CH204
Potions Class

Fall 2006
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!

Buchner filtering

Experiment 3
Qualitative Chemical Analysis

Previous Years

Gorgon's blood
Liquid gold
Vitreous humor of a blind mule

2006

Acids
Bases
Inorganic salts

"Quant" vs "Qual"

Quantitative – how much is there?
Qualitative – what is it?

You will identify the chemical identities of 5 unknown solutions based on how they react *(or don't react!)* with one another.

Two-Part Lab

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

Be Exact!

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

The Known Solutions

Acids: HCl H_2SO_4 HNO_3

Bases: NaOH Na_2S

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

All solutions are 0.10 or 0.20 M.

What are we looking for?

- Explosions
- Supernatural creatures
- Rashes, mutations, transformations

What are we REALLY looking for?

Precipitates, mostly.

(See the solubility table in Appendix 2.)

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

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 sometimes called a molecular equation.

Let's Get Real

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

Total Ionic Equation – write aqueous compounds as individual ions:

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

Lots of spectator ions.

Time to Clean House

Cross out spectator ions

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

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^- or $C_3H_3O_2^-$

Some Quick INsolubility Rules

* All compounds containing PO_4^{3-}, CO_3^{2-}, and SO_3^{2-} ions are insoluble except those that also contain alkali metals or NH_4^+.

* All hydroxides and sulfides are insoluble except those that also contain alkali metals, or NH_4^+. Hydroxides end with –OH, and sulfides end with –S. [Exception: some group II hydroxides are slightly soluble.]

* 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 – 3 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!

Chromium (VI) in particular is nasty!

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

Rinse the plates with ordinary tap water,
do a final rinse with deion water,
and stack the plates in the hood.

Lab Report

Molecular Equations for
11 precipitation reactions.

Net Ionic Equations for
11 precipitation reactions.

11 + 11 is 22 equations altogether.

Post-Lab Preview

$CaBr_2$ (aq) and NaBr (aq)
What will precipitate with Ca^{2+}
but not with Na^+?

$Fe(NO_3)_3$ (aq) and $Mg(ClO_3)_2$ (aq)

What will precipitate with Fe^{3+}
but not with Mg^{2+}?

Next Week

Experiment 4: Acid–Base titration

- more involved than this lab.
- Requires more preparation than our previous labs.
- start preparing early

Quiz Time

* You will need a calculator every week (except next week).
* Make sure you know your section number and your TA's name.