(ii) Magnetic feild intensity (Magnetic intensity)

→ It is the number of ampere - turns (NI) flowing round the unit length of the Solinoid required to produce a given magnetising feild

→ $H = NI$

$B_0 = \mu_0 H$

Si unit of H is Am^{-1}

$$\boxed{H = \frac{B_0}{\mu_0}}$$

Dimensions are $[L^{-1}A]$

(iii) Magnetisation (Intensity of Magnetisation)

→ It is the magnetic moment developed per unit volume of the material when placed in a magnetic feild

→ It is a vector quantity

$$\boxed{\vec{M} = \frac{m}{V}}$$

SI unit of $\vec{M}$ is Am^{-1}

(iv) Magnetic Induction

→ It is the total magnetic feild lines of force crossing per unit area through a magnetic matireal.

$$B_{net} = \underbrace{B_0}_{\text{Magnetising feild}} + \underbrace{B_m}_{\text{Magnetic feild due to Magnetisation of Magnetic Matirial}}$$

due to Magnetsing feild

$$B = \mu_0 (H + M)$$

SI unit of Magnetic induction B_0 is T (Tesla)

(V) Magnetic Permeablity

→ It is the ratio of the magnetic induction to the magnetising field intensity

$$\boxed{\mu = \frac{B}{M}}$$

SI unit of μ is TmA^{-1}

(vi) Relative permeablity (μ_r)

→ The Ratio of the permeablity of the matireal to the permiablity of free space

$$\boxed{\mu_r = \frac{\mu}{\mu_0}}$$

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(vii) Magnetic susceptibility (χ_m)

→ It is the ratio of the intensity of magnetisation (M) induced to the magnetising field intensity (H)

$$\boxed{\chi_m = \frac{M}{H}}$$

$$\mu_r = 1 + \chi_m$$

$$\frac{\mu}{\mu_0} = 1 + \chi_m$$

$$\therefore \boxed{\mu = \mu_0 (1 + \chi_m)}$$

(viii) Classification of Magnetic Matireal

(i) Diamagnetic

→ These are the substances which when placed in a magnetising feild get feebly magnetised in the opposite direction of force applied

→ Such substances are feebly Repelled by magnets and tend to move slowly from weaker to stronger parts of a magnetic feild.

→ These Magnetic feild lines are expelled by these substances.

eg:- Bi, Cu, Pb, Si, N_2, H_2O, NaCl

→ Magnetic feild inside the diamagnetic substances (B) is less than in free space (B_0)

$$B < B_0$$

$$\mu \cancel{H} < \mu_0 \cancel{H}$$

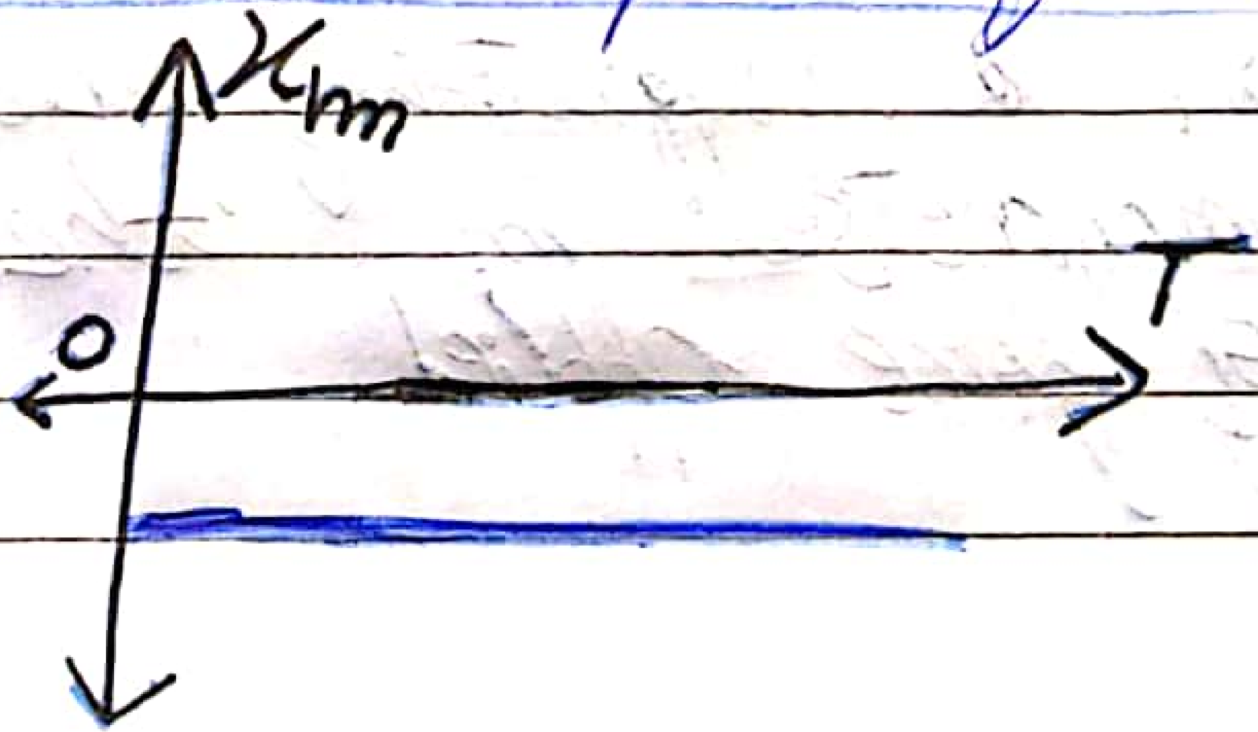
$$\frac{\mu}{\mu_0} < 1$$

$$\boxed{\mu_r < 1}$$

$$\boxed{\mu_r = 1 + \chi_m}$$

→ Magnetic suscptiblity is negative for diamagnetic Matireal

→ χ_m (Magnetic Susseptiblity) of diamagnetic matireal is indefendent of temprature



→ Diamagnetism is a universal property i.e it is present in all substances. However, the effect is so weak in most cases that is shifted by other effects like paramagnetism, ferromagnetism etc.

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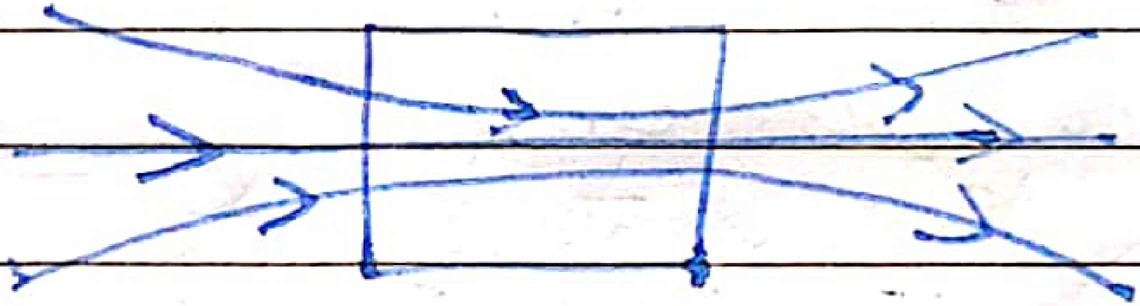
(ii) Paramagnetic Substances

→ These are the substances which when placed in a magnetising feild get feebly magnetised in the direction of the magnetising feild

→ Such substances are feebly attracted by magnets and tend to move slowly from weaker to stronger parts of a magnetic feild

eg:- Al, Na, Ca, O_2 and $CuCl_2$

→ Magnetic feild lines tend to pass through these Substances therefore magnetic field inside substances is more than outside



$B > B_0$

$\mu \cancel{H} > \mu_0 \cancel{H}$

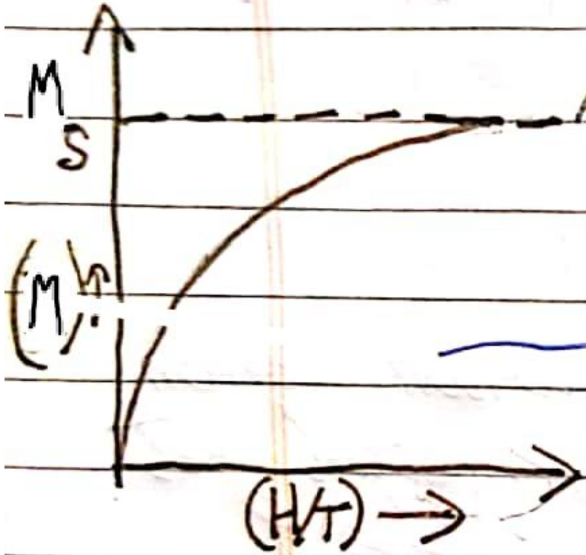
$\frac{\mu}{\mu_0} > 1$ $\boxed{\Rightarrow}$ $\boxed{\mu_r > 1}$

→ $\mu_r = 1 + \chi_m$

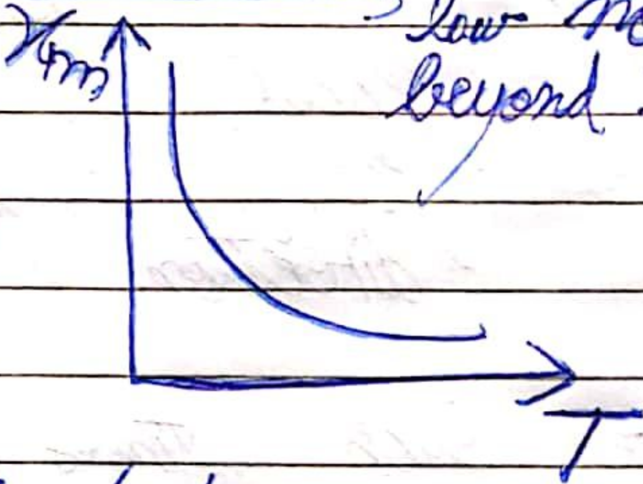
χ_m is +ve

→ **Curie's law**

This law states that the magnetic susceptibility of a paramagnetic material is inversely proportional to temperature → law not Valid beyond T_s



$\chi_m \propto \frac{\mu_0}{T}$



$$\boxed{\chi_m = C \times \frac{\mu_0}{T}}$$

$\chi_m \times H = (C \times \mu_0) \times \frac{H}{T}$

$$\boxed{M = (C \times \mu_0) \times \frac{H}{T}}$$

$$\boxed{M = C \times \frac{B_0}{T}}$$

C = Curie's Constant

(iii) Ferromagnetic Substances (Remain magnetised even after the Magnetising feild is removed)

→ These are the substances which when placed in a magnetising feild get strongly magnetised in the direction of the magnetising feild

→ Such substances tend to move quickly from weaker to stronger parts of the feild

eg:- Fe, Ni, CO, Gd etc

→ Magnetic feild lines tend to crowd into ferromagnetic Material

→ Magnetic permiability (μ) $\left(\mu = \frac{B}{I}\right)$ is very large of the order of hundreds and thousands

→ Magnetic susceptiblity (χ_m) of ferromagnetic substance is very high therefore they can be magnetised easily & strongly

→ **Curie - Weiss law**

Curie Temprature // The temprature above which a ferromagnetic substance becomes paramagnetic is called curie temprature (T_c)

Weiss' modified the Magnetic susceptiblity (χ_m) ⇒ $\boxed{\chi_m = \frac{C}{T - T_c}}$

① $\chi_m < 0$ Diamagnetic mataerals

$|\chi_m| <<< 1$ $\mu \lesssim \mu_0$

② $\chi_m > 0$, $\chi_m <<< 1$ $\Rightarrow$ Paramagnetic mataerals

$\mu_0 \gtrsim \mu_0$

③ $\chi_m >>> 1$ Ferromagnetic materials

$\mu >>> \mu_0$