1 - 6: Solve the following differential equations. (In each case, the independent variable is \( x \) and the dependent variable is \( y \).)

1. \[
x \frac{d^2 y}{dx^2} - \frac{dy}{dx} = 3x^2
\]

2. \[
y' + y = x^2
\]

3. \[
x \frac{dy}{dx} = y - 3y \left(\frac{y}{x}\right)^{1/3}
\]

4. \[
y y'' + (y')^2 = 1
\]

5. \[
2y(x + 1) \frac{dy}{dx} = x \quad y(3) = 0
\]

6. \[
(1 + x^2) \frac{dy}{dx} + 2xy = 0 \quad y(2) = 3
\]

7. Find the orthogonal trajectories of the parabolas of the form \( y^2 = Cx \).

8. One model of population growth (called the Gompertz growth model) states that the rate of change of a population (with respect to time) is proportional to the product of the population and the log of the ratio of the population and its limiting size, \( L \) (which is a known constant).

A population of 20 wolves has been introduced to a national park. The National Park Service estimates the maximum population the park can sustain is 200 wolves. After 3 years the population of wolves is 40. If the population follows a Gompertz growth model, how many wolves will there be 10 years after they have been introduced to the park?

Please indicate clearly the differential equation which models this behavior, solve it, and state your conclusion.