* Irreversible Process:—

The thermodynamical state of a system can be defined with the help of the thermodynamical co-ordinates of the system. The state of the system can be changed by altering the thermodynamical co-ordinates. Changing from one state to the other by changing the thermodynamical co-ordinates is called a process.

Let us consider two states of a system i.e. state A and state B. Change of state from A to B or vice-versa is a process and the direction of the process will depend upon a new thermodynamical co-ordinates called entropy. All process are not possible in the universe.

Suppose the following process:—

(i) Let two blocks A and B at different temp. T_1 and T_2 ($T_1 > T_2$) be kept in contact but the system as a whole is insulated from the surroundings. Conduction of heat takes place between the blocks, the temp. of A falls and the temp. of B rises and thermodynamical equilibrium will be reached.

(ii) Let us consider a flywheel rotating with angular velocity ω. Its initial K.E. is $\frac{1}{2} I\omega^2$. After some time the

wheel comes to rest and K.E. is utilised in overcoming friction at the bearings. The tempr. of the wheel and bearing rises and increase in their internal energy is equal to the original kinetic energy of the flywheel.

(iii) Let us consider two flasks A and B connected by a glass tube provided with a stop cock. Let A contain air at high pressure and B is evacuated. The system is isolated from the surroundings. If the stop ~~cock~~ cock is opened, air rushes from A to B, the pressure in A decreases and the volume of air increases.

All the above ~~three~~ three examples through different are thermodynamical processes involving change in thermodynamical coordinates. Also in accordance with the first law of thermodynamics, the principle of conservation of energy is not violated because the total energy of the system is conserved. It is also clear that with the initial conditions described above three processes will take place.

Let us consider the possibility of the above three processes taking place in the reverse direction. In the first case

if the reverse process is possible, the block B should transfer heat to A and initial condition should be restored. In the second case, if the reverse process is possible, the heat energy must again change to KE and the flywheel should start rotating with the initial angular velocity ω. In the third case, if the reverse process is possible the air in B must flow back to A and the initial condition should be obtained.

But it is a matter of common experience, that none of the above conditions for the reverse processes are reached. It means that the direction of the process can not be determined by knowing the thermodynamical coordinates in the two end states. To determined the direction of the process a new thermodynamical co-ordinates has been devised by Clausius and this is called the entropy of the system. Similar to the internal energy, entropy is also a function of the state of a system. For any possible process, the entropy of an isolated system should increase or remain constant. The process in which there is a possibility of a decrease in entropy can't take place.

If the entropy of an isolated system is max^m any change of state will mean decrease

in entropy and hence that change of state will not take place.

To conclude, process in which the entropy of an isolated system decreases don't take place or for all processes taking place in an isolated system the entropy of the system should increase or remain constant. It means a process is irreversible if the entropy decreases when the direction of the process is reversed. A process is said to be irreversible if it can't be retraced back exactly in the opposite direction. During an irreversible process, heat energy is always used to overcome friction. Energy is also dissipated in the form of conduction and radiation. This loss of energy always takes place whether the engine works in one direction or the reverse direction. Such energy can't be regained. In actual practice all the engines are irreversible. If electric current is reversed, heat is again produced. This is also an example of an irreversible process. All chemical reactions are irreversible. In general, all natural processes are irreversible.