

Types of Chemical Reactions:

Prediction of Products**1. COMBINATION/ SYNTHESIS**

- Metal + Nonmetal \rightarrow Binary salt
- Nonmetallic oxide + $H_2O(l) \rightarrow$ Acid
- Metallic oxide + Nonmetallic oxide \rightarrow Salt

2. DECOMPOSITION

- $CO_3^{2-}(aq)$: Metallic carbonate \rightarrow Metallic oxide + $CO_2(g)$
- $ClO_3^-(aq)$: Metallic chlorates \rightarrow Metallic chloride + $O_2(g)$
- Ammonium carbonate $\rightarrow NH_3(g) + H_2O(g) + CO_2(g)$

Some common reactions:

- $H_2SO_3(aq) \rightarrow SO_2(g) + H_2O(l)$
- $H_2CO_3(aq) \rightarrow CO_2(g) + H_2O(l)$
- Hydrogen peroxide \rightarrow water + oxygen
- $NH_4OH \rightarrow NH_3(g) + H_2O(l)$

3. SINGLE DISPLACEMENT

* apply activity series for metals and nonmetals

4. COMBUSTION

- Hydrocarbon + $O_2(g) \rightarrow CO_2(g) + H_2O(g)$
- Metal + $O_2(g) \rightarrow$ Metallic oxide
- Nonmetallic hydride + $O_2(g) \rightarrow H_2O(g) +$ Nonmetal oxide
- Nonmetallic sulfide + $O_2(g) \rightarrow SO_2(g) +$ Nonmetallic oxide
- If sulfur is present, $SO_2(g)$ is formed. For hydrocarbons containing nitrogen, $N_2(g)$ is formed but in other compounds, $NO(g)$ is formed.

5. DOUBLE DISPLACEMENT/METATHESIS

- Formation of precipitate – apply solubility rules
- Formation of a gas
 - $S^{2-}(aq) +$ acid $\rightarrow H_2S(g) +$ Salt
 - $CO_3^{2-}(aq) +$ acid $\rightarrow CO_2(g) + H_2O(l) +$ Salt
 - $SO_3^{2-}(aq) +$ acid $\rightarrow SO_2(g) + H_2O(l) +$ Salt
 - $NH_4^+(aq) +$ strong hydroxide $\rightarrow NH_3(g) + H_2O(l) +$ Salt

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INSTRUCTIONS:

- **BY GROUP:** Write your answers in an intermediate paper. Show your CLEAR and COMPLETE solution. Otherwise, NO CREDIT shall be given. (TOTAL: 40 points)
- **DEADLINE: 16 Aug (Monday)** in class. Groups that will submit a complete output in advance will be given a bonus (10 points/day).

I. Workshop on Synthesis and Decomposition Reactions

Write the formulas to show the reactants and products for the following laboratory situations described below. Assume that solutions are aqueous unless otherwise indicated.

1. A sample of calcium carbonate is heated.
2. Solid potassium oxide is added to a container of carbon dioxide gas.
3. Liquid hydrogen peroxide is warmed.
4. A pea-sized piece of sodium is added to a container of iodine vapor.
5. A sample of carbonic acid is heated.
6. A sample of solid potassium chlorate is heated.

II. Workshop on Combustion Reactions

Write the formulas to show the reactants and products for the following laboratory situations described below. Assume that solutions are aqueous unless otherwise indicated.

1. A piece of solid bismuth is heated strongly in oxygen.
2. Butanol ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$) is burned in air.
3. Solid copper(II) sulfide is heated strongly in oxygen.
4. Hexane is burned in excess oxygen.
5. Sodium metal is burned in excess oxygen gas.
6. Gaseous silane, SiH_4 , is burned in oxygen.
7. Solid zinc sulfide is heated in an excess of oxygen.

III. Workshop on Single Replacement/Displacement Reactions

Write the formulas to show the reactants and products for the following laboratory situations described below. Assume that solutions are aqueous unless otherwise indicated. Write NR if no reaction occurs.

1. Liquid bromine is added to sodium iodide crystals.
2. An aluminum strip is immersed in a solution of silver nitrate.
3. Zinc pellets are added to sulfuric acid (H_2SO_4).
4. Fluorine gas is bubbled into a solution of aluminum chloride.
5. Calcium metal is added to nitrous acid (HNO_2).

6. A pea-sized piece of lithium is added to water.
7. Magnesium turnings are added to a solution of lead(II) acetate.
8. Liquid bromine is reacted with a solution of calcium chloride.

IV. Workshop on Double Displacement Reactions

Write the formulas to show the reactants and products for the following laboratory situations described below. Assume that solutions are aqueous unless otherwise indicated. Write NR if no reaction occurs.

1. Silver nitrate combines with potassium chromate.
2. Ammonium chloride combines with cobalt(II) sulfate.
3. Lithium hydroxide reacts with sodium chromate.
4. Zinc acetate is mixed with cesium hydroxide.
5. Ammonium sulfide reacts with lead(II) nitrate.
6. Iron(III) sulfate combines with barium iodide.
7. Chromium(III) bromide reacts with sodium nitrate.
8. Rubidium phosphate mixes with titanium(IV) nitrate.
9. Ammonium carbonate combines with nickel(II) chloride.
10. Tin(IV) nitrate reacts with potassium sulfite.

V. Workshop on Gas Formation Reactions

Write the formulas to show the reactants and products for the following laboratory situations described below. Assume that solutions are aqueous unless otherwise indicated. Write NR if no reaction occurs.

1. Ammonium sulfate & potassium hydroxide are mixed.
2. Ammonium sulfide reacts with hydrochloric acid.
3. Cobalt(II) chloride combines with silver nitrate.
4. Solid calcium carbonate reacts with sulfuric acid.
5. Potassium sulfite reacts with hydrobromic acid.
6. Potassium sulfide reacts with nitric acid.
7. Ammonium iodide mixes with magnesium sulfate.
8. Solid titanium(IV) carbonate reacts with hydrochloric acid.
9. Solid calcium sulfite is mixed with acetic acid.
10. Strontium hydroxide combines with ammonium sulfide.