'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.

*

$$I = \frac{M_{induced}}{val.}$$

$$I = \chi H$$

$$\mu_r = 1 + \chi$$

$$\mu = \mu_0 \mu_r$$

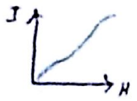
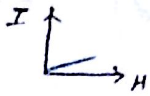
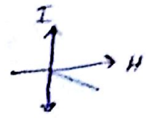
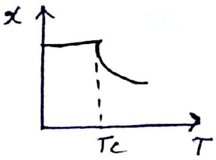
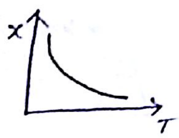
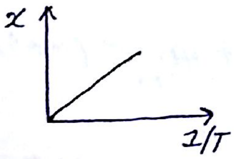
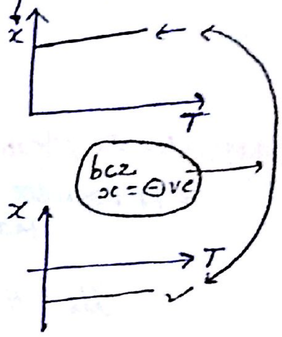
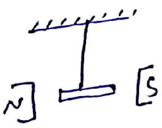
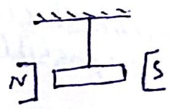
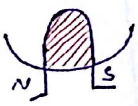
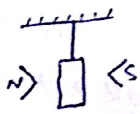
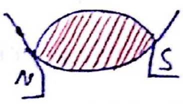
1 oersted = 80 A/m

* 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 $\chi = I/H$	$\chi >>> 1$ (+ve) b/c I & H same dirn $\boxed{\chi >> 1}$	$\chi < 1$ (+ve) bcz I & H same dirn $\boxed{0 < \chi < 1}$	2016 AIIMS: $\chi < 1$ (-ve) b/c I & H opposite dirn $\boxed{-1 < \chi < 0}$
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 $\boxed{\chi = \frac{C}{T - T_c}}$ T_c = curie Temp → IMP* Above which Ferro become para 	Curie law $\boxed{\chi \propto \frac{1}{T}}$  	$\boxed{\chi \propto T^0}$ If there be graph (v) 
⑦ Behavior in non-uniform mag. field.	Moves from weak to strong field (Rapidly)   *Fe, Co, Ni Fe_3O_4, Gd	Move from weak to strong field (slowly)   Na, K, Mg, Pt O_2, Sn, Mn	Move from strong to weak field.   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)

|1| → Diamagnetism
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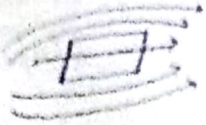

* All paired e^-.
* Atomic dipole moment zero.
* It is Inherent or, basic property of each material.
* Explain by orbital motion of e^-.
* Accd. to Lenz law Induced produced opposite to B.

$$\boxed{\chi = -1}$$

|2| → Paramagnetism

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

$M_{net} = 0$ Before — $M_{net} \neq 0$ After

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

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

|3| → Ferromagnetism
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* 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.

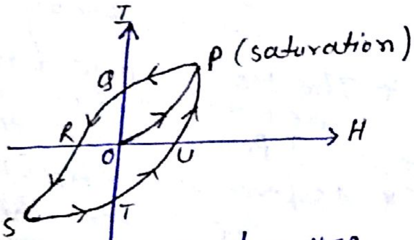
$$\boxed{\chi = \frac{C}{T - T_C}}$$

$M_{dipole} \neq 0$, $M_{domain} \neq 0$, $M_{net} = 0$ Before. — $M_{net} \neq 0$ After

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

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

Hysteresis loop (B-H curve)
2016 AIEEE



* 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).

Hysteresis 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.

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

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

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

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 a 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. ?

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Demagnetising a Magnet

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