Northeastern University - Math 5131
Assignment 1

(2 Points) Problem 1

Find the general solution to $t\frac{dy}{dt} - 2ty = t^2 - t$.

(2 Points) Problem 2

Draw the slop plot for $\frac{dy}{dt} = (1-t)y$ and the tranjectory $y(0) = 0$.

(3 Points) Problem 3 - Modeling Pollution Flow

Consider the lake system with Lake A flowing into Lake B. Lake A is contaminated with arsenic due to a coal gasification plant out-flowing near the lake. Clean water enters Lake A at a rate F and all water flows into Lake B. Write a pair of differential equations, one for the concentration of pollutants in Lake A and one for Lake B. Solve the system of differential equations by first solving for Lake A and then for Lake B.

(3 Points) Problem 4 - Modeling Smoke in a Bar

A bar opens at 6 PM and allows smoking. Smoke contains 4% carbon monoxide and enters the room at a constant rate of $.006\,m^3/min$. Given that the bar's floor area is 20 m by 15 m by 4 m and the bar's ventilation system removes the smoke-air mixture at a 10 times the rate smoke is produced, set up a initial value problem for the concentration of smoke in the bar.

Prolonged expose to a concentration of more than 0.012% carbon monoxide can be fatal. At what time will the lethal limit be reached? (Hint: Think of this a concentration problem)