

Lecture 5 – Volumetric Analysis/Titrations

Methods for Establishing Concentration of Standard Solutions

1. Direct – carefully weighed out sample into a volumetric flask
2. Standardization - solution is standardized by:
 - a. titration with a weighed quantity of a primary std
 - b. weighed quantity of secondary std
 - c. or measured volume of another std solution

Stoichiometric Calculations in Volumetric Analysis

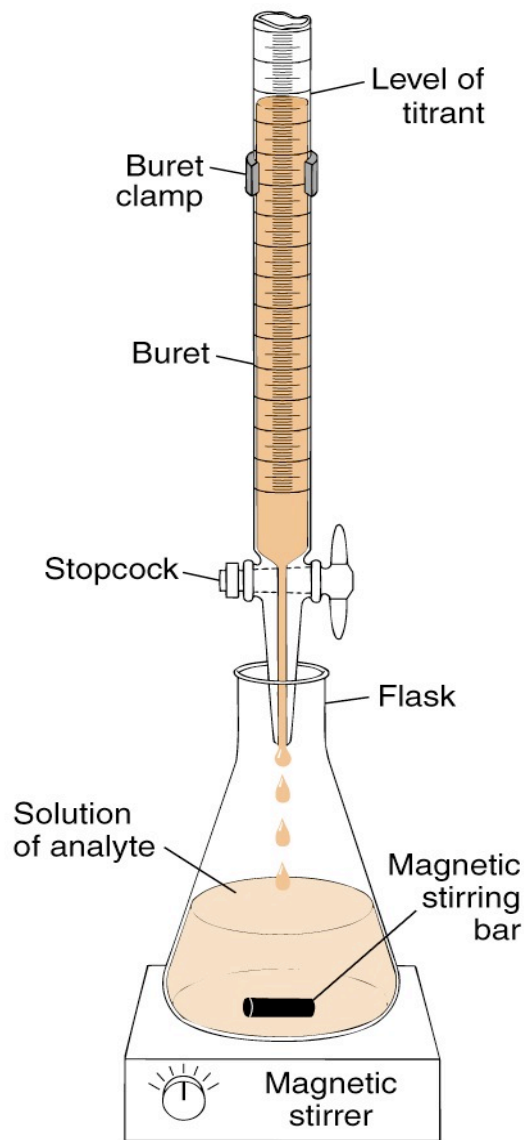
$$1. \text{ amount A} = \# \text{ mol A} = \frac{wt(Ag)}{fw(Ag/mol)}$$

$$2. \text{ amount A} = \# \text{ mol A} = V \text{ (L)} \times C_A \text{ (mol A /L)}$$

* Solution preparation – lecture 1

* When primary std's not available, use standardization method

Volumetric titration – addition of a standardized solution (titrant) from a buret (or other volumetric device) to a solution of analyte until reaction completed (equivalence point).

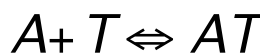


Key: Relate # moles of titrant to moles of analyte
Titration Curves in Titrimetric Methods
(precipitation)

End point = some physical change that occurs near the equivalence point of a titration

Equivalence point - reaction b/t titrant and analyte is complete.

Color change – most recognizable indicator (p.367)



For change - $\frac{[InT]}{[In]}$ change by 1-2 orders of magnitude

Titration curves – allow understanding of the basis of end points and titration errors.

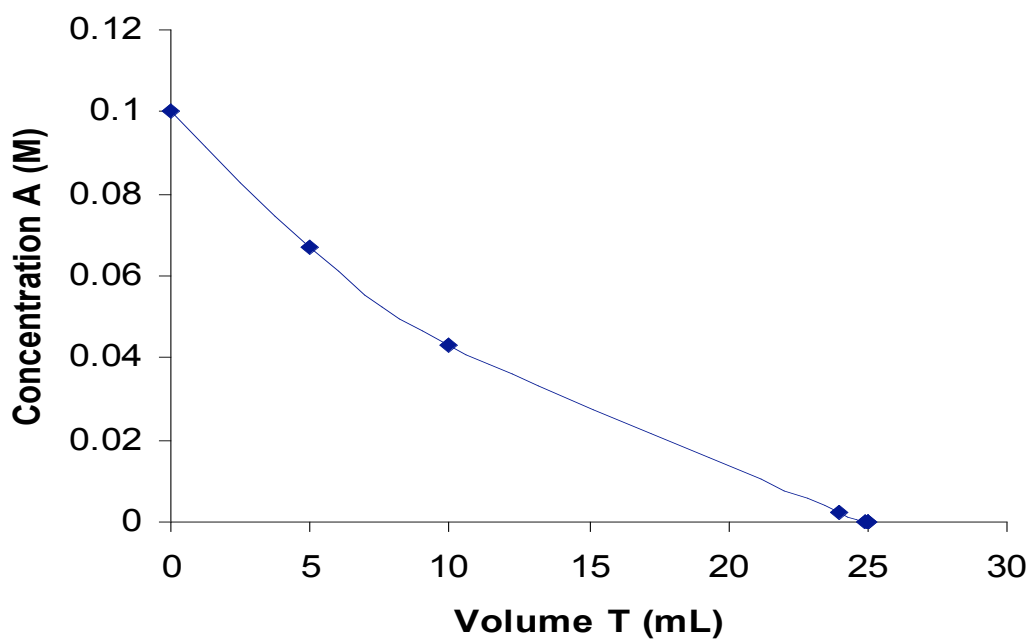
1. Sigmoidal – small region (0.1-0.5 mL) surrounding the equivalence point
2. Linear – measurements made on both sides of the equivalence point.

Using data near the equivalence point

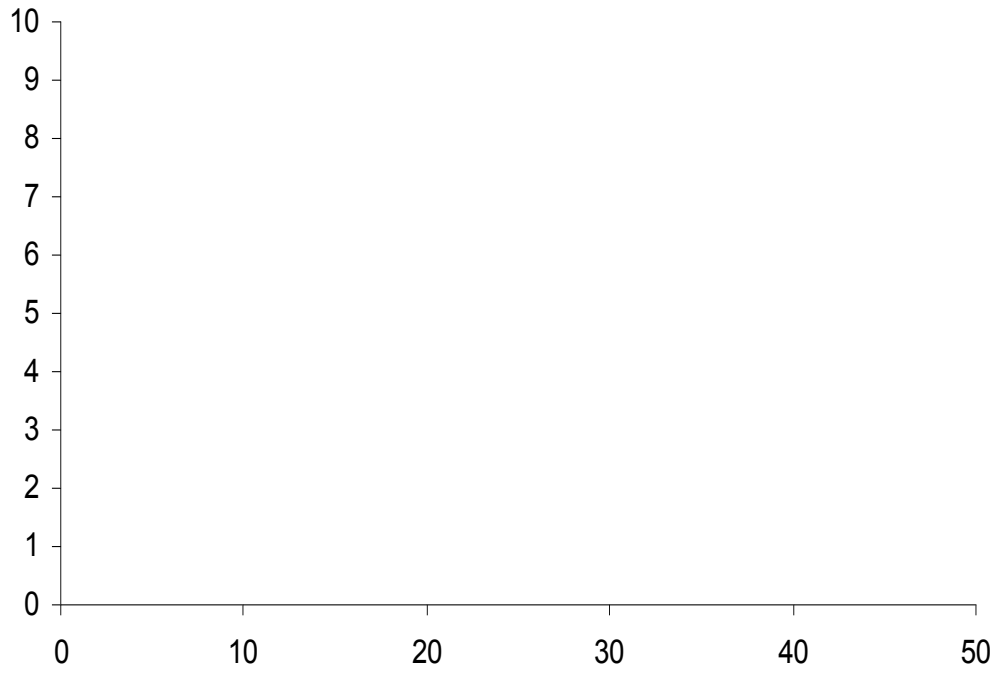
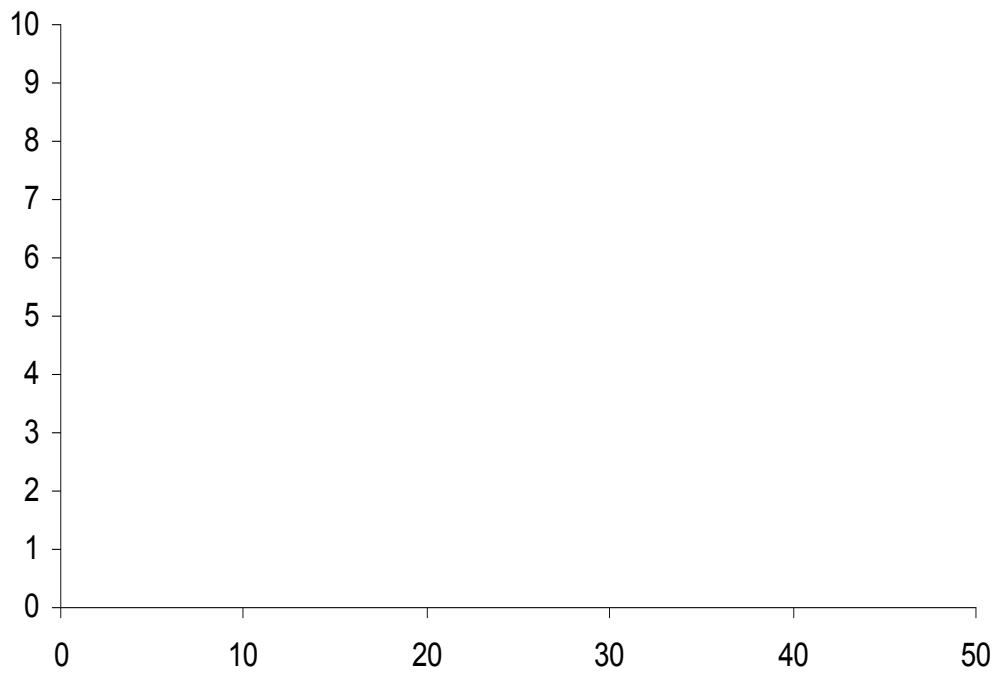
Concentration changes during titration

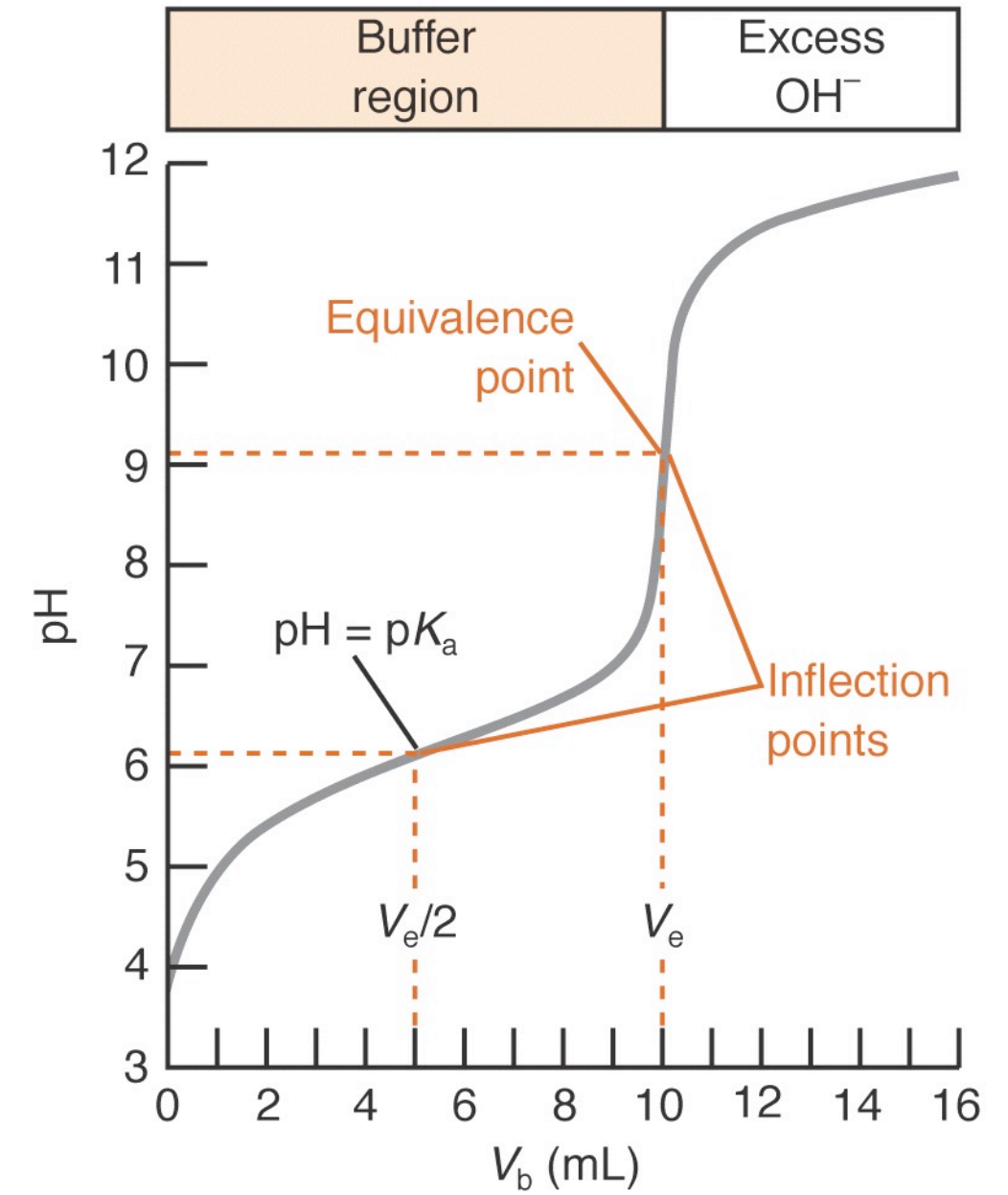
Vol 0.1000 T (mL)	Conc. A (mol/L)	pA
0	1.00×10^{-1}	1.00
5.00	6.67×10^{-2}	1.18
10.00	4.29×10^{-2}	1.37
24.00	2.04×10^{-3}	2.69
24.90	2.00×10^{-4}	3.70
24.99	2.00×10^{-5}	4.70
25.00	2.24×10^{-6}	5.65

25.01	2.50×10^{-7}	6.60
25.10	2.50×10^{-8}	7.60
26.00	2.50×10^{-10}	9.60
40.00	1.67×10^{-10}	9.78
45.00	1.25×10^{-10}	9.90
50.00	1.00×10^{-10}	10.00



Graphs of titration curves

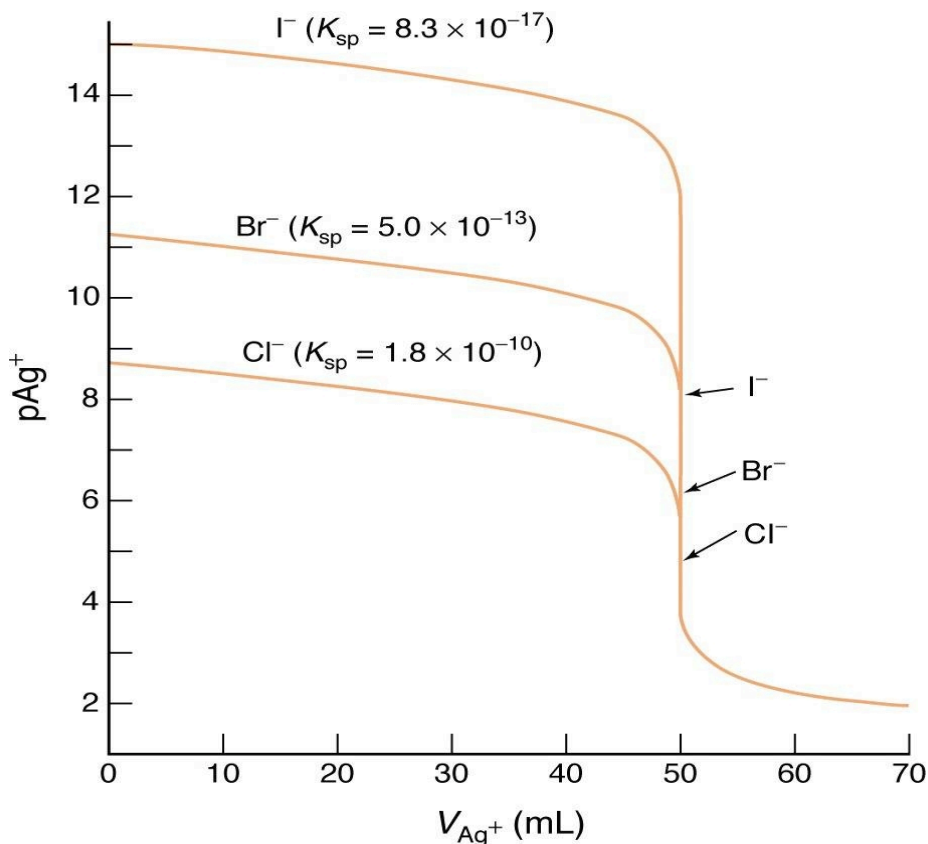




Factors Influencing Endpoints

1. Concentrations- increases in analyte and reagent concentrations enhance the change in pA (equivalence region). Rule: change of 2 in p-function.
2. Reaction completeness – end points improve as reaction becomes more complete.
-product solubility large factor

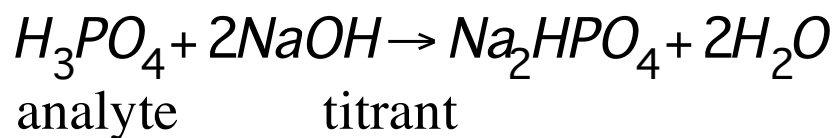
Titration curves of mixtures



Direct Titration

-titrant reacts directly with the analyte:

*amount analyte = amount titrant (moles or mmoles)
x reacting ratio*



Stoichiometric ratio: 2 moles NaOH needed to
react with 1 mole H₃PO₄

$$\text{amt of } H_3PO_4 \text{ (mmol)} = \text{amt NaOH (mmol)} \times \frac{1H_3PO_4}{2NaOH}$$

$$\text{wt } H_3PO_4 = \text{amt } H_3PO_4 \times \text{fw } H_3PO_4$$

$$\% H_3PO_4 = \frac{\text{wt } H_3PO_4}{\text{wt sample}} \times 100$$

*****IN Class Calculations to Follow!**