

1. (10 points) Solve the following initial value problem and determine the interval on which the solution is valid.

$$y' = y^2(2x + 1) \quad y(3) = -1/10$$

2. (10 points) Ten grams of salt is dissolved in a 10 liter tank full of water. Then water containing salt at a concentration of 10 grams per liter trickles in at a rate of 2 liters per hour. The mixed solution flows out of the tank at a rate of 3 liters per hour.

Determine the concentration (in grams per liter) of salt in the tank at the time when the tank contains 4 liters.

3. (10 points) One solution to the differential equation

$$6t^2y'' + 6ty' - 6y = 0$$

is $y_1 = t$. Use the reduction of order method to find the general solution to this linear homogeneous differential equation.

- (10 points) A 0.5 kg mass stretches a spring by 25 centimeters. A damper with coefficient 6 N/(m/s) is also attached. The spring is pulled down another 25 centimeters and released. Determine the amount of time that elapses before the spring crosses the equilibrium for the first time. Use $g = 9.8 \text{ m/s}^2$ for acceleration due to gravity.