

(c) Basic of Transport Phenomenon

When a gas is endowed with mass motion, random molecular motion can lead to transport of energy, momentum or mass, depending on the physical conditions, which lead to the phenomena of thermal conduction, viscosity and diffusion, respectively.

Coefficient of Viscosity (η): The coefficient of viscosity for a gas having velocity

gradient in a direction normal to the direction of mass motion is given by $\eta = \frac{1}{3} mn\bar{v}\lambda$,

where m is the molecular mass and \bar{v} is the average speed of a molecule. At a given temperature, η is independent of pressure.

Thermal Conductivity (K): The thermal conductivity, K is given by $K = \frac{f}{3} n\bar{v}\lambda k_B$,

where f denotes the number of degrees of freedom.

K and η are connected by the relation $\frac{KM}{\eta C_v} = 1$, where M is molecular weight of gas.

Coefficient of Diffusion (D): The coefficient of diffusion D is given by

$$D = \frac{\bar{v}}{3} \lambda = \frac{0.376 (k_B T)^{3/2}}{\sigma p \sqrt{m}}$$