Consider the following differential equation.

\[ x^2 \frac{d^2 y}{dx^2} + 4x \frac{dy}{dx} + (2 + x^2)y = 0. \]

1. [1 point] Are there any singular points of the differential equation? If so, are they regular singular points? Why or why not?

2. [9 points] Find a series solution about the point \( x_0 = 0 \).

3. [1 point] For what values of \( x \) does this series solution converge?

4. [1 point] Is there a nonzero polynomial solution? If so, what is its degree?