Homework #1

Released: 09/22/2014 (Mon) - Due: 10/01/2014 (Wed), in class

The homework will be NOT graded, but we will check for MISSING ANSWERS and CHEATING. Note that a cheated homework will get 80% of the lowest score in the class. You can give the answers <u>either</u> in English <u>or</u> Korean.

1. [Introduction to environmental engineering] Considering the history of environmental engineering, discuss why the Environmental Engineering Program exists as a module of the Department of Civil and Environmental Engineering in many colleges including us.

2. [Basic chemistry concepts] A Na_2CO_3 solution is prepared by adding 20.00 g of Na_2CO_3 to a flask and adding pure water until it reaches the 1.00-L mark. What is the concentration of Na_2CO_3 in units of (a) mg/L; (b) molarity; and (c) normality?

3. [Basic chemistry concepts] A $FePO_4$ solution is prepared by adding 2.4 g of $FePO_4$ to a flask and bringing the final volume to 1.00 L by adding water having a PO_4^{3-} concentration of 1.0 mg/L. What is the concentration of soluble iron in this solution? (temperature = 25˚C)

4. [Basic chemistry concepts] An acetic acid (CH_3COOH) solution is prepared in water by adding 1.1 g of CH_3COONa and bringing the volume to 1.0 L with pure water. The final pH is measured to be 5.25. What are the concentrations of CH_3COO^- and CH_3COOH in this solution? (temperature = 25˚C)

5. [Basic chemistry concepts] Hypochlorous acid (HOCl) decays in the presence of ultraviolet radiation. Assuming that degradation occurs according to first-order kinetics, how long does it take for the concentration of hypochlorous acid to reach 0.05 mg/L if the initial concentration was 3.65 mg/L? The first-order reaction constant is 0.12 day^{-1}.

6. [Basic chemistry concepts] You bought a bottle of carbonated water which is completely sealed and does not have any headspace[1]. You found that the pH of the water was 3.5. You

wanted to know better about the water you would drink and called the factory to find that they blow in 0.1 g of CO_2 into a carbonate-free[2] water to make a 250 mL bottle. The bottle was pressurized that all CO_2 blown in was dissolved in the water. Calculate the concentrations of $[H_2CO_3*]$, $[HCO_3^-]$, and $[CO_3^{2-}]$ in the bottle. (temperature = 25˚C)

[1]This means the water is filled to the top.
[2]This means that before CO_2 was blown in, there was no carbonate species ($[H_2CO_3*]$, $[HCO_3^-]$, or $[CO_3^{2-}]$) in the water.

7. [Basic chemistry concepts] You placed water in a bowl until it equilibrates with atmospheric CO_2 ($P_{CO2} = 10^{-3.5}$ atm). The pH of water is 7.5 and the temperature is 25˚C.

a. Calculate the concentrations of $[H_2CO_3*]$, $[HCO_3^-]$, and $[CO_3^{2-}]$.

b. Calculate the carbonate alkalinity of the water.

8. [Basic biology concepts] What are the three constituents of a nucleotide?

9. [Basic biology concepts] List the four classes of macromolecules essential for life. Briefly explain the importance of each.