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Fall 2005
CEE 432/532
Quiz #6

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

(a) In estuaries, the density differences is primarily due to the difference in salinity between freshwater and ocean water.

(b) As salinity increases where freshwater and saltwater meets, particles brought in by freshwater tend to flocculate together and sink to the bottom rapidly.

(c) Particles in surface water originate from ~~sediments~~ mineral or organic matter.

(d) Wetlands contains soil that are saturated or ~~super~~ partially saturated with water and have a high organic content.

(e) The magnitude of gas transfer coefficient depends on the nature of water velocity and air movement above the water.

(f) The average settling velocity of a particle can be approximated by Stoke's Law.

(g) Two different models of the exchange process are currently in use: thin film model and Surface ~~water~~ renewal model.

(h) In thin film model, for gas film controlled process, the stagnant layer is located in the vapor phase.

(i) According to film theory, the ratio of the gas exchange coefficient of two volatile chemicals is equal to the ratio of their molecular weights coefficients in water.

(j) The gas exchange coefficient is given as: $k_w = D_w/\delta$

2. If the dimensionless Henry's Law constant is <<< 0.01, the most significant barrier to air-water gas exchange is [2]

- (A) transfer through the stagnant boundary layer of water just under the water surface.
- (B) transfer through the stagnant boundary layer of air above the water surface.
- (C) transfer through the layer of air-water within the interface.
- (D) all of the above.

At 20° C Trichloroethene (TCE) drips from a tank truck onto a flat, impermeable parking lot at a rate of 3 liter every 7 minutes. The molecular weight and vapor pressure of TCE are 131 and 0.08 atm, respectively. The gas exchange coefficient is given by the following formula:

$$ka\ (cm/hr) = 1100 * u\ (m/sec)$$

where, ka = gas exchange coefficient ka (in cm/hr)
u = wind velocity (m/sec)

3. If the wind speed at 10 m elevation is 1.5 m/sec, the gas exchange coefficient ka (in cm/sec) is most nearly: [4]

(A) 1650.00
(B) 1100.00
(C) 0.45
(D) 0.08

$ka = 1100\,u$

$= (1100)\left(\frac{1.5\,m}{s}\right) = \frac{1650\,cm}{hr} \times \frac{hr}{3600\,s} = \boxed{\frac{0.46\,cm}{s}}$

4. Given $R = 0.082 \frac{\text{atm L}}{\text{mole } ^\circ\text{K}}$, the flux of TCE (in gm/cm^2-sec) from the puddle to air is most nearly: [4]

(A) 0.72
(B) 0.27
(C) 2×10^{-4}
(D) 131.0

$C_a = \frac{P}{RT} MW$

$= \frac{0.08\,atm}{\left(\frac{0.082\,atm\,L}{mol\,K}\right)(293\,K)}\left(\frac{131\,g}{mol}\right) = \frac{0.436\,g}{L}$

$J = k_a(C_a - 0)$

$J = \left(\frac{0.46\,cm}{s}\right)\left(\frac{0.436\,g}{L}\right)\left(\frac{L}{1000\,cm^3}\right) = \boxed{2.01 \times 10^{-4} \frac{g}{cm^2\,s}}$