

Math 285: Practice problems for Exam I

1. Section 2.2 Separable equations

- $\frac{dy}{dx} = x + xy$

2. Section 2.3 Linear equations

- $\frac{dy}{dx} + y = x$

- $x\frac{dy}{dx} + y = x$

3. Newton's Law of Heating and Cooling: A potato at 70° is placed in an oven at 300° . After $1/2$ hour, the temperature of the potato is 120° . Write the initial value problem that describes this problem. Solve the IVP completely.

4. Mixing Problem: A tank contains 100 gallons of pure water. A salt water solution is pumped in at 2 gallons per minute with a concentration of 3 lb/gal. The tank is well-stirred. Solution is drained from the tank at 3 gallons per minute. Write the IVP that describes this situation prior to the time the tank is emptied.

5. Consider the differential equation

$$\frac{dP}{dt} = P(a - P).$$

Make qualitative graphs including all equilibrium solutions. Find $\frac{d^2P}{dt^2}$ and use this to determine where concavity changes occur. Use the terminology, stable, unstable, semi-stable to label the equilibrium solutions.

6. Consider the differential equation

$$\frac{dP}{dt} = P(50 - P)(100 - P).$$

Make qualitative graphs including all equilibrium solutions. Use the terminology, stable, unstable, semi-stable to label the equilibrium solutions.