Deduction of Gas laws from kinetic theory

(a) Boyle's law —

$V \propto \frac{1}{P}$ when T is constant

$PV = \text{constant}$

We have already derived with the help of kinetic theory —

$PV = \frac{2}{3}KT$ if T is constant, PV will be constant.

(b) Charle's law —

$V \propto T$, if P is constant

$\because PV = \frac{2}{3}KT$

or $V = \left[\frac{2}{3} \times \frac{K}{P}\right] T$

Since K & P are constants

$\therefore V \propto T$

(c) Graham's law of diffusion: —

from kinetic equation —

$PV = \frac{1}{3}mnc^2$

$\therefore M = mn$ = total mass of mass

Hence —

$$PV = \frac{1}{3}MC^2$$

or $C^2 = \frac{3PV}{M}$ $\left[\because \frac{M}{V} = D \text{ (density)}\right]$

$C^2 = \frac{3P}{M/V} = \frac{3P}{D}$ $\therefore C^2 \propto \frac{1}{D}$, when P is Constant

$\therefore C = \sqrt{\frac{1}{D}}$ This equation represents Graham's law of diffusion of gas.