

Homework #2

All problems are from the course textbook (Chapra).

Problem 1.2 (1 point)

Problem 1.3 (1 point)

Problem 1.4 (1 point)

Problem 1.6 (1 point)

Problem 1.13 (1 point)

Problem 1.14 (1 point)

Problem 2.1 (1 point)

Problem 2.4 (1 point)

Problem 2.13 (1 point)

Problem 2.21 (1 point)

Total: 10 points

1.2

Problem

Each individual in a city of 100,000 people contributes about 650 L/capita/d of wastewater and 135 g/capita/d of BOD.

- Determine the flow rate (m^3s^{-1}) and mass loading rate of BOD (mta) generated by such a population.
- Determine the BOD concentration of the wastewater (mg/L)

1.3

Problem

You are studying a 3-km stretch of stream that is about 35 m wide. A gaging station on the stream provides you with an estimate that the average flow rate during your study was 3 cubic meters per second (cms). You toss a float into the stream and observe that it takes about 2 hr to traverse the stretch. Calculate the average velocity (mps), cross-sectional area (m^2), and depth (m), for the stretch. To make these estimates, assume that the stretch can be idealized as a rectangular channel (constant L, B & H).

1.4

Problem

In the early 1970s Lake Michigan had a total phosphorus loading of 6950 mta and an in-lake concentration of 8 $\mu\text{g/L}$ (Chapran and Sonzogni 1979).

- Determine the lake's assimilation factor ($\text{km}^3\text{yr}^{-1}$).
- What loading rate would be required to bring in-lake levels down to approximately 5 $\mu\text{g/L}$?
- Express the results of(b) as a percent reduction.

1.6**Problem**

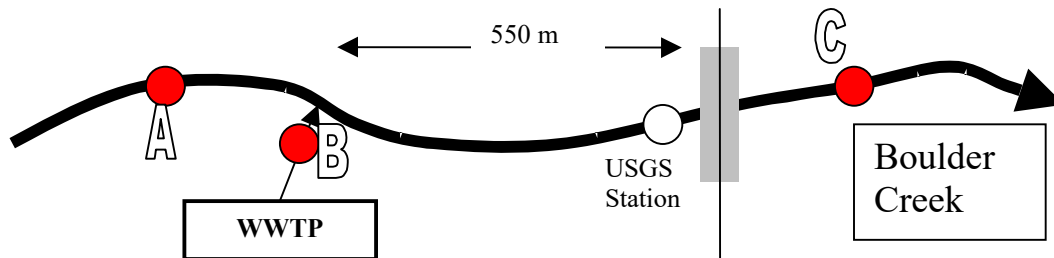
You mix two volumes of water having the following characteristics:

	Volume 1	Volume 2
Volume	1 gal	2 L
Concentration	250 ppb	2000 mg/m ³

- Calculate the concentration (mg/L) for the mixture
- Determine the mass in each volume and in the final mixture. Express your result in grams.

1.13**Problem**

The Boulder, Colorado, wastewater treatment plant enters Boulder Creek just above a USGS flow gaging station.



At 8:00 A.M. on December 29, 1994, conductivities of 170, 820, and 639 $\mu\text{mho/cm}$ were measured at A, B and C respectively. (Note: Conductivity provides an estimate of the total dissolved solids (TDS) in a solution by measuring its capability to carry an electrical current.) If the flow at the gaging station was 0.494 cms, estimate the flows for the treatment plant and the creek.

1.14**Problem**

Sediment traps are small collecting devices that are suspended in the water column to measure the downward flux of settling solids. Suppose that you suspend a rectangular trap (1m x 1m) at the bottom of a layer of water. After 10 d, you remove the trap and determine that 20 g of organic carbon has collected on its surface.

- Determine the downward flux of organic carbon
- If the concentration of organic carbon in the water layer is 1 mg/L, determine the downward velocity of organic carbon
- If the surface area at the bottom of the layer is 10^5 m^2 , calculate how many kilograms of carbon are transported across the area over a 1-month period.

2.1**Problem**

You perform a series of batch experiments and come up with the following data:

t (hr)	0	2	4	6	8	10
C (µg/L)	10.5	5.1	3.1	2.8	2.2	1.9

Determine the order (n) and the rate constant (k) for the underlying reaction.

2.4**Problem**

At a later date the laboratory informs you that they have a more complete data set than the two measurements used in Example 2.5:

T (C)	4	8	12	16	20	24	28
k (d⁻¹)	0.120	0.135	0.170	0.200	0.250	0.310	0.360

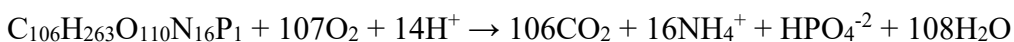
Use this data to estimate θ and k at 20 C.

2.13**Problem**

Estimate the age of the fossil remains of a skeleton with 2.5% of its original carbon-14 content. Note that carbon-14 has a half-life of 5730yr.

2.21**Problem**

A more complete representation (as compared to equation 2.3) of the decomposition reaction is provided by:



On the basis of this equation, given that 10 g-C m⁻³ of organic matter is decomposed, calculate (a) the stoichiometric ratio for the amount of oxygen consumed per carbon decomposed, roc, (b) the amount of oxygen consumed in g-O/m³, and (c) the amount of ammonium released in mg-N/m³.

Assigned: 20 Sept 2017

Due: 29 Sept 2017