0 + a_1(x - x_0) + a_2(x - x_0)^2 + a_3(x - x_0)^3 + \dots}$$

Using these in our differential equation gives recursive formulas for the coefficients. Note that $y(x_0) = a_0$ and $y'(x_0) = a_1$. Thus, inital values for $y(x_0)$ and $y'(x_0)$ allow us to find values for all the coefficients.

Comment. The method works at any ordinary point, but we'll usually work with $x_0 = 0$.

1. Using $x_0 = 0$, write out power series for y, y', and y''. Either use sigma notation or expand each series to the x^3 term.

When you're finished with (or stuck on) problem 1, watch the video example.

2. Find the first 4 coefficients of a series solution to the IVP $(1 + x^2)y'' + 6xy' + 6y = 0$, $y(0) = -1$ and $y'(0) = 1$.

3. Find the first 4 coefficients of a series solution to the IVP $(1 + 8x^2)y'' + 2y' = 0$, $y(0) = 2$ and $y'(0) = -1$.