# Chapter 15

## Summary of pH Calculations

### *Find the pH of…*

1. Strong Acids & Bases
   - Strong acids completely dissociate, so pH = -log[acid]
   - Strong bases completely dissociate, so pOH = -log[base] then pH = 14 – pOH

2. Weak Acids & Bases
   - Add to $H_2O$ and put into a RICE table.
     - Weak Acid: $HA(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + A^-(aq)$
     - Weak Base: $B(aq) + H_2O(l) \rightleftarrows OH^-(aq) + BH^+(aq)$

3. Salt Solution
   - Dissociate salt into component ions (the ion may have been left over in an invader problem)
     - Salt Dissociates: $MA(s) \rightarrow M^+(aq) + A^-(aq)$
   - Add weak ion to $H_2O$ and put in a RICE table ($K_w = K_a / K_b$ or vice versa)
     - Anion of Weak Acid: $A^-(aq) + H_2O(l) \rightleftarrows HA(aq) + OH^-(aq)$
     - Cation of Weak Base: $M^+(aq) + H_2O(l) \rightleftarrows MOH(aq) + H^+(aq)$
       - Ammonium Ion (& Amines): $NH_4^+(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + NH_3(aq)$

4. Buffers

   Henderson – Hasselbalch Equation
   - If given a weak acid and its conjugate base (HA & MA), then use $pH = pK_a + \log\frac{[ion]}{[acid]}$
   - If given a weak base and its conjugate acid (B & $BH^+$), then use $pOH = pK_b + \log\frac{[ion]}{[base]}$

5. Invaders – adding something strong to #2, 3, or 4 above and find resulting pH.
   - First set up stoichiometry table to determine what is left over (will run out of something).
   - Depending on what is left over add to $H_2O$ and use a RICE table or if you have a buffer use Henderson-Hasselbalch.

### *Titrations…*

1. General Set Ups (Remember Acids donate $H^+$ and bases accept $H^+$)
   - Strong Acid + Strong Base (equivalence point is 7)
     - $H^+ + OH^- \rightarrow H_2O$
   - Strong Acid + Weak Base (equivalence point is <7)
     - $H^+ + NH_3 \rightarrow NH_4^+$
   - Strong Base + Weak Acid (equivalence point is >7)
     - $OH^- + HA \rightarrow H_2O + A^-$

2. Equivalence point
   - moles of base = moles of acid
   - When figuring out how many milliliters it takes to reach the equivalence point, you need to take into consideration the mole ratio from the balanced equation.

3. Effective Buffer
   - equal moles of acid and base so $pH = pK_a$

4. ½ Equivalence Point
   - find the pH at the ½ equivalence point by dividing the volume of titrant at the equivalence point by 2
   - use that volume to find pH at the ½ equivalence point. Then…
     - for a weak acid: $pH = pK_a$
     - for a weak base: $pOH = pK_b$

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