Chemistry 6A F2007

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Wednesday

11/28/07

Exam 3: Friday 12/7/07 (here in lecture)

What will be covered on the exam?

- •Chapter 6: 6.9-6.15
- •Chapter 7: All
- •Chapter 8: All
- •Chapter 9: 9.1 - 9.9
- •Any thing from lab as well

What do I need to bring?

Bring a Pencil, Eraser, Calculator and scamtron form 882

YOU NEED TO KNOW YOUR LAB SECTION NUMBER!

Standard Solutions:

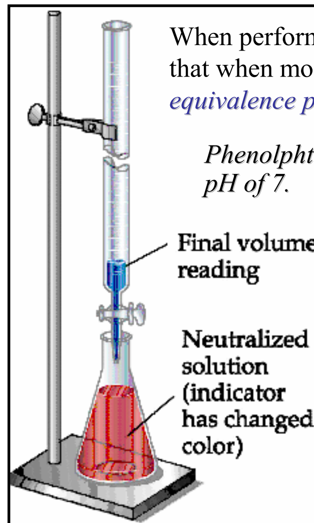
Some solutions cannot be accurately made by weight and dilution methods if the solute is impure or unstable.

When this is the case, one can make up a solution of approximate concentration then "***Standardize***" the solution against a "**Standard**" compound that reacts with the solute in solution.

A standard compound is one that is very stable with a known molar mass that yields a necessary number of sig. figs. (4 or more)

To standardize a solution, one performs a "***Titration***" where a measured volume of the solution is added to a known amount of the standard.

An "***Indicator***" is added to signal the point where the moles of standard = moles of solute reacted (***Endpoint***), knowing moles and volume, one can compute the concentration of the solution.



When performing a titration, an indicator is chosen so that when moles acid (H^+) equals moles base (OH^-) (*the equivalence point*) it changes color.

Phenolphthalein goes from colorless to pink near a pH of 7.

The pH of the color change is called the "*end point*" of the titration.

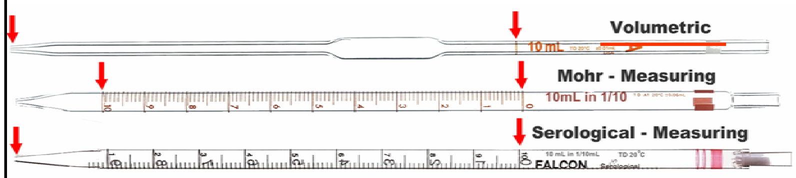
If the *end point* pH is near the *equivalence point* pH then:

moles base added = moles acid present

recall: M ×V = moles

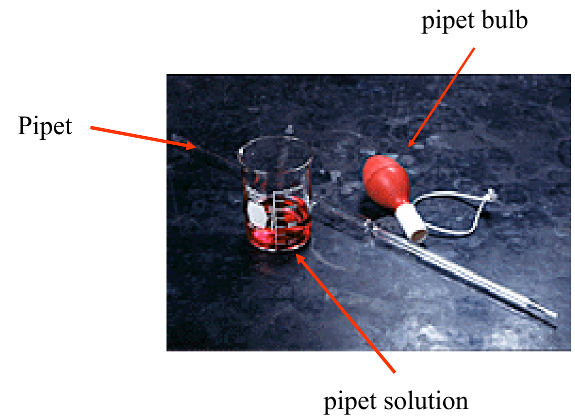
Pipets:

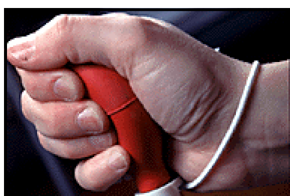
There are many types of pipets that you may encounter in the laboratory:



Volumetric pipets are high precision pieces of glassware that deliver an fixed accurate volume of liquid (*aliquot*) when used properly.
One never "blows out" the remaining liquid at the tip
Mohr pipets and serological pipets are graduated so that variable volumes of liquid can be delivered.

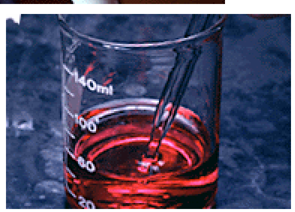
Using a volumetric pipet:



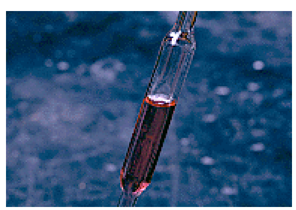


Start by squeezing the bulb in your preferred hand.

Then place the bulb on the flat end of the pipet.



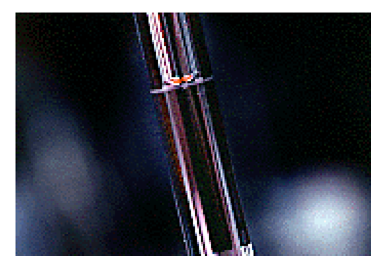
Place the tip of the pipet in the solution and release your grip on the bulb to pull solution into the pipet.



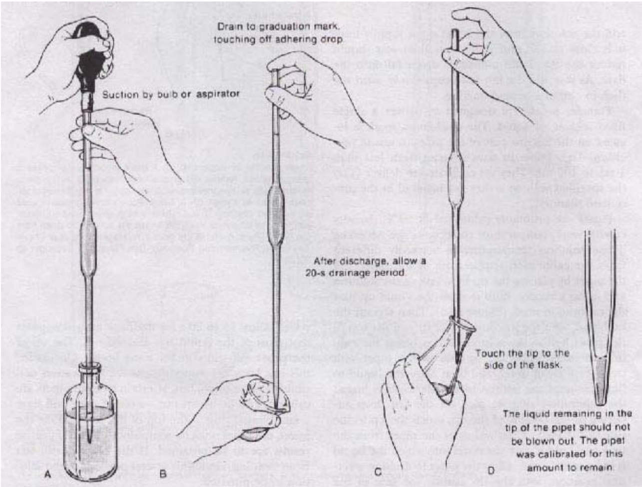
Slowly fill the pipet up through the reservoir up past the calibration mark on the stem.

Quickly, remove the pipet bulb and put your index finger on the end of the pipet.

Gently release the seal made by your finger until the level of the solution meniscus *exactly* lines up with the mark on the pipet.



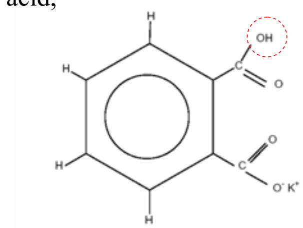
Another example of proper pipetting technique.



A common standard used in base (OH^-) standardizations in the mono–protic acid, KHP.

KHP is an acronym for:

potassium hydrogen phthalate
(not potassium hydrogen phosphorous)



The proton in the upper right of the compound dissociates to yield $H^+(aq)$

1 mol of KHP yields 1 mol of H^+ when dissolved in solution

$$KHP\ (aq) \rightarrow H^+(aq) + KP^-(aq)$$

The molar mass of KHP is 204.22 g/mol ($C_8H_5O_4K$)

A student prepares a solution of NaOH(aq) by weighing some NaOH(s) and diluting it in a flask.

Since NaOH is impure, the concentration must be determined by experiment (titration).

The student prepares a measured sample of KHP and titrates it with the NaOH(aq) solution to a pink phenolphthalein end point.

Since KHP produces H^+ in solution it is an acid.
At the end point:

$$\text{moles } H^+ \text{ from KHP} = \text{moles base form NaOH}$$

$$\text{g KHP} \rightarrow \text{mols KHP} \rightarrow \text{mols H+} \rightarrow \text{mols } OH^-$$

$$\text{mols } OH^- \div \text{volume of titration} = \text{M NaOH}$$

A student prepares a solution of NaOH(aq) by weighing some NaOH(s) and diluting it in a flask.

Since NaOH is impure, the concentration must be determined by experiment (titration).

Based on the following data, determine the NaOH concentration in mol/L.

mass KHP + flask:	95.3641 g	final buret reading:	30.12 mL
mass empty flask:	95.0422 g	initial buret reading:	1.56 mL
mass KHP:	0.3219 g	vol. NaOH:	28.56 mL

$$[OH^-] = \frac{\text{mols } OH^-}{\text{L of solution}} = \frac{\text{mol KHP}}{\text{L titrated}}$$

$[OH^-] = [NaOH]$ ***Strong Electrolyte!!!***

from the stoichiometry, one mole of OH^- reacts with 1 mol of KHP

$$0.3219\text{g KHP} \times \frac{1\text{mol KHP}}{204.22\text{ g}} \times \frac{1\text{ mol OH}^-}{1\text{mol KHP}} \times \frac{1}{28.56\text{ mL}} \times \frac{10^3\text{mL}}{\text{L}}$$

$$= 0.05519\text{M OH}^-$$

$$[\text{NaOH}] = 0.05519\text{ M}$$

remember… strong electrolyte $[OH^-] = [NaOH]$

A 25.00 mL sample of gastric juice is titrated with 0.210 M NaOH solution.
The titration to the indicator end point requires 29.8 mL of NaOH solution.
If the equation for the reaction is:

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$$

What is the molarity of HCl in the gastric juice?

$OH^- + H^+ \rightarrow H_2O$ (*1:1 stoichiometry*)

mL NaOH → mols NaOH = mols HCl ÷ volume of HCl = M HCl

use M (NaOH)

$$M = \frac{\text{moles}}{\text{L}}$$

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The titration to the indicator end point requires 29.8 mL of NaOH solution.
If the equation for the reaction is:

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$$

What is the molarity of HCl in the gastric juice?

$$29.8\text{ mL} \times \frac{1\text{L}}{10^3\text{mL}} \times \frac{0.210\text{ mols NaOH}}{\text{L}} \times \frac{1\text{mol HCl}}{1\text{mol NaOH}} \times \frac{1}{25.00\text{mL}} \times \frac{10^3\text{mL}}{1\text{L}}$$

$$= 0.250\text{ M HCl}$$

HYDROLYSIS REACTIONS OF WEAK ACID SALTS

Salts that contain anion of a weak acid (conjugate base) when dissolved in water will produce the acid.

$$NaA(aq) + H_2O(l) \rightleftarrows HA(aq) + NaOH(aq)$$

This process is know as *"hydrolysis"*.

The strength of a conjugate base depends upon the strength of the acid from which it came.

The stronger an acid is, the weaker is its conjugate base, and *vise versa*.

As a result, conjugate bases of very weak acids will produce higher concentrations of hydroxide in solution.

HYDROLYSIS REACTIONS OF WEAK ACID SALTS

The conjugate base of a strong acid will not undergo hydrolysis:

$$NaCl(aq) + H_2O(l) \rightarrow \text{no reaction}$$

When a salt such as sodium acetate is added to water, acetic acid forms:

weak acid

$$NaC_2H_2O_3(aq) + H_2O(l) \rightleftarrows HC_2H_2O_3(aq) + NaOH(aq)$$

strong base