MAGNETISM

Subject Name: Electrical Fundamentals

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Approved By:

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Sr. No.	Topic
a	▪ Theory of magnetism ▪ Properties of a magnet, Action of a magnet suspended in the Earth's magnetic field ▪ Magnetization & Demagnetization ▪ Magnetic Shielding ▪ Various types of magnetic materialsElectromagnets construction and principles of operation . ▪ Hand clasp rules to determine magnetic field around current carrying conductor
b	Magnetomotive force Filed strength Magnetic Field strength Magnetic Flux density Permeability Hysteresis loop Retentivity Coercive force Reluctance, saturation point, eddy current Precaution for care and storage of magnets

What is the difference between magnetism and electromagnetism?

Magnetism and **electromagnetism** are fundamental concepts i physics. The main **difference between magnetism** an **electromagnetism** is that the term "**magnetism**" encompasses onl phenomena due to magnetic forces, whereas "**electromagnetism** encompasses phenomena due to both to magnetic and electri forces.

Properties of Magnet

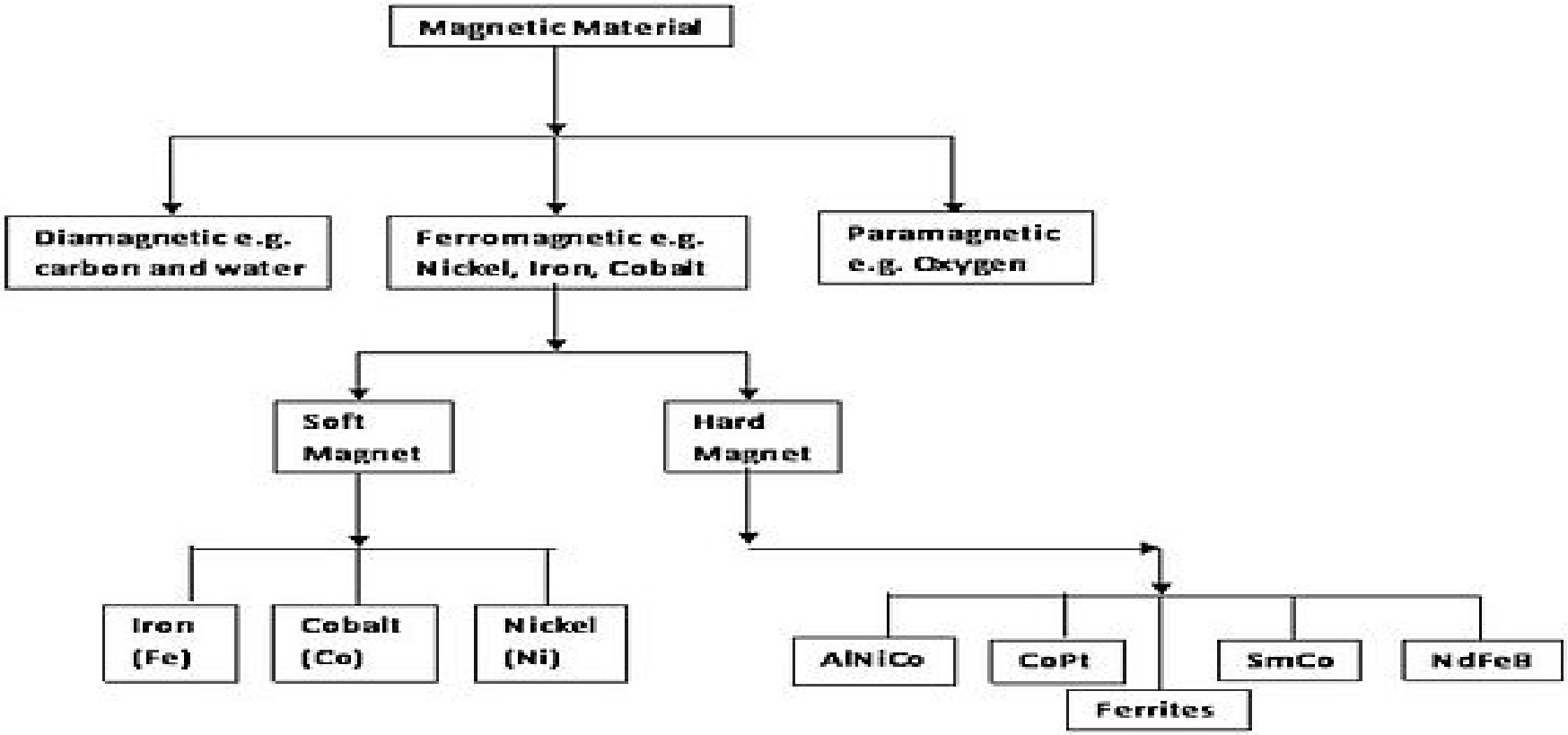
Properties of Magnets

1. Magnets attract objects of iron, cobalt and nickel.
2. The force of attraction of a magnet is greater at its poles than in the middle.
3. Like poles of two magnets repel each other.
4. Opposite poles of two magnets attracts each other.
5. If a bar magnet is suspended by a thread and if it is free to rotate, its South Pole will move towards the North Pole of the earth and vice versa.

Magnetism
VS
Electromagnetism
Comparison Chart

Magnetism	Electromagnetism
Magnetism is defined as a force or a property that can cause two objects to attract or repel each other due to the motion of electric charges.	Electromagnetism is the branch of physics that deals with the study of electricity and magnetism and the interaction between them.
It refers to the phenomena associated with magnetic fields or magnetic forces.	It is the phenomena associated with both magnetic fields and electric fields.
It refers to the magnetic properties of objects that have the tendency to attract or repel each other.	It refers to the properties which govern the rate at which an object responds to absorption or emission of electromagnetic radiations.

Various types of Magnetic Materials



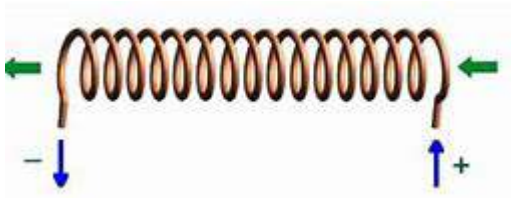
Comparison between magnetic materials

Properties	Ferromagnetic Materials	Paramagnetic Materials	Diamagnetic
State	They are solid.	They can be solid, liquid or gas.	They can be solid, liquid or gas.
Effect of Magnet	Strongly attracted by a magnet.	Weakly attracted by a magnet.	Weakly repelled by a magnet.
Behavior under non-uniform field	tend to move from low to high field region.	tend to move from low to high field region.	tend to move from high to low region.
Behavior under external field	They preserve the magnetic properties after the external field is removed.	They do not preserve the magnetic properties once the external field is removed.	They do not preserve the magnetic properties once the external field is removed.
Effect of Temperature	Above curie point, it becomes a paramagnetic.	With the rise of temperature, it becomes a diamagnetic.	No effect.
Permeability	Very high	Little greater than unity	Little less than unity
Susceptibility	Very high and positive	Little greater than unity and positive	Little less than unity and negative
Examples	Iron, Nickel, Cobalt	Lithium, Tantalum, Magnesium	Copper, Silver, Gold

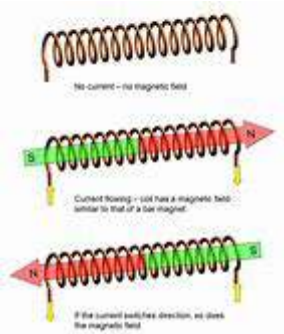
Explain the term of Electromagnet.

An **electromagnet** is a type of magnet in which the magnetic field i
produced by an electric current. Electromagnets usually consist o
wire wound into a coil. A current through the wire creates a magneti
field which is concentrated in the hole, denoting the centre of th
coil. The magnetic field disappears when the current is turned off.

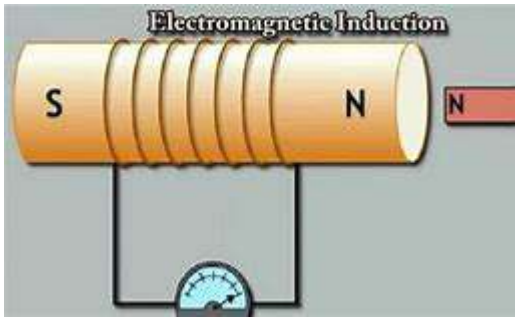
Requirement of materials for development of electromagnet



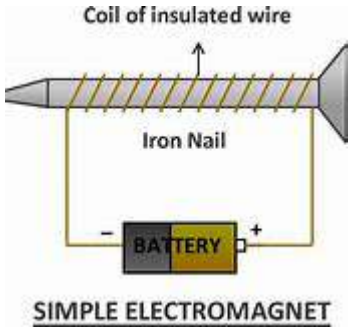
Effect of Current direction in the coil



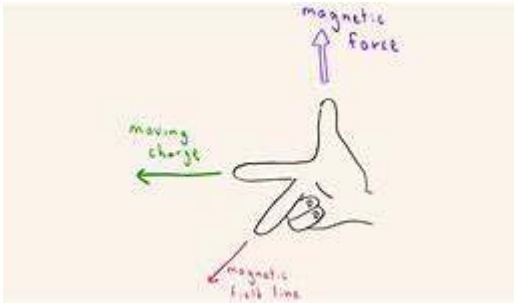
Produce Electromagnet by the use of coil



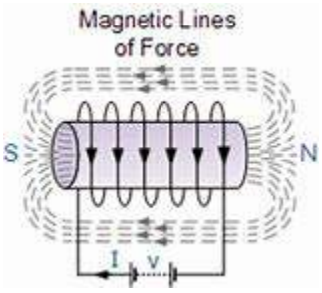
Sample electromagnet



Find out direction of current by using Fleming
Left & Right hand rules.



Magnetic lines of force



Lenz's Law

Electromagnetic Induction

Lenz's Law

- The direction of the emf and thus the current is given by Lenz's law. The statement in bold in the center of page 789 is a statement of Lenz's law. Use this to find the direction of the current. If you are looking down on the loop from above, is the current flowing clockwise or counter clockwise?

Difference between soft and hard magnetic materials

s.no	Soft magnetic materials	Hard magnetic materials
1.	The magnetic materials can be easily magnetize and demagnetize.	The magnetic materials can not be easily magnetize and demagnetize.
2.	The have high permeability.	The have low permeability.
3.	Magnetic energy stored is not high.	Magnetic energy stored is high.
4.	Low hysteresis loss due to small hysteresis loop area.	Large hysteresis loss due to large hysteresis loop area.
5.	Coercivity and retentivity are small.	Coercivity and retentivity are large.
6.	The eddy current loss is small due to its high resistivity.	The eddy current loss is high due to its low resistivity.
7.	The domain walls are easy to move.	The movement of domain wall must be prevented.
8.	They are used in electric motor, generators, transformers, relays, telephone receivers, radar.	They are used in loud speakers and electrical measuring instruments.

Difference between Electro-Magnet and Permanent Magnet

Bar Magnet or Permanent Magnet:

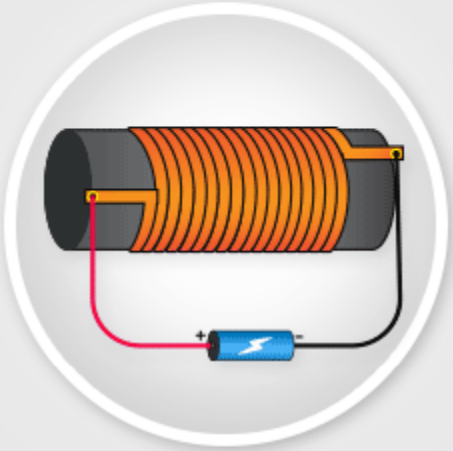
- They are permanently magnetized.
- They are usually made of hard materials.
- The strength of the magnetic field line are constant i.e. it cannot be varied.
- The poles of a Permanent magnet cannot be changed.
- Example of permanent magnet is a Bar Magnet

Electro-Magnet:

- They are temporarily magnetized.
- They are usually made of soft materials.
- The strength of the magnetic field lines can be varied according to our need.
- The poles of electro-magnet can be altered.
- Example of a Temporary magnet is solenoid wounded across a nail and connected to a battery.

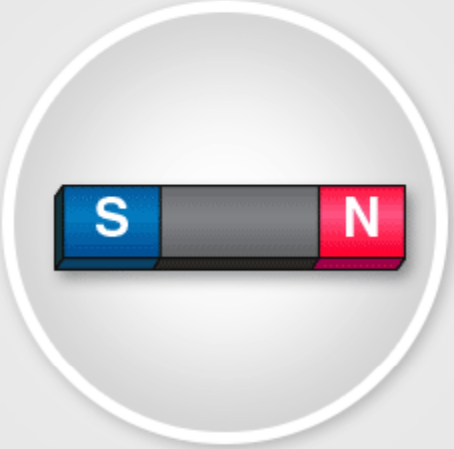
DIFFERENCE BETWEEN ELECTROMAGNET AND PERMANENT MAGNET

BYJU'S The Learning App



ELECTROMAGNET

AN ELECTROMAGNET IS A TYPE OF MAGNET IN WHICH THE MAGNETIC FIELD IS PRODUCED BY AN ELECTRIC CURRENT. THE MAGNETIC FIELD DISAPPEARS WHEN THE CURRENT IS TURNED OFF. ELECTROMAGNETS USUALLY CONSIST OF WIRE WOUND INTO A COIL.



PERMANENT MAGNET

A PERMANENT MAGNET IS AN OBJECT MADE FROM A MATERIAL THAT IS MAGNETIZED AND CREATES ITS OWN PERSISTENT MAGNETIC FIELD. AN EVERYDAY EXAMPLE IS A REFRIGERATOR MAGNET USED TO HOLD NOTES ON A REFRIGERATOR DOOR.

Define the term of Magnetic circuit.

Magnetomotive Force

- The MMF is generated by the coil
- Strength related to number of turns and current, Symbol F, measured in Ampere turns (At)

$$F = NI$$

$$\Phi = \frac{NI}{\Re}$$

Magnetic Field Intensity

- Magnetic field strength
  - H, is the magnetomotive force (mmf) per unit length
- $H = \mathcal{F}/\ell = NI/\ell$
- Units are Ampere•turns/meter
- $N \cdot I = H \cdot \ell$

Magnetic Field Strength

1.2. MAGNETIC FIELD STRENGTH, H (MAGNETISING FORCE)

- Magnetic field strength is defined as magnetomotive force, Fm

$$H = \frac{F_m}{l} = \frac{NI}{l}$$ **ampere turn / metre**

N = bilangan lilitan pengalir
I = arus yang mengalir
l = panjang bahan magnet

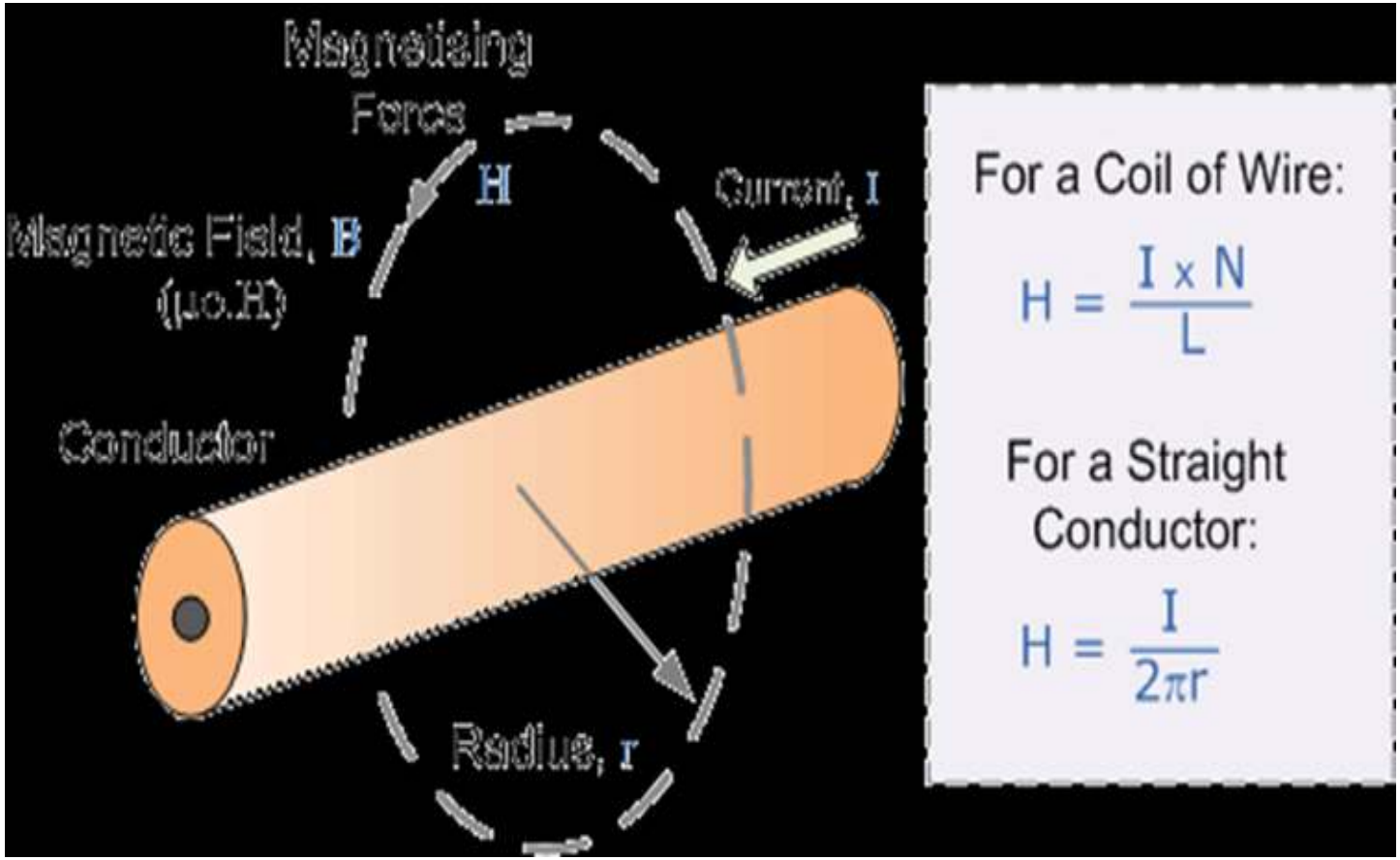
Field Intensity

- The effort made by the current in the wire to setup a magnetic field.
- Magnetomotive force (mmf) per unit length is known as the "magnetizing force" ***H***

$$H = F / l \ (\text{At/m})$$

- Magnetizing force and flux density related by:

$$\mathbf{B} = \mu H \quad (\text{T})$$

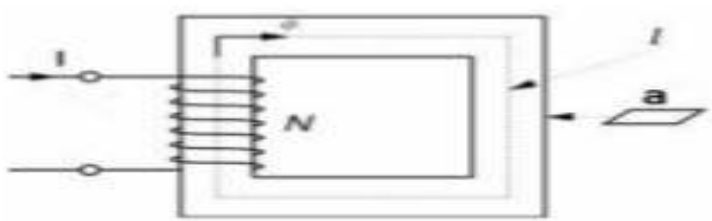

Magnetizing Force
H
Current, I
Magnetic Field, B
(μo.H)
Conductor
Radius, r
For a Coil of Wire:
H = I x N / L
For a Straight Conductor:
H = I / 2πr

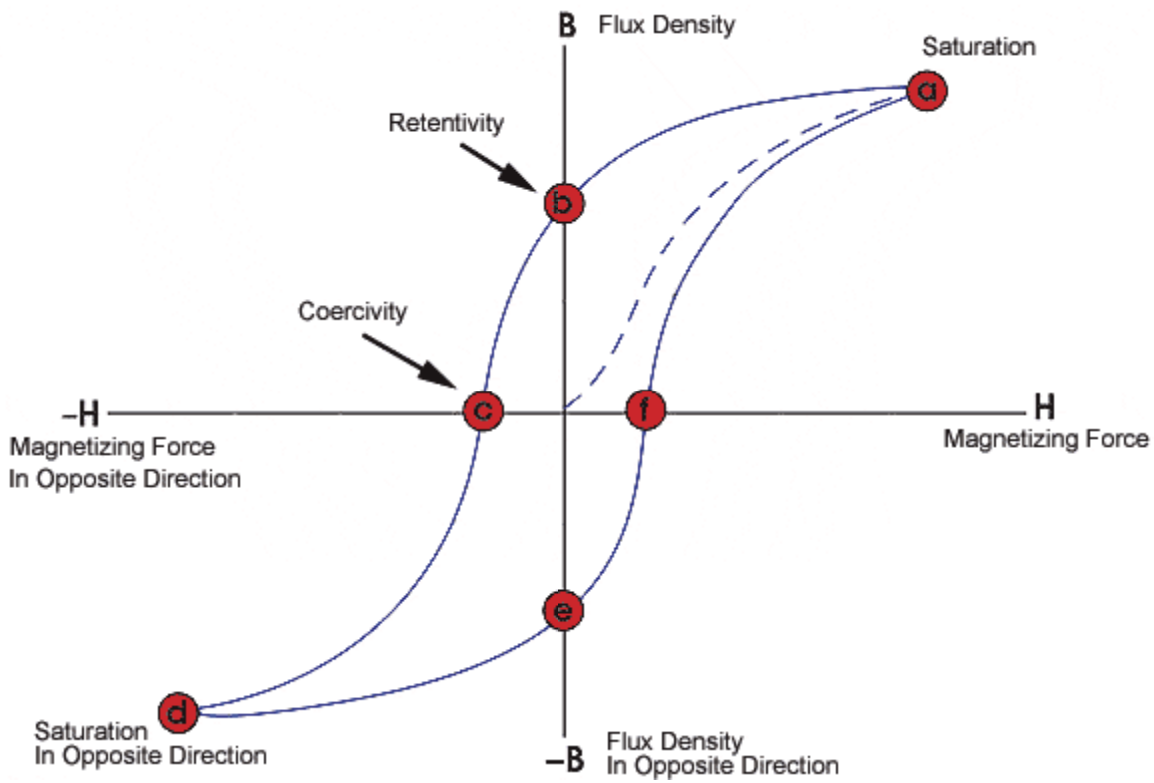
14-1: Ampere-turns of Magnetomotive Force (mmf)

- The strength of a coil's magnetic field is proportional to the amount of current flowing through the coil and the number of turns per given length of coil.
- Ampere-turns = $I \times N$ = mmf
- I is the amount of current flowing through N turns of wire.
- This formula specifies the amount of magnetizing force or magnetic potential (mmf).

Magnetic Circuit Definitions

- **Magnetomotive Force (MMF)**
  - The "driving force" that causes a magnetic field
  - Symbol, F
  - Definition, $F = NI$
  - Units, Ampere-turns, (A-T)




B Flux Density
Saturation
a
Retentivity
b
Coercivity
c
f
–H
Magnetizing Force
In Opposite Direction
H
Magnetizing Force
e
d
Saturation
In Opposite Direction
–B
Flux Density
In Opposite Direction