Key

Titrations Practice

1. Make a sketch of the following scenario: a solution of 0.100 M NaOH is the titrant added from a burette. 25.0 mL of a solution of 0.100 M HCl is the analyte in a flask below the burette.

2. Write the chemical equation for the resulting reaction.

$HCl + NaOH \rightarrow H_2O + NaCl$

Net ionic?

$H^+ + OH^- \rightarrow H_2O_{(l)}$

3. What is the pH of the HCl solution before any NaOH is added?

$pH = -\log[H^+]$

$H^+ + Cl^- \rightarrow HCl$

$HCl \rightarrow H^+ + Cl^-$

$[HCl] = [H^+]$

$pH = -\log[HCl] = -\log[10^{-1}] = 1$

4. After 6 mL of 0.1 M NaOH is added to the flask,

   (a) What is the limiting reactant?

   25 mL 0.1 M HCl = 2.5 mmol HCl

   6 mL 0.1 M NaOH = 0.6 mmol NaOH, limiting

   (b) How many moles of the excess reactant remains in the flask?

   $2.5 - 0.6 = 1.9$ mmol

   (c) Calculate the new pH.

   $\frac{1.9 \text{ mmol}}{(25+6)\text{ mL}} = \frac{1.9}{31}\text{ M HCl} = \frac{1.9}{31}\text{ M } H^+$

   $pH = -\log(1.$

   ~~$= 2.$~~

   1.21

5. Write the definition of the equivalence point.

   moles titrant = moles analyte

   (a) Without calculation identify the volume of NaOH required to reach the equivalence point. (Note: What makes this *shortcut* possible?)

   25 mL. equal concentrations make it easy

   what happens when they are not equal! in next class today?

   (b) Identify the species present in solution at the equivalence point.

   $Na^+ + Cl^- + H_2O$

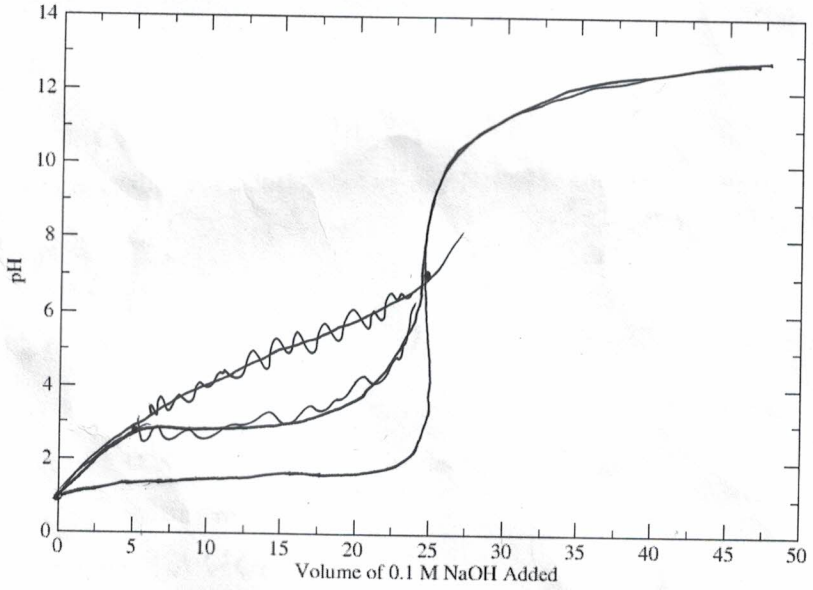
(c) Do you expect the solution to be acidic, basic, or neutral at the equivalence point? (Hint: Don't forget about *potential* acids and bases.)

Conjugates of strong acids or bases do not affect pH

6. If you were to continue adding base beyond the equivalence point what would be the limit in terms of the maximum pH? Consider an infinite amount of base.

b) the pH of the base, 13 in this case

7. Sketch a graph of the corresponding pH vs Volume curve on the axes below.



6(b)

0.5 mmol NaOH

5 mL 0.1 M NaOH

$NaOH \rightarrow \bar{O}H$

$$pOH = -\log[NaOH] = -\log\left(\frac{0.5\,mmol}{55\,mL}\right) = 2.04$$

$$pH = 14 - 2.04 = 11.96$$