MAGNETISM& MATTER LECTURE-26

MAGNETIC SUSCEPTIBILITY: It is defined as the ratio of Intensity of Magnetisation to the Magnetic Intensity.

$$\chi_m = \frac{\vec{I}}{\vec{H}} = \frac{\text{Intensity of Magnetisation}}{\text{Magnetic Intensity}}$$

$\boxed{\chi_m + 1 = \mu_r}$ where $\boxed{\mu_r = \mu_r/\mu_0}$

μ_r = Relative permeability of material &

μ = Absolute permeability of Material.

CLASSIFICATION OF MAGNETIC SUBSTANCES

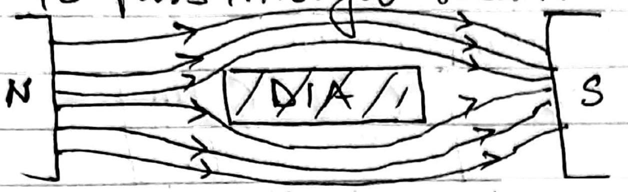
Substances can be classified into three categories on the basis of Magnetic Properties –

1. Dia Magnetic Substances 2. Paramagnetic Substances
3. Ferro magnetic Substances

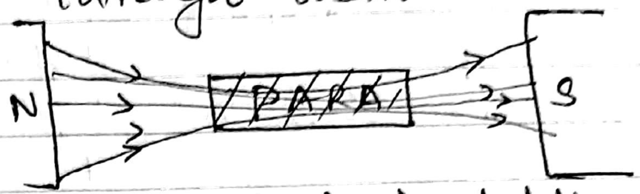
DIFFERANCES BETWEEN DIA & PARA

DIAMAGNETIC	PARAMAGNETIC
1. These are the substance in which every individual atom, moleccules or ion do not posses Net dipole Moment.	1. These are the substances in which each atom, molecule or ion posses Net dipole moment.
Ex: Cu, Zn, Bi, Ag, Au Glass & NaCl.	Ex: Al, Na, Sb, Pt.
2. χ_m is very small and –ve $(-1 \leq \chi_m < 0)$	2. χ_m is small and +ve. $(0 < \chi_m < \epsilon)$
3. Relative permeability $0 \leq \mu_r < 1$	3. $1 \leq \mu_r < 1+\epsilon$
4. These are magnetised Weakly and opposite to applied Field.	4. These are magnetised in the direction of Field.

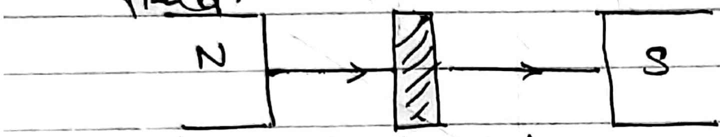
5. Field lines do not prefer to pass through them



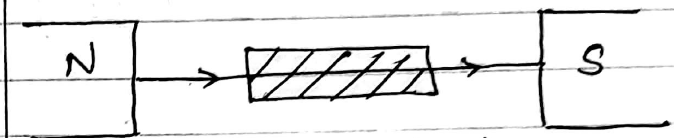
5. Field lines prefer to pass through them.



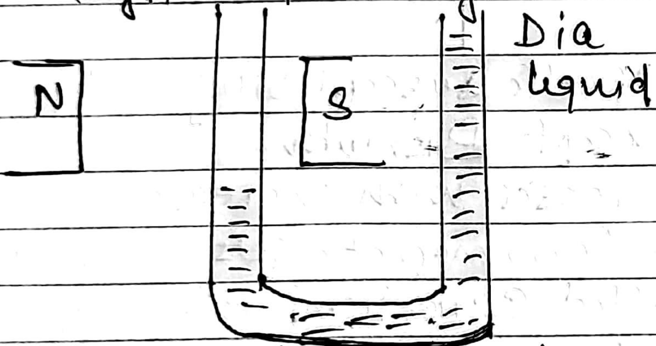
6. **When** freely suspended **They** align ⊥ to the Magnetic field.



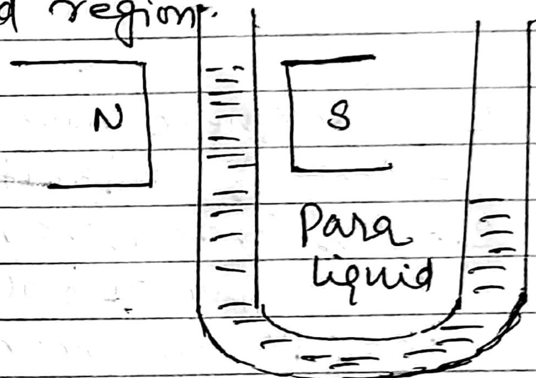
6. When freely suspended they align along the Magnetic field



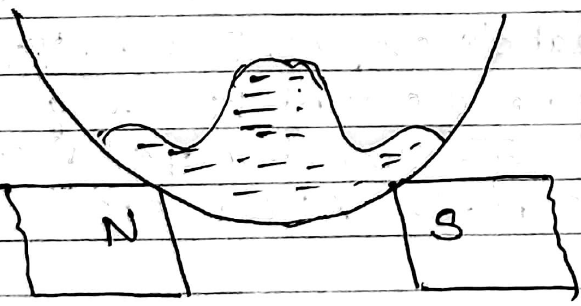
7. liquids tend to move away from the stronger Magnetic field region.



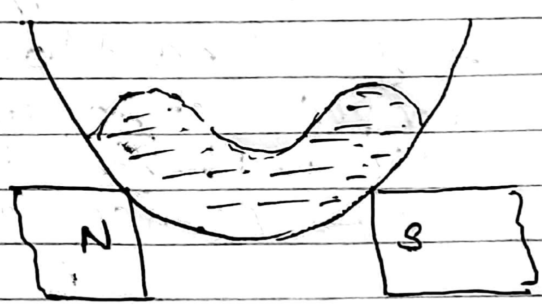
7. Liquids tends to move towards stronger Magnetic field region.



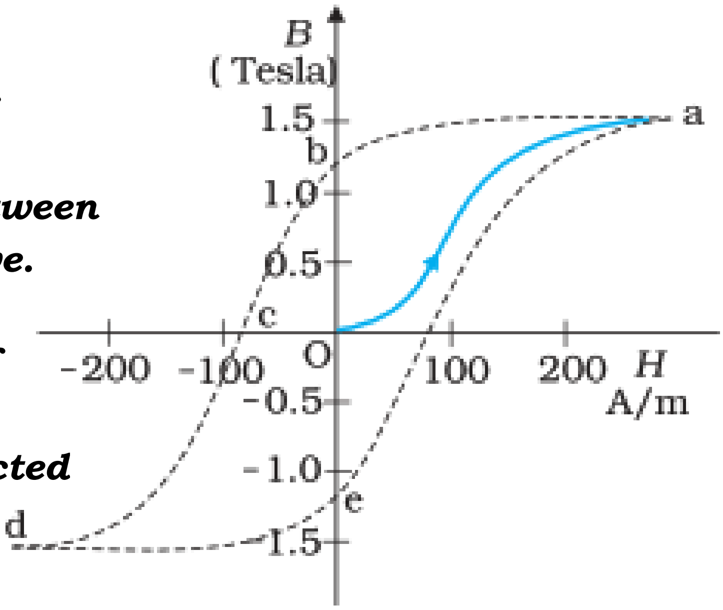
8. Powdered Diamagnetic tends to move away from stronger M.F. region.



8. Powdered Paramagnetic tends to move towards stronger M.F. region.



HYSTERISIS-CURVE OF A MAGNETIC SUBSTANCE



1. When a magnetic substance is subjected to a cyclic reversal of magnetism the graph plotted between B and H is called Hysterisis Curve.

2. The phenomenon of lagging of magnetisation to the Magnetic intensity when material is subjected to the reversal of Magnetism is called Hysterisis.

3. Retentivity is the residual magnetism retained by the substance when magnetic intensity is reduced to zero.

4. Coercivity is defined as the amount of Magnetic Intensity required to be applied in order to reduce residual magnetism to zero. Steel has high coercivity hence suitable for permanent magnets.

5. The area of Hysterisis curve represents the amount of heat developed during one cycle of reversal of magnetism.

6. Area inclosed by Hysterisis curve of Ferromagnetic materials (soft iron) is less hence it is more suitable for making electromagnets which are subjected to reversal of magnetism. (Soft iron has narrow Hyterisis Curve). Such materials also have high permeability and low retentivity.

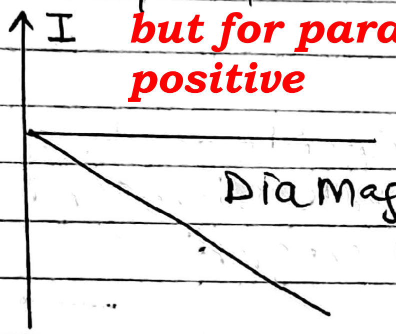
CURIE LAW: It states that the magnetic susceptibility of paramagnetic substances is inversely proportion to its absolute temperature.

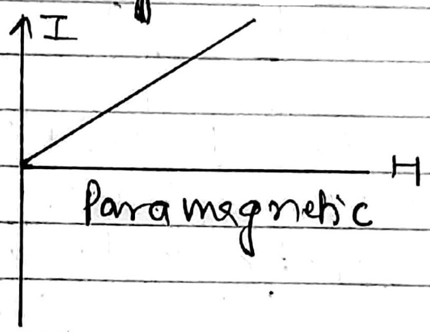
$\therefore \chi_m \propto \frac{1}{T} \Rightarrow \boxed{\chi_m = \frac{C\mu_0}{T}}$

C = curie constant for the material.

Important Points.

1. The slope of I-H graph for dia magnets is negative **but for paramagnets is positive**





2. Diamagnetic have its magnetic susceptibility independent of temperature except Bismuth.
3. χ_m for ferromagnetic decreases with increase in temp. The temperature at which ferromagnetic gets converted into Paramagnetic is called Curie Temperature (T_c)
4. Steel is used for permanent magnets due to high coercivity and soft iron is used for electromagnets due to low coercivity.
5. Soft iron is used for transformer core (choke core) due high μ_r and low heat development during Magnetisation
6. For permanet magnets, materials must have high coercivity and high retentivity. Some developed Materials are — ALNICO, TINCONAL, ALNI etc.