1. Solve the system of differential equations

$$\frac{dy}{dt} = 3x - 2y$$
$$\frac{dx}{dt} = x + y.$$

2. Solve the system of differential equations

$$\frac{dx}{dt} = y + t$$
$$\frac{dy}{dt} = z + t$$
$$\frac{dz}{dt} = x - t.$$

3. Suppose you have two 30 gallon tanks of water with salt dissolved in each so that at time 0, Tank 1 contains 3 lbs of salt, and Tank 2 contains 2 lbs of salt. Every minute 10 gallons of water flows into tank 1, with a concentration of 0.5 lbs of salt/gallon, 12 gallons of water flow from tank 1 to tank 2, 2 gallons flow from tank 2 to tank 1 and 10 gallons of water flow out of tank 2 (and leave the system). Find equations for the amount of salt in each tank over time, and draw a graph of the solutions.

4. Use the substitution $u = y'$ to solve the differential equation $y^2 y'' = y'$.

5. A mass weighing 6 lbs is attached to a spring, which stretches it (downward) by 3 ft. Suppose that this mass is then pulled down 4 additional feet and released with an upward velocity of 1 ft/sec.

   (a) Assuming no drag, find an equation for the motion of this spring.

   (b) Now assume there is a contribution from friction resulting in a damping force numerically 4 times the instantaneous velocity. Find the equation of motion in this case.