'MAGNETIC PROPERTY AND METHOD'

Magnetic Field (H) → It is applied magnetic field for magnetising of ordanary material rod.

* Vector.
* Unit → Amp/M

Intensity of Magnetisation (I) →

* It is induced magnetic moment per unit valume of rod.

or,

Induced pole strength per unit cross-sectional area.

$$I = \frac{M_{induced}}{Valume}$$

$$I = \frac{M_{ind}}{vol} = \frac{M_{ind}}{A}$$

* Vector
* unit → Amp/meter

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Magnetic susceptibility (χ) →

(susceptibility → Tendency.)

* It represent how easily a material can be magnetised.

$$\chi = \frac{I}{H}$$

* unit & dimension less.

$$I = \chi H$$

H → ext. mag. field.

Magnetic Permeablity (μ)

* It represent how many line of force are allowed to pass through a material.

$$\mu_0 = 4\pi \times 10^{-7} \frac{Henery}{M} \text{ (MKS)}$$

$$\mu = \mu_0 \mu_r$$

* Best ($\mu_r = 2000$) of soft Iron.
* Due to high permeablity external magnetic field can't enter in cavity of soft Iron box so soft Iron box are used for magnetic shielding.

NOTE → * Electric & magnetic shielding are possible but gravitational shielding is never possible.

*
$$I = \frac{M_{Induced}}{val.}$$
$$I = \chi H$$
$$\mu_r = 1 + \chi$$
$$\mu = \mu_0 \mu_r$$

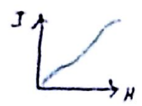
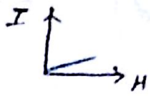
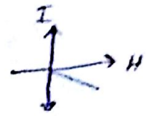
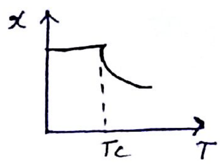
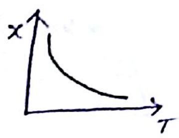
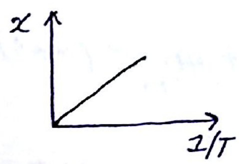
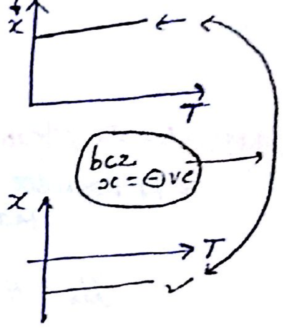
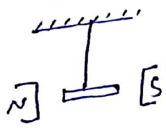
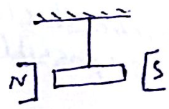
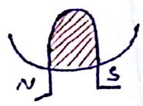
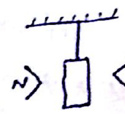
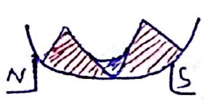
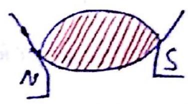
1 oersted = 80 A/m

* Relative permeablity of air → 1.04

A → Soft Iron is used as transfermer core.
R → Soft Iron has narrow Hysteresis loop.

Ans → (A)

Types of Magnetic Material

Property	Ferromagnetic	paramagnetic	Diamagnetic
① I & H	$I >>> H$ (Along 'H')	$I < H$ (Along 'H')	$I < H$ (opposite to H')
② B & B_0	$B >>> B_0$	$B > B$	$B < B_0$
③ $\chi = I/H$	$\chi >>> I$ (+ve) b/c I & H same dirn $\chi >> 1$	$\chi < 1$ (+ve) bcz I & H same dirn $0 < \chi < 1$	2016 AIPMT $\chi < I$ (-ve) b/c I & H opposite dirn $-1 < \chi < 0$
④ $\mu_r = 1 + \chi$	$\mu_r >> 2$	$1 < \mu_r < 2$	$0 < \mu_r < 1$
⑤ I v/s H			
⑥ χ v/s Temp (K)	curie wiss law $\chi = \frac{C}{T - T_c}$ T_c = curie Temp. ↓ MT* Above which Ferro become para 	curie law $\chi \propto \frac{1}{T}$  	$\chi \propto T^0$ There be graph(s) 
⑦ Behavior in non-uniform mag. field.	Moves from Weak to Strong field (Rapidly)  	Move from Weak to Strong Field (slowely)  	Move from Strong to Weak field.  
	*Fe, Co, Ni, Fe_3O_4, Gd	Na, K, Mg, Pt, O_2, Sn, Mn	Bi, Cu*, Ag, H_2O*, Au*, Sb, NaCl
			
⑧ State	only solid	solid, Liq, Gas	solid, liquid, gas.
⑨ When material is filled in U-tube & minescous is kept b/w mag field.	Level Rise	Level Rise	Level Fall

In atom magnetism is produced due to motion of electron.

|I|→ Due to orbital motion (negligible M)
|II|→ Due to spin motion (effective M)

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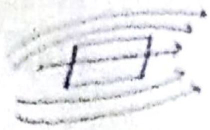
|1|→ Diamagnetism

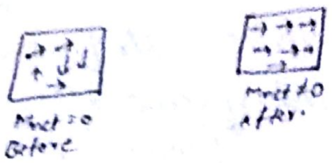


* All paired e^-.
* Atomic dipole moment zero.
* It is Inherent or, basic property of each material.
* Explain by orbital motion of e^-.
* Accdn to Lenz law Induced produced opposite to B.

$\boxed{\chi = -1}$

|2|→ Paramagnetism

* Material having some unpaired e^-
* Atomic dipole moment Non-zero.
* Explain by spin motion of e^-.



$\boxed{\chi = C\frac{\mu_0}{T}}$

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* Liquid oxygen is suspended b/w the two pole faces of Magnet becz liq is paramagnetic.

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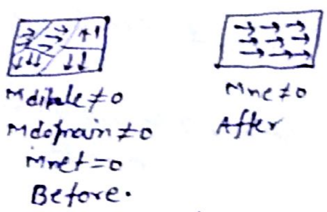
|3|→ Ferromagnetism

* Material having unpaired e^-.
* Atomic dipole Moment is non-zero.
* Interaction b/w atom of ferro material is very strong. So dipole in same direction make group or, Domain.
* So, It is explaind by formation of domain & this phenomenon is called Bark hausen effect.



$\boxed{\chi = \frac{C}{T - T_C}}$

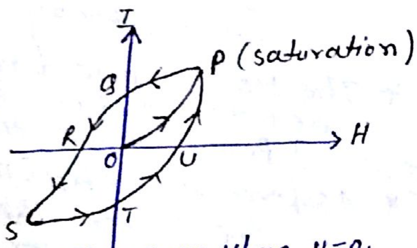
* Above curie temp. Ferromagnetic behave like Paramagnetic due to breaking of domain.
* For Iron curie temp. 1043 K (770°C)
* curie law

$\boxed{M = C\,(B/T)}$

2016 AIEEE

Hysteresis loop (B-H curve)

* only for Ferro Magnetic Material.
* It is I v/s H graph (I - development.
  or, B-H graph (B → net)
  Non-linear curve



* During the magnetisation I or B lags behind H. So It is called Hysteris curve (lake coming)
* Residual magnetism/Retentivity → Remain magnetism even when H=0,
  Forward Retentivity (OQ) = Reversed Retentivity (OT)
* Corcivity → Applied opposite H for complete diamagnetism.
  Forward coercivity (RO) = Reversed coercivity (OU).

Hysteris loss → It is the energy loss during magnetisation & demagnetisation & Represented by Area of BH curve.

* At saturation loop I-H curve = zero.

slope of BH curve = μ_0

$$\vec{B} = \mu_0 (H + \vec{I})$$

$$\boxed{\frac{dB}{dH} = \mu_0}$$

I = const.

$$\boxed{\frac{dI}{dt} = 0}$$

* Area of BH curve = μ_0 [Area of I-H]
* Heat produced in time 't'

*$\boxed{Heat = VAnt}$

V → volume of Rod
A → Area of B-H curve
t → time in sec.

2026
3e
***

A/c to coercivity feromagnetic material are two type

Soft	Hard
Imp * Low coercivity, Low Retentivity.	* High coercivity, high Retentivity.
Imp * Low B-H curve.	* High B-H curve.
* Used for Making temporary Magnet/Electromagnet & Transfermer core. Ex → Soft Iron, permalloy.	* For Making permanent magnet.
	* Ex → cobalt, steel, Al, Ni, Co.
* magnetisation & Demagnetisation Easy.	* Magnetisation & Demagnetisation diffult.

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Superconductor

* perfect dielectric material.

$$\boxed{I = -H}$$

$$x = \frac{I}{H} = -1$$

$$\boxed{\mu_r = 1 + x = 0}$$

When a ferromaterial is magnetic its length (↑) slightly. This is called magnetostriction effect.

* The Most exotic diamagnetic material are superconductor. These are metal cooled to very low temp. Wich exibit both perfect conductivity & Perfect diamagnetism. Here field lines completely expelled.

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* A superconductor Repel a Magnet & (by Newton 3rd law) Repelled by the magnet. The phenomenon of perfect diamagnetism in superconductor is called the Meissner Effect.

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* Superconductor magnet can be gainfully exploited in varity of situation. For ex → For Running magnetically leviated superfast trains.

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* A Frog can be leviated in a magnetic field produced by a current in a vertical solenoid placed below a frog. This is possible bcoz the body of frog behave as → Diamagnetic.

But in Frog
Iron (In blood)
↑
Ferro

But in Any living system
90% H_2O of its weight.
↑
Dia

!!
But Magnetism of Iron one particle is More than Magnetism of many particle of H_2O. ?

[

Demagnetising a Magnet

* Heating
* Hammering (Hitting)
* By put it inside the coil & AC is passed through the coil.