Internal energy of a System:-

According to kinetic theory of matter, matter is made up of large number of tiny particles called molecules which are in the state of rapid motion and hence possess kinetic energy. The total kinetic energy of the molecules is called the internal kinetic energy, while the potential energy arising due to intermolecular attraction is called the internal potential energy.

The energy of the System may be increased by causing its molecules to move faster or by causing the molecules to move against intermolecular forces into a configuration of greater potential energy or both. The Total Sum of this kinetic & potential energy is called internal energy of the System or a body.

Thus, Internal energy may be defined as the energy possessed by a body or a System by virtue of its molecular motion and the Constitution of these molecules.

It is found that the internal energy of a System is a function of state i.e internal energy function is independent of path. If a System returns to its initial state after passing through various states, the change in its internal energy will be zero.

For an isolated System, work done by the system decreases its internal energy and work done

on the system increases its internal energy.

Heat and Work:-

Since heat is a form of energy & energy is the capacity to do work. So work is related to heat.

Relation between heat & work or for the conversion of heat energy into mechanical energy & vice versa, many experiments was formeds by Joules & others.

In all experiments, it was found that when a given amount of mechanical energy(W) was converted into heat, always the same amount of heat (Q) was developed. i.e

$$W \propto Q$$

$$\boxed{W = JQ}$$

where J is the constant of proportionality and is known as "Joule's mechanical equivalent of heat".

If $Q = 1$

$$\therefore \boxed{W = J}$$

Thus Joule's mechanical equivalent of heat may be defined as the amount of work that must be done to produce unit quantity of heat.

If W & Q both are measured in Joule then

$$\boxed{W = Q} \Rightarrow J = 1$$

If W is measured in Joule and heat (Q) in calories, then $J = 4.2$ Joule cal^{-1}

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