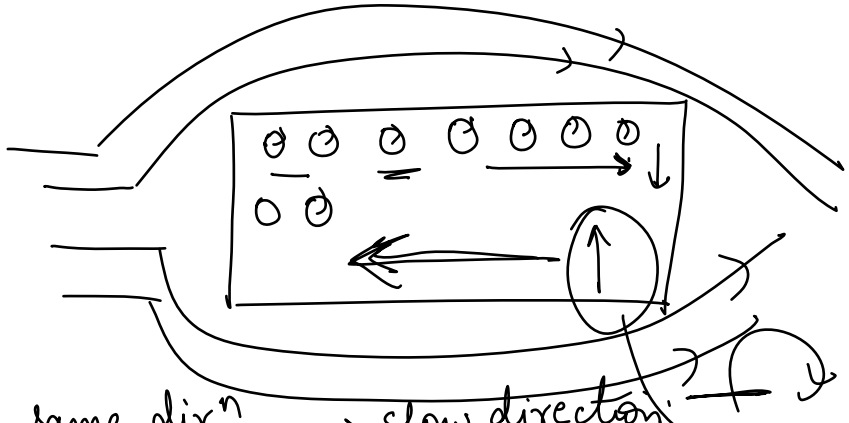
Diamagnetic Material:

1) Which have tendency to move from stronger to the weaker portion of the external field.

Eg: Bi, Cu, N_2, Si, Pb.



Net overall dipole magnetic moment = 0

e^- in the same dir^n → slow direction

Those in the opposite dir^n → ↑

Overall net magnetic field ↑

Superconductors:

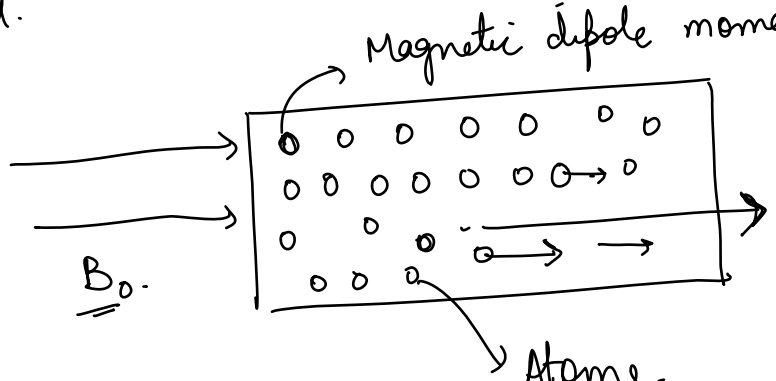
Metals cooled to a very low temperature exhibit both perfect conductivity and perfect diamagnetism.

$$\chi = -1 \;,\; \mu_r = 0$$

Meisner effect : The phenomena of perfect diamagnetism in superconductors

Paramagnetic :

1) Those which gets weakly magnetized when placed in an external magnetic field.



Al, Na, Ca, O_2

$$M = \frac{CB_0}{T}$$

Curie's law

Curie's constant

$M \propto \frac{1}{T}$.

$B_0 \uparrow$, $T \downarrow$ → Magnetisation ↑

Until it reaches M_s.

Ferromagnetism:

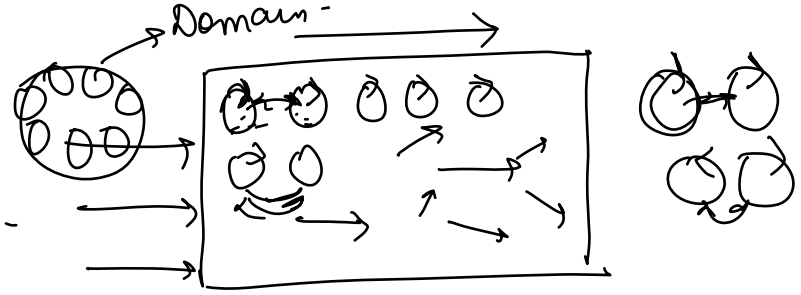
Those substances which gets strongly magnetized when placed in an external material.

Individual atoms possess dipole moment as in paramagnetic material

There interaction, they spontaneously align themselves in a common dirⁿ.

Domain → 10^{11} atoms

Eg: Co, Fe, Ni, Fe_2O_3.



Hard ferromagnetic Material:

As the external field is removed from the material, the magnetisation exist in the material.

Eg: Co, Ni, Cu etc.

Soft ferromagnetic Material

As the external magnet field is removed, magnetisation disappears in the material. Eg: Soft iron.

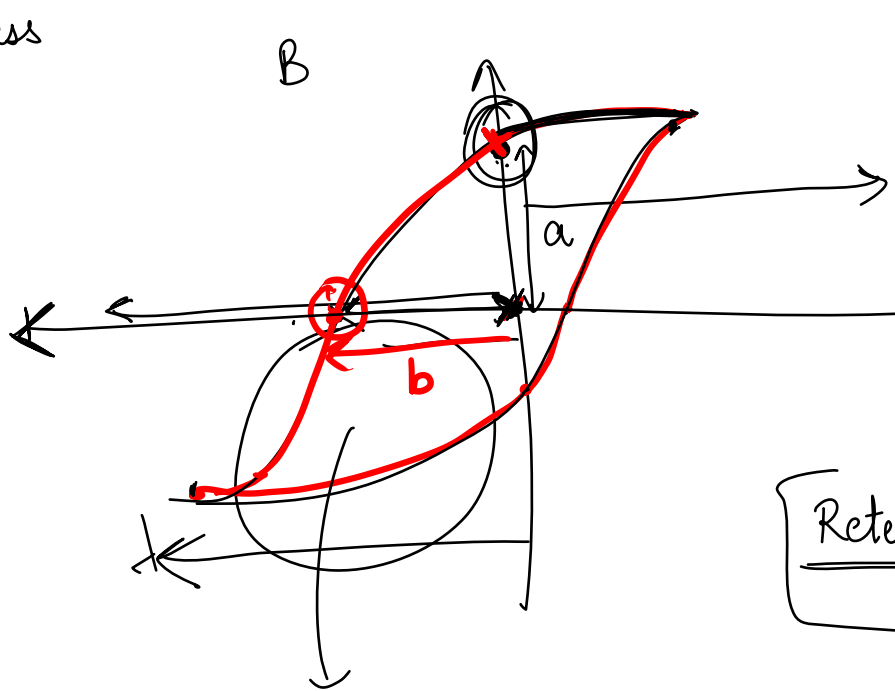
Curie Temperature:

The ferromagnetic property becomes a paramagnetic material as the temperature is increased because the domain structure disintegrates with temp!.

$$\chi = \frac{C}{T - T_C} \quad T > T_C.$$

$$\mu >> 1.$$

Hysteresis



'Coercivity':

Retentivity: [a].

Area of the Curve: Hysteresis

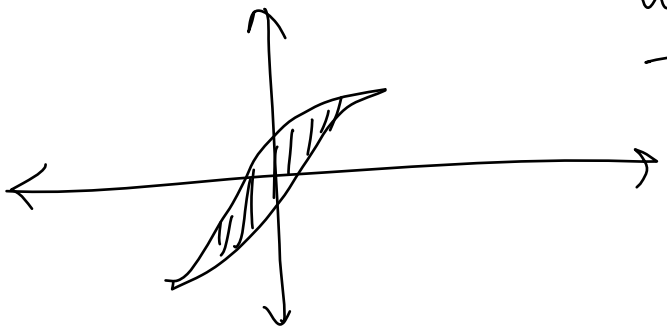
a is larger, retentivity is larger.
Hard ferromagnetic material, a is larger.

Hard ferromagnetic materials have higher retentivity.
[a is larger]

higher coercivity [b is larger].

Soft ferromagnetic materials have lower retentivity [a is smaller].

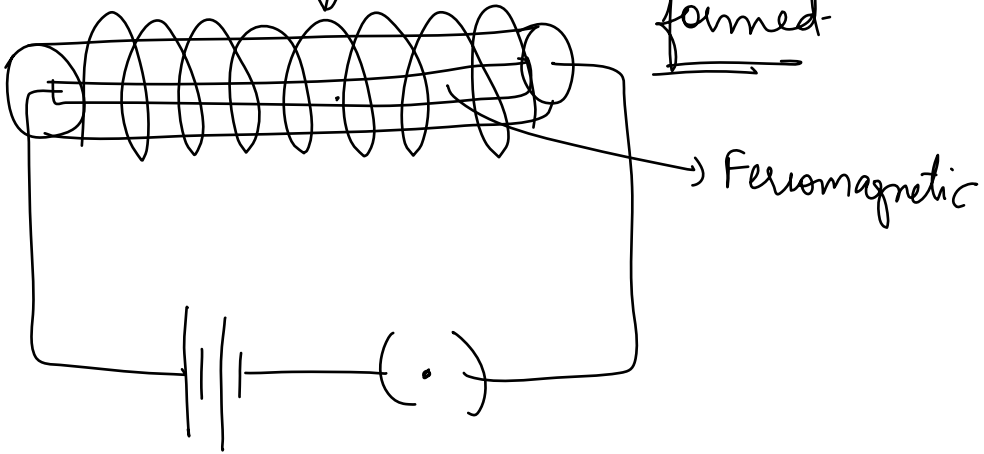
lower coercivity.



Permanent Magnets & Electromagnets:

Substances which at room temperature behaves like ferromagnetic material for a long period of time are called magnets.

"Permanent magnet is formed"



Electromagnets:

a) Electric bells.
b) Machinery | Cranes
c) Loudspeakers

Property for Permanent Magnet:

a) High retentivity / High coercivity [so that magnetisation not erased by magnetic field.

Eg: Steel.

"Electromagnets" → Core → made up of ferromagnetic material.

High permeability / low retentivity.