

Thermodynamics intro reading

Thermodynamics is the study of heat energy and other types of energy, such as work, and the various ways energy is transferred within chemical systems. "Thermo-" refers to heat, while "dynamics" refers to motion.

The First Law of Thermodynamics

The first law of thermodynamics deals with the total amount of energy in the universe. The law states that this total amount of energy is constant. In other words, there has always been, and always will be, exactly the same amount of energy in the universe.

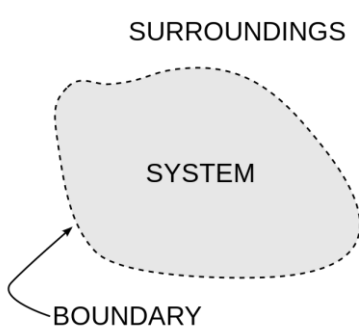
Energy exists in many different forms. According to the first law of thermodynamics, energy can be transferred from place to place or changed between different forms, but it cannot be created or destroyed. The transfers and transformations of energy take place around us all the time. For instance, light bulbs transform electrical energy into light energy, and gas stoves transform chemical energy from natural gas into heat energy. Plants perform one of the most biologically useful transformations of energy on Earth: they convert the energy of sunlight into the chemical energy stored within organic molecules.

The first law of thermodynamics

Shown are two examples of energy being transferred from one system to another and transformed from one form to another. Humans can convert the chemical energy in food, like this ice cream cone, into kinetic energy by riding a bicycle. Plants can convert electromagnetic radiation (light energy) from the sun into chemical energy.

The System and Surroundings

Thermodynamics often divides the universe into two categories: the system and its surroundings. In chemistry, the system almost always refers to a given chemical reaction and the container in which it takes place. The first law of thermodynamics tells us that energy can neither be created nor destroyed, so we know that the energy that is absorbed in an endothermic chemical reaction must have been lost from the surroundings. Conversely, in an exothermic reaction, the heat that is released in the reaction is given off and absorbed by the surroundings. Stated mathematically, we have: $\Delta E = \Delta E_{sys} + \Delta E_{surr} = 0$



The system and surroundings

A basic diagram showing the fundamental distinction between the system and its surroundings in thermodynamics.

Heat and Work

We know that chemical systems can either absorb heat from their surroundings, if the reaction is endothermic, or release heat to their surroundings, if the reaction is exothermic. However, chemical reactions are often used to do work instead of just exchanging heat. For instance, when rocket fuel burns and causes a space shuttle to lift off from the ground, the chemical reaction, by propelling the rocket, is doing work by applying a force over a distance.

If you've ever witnessed a video of a space shuttle lifting off, the chemical reaction that occurs also releases tremendous amounts of heat and light. Another useful form of the first law of thermodynamics relates heat and work for the change in energy of the internal system: $\Delta E_{sys} = Q + W$ While this formulation is more commonly used in physics, it is still important to know for chemistry.

Summarize in a small paragraph:

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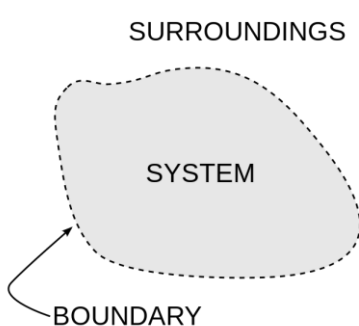
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