GENERAL CHEMISTRY 2

The Second Law of Thermodynamics

The second law of thermodynamics that the total entropy of the universe **always Increase for Spontaneous Process.** It is mathematically stated as,

$$\Delta S_{universe} = \Delta S_{system} + \Delta S_{surroundings} \geq 0$$

Entropy change of the **Universe** is determined from the **sum of entropy change of the system** and **surroundings**. (It must be a positive value which corresponds to an increase in entropy)

Third Law of Thermodynamics

What is the Third law of Thermodynamics?

The third law of thermodynamics states that the entropy of a perfect crystal at a temperature of zero Kelvin (absolute zero) is equal to zero at a temperature of zero Kelvin, the following phenomena can be observed in a closed system:

- The system does not contain any heat.
- All the atoms and molecules in the system are at their lowest energy points.

Entropy

This explains why **Exothermic and Endothermic Reactions may be Spontaneous**.

Endothermic: A+B+Heat→C $\Delta H = +\#$

Exothermic: A+B→C+Heat $\Delta H = -\#$

In **Exothermic Reaction**

The heat released by the reaction increases the disorder of the surroundings of the system is decreased. The **large amount of heat released to the surroundings causes large increase in entropy** resulting to a net increase in entropy of the universe.

In **Endothermic Reaction**

The **disorder within the system increases sufficiently** so that the change in disorder of the system is **greater than the decrease of the surroundings.** Then the total change in disorder can be positive and the reaction becomes spontaneous.

Entropy change of a Reaction

The **exact entropy change** for the process **can be determined** in the same way as the enthalpy change for the reaction **using standard absolute entropies** instead of enthalpies of formation.

For any chemical reaction:

$\Delta S°_{reaction} = \Delta S°_{products} - \Delta S°_{reactants}$