

# Chemical Reaction Types Script

When studying chemistry it is often helpful to recognize different reaction types. This presentation outlines some useful reactions to know and understand.

The first reaction we are going to look at is a precipitation reaction. In a precipitation reaction two solutions are mixed and form a precipitate. A precipitate is an insoluble solid ionic compound. In this reaction we are seeing the formation of lead(II) iodide when aqueous solutions of potassium iodide and lead (II) nitrate are mixed.

Solids in a solution will have an attraction to the solvent molecules, this competes with the forces that hold solids together, and the strengths of these interactions will dictate solubility. In aqueous solutions soluble ionic compounds will become free ions surrounded by water molecules. The positive ion will be attracted to the delta negative oxygen in the water molecule and the negative ion will be attracted to the delta positive hydrogen in the water molecule.

This example shows the progression of a precipitation reaction. Soluble ionic solids, iron (III) chloride and sodium hydroxide, are dissolved in water to form aqueous solutions, the solutions are mixed and the precipitate iron (III) hydroxide is formed. The aqueous solution remaining is a mixture of sodium ions and chloride ions in water. The ions that do not participate in a reaction are called spectator ions.

The next reaction we are going to look at is a combustion reaction, a combustion reaction happens when a reactant combines with oxygen to form one or more compounds containing oxygen. In this reaction propane reacts with oxygen to form carbon dioxide and water.

Combustion reactions are behind many of the amenities that we enjoy, such as: fueling vehicles using gasoline, cooking food using propane and heating our homes with natural gas. Much of the world's power is supplied by burning fossil fuels.

An acid-base reaction is a neutralization reaction between an acid and a base that produces water and a salt. For our purpose we are going to discuss the Arrhenius definition of acids and bases. An Arrhenius acid is a substance that produces protons in an aqueous solution, a proton is the hydrogen ion with a positive charge. A proton associates with a water molecule to form the hydronium ion. An Arrhenius base is a substance that produces the hydroxide ion in an aqueous solution. Acids and bases are classified as strong and weak, strong acids and bases will completely dissociate into their respective ions in an aqueous solution, weak acids and bases do not completely dissociate.

The final reaction we will be looking at is an oxidation reduction reaction, commonly called a redox-reaction. Before we continue, we need to understand some terminology

about this reaction type. Oxidation is the loss of electrons, and reduction is the gain of electrons. In a redox reaction one substance loses electrons and is oxidized, and one substance gains electrons and is reduced. A helpful mnemonic for remembering these definitions is LEO the lion says GER.

To keep track of electrons in a redox reaction we need to assign oxidation states to the atoms in the reaction. Atoms in a molecule are assigned shared electrons based on the atom's electronegativity

The oxidation state is based on the number of electrons that have been assigned to an atom, the oxidation state is a numerical quantity and there are specific rules to follow in assigning oxidation states.

It is important to remember that oxidation states are simply a bookkeeping method for tracking electrons in chemical reactions. Oxidation states do not model the actual placement of an electron in a compound!

This example shows the oxidation states of magnesium and oxygen in a redox reaction. You can see how oxidation states allow us to track electrons. The magnesium has been oxidized because it has lost electrons, and the oxygen has been reduced because it has gained electrons.

When assigning oxidation states to atoms in a redox reaction the rules must be followed in order, this means rule 1 takes precedence over rule 2 and so on. Review the oxidation state rules and use them to work through the redox examples in this section.

Before finishing our discussion of chemical reaction types there is one last concept that we should cover related to chemical reactions, that is the concept of chemical equilibrium.

To understand the idea of chemical equilibrium you need to understand that certain reactions are reversible and can proceed in the forward and reverse directions, which is indicated by the use of two half arrows pointing in opposite directions in the reaction equation.

During a chemical reaction the number of forward reactions occurring could be fast and numerous.

Over time, as the reaction progresses the chances of the reverse reaction occurring increases with the increased amount of products being formed.

Eventually a point will be reached when the number of forward reactions per unit of time is equal to the number of reverse reactions per unit of time, when this occurs the system is in dynamic equilibrium

When a reaction is in dynamic equilibrium the concentrations of the products and reactants no longer change. This does not mean the concentrations of products and

reactants are equal to each other. It is important to recognize that at equilibrium the reaction has not stopped, the forward and reverse reactions are continually occurring.

This concludes the chemical reactions presentation. By now you should be able to recognize and define: precipitation, combustion, redox and acid base reactions. You should be able to identify the species being reduced or oxidized in a redox reaction as well as assign oxidation states, and you should have a basic understanding of chemical equilibrium.