Section 9.3   ***Differential Equations***

Def: A differential equation is any equation that involves one or more derivative of an unknown function. (i.e. solution(s) of DE are functions)

Where do differential equations come from?

   Population:

   Newton's Law of Cooling:

   Second Newton's Law:

Def: A separable equation is a first – order differential equation in which the expression for $\dfrac{dy}{dx}$ can be factored as a function of x times a function of y.

Ex: Solve the following DE:

   a) $\dfrac{dy}{dx} = \dfrac{e^{2x-3y}}{e^{2y-3x+2}}$

b) $\dfrac{dy}{dx} = 3x^2 y^2 - 5xy^2 + 3y^2$

Ex: Initial Value Problem (IVP)

a) $\dfrac{dy}{dx} = \dfrac{2x+1}{2y}$; $y(-2) = -1$

b) $\quad \dfrac{dy}{dx} = 3y + 2; \ y(1) = 3$

Mixing Problems:

Ex: A tank contains 20 kg of salt dissolved in 5000 L of water. Brine that contains 0.03 kg of salt per liter of water enters the tank at a rate of 20L/min. The solution is kept thoroughly mixed and drains from the tank at the same rate. How much salt remains in the tank after half an hour?

Ex: A natural gas leak has filled a building enclosing 50,000 m^3 with a 1 percent mixture of natural gas and air. The gas line is shut off, and an emergency ventilation system pumps in fresh air at the rate of 1000 m^3/min. How long must the ventilation system be run to reduce the concentration of natural gas to 0.01 percent?

Ex: Mortgage: Determine the monthly payment of a loan of $650,000 at interest rate of 4.5% per year compounded continuously for 30 years. Then determine the total interest of the loan when it's paid off after 30 years.