EVE 290
Introduction to Environmental Engineering
Fall 2010
Homework #10 (Exam #1 Review)

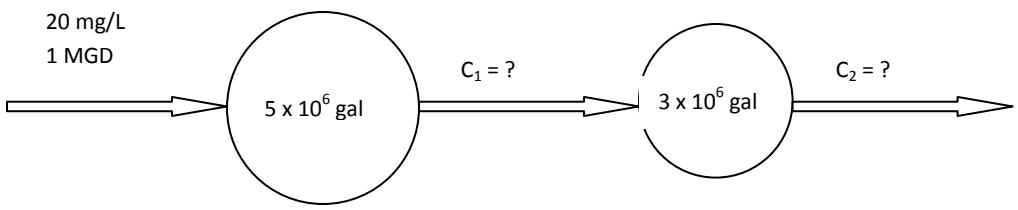
1. Water flows through a length of pipe with a velocity of 3.0 m/s. The pipe splits into two pipes with an equal volumetric flow in each. Calculate the linear velocity and mass flow rate of the water in one of the pipes after the split. The inside diameters of the large and small pipes are 10.23 cm and 5.25 cm, respectively. Clearly state all assumptions.
   Ans: 0.0123 m^3/s; 5.7 m/s

2. A treated wastewater stream flowing at 5000 L/s contains 75 mg/L of solid particles. It flows into a river that was flowing at 35,000 L/s and carrying 5 mg/L of solids. What is the concentration of particles in the combined stream (river plus wastewater)?
   Ans: 13.75 mg/L

3. Consider a hilly area in which new homes are being constructed. As rain falls on the site, the runoff water will carry mud and dirt into a nearby creek – polluting it badly. A detention pond was built to catch the runoff and allow the mud to settle before the water flows into the creek. For simplicity, assume the rain is steady, and ignore any transient effects on the pond water concentration.

   The runoff generated by the rainstorm is 10 m^3/s, and has a particle concentration of 5.0 mg/L. The creek flows at 200 m^3/s and normally has a concentration of 15.0 mg/L of particles. The detention pond will catch and remove most of the mud, leaving the overflow water with a concentration of 400 mg/L. Assume that 5% of the water that comes into the pond will seep down through the bottom (filtering out all particles), while the rest will overflow into the creek. Calculate the mass of mud accumulated in the detention pond after three hours of the rainfall/runoff operation. Also, calculate the concentration of particles in the creek after mixing with the overflow from the pond.
   Ans: 499,000 kg; 32.5 mg/L

4. The two-pond system shown below is fed by a stream with a flow rate of 1.0 MGD and a non-conservative pollutant concentration of 20.0 mg/L. The rate of biological consumption is 0.3 day^{-1}. Find the pollutant concentration leaving each pond if the volume of the first is 5.0 million gallons and the volume of the second is 3.0 million gallons.
   Ans: 8.0 mg/L; 4.2 mg/L



5. A lagoon with a volume of 1200 m^3 has been receiving a steady flow of a conservative waste at a rate of 100 m^3/day for a long enough time to assume that steady-state conditions apply. The waste entering the lagoon has a concentration of 10 mg/L, and converts biologically at a rate of 0.2 day^{-1}. What is the concentration of pollutant in the lagoon's effluent?
   Ans: 2.94 mg/L

6. A lake has the following dissolved oxygen (DO) readings [mg/L]:
   12, 11, 10, 9, 10, 8, 9, 6, 10, 11, 10, 11

   a. What is the average [DO]? **Ans: 9.75 mg/L**
   b. What is the standard deviation? **Ans: 1.6 mg/L**

7. The die-off of coliform organisms below a wastewater discharge point can be described as a first-order reaction. It has been found that 30% of the coliforms die off in 8 hours and 55% die in 16 hours. About how long would it take to have 90% die off?
   Ans: 46 hrs

8. An industrial wastewater treatment process uses activated carbon to remove color from the water. The color is reduced as a first-order reaction in a batch adsorption system. If the rate constant (k) is 0.35 per day, how long will it take to remove 90% of the color?
   Ans: 6.58 days