NEET Chemistry

Short Notes

Basic terms and Laws of Thermodynamics

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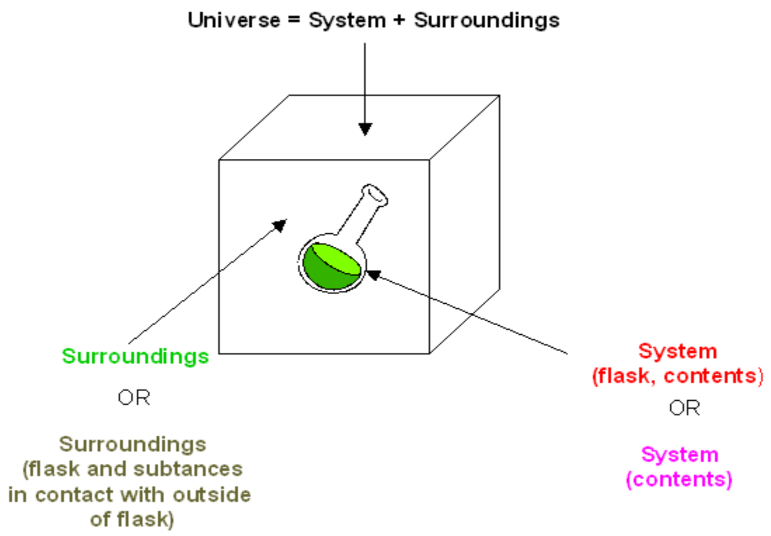
In this article we are providing the revision notes from the Unit Chemical Thermodynamics. Thermodynamics is very important from both Chemistry and Physics sections of NEET and other entrances as well. The weight of this topic is approximately 6% in the NEET exam.

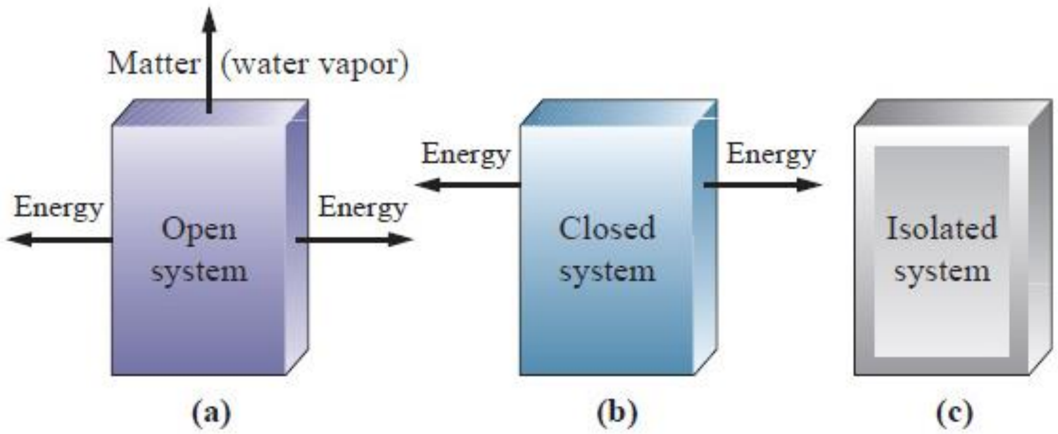
The Basic Concepts:

1) Thermodynamics : It is the branch of physics which deals with process involving heat, work and internal energy. Thermodynamics is concerned with macroscopic behavior rather than microscopic behavior of the system.

2) System: A system in thermodynamics refers to that part of universe in which observations are made and remaining universe constitutes the **surroundings.**



3) Types of the System:



(a) Open System
In an open system, there is **exchange of energy and matter** between system and surroundings. The presence of reactants in an open beaker is an example of an open system. Here the boundary is an imaginary surface enclosing the beaker and reactants.

(b) Closed System

In a closed system, **there is no exchange of matter, but exchange of energy is possible** between system and the surroundings. The presence of reactants in a closed vessel made of conducting material e.g., copper or steel is an example of a closed system.

Note that the system may be defined by physical boundaries, like beaker or test tube, or the system may simply be defined by a set of Cartesian coordinates specifying a particular volume in space.

(c) Isolated System

In an isolated system, there is no exchange of energy or matter between the system and the surroundings. The presence of reactants in a thermos flask or any other closed insulated vessel is an example of an isolated system.

4) State Functions

The **state** of a thermodynamic system is described by its measurable or macroscopic (bulk) properties like pressure (p), volume (V), temperature (T), amount (n) etc. Variables like p, V, T are called **state variables** or **state functions** because their values depend only on the state of the system and not on how it is reached. In order to completely define the state of a system it is not necessary to define all the properties of the system; as only a certain number of properties can be varied independently.

5) Extensive and Intensive properties

An extensive property is a property whose value depends on the quantity or size of matter present in the system. For example, mass, volume, internal energy, enthalpy, heat capacity, entropy,energy etc. are **extensive properties.**

Those properties which **do not depend on the quantity or size of matter** present are known as **intensive properties**. For example **temperature, density, pressure, viscosity, velocity, specific gravity, specific heat capacity, concentration** etc. are intensive properties. A molar property, m, is the value of an extensive property of the system for 1 mol of the substance. If n is the amount of matter, n is independent of the amount of matter. Other examples are molar volume, V_m and molar heat capacity, C_m.

Important Note: *Let us understand the distinction between extensive and intensive properties by considering a gas enclosed in a container of volume V and at temperature T. Let us make a partition such that volume is halved, each part now has one half of the original volume, but the temperature will still remain the same i.e., T. It is clear that volume is an extensive property and temperature is an intensive property.*

6) Zeroth Law and Temperature:

The zeroth law states that if two systems are in thermal equilibrium with a third system then they are also in thermal equilibrium with each other.

It says that there is a state that two objects can share in which heat will not flow between them when they are touching. This is state of thermal equilibrium. If the state is not maintained then theat flow occurs from hot to cold body. This concept gives rise to the idea of **temperature**. A state function helps to determine direction of flow of heat is called temperature.

Microscopically, temperature is the measure of the average energy of motion, called kinetic energy, of particles of matter, whether in solids, liquids, gases, or plasmas.

Temperature scales: Kelvin: Gives absolute temperature. **Always used in calculations**. 0K = - 273.15^0 C.

7) Process: The path along which state of a system changes is called as process. The types of Processes:-

(i) Isothermal process - The process which takes place at a constant temperature is called Isothermal process.

(ii) Isobaric process - The process which takes place at a constant pressure is called Isobaric process.

(iii) Isochoric process - The process which takes place at a constant volume is called Isochoric process.

(iv) Adiabatic process - The process in which no transfer of heat can take place between system and surrounding.

(v) Cyclic process - The process in which system comes back to its initial state after undergoing series of changes.

(vi) Reversible process - The process during which the system always departs infinitesimally from the state of equilibrium *i.e.* its direction can be reversed at any moment.

(vii) Irriversible Process - The process that cannot be reversed. All the natural processes are of this type. These processes are very fast and gets completed in a single step.

8) The first law of thermodynamics: This is a the conservation of energy.

The statement of First law of thermodynamics is: "If the quantity of heat supplied to a system is capable of doing work, then the quantity of heat absorbed by the system is equal to the sum of the increase in the internal energy of the system, and the external work done by it.
dQ = dU+dW

9) The second law of thermodynamics: The second law of thermodynamics says that the entropy of the system always increases. It also states that the changes in the entropy in the universe can never be negative. Example: ΔS is positive for melting of ice.

Entropy is the degree of randomness thus it increases with increase in randomness of particles of the system. Mathematically defined as, ΔS = dQ/dT.
At equilibrium, ΔS = 0

10) The third law of thermodynamics: The entropy of a perfect crystal at absolute zero is exactly equal to zero.

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