

## 5.S: Chemical Reactions (Summary)

- The processes that occur during a chemical change can be represented using a **chemical equation**. In a chemical equation, the chemical formulas for the substance or substances that *undergo* the chemical reaction (the **reactants**) and the formulas for the new substance or substances that are formed (the **products**) are both shown, and are linked by an **arrow**. The arrow in a chemical equation has the properties of an “equals sign” in mathematics, and because of this, *in a chemical equation, there must be the same number and types of atoms on each side of the arrow*.
- A chemical equation in which the same number and types of atoms appear on each side of the arrow is called balanced. In order to balance an equation, insert **coefficients** in front of the appropriate reactants or products until there are the same number and types of atoms on both sides of the arrow.
- In a **synthesis reaction**, *elements or compounds undergo reaction and combine to form a single new substance*.
- In a **decomposition reaction**, *a single compound will break down to form two or more new substances. The substances formed can be elements, compounds, or a mixture of both*.
- In a **single-replacement (single-displacement) reaction**, *an element and a compound will react so that their elements are switched. As a general rule, metals will replace metals in compounds and non-metals will typically replace non-metals*.
- A **double-replacement (double-displacement) reaction**, *two ionic compounds in aqueous solution switch anions and form two new compounds. In order for a chemical reaction to occur, one of the new compounds that is formed must be insoluble in water, forming a solid precipitate or a gas*.
- The **oxidation number** of an element represents the total number of electrons which have been removed (a positive oxidation state) or added (a negative oxidation state) to get the element into its present state. The term *oxidation* describes the loss of electrons by an element and an increase in oxidation state; the term *reduction* describes the gain of electrons and a decrease in oxidation state.
- A chemical reaction in which oxidation numbers undergo a change is called a **redox reaction**. In a redox reaction, the element that “loses electrons” is said to be **oxidized** and will have an increase in its oxidation number. The element that “gains electrons” in a redox reaction is said to be **reduced** and will have a decrease in its oxidation number.
- In a simple **synthesis reaction** involving reaction of elements, the product will be a compound containing both elements. Write the product considering the common charges that the elements adopt as ions or the number of bonds that the elements typically form in molecules.
- In a simple **single-replacement** reaction, (in general) *metals* (including **carbon** and **hydrogen**) will tend to replace *metals* and that *non-metals* will replace *non-metals*.
- In a **double-replacement** reaction, the anions and cations simply of the two compounds simply exchange. In order for a reaction to occur, one of the products must **precipitate**, otherwise no chemical reaction has occurred. Changes in oxidation numbers do not occur in double-replacement reactions.
- Solubility trends can be predicted using a simple set of rules shown in Table 5.5; you should review there rules, remembering to apply them *in order*.
- The energy required to initiate a chemical reaction is called the **activation energy**. The greater the activation energy, the slower, or less favorable a reaction will be. The magnitude of the activation energy is directly linked to the *rate* of a chemical reaction.

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