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The Second Stage
Thermodynamics and Heat
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Lecture . 6

Entropy and the second law of thermodynamics

spontaneous process: physical or chemical process that can occur on its own when certain conditions (without without the influence of any external factor)

Example about this process

1- Heat Transfer from hot body to cold body ,but the reverse process do not occur Spontaneous.
2- Bodies roll from high positions to low positions but they cannot climb up to the high places spontaneous.
3- The sugar dissolves in the coffee Spontaneously but the melted sugar does not dissolve Spontaneously in its primary form.
4- Passage of electric current from high voltage to low voltage .
5- Gases extend form high pressure to low pressure , Reverse process for this case dot occur spontaneous

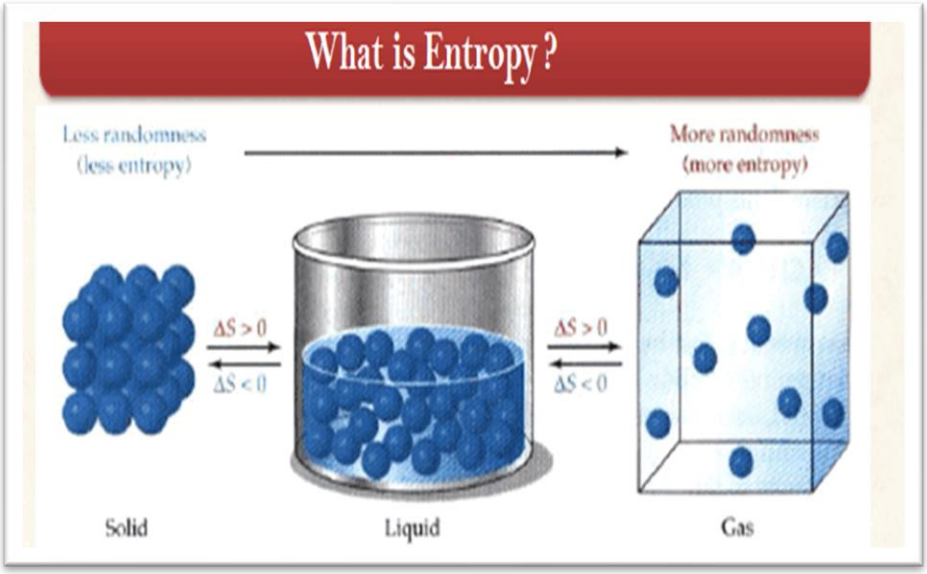
Entropy

Entropy symbolizes it (symbol S). Is a direct measure of the irregularity property (degree of chaos - random) among the particles (ions, atoms or molecules) that make up the system , or in Briefly the Entropy is (Irregularity scale) .

Entropy Describes how far the degree of disorder and irregularity of particles , And dispersion of energy associated with these particles . The smaller regularity of the system (the greater the random) then the entropy is large , and the more regular the system (the less random), Leads to the smaller value of the entropy.

Q: What is the benefit of the value of entropy?

Chemists benefit by knowing whether a chemical reaction can happen automatically or not at certain conditions of pressure and temperature.



S (s) <S (L) <S (g)

S (s) Entropy Solid Material, S (L) Entropy Liquid Material, S (g) Entropy gaseous substance

Q: Is Entropy Status function ?

Yes, the entropy is a function of the situation (ie depends on the initial state and final state and does not depend on the path the system takes) Therefore, the change in entropy is measured by changing the system from its initial state to the final state

$$\Delta S = S_f - S_i$$

Entropy units:

From the equation:

$$\Delta S = q / T$$

Then the entropy is measured in unity (J / K mole) .

Q: Are all automatic processes accompanied by an increase in entropy?

No, not all processes are accompanied by an increase in entropy.

For example: photosynthesis presses in which H_2O and CO_2 and other materials conversion (in presence of solar energy) into a very regular system.

• Oxygen, water and various foods are converted into a very regular and complex system.

The Second Law of Thermodynamics

This law may be formulated in other formulations or expressions, the most important of which are:

Blanc's formula: "A machine cannot be installed on steps to turn the heat into a work without losing part of that heat , or have side effects ".

Kelvin formula: It is impossible to use the circular process to transfer heat from a Thermal Storage and convert this heat into a work without transferring a certain amount of heat from a body with a high temperature to a body with a low temperature and the same time.

Classius formula: It is impossible to use circular processes to transfer heat from a body with a low temperature to another body whose temperature is high without converting a certain amount of work to heat.

Such formulations of the second law do not can be applied directly to the question Whether a particular chemical reaction or physical process is possible or not , so a new thermodynamic function is required for this purpose This function is entropy.

The second law of thermodynamics accordance to the entropy function

The second law states according to the Entropy that "**every spontaneous change must be accompanied by an increase in entropy and remain constant in Balance state ".**

In other words: "When there is an automatic change in a certain system there is an increase in the entropy of the universe.

That is mean the total change in the entropy is determines whether the process is happen automatic or not

a) When an exothermic reaction occurs in the system ($\Delta H < 0$) , the surroundings gain heat and their entropy increases (ΔS surr > 0) .

b) When an endothermic reaction occurs in the system ($\Delta H > 0$) , the surroundings lose heat and their entropy decreases (ΔS surr < 0)

Energy and entropy

Energy is not depleted and does not develop any remaining fixed energy conservation law during chemical or physical changes, while these changes are accompanied by an increase in the value of entropy.

Mathematical Formula The Second Law of Thermodynamic

The change in the entropy (ΔS_t) is the total change in the entropy of the system (ΔS_s) and the entropy of the system the entropy of the surround (ΔS_r)

$$\Delta S_t = \Delta S_s + \Delta S_r$$

According to the second law, the total change in the entropy ΔS_t is positive amount for any automatic process

$$\mathbf{\Delta S_t = \Delta S_s + \Delta S_r > 0}$$

At equilibrium:

$$\mathbf{\Delta S_t = \Delta S_s + \Delta S_r = 0}$$

Therefore **(ΔS_t = +)** , then interaction is automatic.