Fall 2005
CEE 432/532
Quiz #3

1. Fill in the blanks: **[10]**

(a) Often, several steps must occur in sequence to bring about a certain overall chemical process, the slowest in known as the __rate__-limiting step.

(b) Mathematically, for first-order reactions, the rate at which the concentration of reacting molecules change with time is described as

$$\frac{dC}{dt} = -k * \underline{\;C\;}$$

(c) The half-life of first-order reaction is given by $t_{1/2} = \frac{0.693}{k}$

(d) If the rate constant is known for two different temperature, the rate constant at any other temperature can be calculated using the __Arrhenius__ rate law.

(e) Pure air is an example of __air__ phase.

(f) An immiscible liquid can form its own __Non-aqueous__ phase liquid (or NAPL).

(g) A pool of industrial solvent floating on a water surface is an example of a __Light__ NAPL.

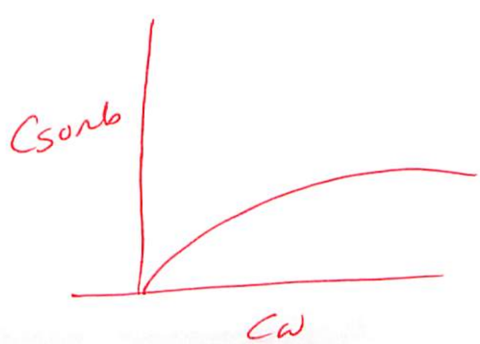
(h) Vapor pressure is defined as the __partial__ pressure of a chemical in a gas phase that is in equilibrium with the pure liquid or solid chemical.

(i) Aqueous solubility is defined as the concentration of a chemical dissolved in water when that water is both in __contact__ and at __equilibrium__ with the pure chemical.

(j) The relationship between dissolved and sorbed chemical concentrations is often nonlinear and may be expressed as a sorption __isotherm__.

2. The following figure shows a sorption isotherm for a chemical. The value of n is most nearly: **[2]**

(A) equal to 1.
(B) less than 1.
(C) slightly less than 1
(D) greater than 1.



3. The chemical 1,4-Dichlorobenzene (1,4-DCB, Mol. Wt. = 147) is used in an enclosed area. At 20°C the saturated vapor pressure of DCB is 5.3 x 10^{-4} atm. The concentration of DCB in air (in gm/m^3) is most nearly: **[4]**

(A) 2.2 x 10^{-5}
(B) 2.2 x 10^{-3}
(C) 3.2
(D) none of the above

Physical Constants

The Gas-Law Constant R	
Numerical Value	Units
1.987	g cal/(g mole)(°K)
1.987	Btu/(lb mole)(°R)
82.057	(cm^3)(atm)/(g mole)(°K)
0.08205	(liter)(atm)/(g mole)(°K)
10.731	(ft^3)(lb_f)/$(in.)^2$(lb mole)(°R)
0.7302	$(ft)^3$(atm)/(lb mole)(°R)

$$\frac{n}{V} = \frac{P}{RT} = \frac{5.3\times10^{-4}\ atm}{0.082\ \frac{L\text{-}atm}{mole\ °K}\ 293\ °K}$$

$$= 2.2\times10^{-5}\ mole/L$$

$$* \frac{1000\ L}{m^3} * 147\ \frac{gm}{mole}$$

$$= 3.2\ \frac{gm}{m^3}$$

4. An owl eats frogs as delicacies, and his intake of frogs is directly dependent on how many frogs are available. There are 200 frogs in the pond, and the rate constrant is 0.1 days^{-1}. The number of frogs eaten after 10 days is most nearly: **[4]**

(A) 20
(B) 73
(C) 127
(D) 199

$$A = A_0 e^{-kt}$$

$$= 200\ e^{-0.1 * 10}$$

$$= 200\ e^{-1}$$

$$= 73.57 = \text{Remaining} \simeq 74$$

$$\text{Eaten} = 200 - 73.57$$

$$= 126$$