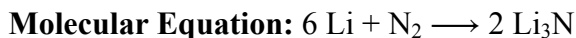


## Synthesis & Decomposition Reactions – Binary Compounds & Metallic/Nonmetallic Oxides (from The Ultimate Chemical Equations Handbook)

**Synthesis Reactions** occur when two or more reactants combine to form a single product. There are several common types of synthesis reactions we will cover.

***A metal combines with a nonmetal to form a binary salt. This is a redox reaction.***

e.g. A Piece of lithium metal is dropped into a container of nitrogen gas



**Net Ionic Equation** is the same since this is not aqueous.

***Metallic oxides and water form bases (metallic hydroxides). This is not redox.***

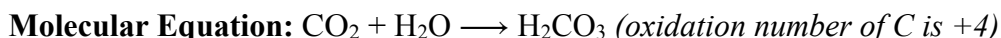
e.g. Solid sodium oxide is added to water



**Net Ionic Equation:**  $\text{Na}_2\text{O} + \text{H}_2\text{O} \longrightarrow 2 \text{Na}^+ + 2 \text{OH}^-$  (*soluble ionic compound*)

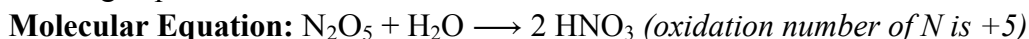
***Nonmetallic oxides and water form acids. The nonmetal retains its oxidation number.***

e.g. Carbon dioxide is bubbled into water



**Net Ionic Equation** is the same since  $\text{H}_2\text{CO}_3$  is a weak acid and does not dissociate.

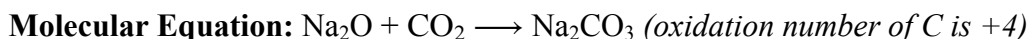
e.g. Dinitrogen pentoxide is bubbled into water



**Net Ionic Equation:**  $\text{N}_2\text{O}_5 + \text{H}_2\text{O} \longrightarrow 2 \text{H}^+ + 2 \text{NO}_3^-$  (*HNO<sub>3</sub> is a strong acid*)

***Metallic oxides and nonmetallic oxides form salts. The nonmetal retains its oxidation number.***

e.g. Solid sodium oxide is heated in carbon dioxide.



**Net Ionic Equation** is the same since this is not aqueous.

**Decomposition Reactions** occur when a single reactant is broken down into two or more products. We will cover binary compounds and those that produce oxides.

***Metallic carbonates decompose into metallic oxides and carbon dioxide. This is not redox.***

e.g. Magnesium carbonate is heated (*note: since air or O<sub>2</sub> are not mentioned, O<sub>2</sub> is not a reactant*)



**Net Ionic Equation** is the same since this is not aqueous.

***Oxyacids decompose into the nonmetallic oxide and water. The nonmetal retains its oxidation number.***

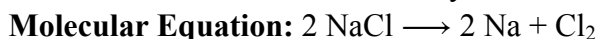
e.g. A sample of sulfurous acid is heated



**Net Ionic Equation** is the same since  $\text{H}_2\text{SO}_3$  is a weak acid and does not dissociate.

***A binary compound may break down to produce two elements. This is a redox reaction.***

e.g. Molten sodium chloride is electrolyzed.



**Net Ionic Equation** is the same since this is not aqueous.

**Exercises** Predict and balance the following reactions from the *above synthesis & decomposition reactions* and from the *metallic hydrides and alkali & alkaline earth metal reactions* from the notes on variation in chemical properties of the representative elements. Assume that solutions are aqueous unless otherwise indicated. Write the **molecular equation** and, if appropriate, the **net ionic equation**, with extensively ionized compounds written as dissociated ions and spectator ions removed.

1. A sample of calcium carbonate is heated.
2. Sulfur trioxide gas is bubbled through water.
3. Solid potassium oxide is heated in a container of carbon dioxide gas.
4. Liquid hydrogen peroxide is warmed.
5. Solid lithium oxide is placed in water.
6. Molten aluminum chloride is electrolyzed.
7. A small piece of solid sodium is heated with iodine vapor.
8. A sample of carbonic acid is heated.
9. Solid magnesium oxide is heated with sulfur trioxide gas.
10. Dichlorine heptoxide gas is bubbled through water.
11. A sample of solid strontium is added to water.
12. A small piece of potassium hydride is reacted with water.