

BIO 365 Environmental Contaminants

Review material for test I – Water, Soil and Atmospheric chemistry

This test will cover the basics of water, soil and atmospheric chemistry.

My suggestions for the test:

- 1) You should be comfortable with the review problems that we went over on the first day of class.
- 2) Make sure you understand what is covered in the notes (problems we worked through in class, concepts, etc.)
- 3) Be able to work through the problems that I mentioned in the chapters (9-1; 9-22; etc.). They are given below.
- 4) You should be able to convert values readily (ppm - molarity - mg/L)

I will post the answers for the chapter questions and the following questions.

Water chemistry

Baird Problems 9-1, 4, 8, 10a, 11, 22 Review 2, 3, 4, 5, 7, 8, 11, 12, 20

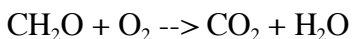
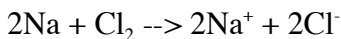
What is the oxidation state of C, N or S in the following compounds?

CO₂, CH₄, C₆H₁₂O₆, CO

NH₄⁺, NH₃, NO₂⁻, N₂O, NO, NO₃⁻

SO₄²⁻, H₂S, H₂SO₄, H₂SO₃, SO₂

Write half reactions for the following balanced equations and be able to determine the oxidation states of the atoms involved.



Determine the pH of the following solutions

0.02 M HCl (strong acid)

0.02 M H₂SO₄ (H₂SO₄ is a strong acid, however HSO₄⁻ is a weak acid and its dissociation is insignificant)

0.02 M NaOH (strong base)

0.5 M solution of HNO₃ (a weak acid whose K_a is 4.5 x 10⁻⁴)

0.05 M solution of N₂H₄ (a weak base whose K_b is 9.8 x 10⁻⁷)

Make sure you understand the pE concept and what a high or low pE represents.

Be familiar with the concept of carbonate equilibrium.

What is alkalinity and what does it represent?

For the reaction: BaSO₄ --> Ba²⁺ + SO₄²⁻

$$K_{sp} = 1.23 \times 10^{-10} = [\text{Ba}^{2+}] [\text{SO}_4^{2-}]$$

What is the concentration of sulfate in a solution saturated with BaSO₄ in M? in g / L?

Why does Al solubility increase by 3 orders of magnitude with a single unit pH decrease?

Soil Chemistry

Baird Problems 12-3 Review 13, 14, 15,

How do increases/decreases in soil pH influence AEC and CEC?

Expect to have a problem similar to the septic tank example that I worked through in class.

In what ways can soil organic matter influence the movement of polar and non-polar contaminants?

Atmospheric chemistry

Baird problems 1-8, 9, 12 Review 10, 11, 12, 14,

Baird problems 2-11 Review 8

CO₂ is present in the atmosphere at concentrations over 200x that of CH₄ and over 1100x that of N₂O. Why are we concerned with the rise in the levels of the others?

What is the pH of CO₂ saturated rain water?

Henry's Law: $[H_2CO_3] = K_H \times P_{CO_2}$

$$K_H = 3.4 \times 10^{-2} \text{ mol L}^{-1} \text{ atm}^{-1}$$

$$P_{CO_2} = 0.00036 \text{ atm}$$

$$K_a = [H^+][HCO_3^-] / [H_2CO_3] = 4.5 \times 10^{-7} \text{ mol L}^{-1}$$

What would the pH be if the atmospheric [CO₂] quadruples?

If H₂SO₄ and HNO₃ influence the acidity of rain, why is there concern over atmospheric levels of SO₂ and NO_x (both of which are not very soluble in water)?

If the first step in the destruction of ozone is: $\text{NO}^\bullet + \text{O}_3 \rightarrow \text{NO}_2^\bullet + \text{O}_2$

And the overall reaction is: $\text{O}_3 + \text{O} \rightarrow 2 \text{O}_2$

What is the second step (what happens to the NO_2^\bullet produced in the first step)?

How does a single Cl^\bullet destroy so much ozone?

Where is ozone formed and why? How is it destroyed?