1. Solve the following IVP \( \frac{dy}{dx} = \frac{y^2 + 1}{y(x+1)} \) with \( y(0) = 2 \).

2. Find the general solution to the differential equation \((2x+y^3 \sec^2 x)dx = (1+3y^2 \tan x)dy\).

3. An object is dropped from a height of 400 meters with initial velocity 0. The magnitude of the force due to gravity is \( F_G = mg \), and the magnitude of the force due to air resistance is \( F_R = 0.7mv \), i.e. the drag coefficient is \( \rho = 0.7 \). Find the time of impact with the ground and the limiting velocity.

4. Solve the differential equation \( y' = \frac{2y^2}{xy - x^2} \).

5. A brine solution of salt with concentration of .2 kg/L flows at a constant rate of 4 L/min into a tank that initially held 20 L of brine solution containing 5 kg of salt. The well-stirred solution flows out of the tank at the rate of 3 L/min. Find the amount \( x(t) \) of salt in the tank at time \( t \) and also the concentration \( y(t) \) and the limiting value of the concentration.

6. A water tank in the shape of a cube 10 ft x 10 ft x 10 ft has a circular hole at the bottom with radius 2 in. Assuming the tank starts out full, how long will it take for the tank to become empty?

7. Solve the initial value problems:
   (a) \( ty' + 2y = 4t^2 \); \( y(1) = 2 \).
   (b) \( y' + (2/t)y = (\cos t)/t^2 \); \( y(\pi) = 0 \); \( t > 0 \).

8. Suppose a rabbit population satisfies the logistic equation \( dP/dt = aP - bP^2 \). Suppose the initial population is 240 rabbits and there are 9 births per month and 12 deaths per month occurring at time \( t = 0 \). Determine the limiting population \( M = \lim_{t \to +\infty} P(t) \), and how many months it takes for \( P(t) \) to reach 105% of the limiting population \( M \).