1. (20pts) Solve:

$$(y + x^2)dx + (x + \sin y)dy = 0, \quad y(0) = 0.$$
2 (20pts) Solve:

\[
\frac{dy}{dx} = \frac{y}{x} + xy^2, \quad x > 0.
\]
3 (15pts) Find the general solution:

\[ y'' - 6y' + 13y = 0. \]
4 (20pts) Solve:

\[ y' = \frac{3x^2 + 4x + 2}{2y + 1}. \]
5 (15pts)

Use Euler’s method to approximate the solution to

\[ \frac{dy}{dx} = x^2 y + 1, \quad y(0) = 2. \]

at the points \( x = 0.1 \) and \( x = 0.2 \). Let \( h = .1 \).
6 (10pts) Suppose \(y_1(x)\) and \(y_2(x)\) are each particular solutions to

\[ y'' + 7y' + 4y = f(x). \]  

(1)

Also suppose that \(y_3(x)\) is a particular solution to

\[ y'' + 7y' + 4y = g(x). \]  

(2)

- Is \(y(x) = 2y_1(x) - y_2(x)\) also a solution to (1)? Explain.

- Find a solution to

\[ y'' + 7y' + 4y = f(x) - 2g(x). \]