Reading Science

Name: _____ Date: _____ Group: _____

Exothermic and Endothermic Reactions

1 We are constantly surrounded by chemical reactions, every day, every second. Chemical reactions are more than just things done in a science laboratory. Digesting food occurs because of a series of chemical reactions. Wood burning on a campfire is a chemical reaction. The process of photosynthesis in plants happens because of a series of chemical reactions. All of these reactions take starting chemicals and then produce new chemicals, some releasing energy, others storing energy.

2 In order to understand whether chemical reactions release or store energy, it is important to understand how chemical reactions work. As you may already know, all chemicals are made of atoms, often in the form of molecules. Some molecules have only two atoms, where others may have thousands, all held together by chemical bonds. Certain bonds are easy to break, while other bonds are hard. How do we know this? Chemists have done many tests over time to find how much energy it takes to break specific bonds. This energy is called bond energy and is different for every chemical bond. For example, let's look at three types of atoms: carbon, hydrogen, and oxygen. There is a specific amount of energy required to break the chemical bond between a carbon and a hydrogen atom. It takes a different amount of energy to break the bond between a carbon and an oxygen atom. Every chemical bond has its own unique bond energy.

3 As stated before, it takes energy to break bonds. On the other hand, energy is released as chemical bonds are formed. The starting chemicals in a chemical reaction are called the reactants, and the final products of a chemical reaction are called products. On the reactant side of the chemical equation, bonds are broken. On the product side of the reaction, bonds are formed. Energy is required to break the chemical bonds of the reactants, and energy is released as the new bonds are formed in the products. The number and types of bonds within a molecule determine how much energy is available within that molecule. So how does this relate to chemical reactions releasing or storing energy?

4 We can calculate the bond energies of both the reactants and the products of any chemical reaction. In all chemical reactions, energy is required to start the reaction, and energy is released during the reaction. How much energy is needed or how much energy is released depends on the molecules involved in the chemical reaction. Remember that each molecule has its own bond energy based on the types of atoms in that molecule. In the same way, each chemical reaction will have its own energy input and output based on the types of molecules involved. If you add the total bond energies found in the reactants and compare this to the total bond energies found in the products, you can determine whether the chemical reaction releases or stores energy.

5 A chemical reaction that releases energy is called an exothermic reaction. A chemical reaction that stores energy is called an endothermic reaction. If more energy is released as products form than the energy needed to break the reactants apart, the chemical reaction will release energy and therefore be an exothermic reaction. If less energy is released as the products form than the energy needed to break the reactants apart, the chemical reaction absorbs (stores) energy and therefore will be an endothermic reaction. This may sound very confusing, but let us look at these two types of reactions in more detail.

6 In an exothermic reaction, more energy is released during the chemical reaction than is needed to start the chemical reaction. In exothermic reactions, it takes less energy to break the reactant bonds than the energy released as the products form. Therefore, during exothermic reactions, energy is released as a product to the surroundings, often in the form of heat. On the other hand, in an endothermic reaction, the opposite is true. Less energy is released during the chemical reaction than is required to start the reaction. As a result, it takes more energy to break the reactant bonds than the energy released as the products form. As a result, energy is absorbed from the surroundings during endothermic reactions and is often stored for later use.

7 Let us look at some examples of endothermic and exothermic reactions. Plants absorb energy from the sun in the form of sunlight, which is then used in the chemical reactions that happen during photosynthesis. In other words, the energy from the sun can be considered a reactant that is used to create the products of photosynthesis. This makes photosynthesis an endothermic reaction. The products of photosynthesis include glucose (sugar), cellulose (starch), and the other molecules that make up plants. The energy absorbed from the sun is stored in these products of photosynthesis for later use. The energy stored in these products may then be released during exothermic reactions such as the burning of wood, the burning of fossil fuels, or the digestion of glucose in cells during cellular respiration. These types of reactions are also known as combustion reactions. In exothermic combustion reactions, you can look at the energy released as a product, often in the form of heat or light.

1 Which of the following statements regarding bond energies is FALSE?

A All chemical bonds are hard to break.

B Some chemical bonds are easier to break than others.

C Bond energy is the amount of energy it takes to break a chemical bond.

D Every chemical bond has its own unique bond energy.

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2 What specifically determines how much energy is available in a molecule?

A How many atoms are in the molecule.

B Whether the molecule is a reactant or a product.

C The number and types of bonds within the molecule.

D Whether the molecule is hard or soft.

3 How do scientists determine whether a chemical reaction releases or stores energy?

A Scientists can calculate the bond energies of the reactants and the products.

B Scientists compare the total bond energies of the reactants and the products.

C Scientists know that each chemical has its own unique bond energy.

D All of the above.

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4 What type of chemical reaction occurs when more energy is released during the chemical reaction than is needed to start the chemical reaction?

A A bond energy reaction.

B An exothermic reaction.

C An endothermic reaction.

D A simple chemical reaction.

5 What type of chemical reaction occurs when less energy is released during the chemical reaction than is needed to start the chemical reaction?

A A bond energy reaction.

B An exothermic reaction.

C An endothermic reaction.

D A simple chemical reaction.

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6 Some chemical reactions release energy. Others store energy. What important chemical reaction stores energy?

A The burning of fossil fuels

B Combustion reactions

C Photosynthesis

D Digestion