

7.2 C.G.S Unit : $\text{Cal gm}^{-1}(\text{°C})^{-1}$ SI Unit : $\text{J kg}^{-1} \text{K}^{-1}$

Dimensional Formula : $[\text{M}^0 \text{L}^2 \text{T}^{-2} \text{K}^{-1}]$

7.3 Molar specific heat : The amount of heat required to raise the temperature of 1gm mole of a gas through 1°C or 1K.

Molar specific heat $C = \frac{1}{n} \frac{dQ}{dT}$. Here n is the number of moles of the gas

7.4 Specific heats of a Gas : A gas can be heated either at constant pressure or at constant volume. Hence two types of specific heats are possible.

(i) specific heat of a gas at constant pressure (C_p)

(ii) specific heat of a gas at constant volume (C_v)

7.5.1 Specific heat at constant pressure (C_p) : At constant pressure, the quantity of heat necessary to increase the temperature of one mole of a gas through one degree, is called specific heat of the gas at constant pressure.

$C_p = \frac{1}{m} \frac{dQ}{dT}$ S.I unit is J/mole K

7.5.2 Specific heat at constant volume (C_v) : At constant volume, the quantity of heat necessary to increase the temperature of one mole of a gas through one degree, is called specific heat of gas at constant volume.

$C_v = \frac{1}{m} \frac{dQ}{dT}$ S.I unit is J/mole K.

7.5.3 Relation between C_p and C_v : $C_p - C_v = R$, R is the universal gas constant.

8. Thermodynamic process:

8.1. Quasi - Static process: A Quasi-Static process can be defined as 'an infinitesimally slow process' in which the system remains in thermal and mechanical equilibrium with the surroundings at each and every intermediate state.

8.2 Isothermal Process : The process in which pressure and volume changes occur at constant temperature is called isothermal process.

8.3 Adiabatic Process : A process in which changes in pressure and volume of a gas takes place at constant amount of heat energy is called Adiabatic process.

8.4. Isochoric Process: In an isochoric process, volume V is constant. No work is done on or by the gas. The heat absorbed by the gas goes entirely to change its internal energy and its temperature.

8.5. Isobaric Process: In an isobaric process pressure P is constant. Here, temperature and internal energy change. The heat absorbed goes partly to increase internal energy and partly to do work.

8.6. Cyclic Process: 'A process in which the system after passing through various stages (of pressure, volume and temperature changes) returns to its initial state' is defined as a cyclic process.

In a cyclic process, the total heat absorbed by the system equals the work done by the system'.

9.1 Heat Engines : 'A device used to convert heat energy into mechanical energy is called a heat engine. Usually in a heat engine, a system is made to undergo a cyclic process that results in the conversion of heat into work.

9.2 Refrigerators : The refrigerator is just the reverse of a heat engine.

10. Second law of Thermo dynamics :

(a) Kelvin - Plank Statement: It is impossible to construct a heat engine that absorbs heat from a hot reservoir which converts completely that heat into work .

(or) It is impossible to construct an ideal heat engine with 100% thermal efficiency.

(b) Clausius Statement: It is impossible to transfer heat from a colder object to a hotter object

(or) It is impossible to construct an ideal refrigerator.

11. Reversible and Irreversible Processes :

11.1 Reversible process : A process that can be retraced back in the opposite direction is called a reversible process.

The conditions required for a process to be reversible are

(i) The changes must take place at an infinitesimally slow rate.

(ii) The system must always be in thermal and mechanical (thermodynamics) equilibrium with the surroundings.

Conditions (i) and (ii) insist that the process should be a quasi-static process.

(iii) There should be no loss of energy due to conduction, convection or dissipation of energy against any resistance like friction, viscosity etc.,

(iv) No amount of heat is to be converted into electric or magnetic forms of energy

Examples of reversible processes :

(i) Fusion of ice (ii) vaporisation of water

11.2 Irreversible Process : 'A process that cannot be retraced back in the opposite direction' is called an irreversible process.

All the spontaneous natural processes are irreversible.

Examples of irreversible processes are :

(i) Work done against friction (ii) Diffusion of gases (iii) Magnetization of a material.

Imp. Formulae

1. First Law of Thermodynamics: $dQ = dU + dW$

2. Heat capacity = $\frac{dQ}{dT}$

3. Specific heat capacity $S = \frac{1}{m} \frac{dQ}{dT}$

4. $C_p - C_v = R$

5. In an adiabatic process of an ideal gas $PV^\gamma = \text{constant}$, $\gamma = \frac{C_p}{C_v}$

6. Efficiency of heat engine $\eta = \frac{W}{Q_1} = 1 - \frac{Q_2}{Q_1}$

7. Efficiency of Carnot's heat engine $\eta = 1 - \frac{T_2}{T_1}$