CH204
Potions Class

Spring 2009
Professor Severus Snape

Last Week in the Potions Laboratory

- Separated mixtures based on differing physical and chemical properties
- Used Excel to calculate average, standard deviation, and weight percents
- Q-test in action!
- Büchner filtering

Experiment 3
Qualitative Chemical Analysis

Qualitative Analysis

What are solutions A-F?

You will identify <u>what</u> these chemicals are based on how they react *(or don't react!)* with one another.

Two-Part Lab

- Part 1: Mix eleven known potions and record the results of the reactions
- Part 2: Mix your five unknowns potions and compare the results with what you saw in Part One.

What are we looking for?

Precipitates.

(See the solubility table in Appendix 2.)

Don't expect to see any acid-base action.

Write chemical equations for all of the reactions that form a precipitate.

Be Exact!

The more accurately you record your observations, the easier it will be to identify your unknowns.

The Known Potions

Acids: H_2SO_4 HNO_3

Bases: NaOH Na_2S Na_3PO_4

Salts: NaCl $Ba(NO_3)_2$ $AgNO_3$
$Fe(NO_3)_3$ $Ni(NO_3)_2$ K_2CrO_4

All potions are 0.10 or 0.20 M.

Naming Ionic Compounds

If the cation forms only one kind of ion, name the cation, then the anion. Don't use prefixes like mono- or di-, just name the ions.

$BaCl_2$ – barium chloride

K_2CO_3 – potassium carbonate

$Al(NO_3)_3$ – aluminum nitrate

Naming Ionic Compounds

If the cation can form more than one kind of ion, put the positive charge in Roman numerals:

$Sn(NO_3)_2$ – tin (II) nitrate

$Sn(NO_3)_4$ – tin (IV) nitrate

FeO – iron (II) oxide

Fe_2O_3 – iron (III) oxide

Naming Ionic Compounds

Monatomic anions: -ide ending

Cl^- – chloride

O^{2-} – oxide

S^{2-} – sulfide

Polyatomic anions: learn the names!

OH^- – hydroxide

PO_4^{3-} – phosphate

SO_4^{2-} – sulfate

See the table on page A-5 of the lab manual

Riddle me this

What do you get when you cross hydrochloric acid with silver nitrate?

Balanced Chemical Equation

$$HCl + AgNO_3 \longrightarrow AgCl + HNO_3$$

Add the physical states of each compound

$$HCl_{(aq)} + AgNO_{3(aq)} \longrightarrow AgCl_{(s)} + HNO_{3(aq)}$$

This is called a molecular equation.

Let's Get Real

$HCl_{(aq)} + AgNO_{3(aq)} \longrightarrow AgCl_{(s)} + HNO_{3(aq)}$

Write aqueous compounds as individual ions:

$H^+_{(aq)} + Cl^-_{(aq)} + Ag^+_{(aq)} + NO_3^-{}_{(aq)} \longrightarrow$
$AgCl_{(s)} + H^+_{(aq)} + NO_3^-{}_{(aq)}$

This is a total ionic equation.
Lots of spectator ions.

Time to Clean House

Cross out spectator ions

~~$H^+_{(aq)}$~~ + $Cl^-_{(aq)}$ + $Ag^+_{(aq)}$ + ~~$NO_3^-{}_{(aq)}$~~ $\longrightarrow$
$AgCl_{(s)}$ + ~~$H^+_{(aq)}$~~ + ~~$NO_3^-{}_{(aq)}$~~

This leaves us with a Net Ionic Equation

$Ag^+_{(aq)} + Cl^-_{(aq)} \longrightarrow AgCl_{(s)}$

The Net Ionic Equation

$NaCl_{(aq)} + AgNO_{3(aq)} \longrightarrow NaNO_{3(aq)} + AgCl_{(s)}$

$Ba(Cl)_{2\ (aq)} + 2AgCH_3COO_{(aq)} \longrightarrow$
$Ba(CH_3COO)_{2\ (aq)} + 2AgCl_{(s)}$

$NH_4Cl_{(aq)} + AgClO_{3(aq)} \longrightarrow NH_4ClO_{3(aq)} +$
$AgCl_{(s)}$

All of these reactions have the same net ionic equation:

$Ag^+_{(aq)} + Cl^-_{(aq)} \longrightarrow AgCl_{(s)}$

Simple is Good

- The net ionic equation describes the chemical reaction that occurs, and does not include any ions that do not take part in the reaction, *even though those ions are present in solution.*
- How do we know which ions will react and which ones won't?

Some Quick Solubility Rules

* All compounds containing alkali metals and ammonium ion are soluble.

  Li^+ Na^+ K^+ Rb^+ Cs^+ NH_4^+

* All compounds containing nitrate, chlorate, perchlorate, and acetate are soluble.

  NO_3^- ClO_3^- ClO_4^- CH_3COO^-

Some Quick INsolubility Rules

* All compounds containing PO_4^{3-} CO_3^{2-} or SO_3^{2-} are insoluble, except those that contain alkali metals or NH_4^+.
* All compounds containing OH^- or S^{2-} are insoluble, except Group I and NH_4^+ And some group II metals.
* When in doubt, Ag^+ Pb^{2+} and Hg compounds tend to be insoluble.

In the Potions Laboratory

* Create an array of reactions in the microwell plate similar to the one in the lab manual.
* Use only 2 drops of each reactant.
* *DO NOT* touch the tips of the dropper bottles to the solutions in the microwell plate or you will die a most painful death.

Vile, hideous fluids!

Empty your used microwell plates into the disgusting plastic tray in the hood.

Rinse the plates into the tray, then stack them in the hood.

Lab Report

Molecular Equations for 15 precipitation reactions.

Net Ionic Equations for 15 precipitation reactions.

15 + 15 is 30 equations altogether.

Warning! Dark Magic!

Four reactions will turn cloudy even though no solid should be formed.

Na_2S + acid

Na_2S + $Ba(NO_3)_2$

$Ba(NO_3)_2$ + NaOH

These precipitates are due to unavoidable trace contaminants in the solutions (polysulfides in Na_2S and carbonate ion in NaOH).

Simple lab, monster write-up

The report and post-lab for this experiment take a lot of time!

Answer post-lab question 2 using only the reagents used in this experiment <u>or your ta will mark them wrong</u>!

Next Week

Quiz 3: Make sure you can name ionic compounds if I give you the formula, and can write formula if I give you the name. (See post-lab problems 1, 3, and 4.) Also know some general solubility rules.

Experiment 4: Acid-Base titration

Pre-Lab question 1:

the answer is <u>NOT</u> 71!

Final Exam, Part 2

* You will need a calculator every week (except next week).

* Make sure you know your section number and your TA's name!