1. Show that the series
\[ \sum_{k=0}^{\infty} \frac{(-1)^k}{(2k+1)!} x^{2k+1} = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots \]
is equal to \( \sin x \) by showing that the series is a solution to the initial value problem
\[ \frac{d^2y}{dx^2} = -y, \quad y(0) = 0, y'(0) = 1. \]

2. For each of the differential equations, find a power series solution to the initial value problem with \( y(0) = 1 \) and \( y'(0) = 1 \).
(a) \( y'' + ty' + y = 0 \)

(b) \( y'' + ty = 0 \)

3. Find the general solution for the following differential equations using power series.
(a) \( y' + 2y = 0 \)

(b) \( y' - 2ty = 0 \)