**Problem 1:** Find all singular points of the followings equations and determine whether each of them is regular or irregular. For each regular singular point, determine the indicial equation and the exponents at the singularity.

1. \((x^2 - 4)^2 y'' + 8(x + 2)y' + y = 0\)

2. \((x^2 - 2x - 3)y'' + (x - 3)y' + (x + 1)y = 0\)

**Problem 2:** For the following equation, verify that \(x = 0\) is a regular singular point, find the indicial equation and the exponents at the singularity, find the recurrence relation and find the first three nonzero terms of the series solution for \(x > 0\) corresponding to the larger root of the indicial equation.

\[2xy'' + y' - xy = 0\]

**Problem 3:** Verify that \(x = 0\) is a regular singular point of the following equation. Find the first three nonzero terms in each of two linearly independent solutions about \(x = 0\).

\[2x^2y'' + (3x + x^3)y' - y = 0\]

**Problem 4:** Verify that \(x = 0\) is a regular singular point of the following equation. Find the first four nonzero terms in each of two linearly independent solutions about \(x = 0\).

\[6x^2y'' - xy' + 2(1 + x)y = 0\]