5.111 Principles of Chemical Science: Week 9

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Progress Update

Over the past week I have:

1. Watched lectures 23-24 and completed associated review problems.
2. Completed exam 3.

Acid-base Titration

Acid-base titrations fall into 3 classes:

1. Strong acid - strong base
2. Strong acid - weak base
3. Weak acid - strong base

The foremost case (Strong acid - strong base) has a simple method and the latter two cases have nearly identical methods, sans swapping k_a of the weak acid for k_b of the weak base and relevant equation formatting.

Strong acid - strong base titration

Strong acid/ strong base titrations are the easiest titration problems, made up of 3 steps:

1. Find whether there is a surplus of hydronium or hydroxide generated by the addition of the acids and bases.
2. Find the difference of the greater presence minus the lesser presence, and plug into $pH = -\log([H_3O^-]) = 14 + \log([OH^-])$

Titrations of weak acids or weak bases

In titrations of weak acids or weak bases, we consider a few points in particular at which a certain amount of a strong base or strong acid has been added:

1. When no titrant has been added, we use the given k_a or k_b on its own alongside the initial concentration.
2. At the half equivalence point, we use the Henderson-Hasselbach equation to solve for this buffer solutions pH.
3. At the equivalence point, we solve for the equation involving the conjugate in the quantity of solute, and
4. Past the equivalence point, we account for how much extra ion is added by the strong acid and/or strong base.

Review problem

Consider the following review problem from lecture 23:

3. 50.0 mL of 0.10 M acetic acid (CH_3COOH (aq)) is titrated 0.20 M NaOH (aq). The K_a of acetic acid is 1.74×10^{-5}.
(a) Calculate the initial pH of the 0.10 M acetic acid solution?
(b) Calculate the pH of the solution after addition of 10.0 mL of NaOH.
(c) Calculate the volume of 0.20 M NaOH required to reach the half-equivalence point.
(d) Calculate the pH at the half-equivalence point.

Olympiad Exam Problem

I was unable to find a problem.