{ B.Sc Part II, Physics (Hons) }
{ Dr Satyadeo Narayan Singh }
S. B. College, Ara

Q. Discuss Weiss's theory of Paramagnetism ?

Ans :→

Langevin considered an ideal-gas in which the mutual effect of the elementary magnets is negligible, so that the only oppositing factor to the turning action of the external field is thermal agitation. Weiss assumed that since in real gas the molecules are mutually influenced by their magnetic moments, there should exist within the gas a molecular field produced at any point by all the molecules in the neighbourhood proportional to the acting in the same sense as the intensity of magnetisation. Let this molecular field be H_m, then $H_m = AI$ where A is molecular field co-efficient and I be intensity of magnetisation. The effective field is given as

$$H_e = H + H_m = H + AI$$

and so

$$\sigma = \frac{\sigma_0^2 (H + AI)}{3RT}$$

where σ the gm molecular magnetic moment and σ_0 the gm molecular saturation moment.

$$\text{or } \sigma = \frac{\sigma_0^2 H}{3RT} + \frac{\sigma_0^2 AI}{3RT}$$

But we know that

$$I = \frac{\sigma}{V} = \frac{\sigma}{M/\rho} = \frac{\sigma\rho}{M}$$

where M is the mass and ρ is the density of gm molecules

$$\sigma = \frac{\sigma_0^2 H}{3RT} + \frac{\sigma_0^2}{3RT} A \cdot \frac{\sigma\rho}{M}$$

$$\text{or, } \frac{\sigma}{\sigma_0} = \frac{\sigma_0 H}{3RT} + \frac{\sigma_0^2}{\sigma_0} \cdot \frac{A\rho\sigma}{3RMT}$$

$$\text{or, } \frac{\sigma}{\sigma_0}\left[1 - \frac{A\rho\sigma_0^2}{3RMT}\right] = \frac{\sigma_0 H}{3RT}$$

$$\text{or, } \frac{\sigma}{\sigma_0} = \frac{\sigma_0 H/3RT}{\left[1 - \frac{A\rho\sigma_0^2}{3RMT}\right]} = \frac{\sigma_0 H/3R}{\left[T - \frac{A\sigma_0^2\rho}{3RM}\right]}$$

$$\therefore \chi_m = \frac{\sigma}{H} = \frac{\sigma_0^2/3R}{\left[T - \frac{A\rho\sigma_0^2}{3RM}\right]}$$

Now $\chi_m = \frac{C_m}{T-\theta}$ $\left[\because C_m = \frac{\sigma_0^2}{3R} \text{ and } \theta = \frac{A\rho\sigma_0^2}{3RM}\right]$

This is the curie-weiss's law, θ is the weiss constant also known as curie temperature at which ferromagnetics becomes paramagnetics.