

Chemistry 101 Laboratory

Fall 2005 - 2006

Lecture4

Chemical Reactions and Acid Rain

Purpose

- To observe different ways of detecting chemical changes.
- To be introduced to the basic types of chemical reactions.
- To produce one of the main components of acid rain (sulfuric acid) and to observe some of its properties.

Detection of Chemical Changes

Five main observations usually indicate that a chemical reaction has occurred.

1- Precipitate formation.

2- Gas evolution.

- Use a **lit** wooden splint to identify the gas evolved
- If the gas is **oxygen**, the splint will **grow brighter**.
- If the gas is **hydrogen**, a **popping** sound will occur as the hydrogen ignites.
- If the gas is **carbon dioxide**, the ignited match will **go out**.

Detection of Chemical Changes (Cont'd)

3- *Color changes.*

4- Heat / energy evolved or absorbed: the test tube becomes warm or cold or light/fire is given off.

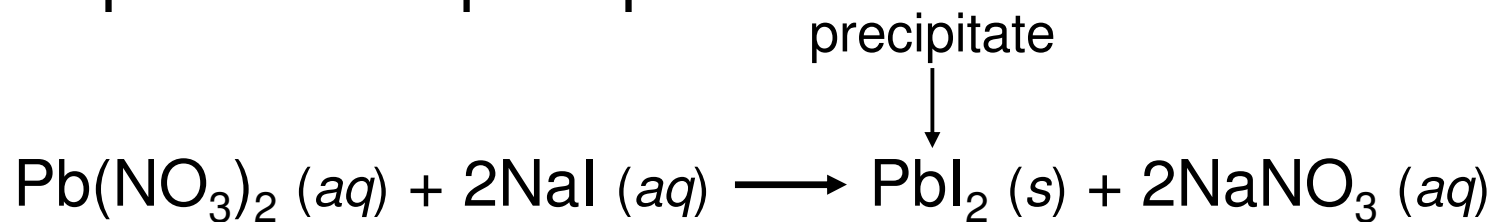
- Reactions that give off heat are ***exothermic***.
- Reactions that absorb heat are ***endothermic***.

5- Change in acidity:

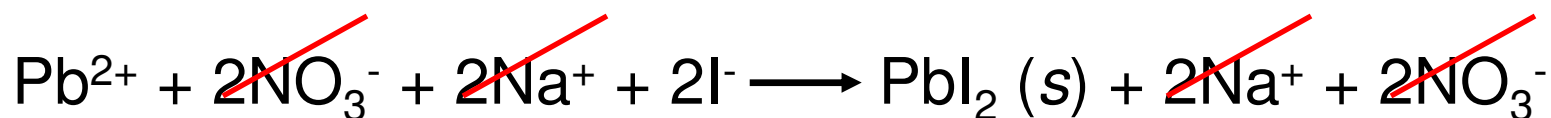
- Use a litmus paper to detect a change in the acidity of a solution.
- Litmus paper is **pink in acidic solutions** and **blue in basic solution**

Types of Chemical Reactions

a- Precipitation Reactions: Are double replacement reactions that are characterized by the formation of an insoluble product or precipitate.



molecular equation



ionic equation



net ionic equation

Na^+ and NO_3^- are ***spectator*** ions

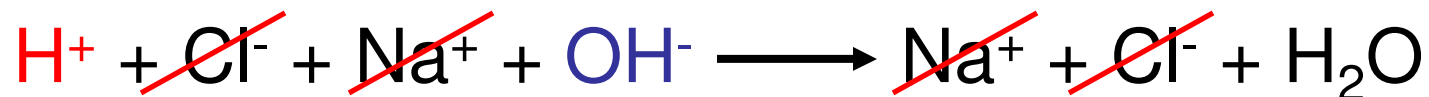
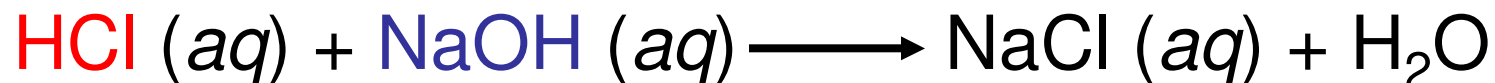
Solubility Rules for Common Ionic Compounds in Water at 25°C

TABLE

Soluble Compounds	Exceptions
Compounds containing alkali metal ions (Li^+ , Na^+ , K^+ , Rb^+ , Cs^+) and the ammonium ion (NH_4^+)	
Nitrates (NO_3^-), bicarbonates (HCO_3^-), and chlorates (ClO_3^-)	
Halides (Cl^- , Br^- , I^-)	Halides of Ag^+ , Hg_2^{2+} , and Pb^{2+}
Sulfates (SO_4^{2-})	Sulfates of Ag^+ , Ca^{2+} , Sr^{2+} , Ba^{2+} , Hg^{2+} , and Pb^{2+}
Insoluble Compounds	Exceptions
Carbonates (CO_3^{2-}), phosphates (PO_4^{3-}), chromates (CrO_4^{2-}), sulfides (S^{2-})	Compounds containing alkali metal ions and the ammonium ion
Hydroxides (OH^-)	Compounds containing alkali metal ions and the Ba^{2+} ion

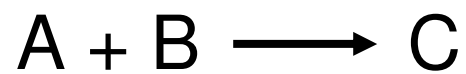
b- Neutralization Reaction

Are double replacement reactions in which H⁺ ions are transferred between reactants

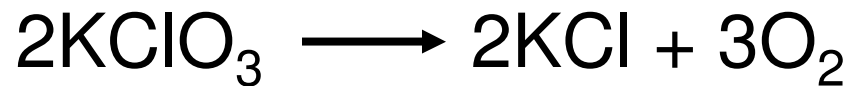


c- Oxidation-Reduction Reactions

Combination Reaction

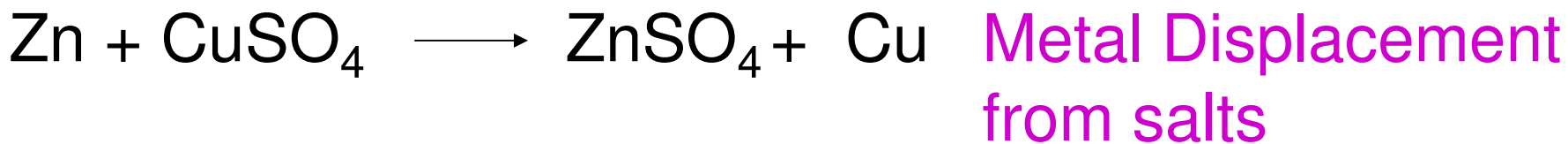
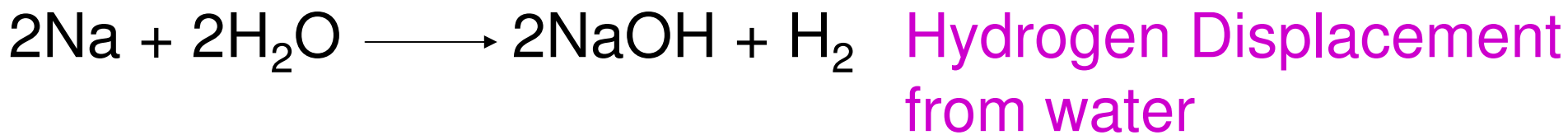
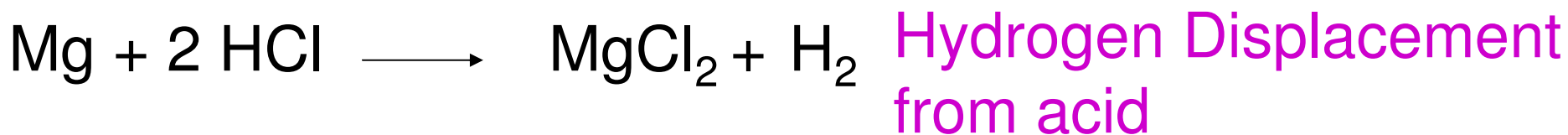


Decomposition Reaction



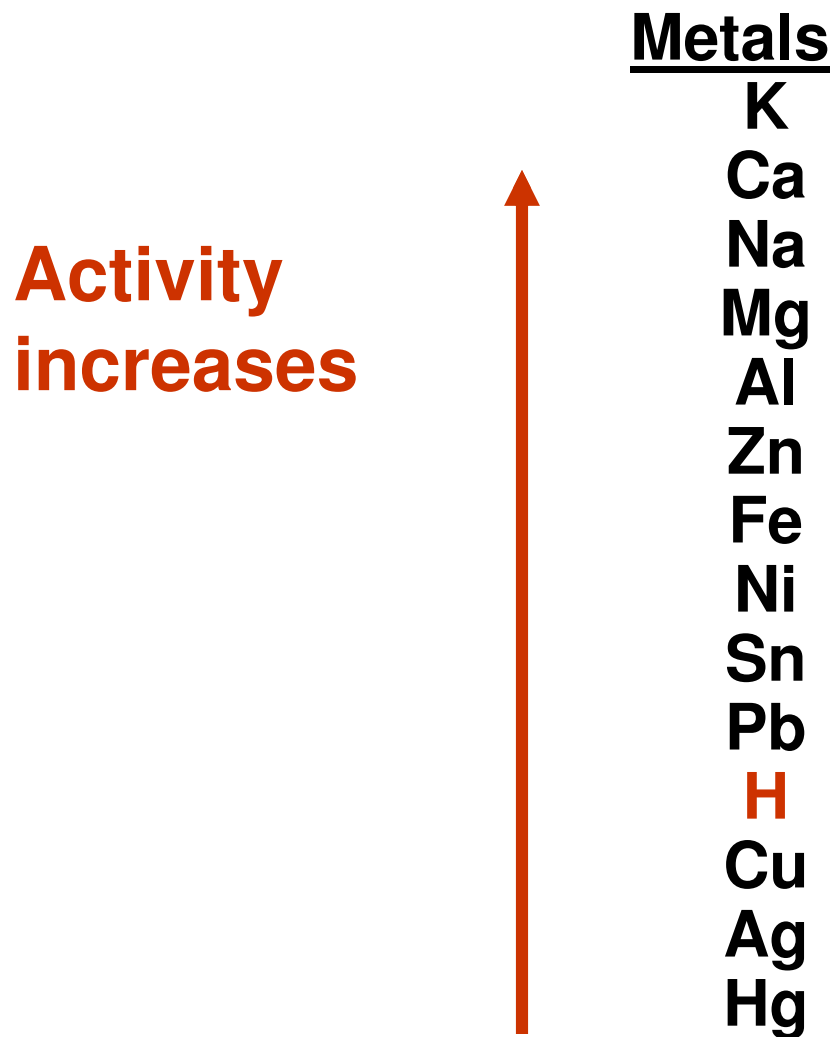
c- Oxidation-Reduction Reactions (Cont'd)

Displacement Reaction



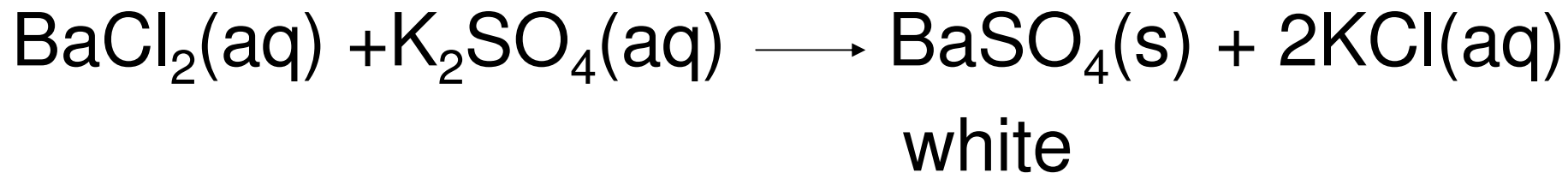
The Activity Series for Metals

An atom of an element in the activity series will displace an atom of an element below it from one of its compounds .

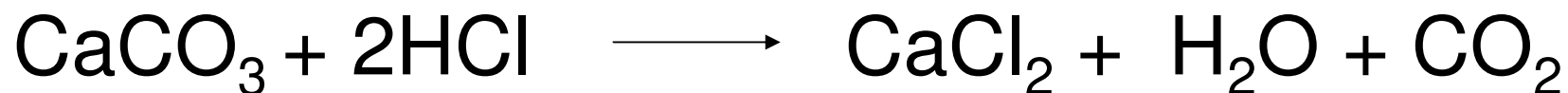


Experimental- Part A

1- *Precipitation reactions:*



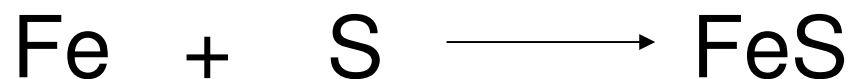
2- *Acid – Base reactions:*



Check for the gas

3- *Oxidation – Reduction reactions:*

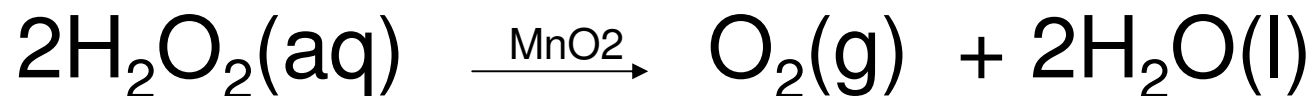
a- Combination (Formation of iron sulfide):



Exothermic or endothermic reaction?

Experimental- Part A (cont'd)

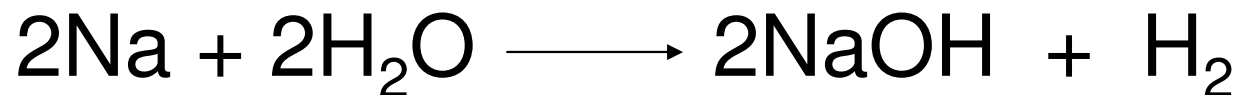
b- Decomposition:



Check for the gas

c- Single replacement:

i- Replacement of hydrogen from water

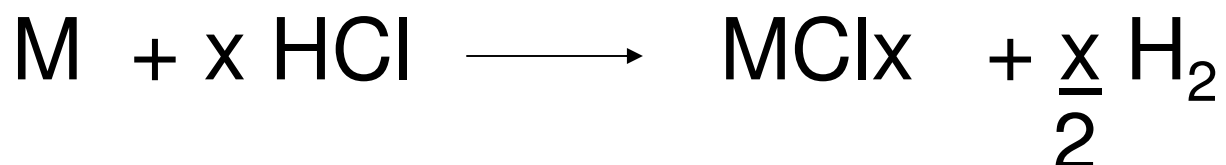


BE CAREFUL! (Na)

Check acidity using litmus

Experimental- Part A (cont'd)

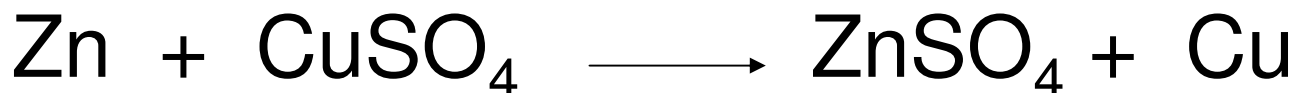
ii- *Replacement of hydrogen from acids:*



M is Cu, Fe, Al, Zn or Mg

Observe rate of H₂ evolution and arrange the metals in order of chemical activity.

iii- *replacement of metals from their salts:*



Explain your observations

Acid Rain

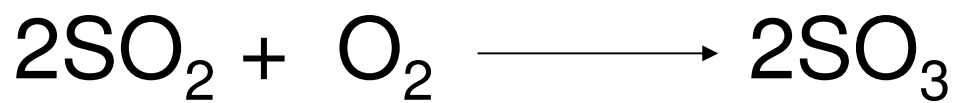
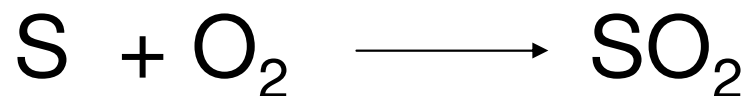
- Any atmospheric precipitation that is more acidic than usual.
- It is a growing environmental problem worldwide.
- Formation:
 - Emission of nitrogen and sulfur oxides into the air from the burning of fossil fuels.
 - Chemical reactions between the oxides and water forming sulfuric acid (H_2SO_4) and nitric acid (HNO_3)

Effects of Acid Rain

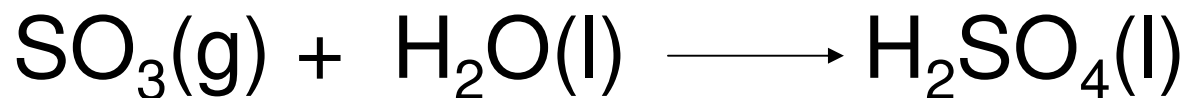
- Freshwater, plants and animals decline significantly when rain is acidic.
- aluminum is leached from the soil into lakes and adversely affects fish gills.
- the waxy protective coat on plants is dissolved making them vulnerable to bacteria and fungal attack.
- it is responsible for extensive and continuing damage to buildings, monuments and statues.

Experimental – Part B

- Place a small lump of sulfur into a deflagration spoon and ignite it under the hood.



- Trap the formed SO_3 in a wide-mouth bottle and add water.



- Check acidity of the solution