**TYPES OF CHEMICAL REACTIONS**

Most reactions can be classified into one of five categories by examining the types of reactants and products involved in the reaction. Knowing the types of reactions can help a person to predict the products which would be formed in a reaction.

***1. SYNTHESIS REACTIONS*** ( 2 singles to a dance ------> couple + heat )

- two or more elements or compounds combine to form a new substance also called a combination reaction

e.g. A + B ----> AB

a) element + element ------> compound

i) formation of an oxide

ii) metal + nonmetal

b) compound + compound -------> larger compound

i) formation of an acid (oxide of a nonmetal + water)

ii) formation of a base (oxide of a metal + water)

***2. DECOMPOSITION REACTION ( A couple have a heated argument and break up )***

- a compound breaks down into elements and/or other compounds

e.g. AB ------> A + B

a) simplest type is when compound breaks into its component elements

b) carbonates usually decompose into carbon dioxide plus the metal oxide when heated

c) others are more complicated and harder to predict

***3. COMBUSTION***

-reaction of a compound or element with oxygen to form one or more oxides accompanied by the production of light and heat

a) combustion of any compound containing carbon, hydrogen and water, or of a hydrocarbon (a compound containing only C and H) produces carbon dioxide and water

-complete combustion occurs if oxygen supplies are sufficient and above products are

 obtained

-incomplete combustion occurs in absence of sufficient oxygen leading to formation

 of carbon monoxide along with the carbon dioxide and water (sometimes formed

 as well)

**Single Displacement** *( couple + single* → new couple + single ) ; single causing breakup can be a metal or non-metal

 One element replaces (or displaces) another element in a compound because it is more active.

 **A + BC → AC + B *(metal replaces a metal ion in a compound)***

**AB + C → AC + B *(usually a halogen replaces an anion in a compound)***

Note: i) Treat hydrogen as a metal

 ii) Treat acids (e.g HCl) as ionic compounds ( H+, Cl-)

1. Treat water as ionic (H+, OH-)

iv) Use The Activity Series of the Elements Table : any element will displace another element below it on the series. This is used to predict if a reaction will occur or not.

**Single Displacement Reactions and the Activity Series**

a) one metal displaces another metal in an ionic compound

b) a metal displaces the hydrogen in an acid

c) a metal displaces the hydrogen in water

d) a non metal displaces another nonmetal in a compound

Activity Series Predictions

\_\_\_\_\_Zn + \_\_\_\_\_ Pb(NO3)2 => \_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_ Al + \_\_\_\_\_ HCl => \_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_ Cu + \_\_\_\_\_ AgNO3 => \_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_ Ba + \_\_\_\_ FeCl2 => \_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_ Cu + \_\_\_\_\_\_ MgSO4 => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ Zn + \_\_\_\_\_\_ FeCl2  => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ K + \_\_\_\_\_ H2O => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ Fe + \_\_\_\_ Al2(SO4)3 => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ Ag + \_\_\_\_ H2SO4 => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ Mg + \_\_\_\_ SnCl2 => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ Br2 + \_\_\_\_ KCl => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ Cl2 + \_\_\_\_ NaI => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ Pb + \_\_\_\_ HCl => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ KI + \_\_\_\_\_ Br2 => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ KF + \_\_\_\_\_ Cl2 => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_ MgSO4 + \_\_\_\_\_ Zn => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ Ni + \_\_\_\_ H2SO4 => \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**DOUBLE DISPLACEMENT REACTIONS ( couples change partners )**

-the exchange of cations between two ionic compounds

-usually in aqueous solutions

AB + CD ------> AD + CB (A and C are cations, B and D are anions)

a) formation of a precipitate

-one of the products will be insoluble in water and produce a precipitate

-the other product will be soluble

-solubility is determined by using a table of solubilities ( see chemistry helper )

Solubility is a measure of how a substance dissolves in water at a given temperature and pressure.  A substance that does not dissolve well in water is called insoluble  .  Chalk is a substance that has a low solubility.  Substances like sodium chloride, NaCl, that dissolve well in water are called soluble.

Solubility Table

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**Predicting The Formation of A Precipitate**Follow these steps to correctly determine if a product is an insoluble precipitate.
**Example 1:
Determine the products (if any) when a solution of sodium sulfate is mixed with a solution of lead(II) nitrate.  If a reaction occurs, summarize the reaction as a balanced chemical equation.**

|  |  |
| --- | --- |
| Step | What you should write |
| 1 | We are starting with two compounds therefore this is a double displacement reaction and the products will be sodium nitrate and lead(II) sulphate     |
| 2 | sodium sulphate + lead(II) nitrate  ------>    sodium nitrate + lead(II) sulphate |
| 3 | Anything with nitrate in it is soluble, anything with sodium in it is soluble therefore only lead(II) sulphate is insoluble |
| 4 | sodium sulphate(aq) + lead(II) nitrate(aq)  ------>          sodium nitrate(aq) + lead(II) sulphate(s) |
| 5 |    Na2SO4(aq) +     Pb(NO3)2 ----->      NaNO3(aq)  +      PbSO4(s) |
| 6 |    Na2SO4(aq) +     Pb(NO3)2 ----->   \_\_\_\_\_NaNO3(aq)  +    PbSO4(s) |

**Complete :**

\_\_\_ \_\_\_\_\_ + \_\_\_\_\_ ZnCl2 (aq) → \_\_\_\_ZnS(s) + \_\_\_\_ NaCl(aq)

\_\_\_\_\_ Na2CO3(aq) + \_\_\_\_\_ Ca(OH)2(aq) 🡪 \_\_\_\_\_ NaOH( ) + \_\_\_\_\_ CaCO3( )

b) formation of a gas

Reactions Producing Gas ( double displacement followed by decomposition )

Reactions Producing Gas

Summary of Reactions Producing Gas



c) **Neutralization**

A special double displacement reaction involving an acid and a base. The reaction always produces a \_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_. The acid provides the \_\_\_\_ and the base \_\_\_\_\_\_\_\_\_ to make \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Acid + Base → \_\_\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**HCl(aq) + NaOH (aq) → \_\_\_\_\_\_\_\_\_(aq) + \_\_\_\_\_\_\_\_\_\_(l)**

 **H2SO4 (aq) + \_\_\_NaOH (aq) → \_\_\_\_\_(aq) + \_\_\_ \_\_\_\_\_\_\_\_\_\_\_( )**

**Double Displacement**

Re-write the reactants with appropriate state symbols (use the solubility chart on the back of the periodic table).

1. Predict the products for each double displacement reaction.
2. Use the solubility rules again to determine the states of each product.

 Example: 2NaCl(aq) + H2SO4(aq) → Na2SO4(s) + 2HCl(aq)

|  |
| --- |
| 1. FeBr2 + K2CO3 →
 |
| 1. Ag2S + CuCl2 →
 |
| 1. Pb(NO3)2 + HI →
 |
| 1. BaI2 + H2SO4 →
 |
| 1. CuBr2 + K2S →
 |
| 1. Na3PO4 + MgSO4 →
 |
| 1. NaC2H3O2  + AgNO3 →
 |
| 1. FeCl2 + H2S →
 |
| 1. (NH4)2SO3 + Sr(OH)2 →
 |
| 1. HCl + NH4OH →
 |