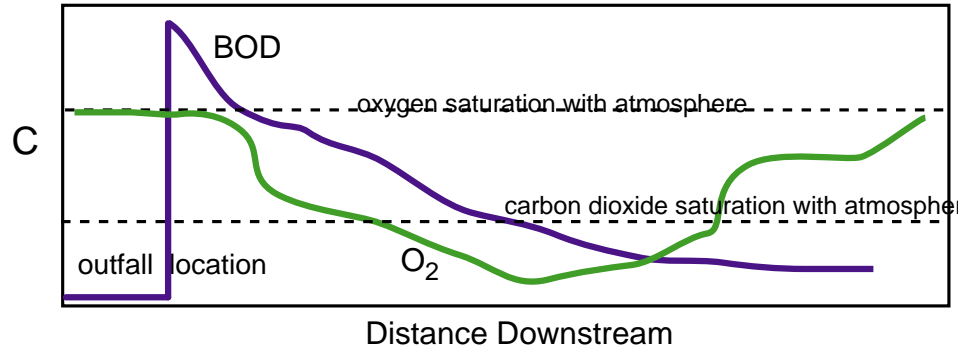


Fate and Transport Second Exam – 2006 (100/108)

Closed Book Section (58):

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

a) (4) Mark the point of most rapid exchange of oxygen between the atmosphere and the river. Explain the location.



b) (4) There is a short section of whitewater 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 water-fall.

c) (4) There is a slow pool the river passes through. Mark its location.

d) (4) Draw a likely profile for dissolved inorganic carbon in the river.

2) Write the Chemical Kinetic equations for

a) (2) Zero Order Reactions

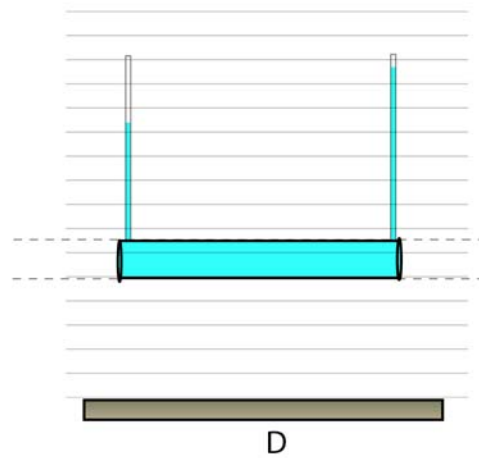
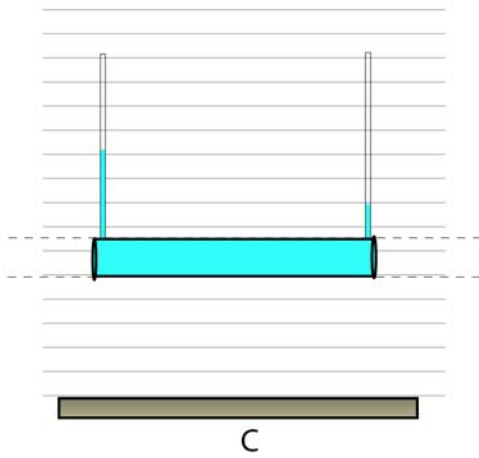
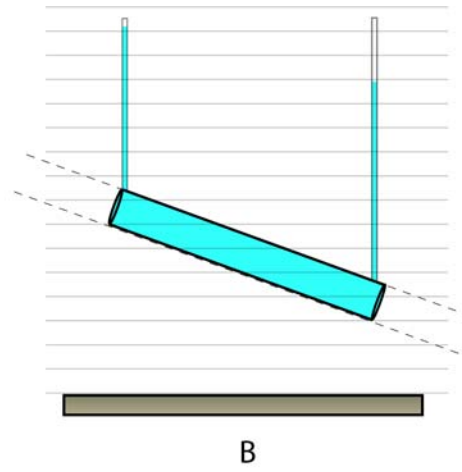
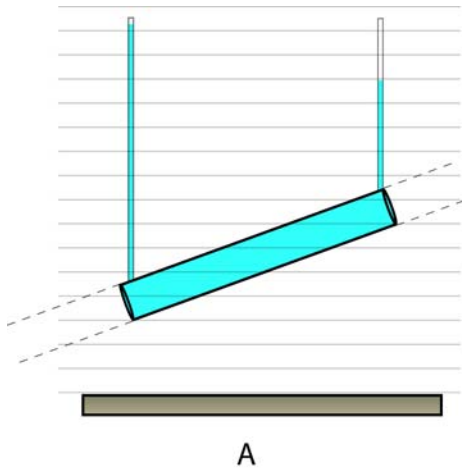
b) (2) First Order

c) (2) Second Order

d) (8) Two friends want to know what fraction of the initial radioactive Strontium will remain given the half life is approximately 29 years. Show necessary calculations and equations.

3)(10)What is the name of equation? What are terms and define the units?

$$\frac{p_1}{\rho g} + z_1 + \frac{V_1^2}{2g} = \frac{p_2}{\rho g} + z_2 + \frac{V_2^2}{2g} + H_L$$



4)(16) The piezometers are placed at either end of the tube which is filled with sand having a hydraulic conductivity of 10^{-4} m/s and a porosity of 0.3. Estimate the specific discharge in each tube and show the flow direction.

Open Book Section (60)

6) (20) Metropolis is plagued by temperature inversions in late fall in early winter which cause the low lying air to be trapped and not mix with the overall atmosphere during the evening, night, and early morning hours. The carbon monoxide is generated throughout the night at a rate of 3000 kg/hr. Decomposition removes 500 kg/hr of carbon monoxide per hour. The initial concentration of carbon monoxide is 2 mg/m^3 . Find how the concentration of carbon monoxide inside the inversion during the night.

a) use the control volume approach to find an equation describing the change in concentration with time

b) find the concentration after 1 hour and after 12 hours after the inversion begins.

7) (20) Lake Tangerine has an alkalinity of 1 mEq/L. During the month of June the pH in the hypolimnion changes from 6.5 to 6 while the oxygen goes from 10 mg/L to 2 mg/L. Calculate the respiration rate separately using the change in carbon dioxide and the change in oxygen and compare the two. Show all of your work.

8) (20) Calculate the oxygen demand from dissolved manganese at a depth of seven meters in Peacock Hill. Show the reactions for oxygen demand from manganese and appropriate calculations.