Curie's Law :- The dependence of magnetic susceptibility of a substance on its moment is known by curie's equation.

In order to determine the magnetic susceptibility of a substance, it has to be subjected to an applied magnetic field. The applied field tends to bring about an arrangement of the para-magnetic dipoles with the direction of the field, while the temparature tends to disrupt this alignment. Thus the alignment of magnetic dipoles will increase at low temparature and high field. An inverse relation between susceptibility and temparature thus exists. This is shown by "Pierre Curie" in his classic studies. He showed that paramagnetic susceptibility depends inversely on tempa-rature and followed the following type equation —

$$\chi_M^{corr} \propto \frac{1}{T}$$

$$\text{or } \chi_M^{corr} = \frac{C}{T} \quad \text{— (1)}$$

where χ_M^{corr} = Molar susceptibility after correction considering diamagnetic contribution

T = Absolute temparature

C = curie's constant

Applying statistical treatment, one can easily obtain the following type equation —

$$\chi_M^{corr} = \frac{N\mu^2/3K}{T} \quad \text{— (2)}$$

where N = Avogadro number
K = Boltzmann's constant

So from eanation (1) and (2), it is clear that –

$$C = \frac{N\mu^2}{3K}$$

and $\mu = \sqrt{\frac{3K}{N}} \times \sqrt{X_M^{corr} \cdot T}$

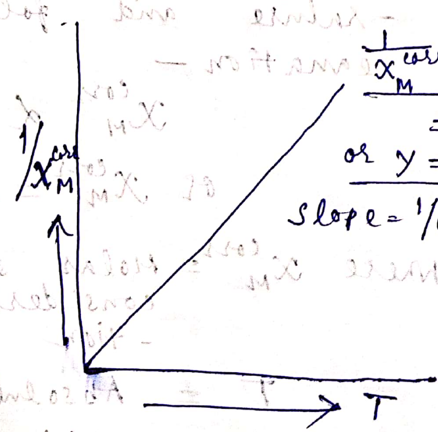
$$= \sqrt{3(K/N)} \times \sqrt{X_M^{corr} \cdot T}$$

$$= \sqrt{3R} \times \sqrt{X_M^{corr} \cdot T}$$

$$\therefore = 2.84\sqrt{X_M^{corr} \cdot T} \quad B.M$$

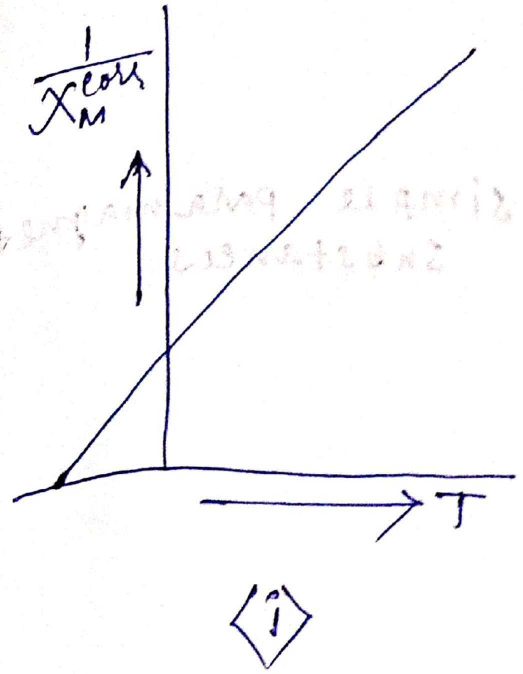
From experimental measurements, X_M^{corr} can be obtained at different temparatures and a plot of reciprocal of (X_M vs. T) gives a straight line passing through the origin where the slope is $1/C$ or is $3K/N\mu^2$.

Although there are many substances which show this behaviour within the limits of experimental errors but there are many other for which the line does not go through the origin. For them the following two types of curves may be obtained where the intersection may occur either above 0K or even below 0K.

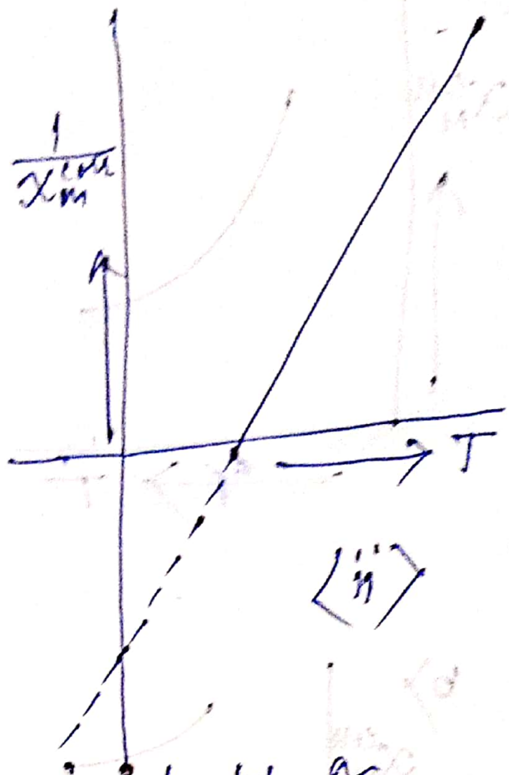


$$\frac{1}{X_M^{corr}} = \frac{T}{C}$$
$$= \frac{1}{C} \times T$$
or $y = mx$

slope = $1/C$



(i)



(ii)

Such lines can be represented by a modified form of curie's equation known as curie- weiss equation.

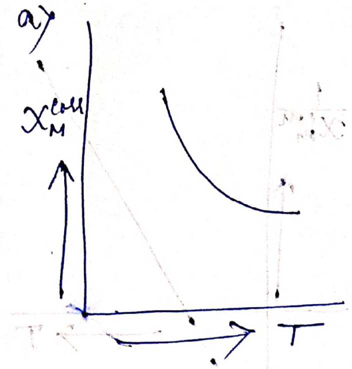
$$\chi_M^{corr} = \frac{C}{T-\theta}$$

where θ = constant which represents the temparature or indicates the temparature at which the line cuts the T- axis and is known as weiss constant.

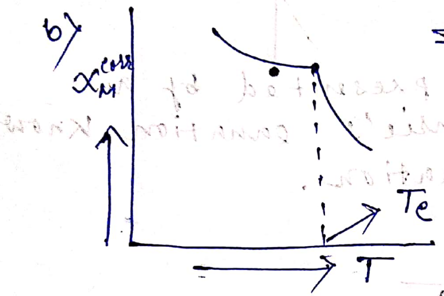
A similar Equation showing the relation with μ can be obtained as —

$$\mu = 2.84\sqrt{\chi_M^{corr}(T-\theta)} \text{ BM}$$

If a plot of χ_M^{corr} vs T is done, the following types of curve will be obtained.

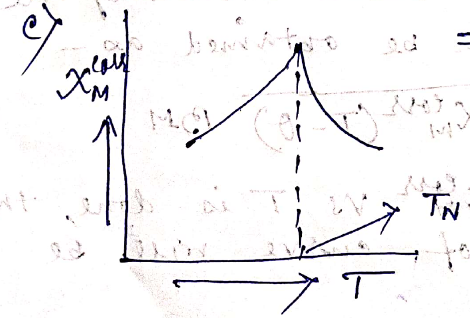
a) 

$\Longrightarrow$ simple paramagnetic substances

b) 

$\Longrightarrow$ Ferromagnetic substances
T_c = curie temp.

For Ferromagnetic substances the plot of χ_M Vs T shows a discontinuity at a temp-erature known as curie temparature, above which these substances behave as simple para-magnetic but below which it varies in a different manner with both temparature and field strength.

c) 

$\Longrightarrow$ Anti ferromagnetic substances
T_N = Neel temparature

For Anti ferromagnetic substances, there is also a particular temparature called the neel tempa-rature, above which these substances behave as simple paramagnetic but below that χ_M^{corr} increases with temparature.