Chapter 1

Chemical Reactions

1.1 Chemical Reactions

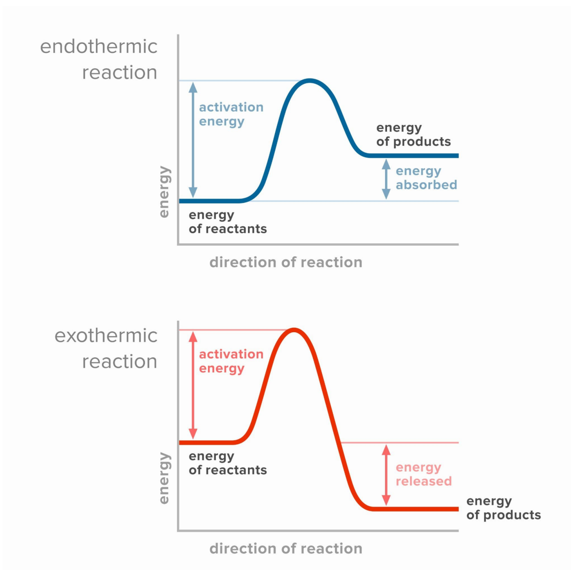

Figure 1.1

Hydrogen and oxygen have a special tendency to bond with themselves. Almost never will you find them unbonded. Oxygen is most often found as O_2 and hydrogen as H_2. If you mix these together in a 2:1 ratio of hydrogen to oxygen and light a match, they will rearrange themselves into water molecules. This is called a *chemical reaction*. In any chemical reaction, the atoms are rearranged into new molecules.

When a chemical reaction happens, some bonds are broken and new bonds are formed. The breaking and forming of bonds requires energy. The amount of energy required to break bonds is different for different bonds. The amount of energy released when new bonds are formed is also different for different bonds. Some chemical reactions (like the burning of hydrogen gas described above) are *exothermic* — that is, they give off more energy than they absorb. Burning hydrogen gas happens quickly and gives off a lot of energy. If you have enough, it will make quite an explosion! Other chemical reactions are *endothermic* — they consume energy.Photosynthesis, the process by which plants consume energy from the sun to make sugar from CO_2 and H_2O requires an endothermic chemical reaction. Energy stored in chemical bonds is called *chemical energy*. which is a form of *potential energy*.

Examine the diagrams in figure **??**. The x-axis represents time - time passes as we move from left to right across the diagram. At the far left, the energy of the reactants (the ingredients that go into the reaction) is shown. At the far right, the energy of the products (what is made in the chemical reaction) is shown. Look at the endothermic reaction diagram (the blue one). Based on the relative energies of the reactants and products, do you expect and endothermic reaction to release or absorb heat? Absorb! Since the products have more energy, they must have absorbed energy, in the form of heat, from the surroundings.

Now, the red diagram shows an exothermic reaction: the products have less energy than the reactants. Since energy is never created or destroyed, where did the energy go? It is released as heat. So, exothermic reactions release heat. What does this look and feel like in real life? If an exothermic reaction were happening in a glass beaker, you would feel warmth if you held the beaker. The heat is leaving the beaker and entering your hand, which feels warm. What about an endothermic reaction? Many students think that since an endothermic reaction absorbs heat, it must be getting hot. This is incorrect: *exothermic* reactions feel hot. If an endothermic reaction were happening in a beaker and you touched the beaker, it would feel **cold**. Why? Well, if the reaction is absorbing heat, then heat must be leaving it surroundings (your hand) and entering the reaction (this heat energy is turned into chemical energy that is stored in the new chemical bonds that are forming). So your hand feels cold.

Appendix A

Answers to Exercises

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