

# 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.  $K_w$  increases/decreases/stays constant 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.

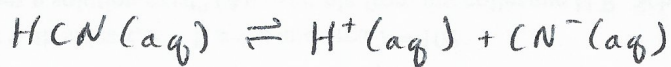
$$\text{Henderson-Hasselbalch equation: } pH = pK_a + \log\left(\frac{[A^-]}{[HA]}\right)$$

(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  $1.0 \times 10^{-5} \text{ M}$  HCN (hydrocyanic acid) solution.



(You should get  $\text{pH} \approx 7.11$  as your answer using ICE tables. But isn't HCN an acid? How is  $\text{pH} > 7$ ?)