Titration

Method used to determine the concentration of an analyte (in the flask). A standard solution of titrant (in the buret) is added to the flask until stoichiometric equal moles of analyte and titrant react. Knowing the concentration and volume of titrant used to react with the known volume of analyte allows one to determine the concentration of the analyte.

Equivalence point: stoichiometric **equal moles of acid and base**

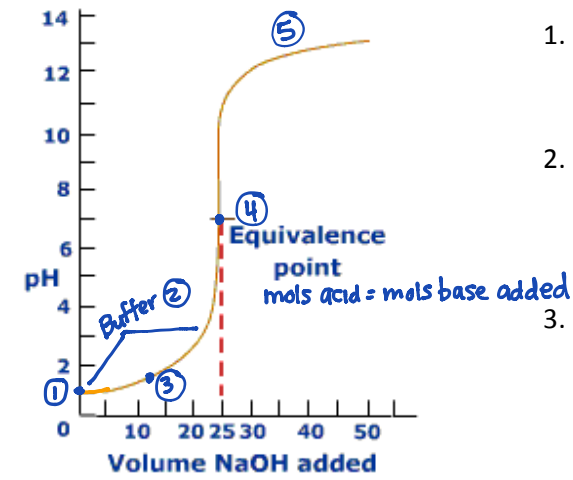
End point: when indicator **changes color**, signifies the end of titration. We want to use an indicator that will change color around the equivalence point

Indicators: use an indicator that will change color in the pH range of the equivalence point (see pg. 654)

1. SB + WA: pH >7 = phenolphthalein
2. SA + SB: pH =7 = bromothymol blue
3. SA + WB: pH < 7 = methyl red

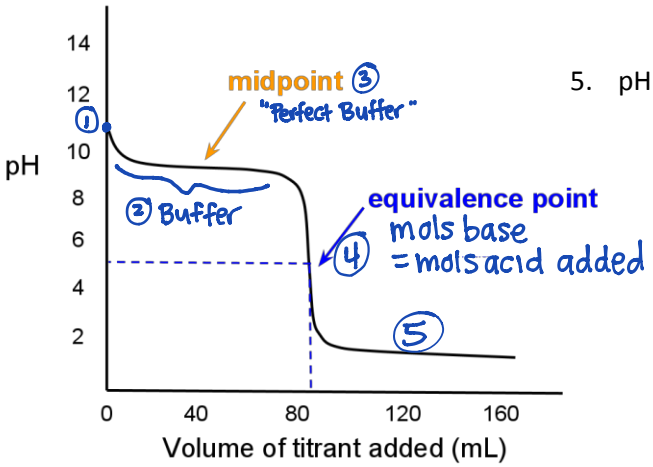
Titration curve: plot of pH (y-axis) vs. volume of titrant added (x-axis)

5 Main Regions of Titration Curve



Titration curve of strong acid (HCl) with a strong base (NaOH)

1. pH before titration begins
   a. Strong acid or strong base: use molarity for pH = -log [H^+]
   b. Weak acid or weak base: use ICE to find pH
2. pH as titrant is being added at the beginning (Before equivalence pt. is reached)
   a. Buffer is made
   b. Find pH using: $[H^+] = Ka \times \left(\frac{mols\ weak\ acid}{mols\ conjugate\ base}\right)$
3. pH ½ way to equivalence point
   a. Perfect buffer is made (mols weak acid = mols conjugate base)
   b. Find pH using: $[H^+] = Ka \times \left(\frac{mols\ weak\ acid}{mols\ conjugate\ base}\right)$
   c. Thus, [H^+] = Ka and pH = pKa
4. pH at equivalence point
   a. all added acid or base has been neutralized
   b. only water + salt present
   c. Find pH of the salt solution using ICE chart of salt + H_2O
5. pH beyond equivalence point
   a. excess titrant present
      i. if titrant is base then excess OH^-, find [OH^-]
      ii. if titrant is acid then excess H^+, find [H^+]
   b. Find pH using [H^+] and/or pOH using [OH^-]



weak base titrated w/ strong acid

Titration Example Problems

1. 50.0 mL of a 1.00 M HF is titrated with a 1.00 M NaOH. If Ka = 6.9×10^{-4}, what is the pH
   a. before titration begins?
   b. ½ way to the equivalence point?
   c. at the equivalence point?
   d. What indicator should be used for this titration?
   e. Choose sketch of the titration curve below that is representative of this titration.

2. 100.0 mL of a 1.00 M KOH is titrated with a 1.00 M HCl. What is the pH
   a. before titration begins?
   b. ½ way to the equivalence point?
   c. at the equivalence point?
   d. What indicator should be used for this titration?
   e. Choose sketch of the titration curve below that is representative of this titration.

3. 50.0 mL of a 0.300 M NH_3 is titrated with a 0.150 M HI solution. If Kb = 1.8×10^{-5}, what is the pH
   a. before titration begins?
   b. ½ way to the equivalence point?
   c. at the equivalence point?
   d. What indicator should be used for this titration?
   e. Choose sketch of the titration curve below that is representative of this titration.