Unit Test #4 Breakdown/Review

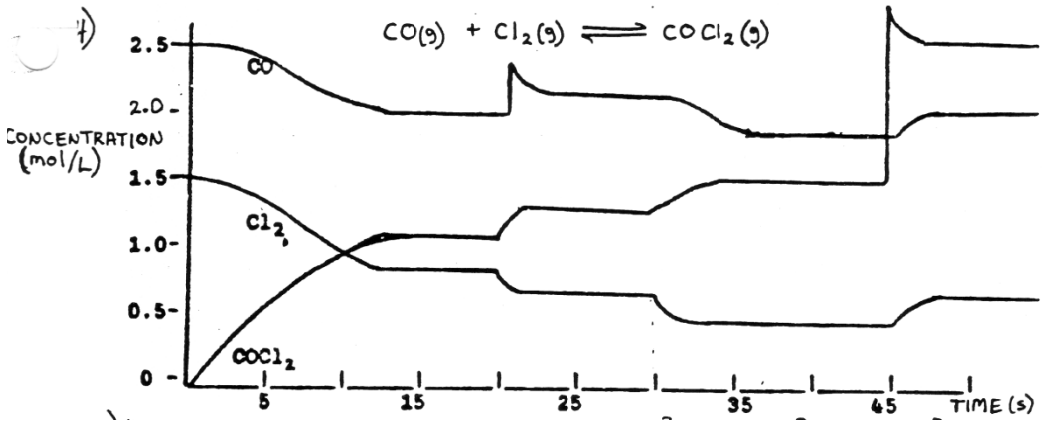
Multiple Choice / Matching

There will be some multiple choice and matching to start the test.

Short Answer (Thinking/Inquiry)

Question 1.

Consider the following concentration-time graph:



a) What imposed change occured at:

i. @ 20s?

ii. @ 30s?

iii. @ 45s?

b) Explain the changes between 20 s & 25 s using Le Chatelier's principle.

c) What change, if any, would have been noted if a catalyst had been present for the entire course of the reaction?

Question 2.

-this questioned first appeared on the quiz with only two students out of 22 providing a correct answer. If at first you don't succeed, try, try again. My solution appears below. If you don't understand the solution, please see me.

Consider the hypothetical reaction:

$$A(g) + B(g) \rightleftharpoons 2C(g) \qquad K = 0.24$$

If the initial concentration of A is 0.500 M and the initial concentration of B is 1.00 M, what will be the composition of the equilibrium system?

Question 3.

If the pH of an acid solution at 25 ^{o}C is 6.18, what is the pOH; and the [H^{+}], [OH^{-}] in mol/L?

Question 4.

What is the equilibrium constant expression for the following equilibrium reaction? –I won't give you the reaction, this is very straight forward. See me if you don't know how to do this.

Question 5.

Label the conjugate acid-base pairs in each reaction. I won't give you the reactions, you must read up on this (it is in our notes and also in text) and know what conjugate acid-base pairs are.

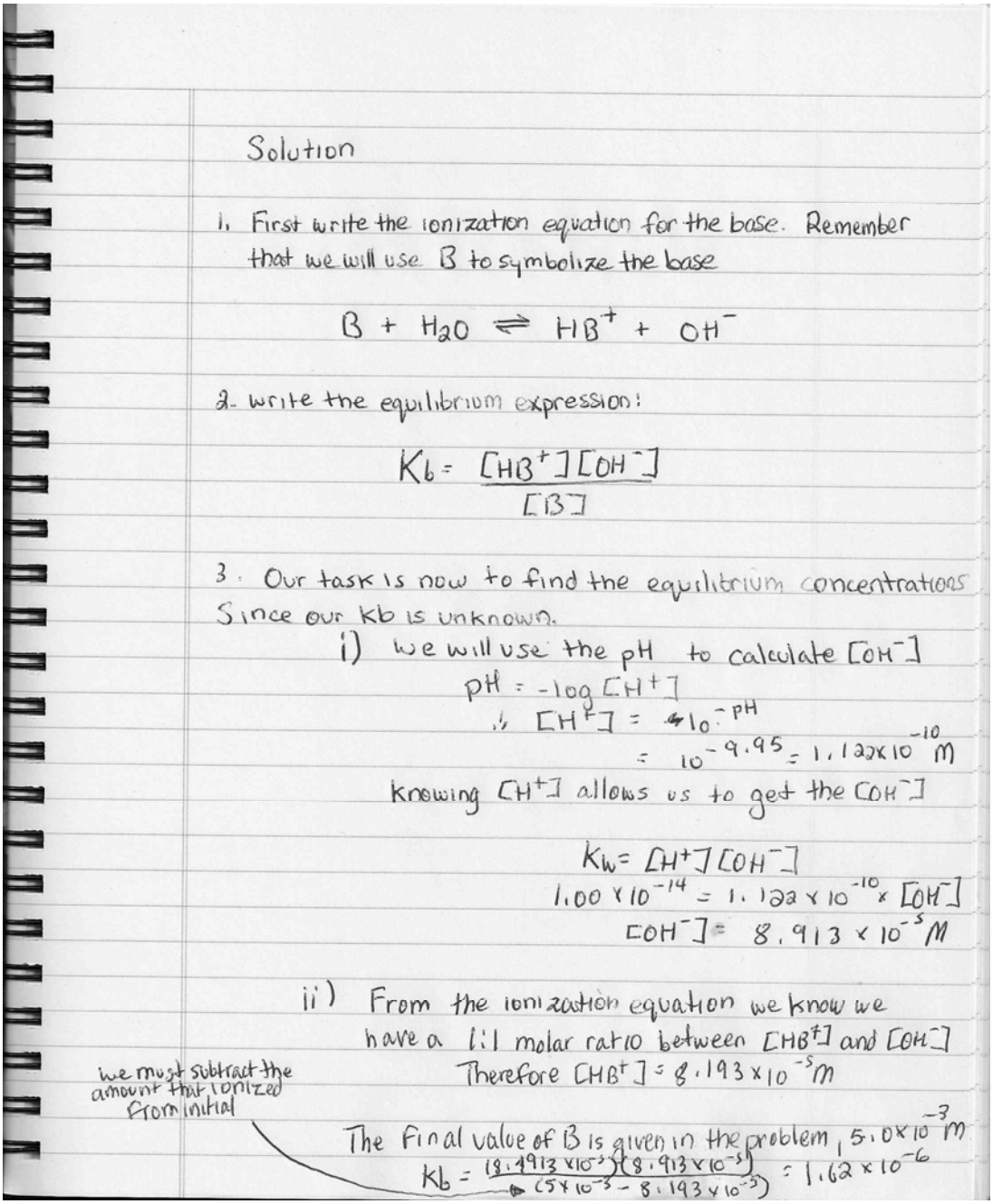
Question 6.

Calculate the molar solubility of calcium sulfate (in moles per litre). Ksp = 2.4×10^{-5}

-we did a question just like this in class, with zinc hydroxide. check your notes! This question should work out to 4.9×10^{-3} mol/L.

Question 7.

Codeine is a weak base. A 5.0×10^{-3} mol/L solution has a pH of 9.95. Calculate the value of Kb for this substance.



Solution

1. First write the ionization equation for the base. Remember that we will use B to symbolize the base

$$B + H_2O \rightleftharpoons HB^+ + OH^-$$

2. write the equilibrium expression:

$$K_b = \frac{[HB^+][OH^-]}{[B]}$$

3. Our task is now to find the equilibrium concentrations since our Kb is unknown.

i) we will use the pH to calculate $[OH^-]$

$pH = -\log[H^+]$

$\therefore [H^+] = 10^{-pH}$

$= 10^{-9.95} = 1.122 \times 10^{-10}$ M

knowing $[H^+]$ allows us to get the $[OH^-]$

$K_w = [H^+][OH^-]$

$1.00 \times 10^{-14} = 1.122 \times 10^{-10} \times [OH^-]$

$[OH^-] = 8.913 \times 10^{-5}$ M

ii) From the ionization equation we know we have a 1:1 molar ratio between $[HB^+]$ and $[OH^-]$

Therefore $[HB^+] = 8.193 \times 10^{-5}$ M

we must subtract the amount that ionized from initial

The Final value of B is given in the problem, 5.0×10^{-3} M

$K_b = \frac{(8.1913 \times 10^{-5})(8.913 \times 10^{-5})}{(5 \times 10^{-3} - 8.193 \times 10^{-5})} = 1.62 \times 10^{-6}$

Question 8.

There will be a question on entropy/ Gibbs free energy, this concept seems pretty well understood based on the quiz.

Short Answer (Communication)

Question 1.

What is the hydronium ion? What does its formation have to do with water being a Bronsted-Lowry base?

-the hydronium ion is H3O+. It forms when water acquires a hydrogen. In acquiring hydrogen, it behaves like a Bronsted-Lowry base, which is a substance that accepts hydrogens.

Question 2.

Write the equilibrium expression for the auto-ionization of water.

-this is in our notes.

Question 3.

Distinguish between the end-point and the equivalence point in a titration.

-we are learning about titrations on Monday.

Short Answer (Application)

Question 1.

If you were managing an industrial process in which PH_3 is made by the following reaction and you wanted to increase the output of this product (shift the equilibrium to the right) so that you could make more money, what would you do in terms of a high or low concentration of H2, high or low pressure, and high or low temperature?

$$2\ P(s) + 3\ H_2(g) \rightleftharpoons 2\ PH_3(g) + \text{heat}$$

-a high concentration of H_2 would be desirable because the equilibrium would shift toward the product in order to consume the added H_2. A high pressure would be desirable because the equilibrium would shift to the right, where there is less gas. A low temperature would be desirable because the reaction is exothermic and the removal of heat would cause a shift to the right to replace this heat.

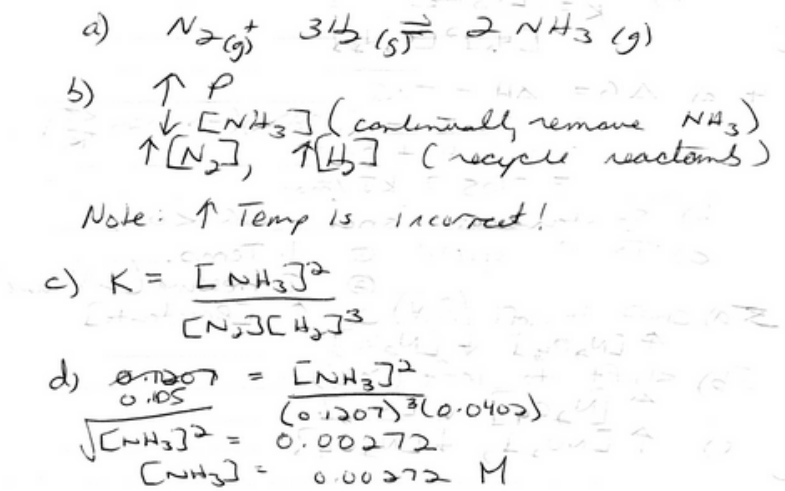
Question 2.

What is acid rain? How does it form? Give an example of an acid that may be dissolved in acid rain.

-acid rain is rain that has an acidic pH. It forms when rain falls through an atmosphere that contains oxides of non-metals. An example is HNO_3, formed when rain falls through an atmosphere that contains NO_2.

Question 3. -Our last assignment involved the Haber process. -see page 461 of the textbook to refresh your memory, or my solution which appears below.

a. Write a balanced equation for the Haber Process.
b. Explain two ways that Haber used Le Chatelier's principle to increase the yield of the product(s).
c. Write the equilibrium constant expression for the reaction.
d. K = 0.105 for this reaction at 472°C. If the equilibrium concentration of hydrogen was 0.1207 M and the concentration of nitrogen was 0.0402 M, what is the equilibrium concentration of ammonia?



Question 4.

If 365 mL of a 0.0054 mol/L solution of $Pb(NO_3)_2$ was mixed with 595 mL of a 6.34×10^{-4} mol/L solution of KI, would a precipitate form? Calculate the ion product for the potential precipitate. The Ksp of PbI_2 is 7.9×10^{-9}.

-we did one question just like this in class. The most difficult part is the first step of writing the balance equation and determining what will form the precipitate. –should work out to a Q less than Ksp