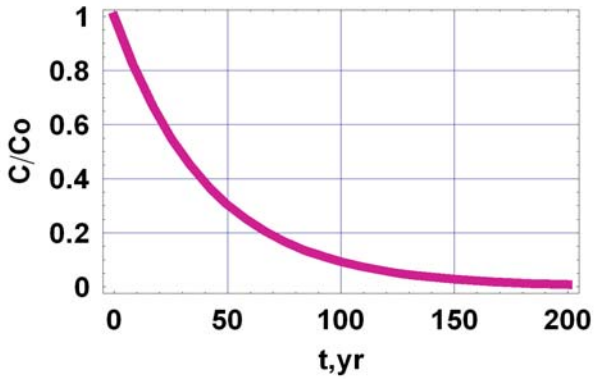
Fate and Transport Final Exam – 2007 (100/113)

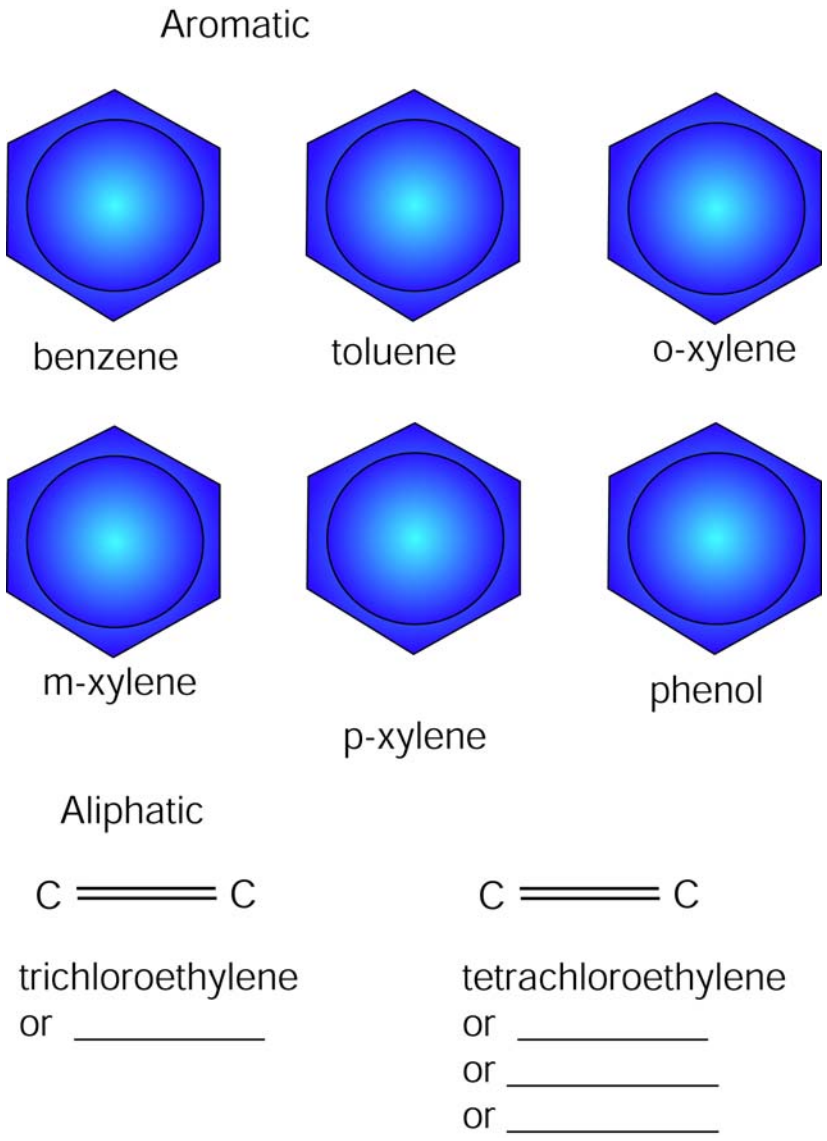
Closed Book Section (58):

1. (6) What is the half life and decay constant (k) for the chemical in the figure illustrating first order decay.

$$\frac{C}{C_o} = \exp(-kt)$$

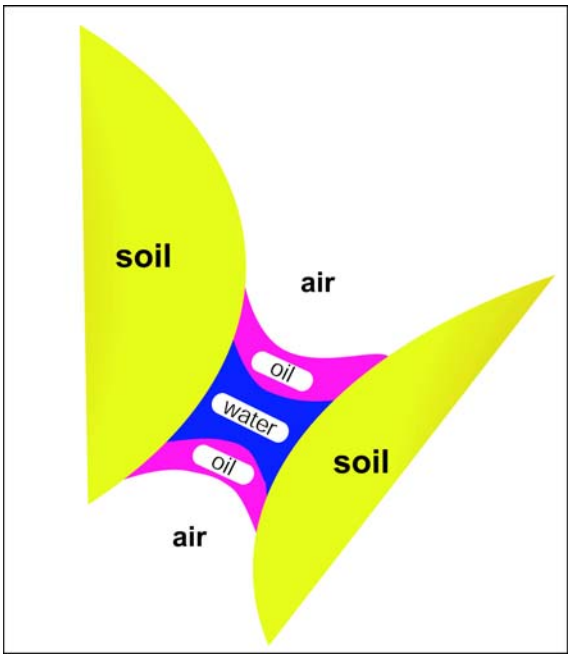


2. (6) Fill in the blanks, finish the figures.

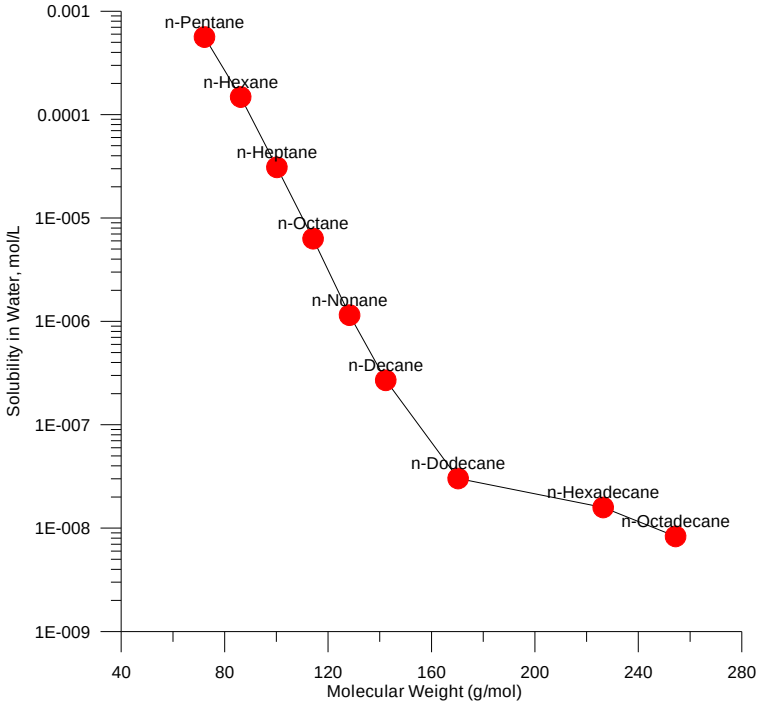


3. (4) Which of the three fluids is the wetting fluid? _____
The radius of curvature of the fluid interfaces is related to:

a) the Henry's Law constant
b) the vapor pressure of the oil and water phases
c) the soil type
d) the change in pressure between the fluids and the interfacial surface tension
e) the piston velocity_(

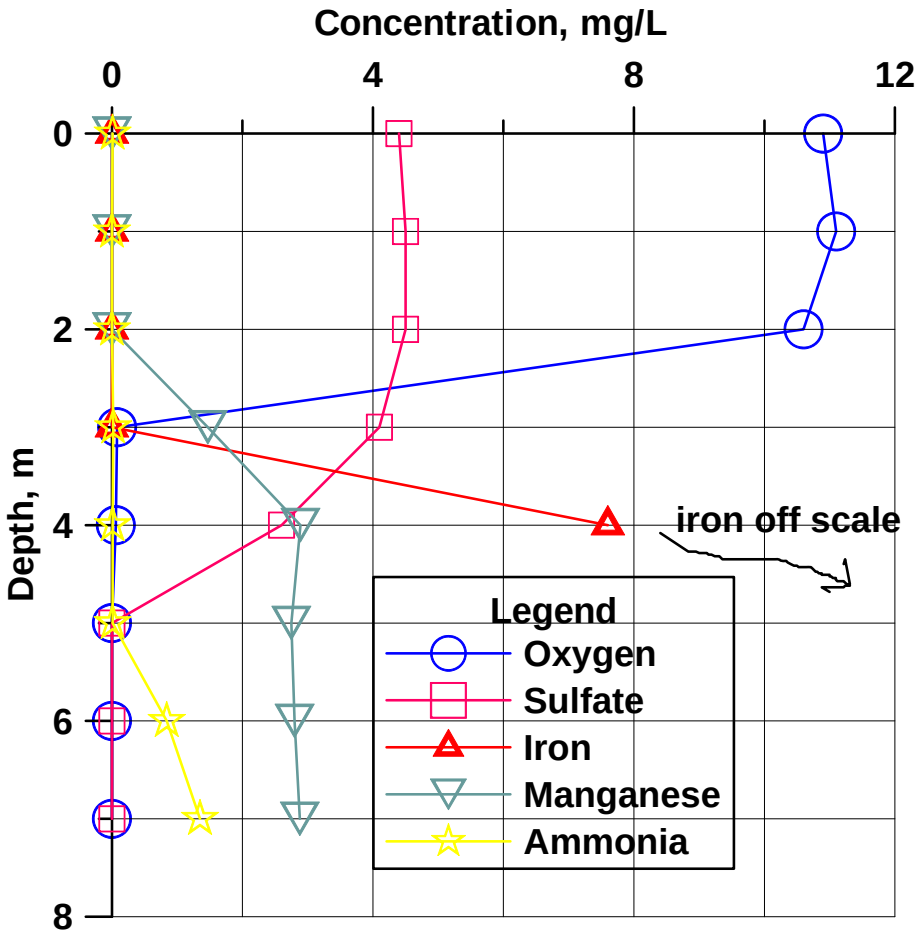


4. (3) Use the figure to estimate the solubility of propane to the nearest order of magnitude



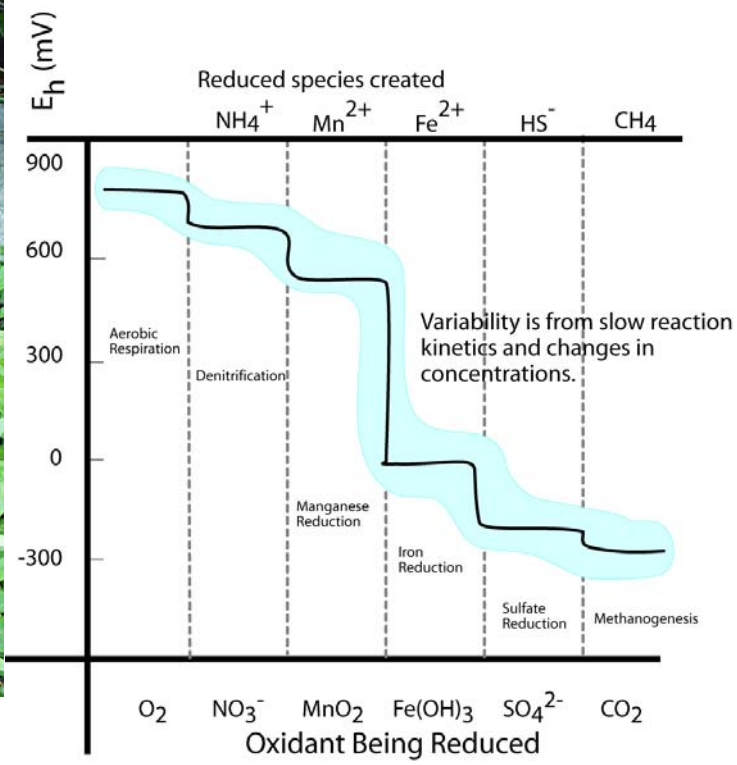
_____. Please enlighten me with your logic for the estimation _____.

5. (9) Draw a plausible temperature profile onto the figure. If a big storm comes along and mixes the lake waters,



what will you be able to see in them? Draw a plausible depth profile for nitrate on the figure, explain your logic for it.

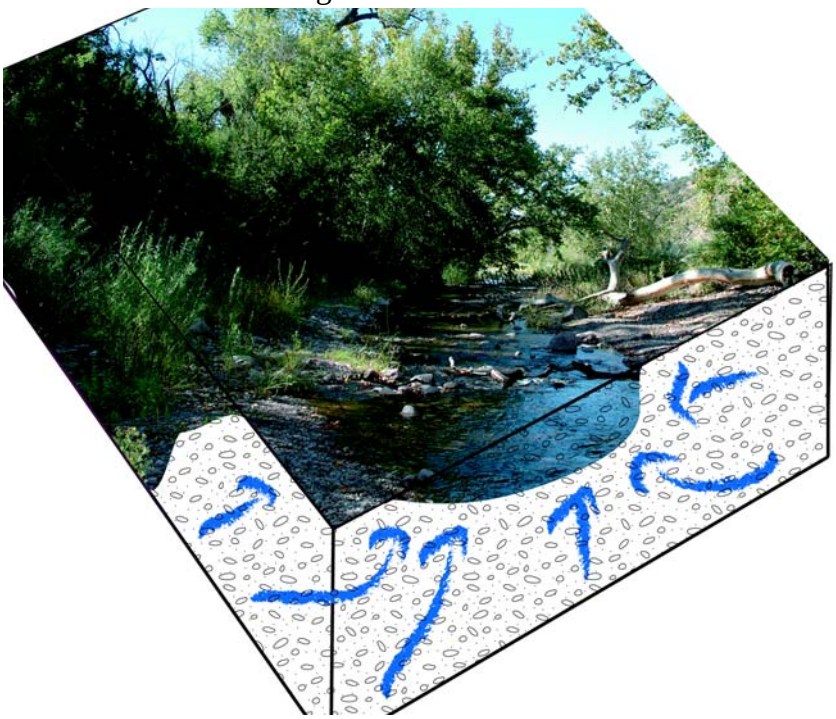
6. (6) Draw vertical arrows on the figure to the right showing the two reactions with visible products in the spring



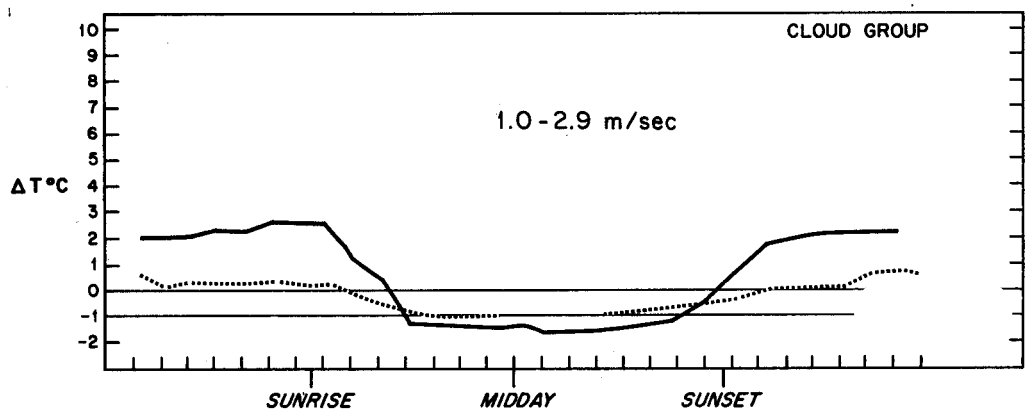
to the left. Draw a circle where the water 25 cm below the spring is in the figure to the right and a square where the surface water touching the atmosphere is (in terms of Eh).

7. (3)Carbon dioxide is moving INTO the air or OUT OF the air. (circle)

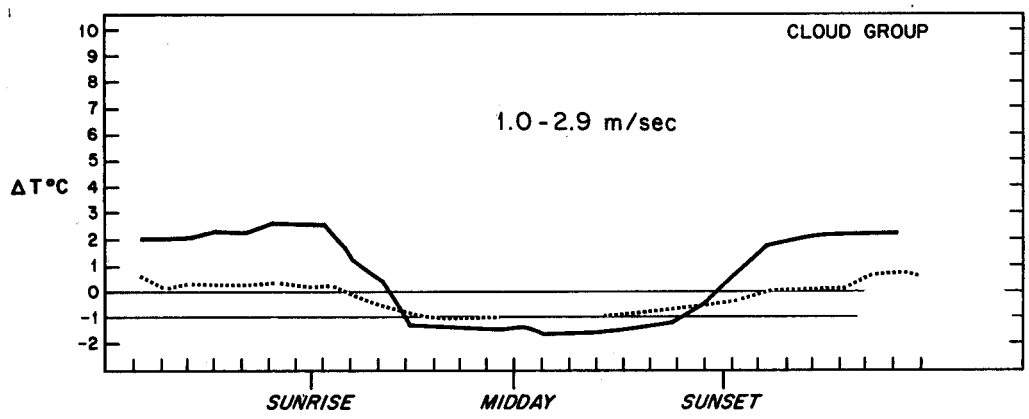
8. (3) The partial pressure of carbon dioxide is greater in the STREAM or in the GROUNDWATER below?

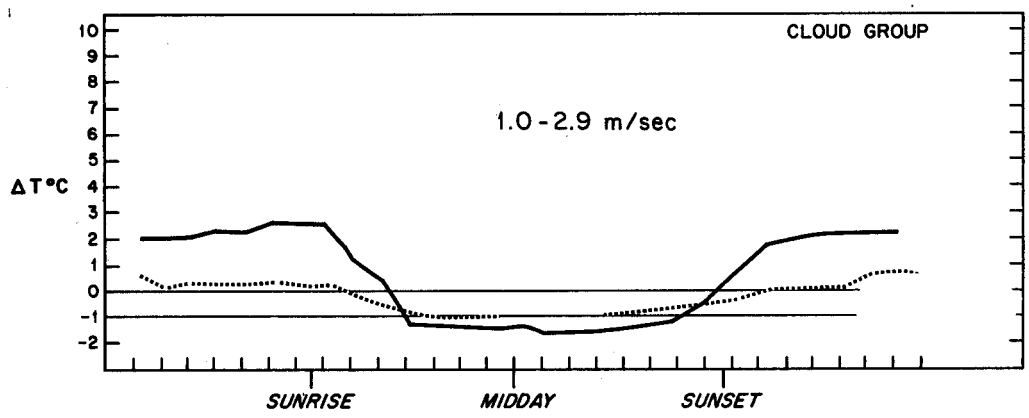


9. (12) Modify the first figure to show what happens at 0 - 0.8 m/s wind speed. Modify the last figure to show 6-9



m/s wind speed results. Delta T is $T_{110} - T_{10}$ meters. Label the cloudy and clear curves. Mark areas of likely A, D, and F stability on the middle figure.





10. (3) Is this stack high enough to represent good engineering design?. Is an inversion present at the surface?

11. (3) On the A to F scale the stability is:

Open Book Section (55)

Benzene stored in a 33 m^3 tank is spilled on the pavement. Wind speed from the nearest meteorological station is reported as 1.5 m/s, the barometric pressure is 0.95 atm, temperature is 25 Celsius. The hydraulic conductivity of the soil beneath the impermeable pavement is 10^{-4} cm/s. It is a clear fall night in El Paso. The benzene is spilled at a rate of 0.1 cubic meters per hour.

12. (10) What is the evaporation rate of benzene per unit area?

13. (10) Assuming the evaporation rate is 10^{-4} m^3/m^2/hour, find the steady state size of the puddle. Show all of your work.

14. (15) Estimate the steady state concentration of benzene in the air at a downwind distance of 300 meters at ground level, plume centerline, assuming the spill can be approximated as a point source. Simplify the Gaussian plume equation for your problem. How does the downwind concentration depend upon the evaporation rate? Show all your work.

15. (10) The fire department sprays water on the spill in an attempt to reduce the evaporation rate. Assuming there is an excess of benzene, what is the concentration in the remaining water puddles? Does the water cover the benzene?

16. (10) How much water would have to be continuously added to dissolve all the benzene?