

## Test 1 - Sample

### Units and Measures

- How much mass (in g) of water and salt is contained in 2.5 L of estuarine water that has a salt concentration of 8.5 ppt?
- Each individual in a city of 100,000 people contributes about 650 L per capita per day of wastewater and 135 g per capita per day of BOD.
  - Determine the flow rate and the mass loading rate of BOD generated by this population
  - Determine the BOD concentration in mg/l
- In the early 1970's Lake Michigan had a total phosphorus loading of 6,950,000 kg/yr and an in-lake concentration of 8  $\mu\text{g/l}$ .
  - Determine the lake's assimilation factor.
  - What loading would be required to bring the in-lake concentrations down to 5  $\mu\text{g/l}$ ?
  - Express the results in (b) as a % reduction (normalize by present loading)
- A river and waste mix. The river and waste flows are 100 cfs and 10 MGD respectively. The river and waste concentrations are 200 ppb and 2 mg/l, respectively. What is the flow and concentration at the downstream edge of the mixing zone?
- You required 4  $\text{m}^3/\text{s}$  of water w/ a salt content of 0.1 g/l. Your two sources of water (A and B) have salt contents of 500 ppm and 50 ppm respectively. What flow rates of A and B should you withdraw?
- A 1-m pipe carries a wastewater flow of 10  $\text{m}^3/\text{s}$  with a  $\text{NH}_3$  of 1.0 mg/l.
  - What is the water velocity?
  - What is the ammonia flux and loading?
- Overnight, the DO concentration drops from 10 to 1 mg/l. Estimate the following:
  - the flux of DO across the water surface
  - the mass of DO lost from the pond (assume 1 m average depth)

### Open Channel Flow

- A 2-m wide channel has a bed slope of 0.01%, a water depth of 0.2 m, and a Manning's n of 0.035. Estimate the following parameters:
  - flow
  - velocity
  - type of flow (sub or supercritical)
  - bed slope to give critical flow
  - hydraulic radius
- A 1-m deep river has a Manning's n of 0.030. Give the corresponding Darcy friction factors (f) and Chezy c values, with the proper units.
- Find the width to depth ratio (w/d) for a rectangular channel that has a hydraulic radius that is (a) 80% and (b) 95% of the channel depth
- A rectangular channel has a width of 15 m and a depth of 1 m. The Manning's n is 0.03. Find the bed slope that would give a velocity of 0.5 m/s in this channel. If a rock is dropped into this channel, estimate how ripples would move upstream and downstream.
- A 100-m long rectangular channel has critical velocity of 3.5 m/s at the downstream end of the channel and a Froude number of 0.5 (the uniform flow value) at the upstream end of the channel. The Manning's n is 0.03. Estimate the following
  - the upstream velocity
  - the bed slope
  - the surface water slope

### Completely Mixed Reactors

see problems from handout