Acids + Bases Problem Set

Review:

1. For acid dissociation $HA(aq) + H_2O(l) \rightleftharpoons A^-(aq) + H_3O^+(aq)$, what is the K_a expression?

2. For base dissociation (association?) $B(aq) + H_2O(l) \rightleftharpoons HB^+(aq) + OH^-(aq)$, what is the K_b expression?

3. What is the value of K_w at 298 K?

4. K_w <u>increases/decreases/stays constant</u> with increasing temperature.
   (choose one)

5. What is the mathematical relationship between K_a, K_b, and K_w?

Problems:

1. Calculate the hydronium ion concentration in 50.0 mL of 0.10 M NaH_2AsO_4. [$K_1 = 6.0 \times 10^{-3}$, $K_2 = 1.1 \times 10^{-7}$, $K_3 = 3.0 \times 10^{-12}$]

2. 1.0 L of an aqueous solution of which $[H_2CO_3] = [HCO_3^-] = 0.100\ M$ has $[H^+] = 4.2 \times 10^{-7}\ M$. What is the $[H^+]$ after 0.005 moles of NaOH have been added?

3. The pH of a saturated solution of $Fe(OH)_2$ is 8.67. What is the K_{sp} of $Fe(OH)_2$? (Hint: $K_{sp} = [Fe^{2+}][OH^-]^2$)

4. The Henderson-Hasselbalch equation describes pH of something called a buffer solution through altering concentrations of an acid and its conjugate base. Derive this equation from your answer to Review question 1.

Henderson-Hasselbach equation: $pH = pK_a + \log\left(\frac{[A^-]}{[HA]}\right)$ (really important!)

Food for Thought...

We've learned about the 5% rule and ice tables in order to solve for the pH of a given solution. Take a look at this problem:

Calculate the pH of a 1.0×10^{-5} M HCN (hydrocyanic acid) solution.

$$HCN(aq) \rightleftharpoons H^+(aq) + CN^-(aq)$$

(You should get pH ≈ 7.11 as your answer using ICE tables. But isn't HCN an acid? How is pH > 7?)