# Fate and Transport Second Exam – 2005 (100/108)

Closed Book Section (58):

1. Sewage is being dumped into a stream. On the figure:

a) (5) Mark the point of most rapid BOD degradation.

b) (5) There is a short section of white-water in the stream. Whitewater occurs when the stream mixes with the atmosphere, increasing mass transfer between the air and the water. Mark the location of the waterfall.

c) (5) Draw a likely profile for dissolved inorganic carbon in the river.
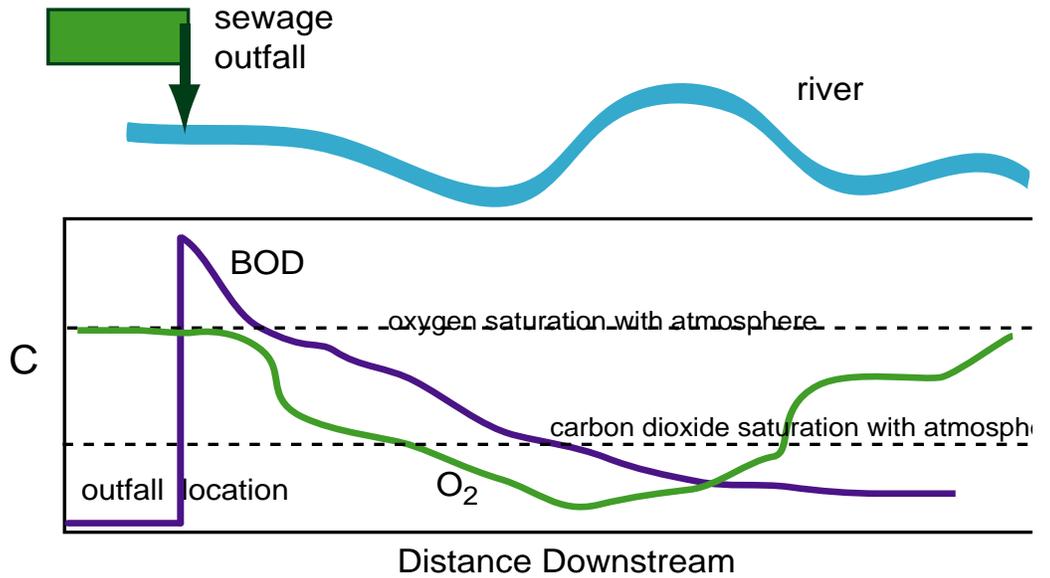

2. (5) The vapor pressure of simple hydrocarbons
    a) increases with molecular weight
    b) does not depend upon molecular weight
    c) decreases with molecular weight
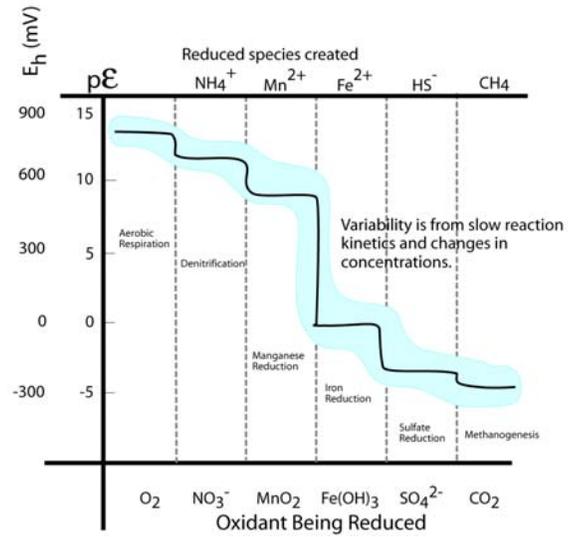
3. (5) The evaporation rate of organic compounds:
    a) increases with temperature
    b) decreases with temperature
    c) does not depend upon temperature

4. (10) What river is this data collected from? What causes the flow to go up and down annually?
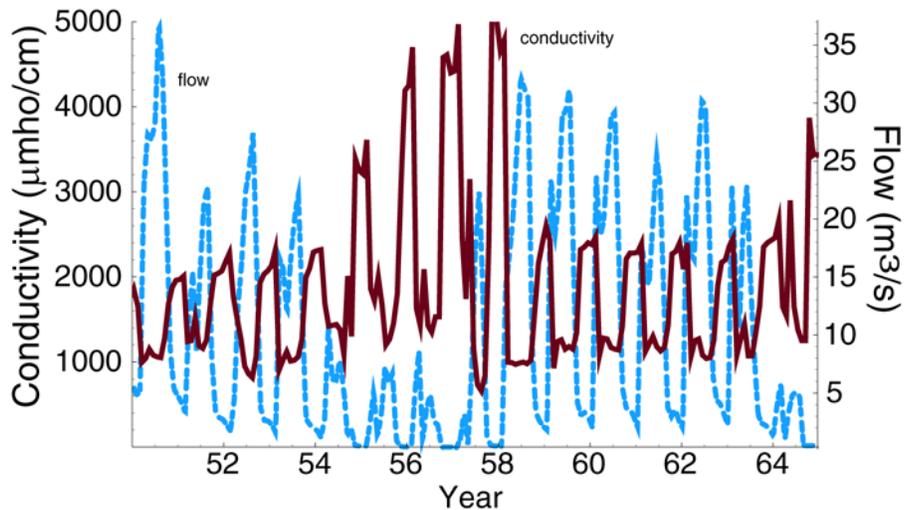
5. (5) (10) The seminar by Dr. Crimi was based upon which element shown here? Were the reactions she showed above or below the line? Why?
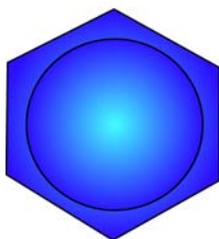

6. (5) The phenomenon in the picture causing the white water is called
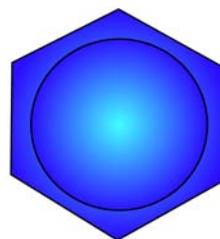_____

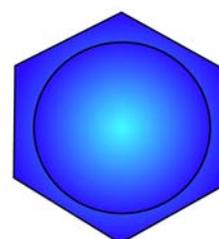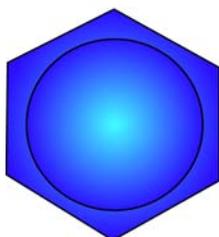7. (8) Complete the figures for each compound and fill in the blanks.

Aromatic

benzene   toluene   o-xylene

m-xylene   phenol
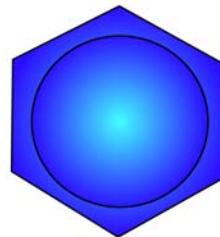
p-xylene

Aliphatic

$C \equiv\!\!\!= C$
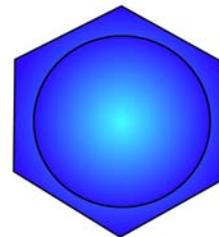
trichloroethylene
or _____

$C \equiv\!\!\!= C$

tetrachloroethylene
or _____
or _____
or _____

Open Book Section (50)

8. (20) In the stream shown in the open book portion of the test, the pH drops from a starting value of 10.5 down to pH of 9. The alkalinity is 3 mEq. What is the concentration of total dissolved inorganic carbon before and after the pH change? What form is most of the dissolved inorganic carbon in at pH 10.5 and at pH 9? Why? A small amount of hydrogen sulfide is generated in the sediments of the river. What form is most of the hydrogen sulfide in at pH 9? Why?

9. (20) You are designing a new and innovative ground water remediation system. 0.5 cubic meters per minute of 10,000 ppm of potassium permanganate 300 ppm of *Suckereact*, a proprietary compound to enhance the remediation effort, are poured into a 10 cubic meter mixing tank. Initially the mixing tank is filled with pure water.

a) Use the control volume approach to simplify the problem.

b) Find the average residence time of potassium permanganate and *Suckereact* in the tank.

c) When does the concentration of *Suckereact* in the tank reach 100 ppm?

10. (10) Write a balanced complete reaction for reduction of ferric hydroxide to ferrous iron during oxidation of organic matter.