Show all your work in answering the following questions. Simply writing the answer is not acceptable. Staple all your pages together. The professor is not responsible for lost pages.

1. Find the general solution of the following homogeneous differential equations

   (a) \( \frac{d^2y}{dx^2} - 3 \frac{dy}{dx} + 2y = 0 \)

   (b) \( \frac{d^2y}{dx^2} - 6 \frac{dy}{dx} + 9y = 0 \)

   (c) \( \frac{d^2y}{dx^2} - 2 \frac{dy}{dx} + 5y = 0 \)

2. Find the general solution of the following non-homogeneous differential equations

   (a) \( \frac{d^2y}{dx^2} - 2 \frac{dy}{dx} + y = -2e^x \)

   (b) \( \frac{d^2y}{dx^2} + \frac{dy}{dx} - 2y = 3 \)

   (c) \( \frac{d^2y}{dx^2} + 9y = 4 \cos 2x \)

3. A 2 Kg weight stretches a spring 6 cm. The weight is pushed 7 cm above the equilibrium position and released.

   (a) Find the motion of the weight as a function of time, assuming no damping and no external force.

   (b) Find the motion of the weight as a function of time, assuming no external force and a damping force numerically equal to 1/16 of the velocity.

   (c) Find the motion of the weight as a function of time, assuming no damping and an external force equal to \( f(t) = \frac{1}{4} \sin 4t \).

4. Write each expression as a single logarithm, if possible. At each step, specify which property you are using. Simplify as much as you can!

   (a) \( \log_2 3 + 3 \log_2 4x \)

   (b) \( 2 \log_4 3x - \log_3 4x^2 - 3 \log_4 2x^2 \)
5. Write the following expressions as sum, difference, or multiple of logarithms, using the properties of logarithms. At each step, specify which property you are using. *Break it down as much as you can!*

(a) \( \log_2 \frac{\sqrt{8x^3}}{4x^2} \)

(b) \( \log_3 \frac{3}{\sqrt[3]{4x}} \)