EVE 290
Introduction to Environmental Engineering
Fall 2010
Homework #11

1. A Φ of 1.047 is typically used for making temperature corrections to the biochemical oxygen demand (BOD) rate constant k. If $k(T_0 = 25°\ C) = 0.2\ day^{-1}$, determine $k(T = 20°\ C)$.

2. A zero-order reaction is known to have a temperature correction factor (Φ) of 1.01. A batch reactor was used in the laboratory (25 C) with a reaction time of 3 hrs to achieve a reduction in the concentration of a synthetic organic compound from 3.0 to 0.1 mg/L. How long with the reaction take under field conditions (12° C) to achieve the same treatment efficiency?

3. A completely mixed continuous bioreactor used for growing penicillin operates as a zero-order system. The input, glucose, is converted to various organic yeasts. The flow rate to this system is 20 L/min, and the conversion rate constant is 4 mg/(min-L). The influent glucose concentration is 800 mg/L, and effluent must be less than 100 mg/L. What is the smallest reactor capable of producing this conversion?

4. Suppose you are to design a chlorination tank for killing microbes in the effluent from a wastewater treatment plant. It is necessary to achieve 99.99% kill in a wastewater flow of 100 m^3/hr. Assume the disinfection is a first-order reaction with a rate constant of 0.2 min^{-1}.

    a. Calculate the tank volume for a CMF reactor;
    b. Calculate the tank volume for a PFR reactor;
    c. Determine the retention time for both reactors.