

Perform all lab work in the fume hood!

At the end of the lab period, you should
clean your lab bench and close the hood sashes
lock your drawers and turn OFF hood light
submit a copy of notebook pages to your TA
submit your lab report to the RED locker

Who can turn the fume hoods ON/OFF?

Follow the Notebook Guidelines. An example of Exp 1 notebook pages is now posted on the Lab Info Page of the course web.

A 2-pts penalty will be imposed on mistakes such as wrong/missing ChemID/unknown #, white-outs, pencil, etc.

Graded reports/tutorials will be returned in lab. Unclaimed work will be placed on racks in LS136. Grading keys will be posted tomorrow. No late work will be accepted after keys are posted. Re-grade requests must be submitted no later than next Monday.

Do you understand your observations ?

Have you observed unexpected results?

How to predict types of bonding form conductivity?

What are the major species in solution?

Species that are highest/one of the highest in conc.

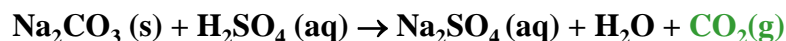
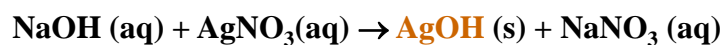
Chem 151 Lecture 3
Exp 2 Ion Exchange Reactions

- Three Categories of Inorganic Reactions in Aqueous Solution
- **Ion Exchange Reactions**
- Solubility Guidelines of Inorganic Compounds
- How to write net ionic reaction equations
- Flame tests

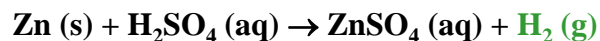
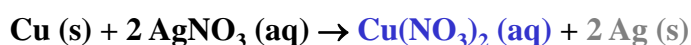
DQ #3 and #4 are now posted on Chem151 web
Q & A Session today at 5 pm in LS250

The 3 categories of Inorganic Reactions:

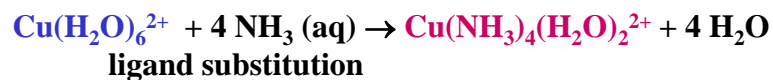
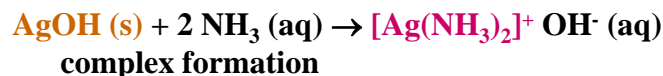
1) Ion Exchange Reactions (Exp. 2)



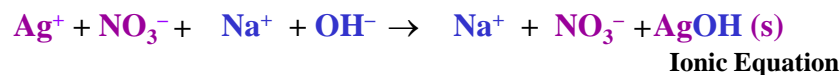
2) Oxidation-Reduction (Redox) Reactions (Exp. 3 & 4)



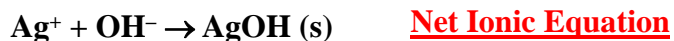
3) Reactions Involving Complex ions (Exp. 5 & 6)



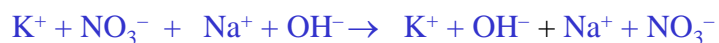
Ion Exchange Reactions a.k.a. Double Displacement Reactions



Na^+ and NO_3^- are called



If one asks: $\text{KNO}_3 (\text{aq}) + \text{NaOH} (\text{aq}) \rightarrow \text{KOH} + \text{NaNO}_3$



What makes an Ion-Exchange Reaction Occur?

For an ion exchange reaction: $\text{AB} (\text{aq}) + \text{CD} (\text{aq}) \rightarrow \text{AD} + \text{CB}$
to occur, AD and CB cannot both be soluble strong electrolytes.
One of the products must be either

1. an insoluble compound



2. a weak electrolyte



3. a compound that dissociates to form a gas



Some substances are less soluble and some are more soluble

Solubility Guidelines

Soluble Compounds

**All cpds of Na^+ , K^+ , and NH_4^+
Alkali metal compounds**

**All cpds of NO_3^- , ClO_3^- , and
 CH_3COO^-**

All cpds of Cl^- , Br^- , and I^-

All cpds of SO_4^{2-}

Exceptions

No exceptions

**$\text{Ag}(\text{CH}_3\text{COO})$ is slightly
soluble**

**Salts of Pb^{2+} , Ag^+ ,
 Hg_2^{2+} , and HgI_2**

**Salts of Pb^{2+} , Ag^+ , Hg_2^{2+} ,
 Ba^{2+} , and Ca^{2+} . (Ag_2SO_4
is slightly soluble.)**

Solubility Guidelines

Insoluble Compounds

**Cpds of CO_3^{2-} , PO_4^{3-} , SO_3^{2-} ,
 AsO_4^{3-} , O^{2-} , and OH^-**

Cpds of S^{2-}

Cpds of CrO_4^{2-}

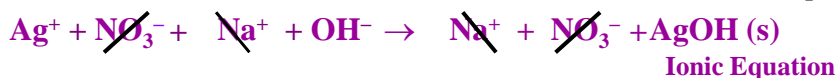
Exceptions

**Cpds of Na^+ , K^+ , and NH_4^+
Alkali metal hydroxides
 $\text{Ca}(\text{OH})_2$ and $\text{Ba}(\text{OH})_2$ are
moderately soluble.**

**Cpds of Na^+ , K^+ , NH_4^+ , Ba^{2+} ,
 Ca^{2+} , and Mg^{2+}**

**Cpds of Na^+ , K^+ , NH_4^+ , Li^+ ,
 Co^{3+} , and Cu^{2+} .**

How to write net ionic equations ?



Net ionic equation is not just for Ion-Exchange reactions



Net Ionic Equation

**Net ionic equations are only for reactions
occurring in aqueous solutions**

Shortcut of writing net ionic equations for Ion Exchange Rxns

Example magnesium sulfate solution mixes with barium chloride solution



Is magnesium chloride soluble?

Is barium sulfate soluble?

Example aluminum sulfate solution mixes with sodium hydroxide solution



Is aluminum hydroxide soluble?

Is sodium sulfate soluble?

Example Hydrochloric acid is added to a sodium carbonate solution



You realize that H^+ and CO_3^{2-} forms H_2CO_3 , which then decomposes to $\text{H}_2\text{O} + \text{CO}_2$.



Example Hydrochloric acid is added to calcium carbonate powder

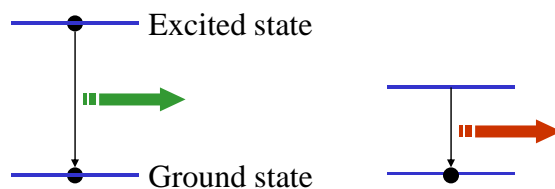


Net ionic equations must be balanced on net charges too!!



$\lambda = 400 \text{ nm}$

$\lambda = 700 \text{ nm}$



A flame test is a very sensitive mean to identify metal cations.

When you perform a flame test, be sure of the following:

The wire is clean (**Repetitive** cleaning with HCl and heating)

The wire is heated on a hot flame (at the tip of the blue cone)

To distinguish the flame color of the tested chemical from the color of a contaminant.

Relation of pH and $[H^+]$ = Molarity of H^+

$$pH = -\log[H^+] \quad p^x \equiv -\log [x]$$

If $[H^+] = 0.012 \text{ M}$, then $pH = -\log(1.2 \times 10^{-2}) = -(-1.92) = \underline{1.92}$

If $[H^+] = 0.000000000012 \text{ M}$, then $pH = -\log(1.2 \times 10^{-11}) = \underline{10.92}$

Note the large change in $[H^+]$ is covered by small change in pH
The the lower the $[H^+]$, the higher the pH

When a 0.012 M HCl solution is diluted to 0.0060 M , what is the pH of the diluted solution?

Ans: pH =

At 25°C , pH = 7 is a neutral solution
pH < 7 is acidic
pH > 7 is basic

In Experiment 2, you will

Before you perform this part, try to predict the outcomes.

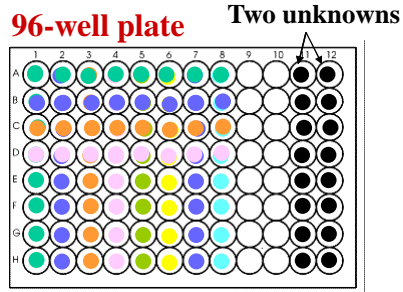
1. Study the ion exchange reactions of 8 stock solutions
2. Use pH paper to estimate the pH of the 8 stock solutions
3. Perform flame tests of the 8 stock solutions
4. Study the ion exchange reactions, flame tests, and pH of two unknown solutions and find their identities

**One of your unknown is one of the 8 stock solutions.
Another unknown is a 1:1 mixture of two stock solutions.**



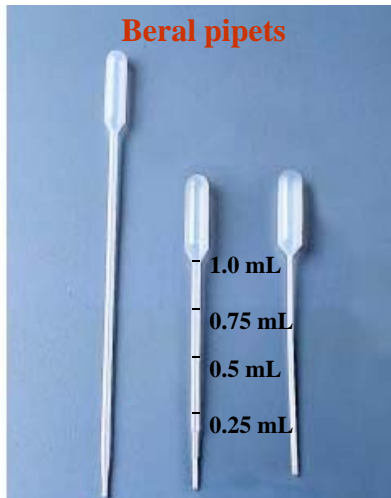
24-well plate

For holding the vials of stock solutions and unknowns



96-well plate

Two unknowns



Beral pipets

The graduated ones are called graduated disposable pipets in the manual.

Observe the color changes using a black background and a white background

diagonally symmetrical

