
SAFALTA CLASS™
An Initiative by अमर उजाला

Electric current:

1 Amp = 6.25×10^{18} e⁻/sec

e⁻ → → → Current

$q = ne$

$I = n(1.6 \times 10^{-19} C)$

- Electric current is the flow of charge with respect to time.
- Electric current=q/t

i or $I = \frac{q}{t}$ unit → Ampere

1 A = 1 C / 1 sec

- An electric current whose direction does not change with time is called direct current (D.C).

- An electric current whose direction changes with time is called alternating current (A.C).

220V – 240V

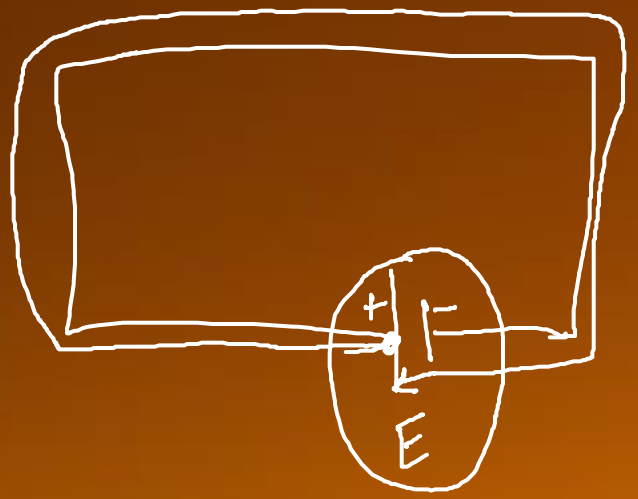
50Hz

- In solids- Current flow due to the flow of electrons
- In the liquid- Current flow due to the flow of ions as well as electrons In semiconductors- Current flow due to the flow of electrons and holes.

* E.M.F. (e.m.f.):- वैद्युत वाहक बल:-

⇒ Force, energy, Potential, Current,

ऊर्जा



e ⇒ J/C (Volt)

Resistance: (प्रतिरोध):

- The resistance offered by any material in the flow of current is called as electrical resistance.

- Its S.I unit is ohm and [ML2T-3A-2] is its dimension.

- R=PL/A $R = \frac{\rho l}{A}$

- L=length of conductor • A=cross sectional area • The P= resistivity of the material

① internal :- Collision b/w e⁻

② External :-

Ohm's Law

- It states that if physical conditions of any conductor such as temperature, pressure etc. remain unchanged then electric current(I) through it is directly proportional to the potential difference(V) applied across its ends.

- 

V=IR

$V \propto I$

$V = IR$

Resistance $R = \frac{V}{I}$ X

$R = \rho \frac{l}{A}$ — l → length (लंबाई), A → Area (क्षेत्रफल)

$R_1 = l_1$

$R_2 = l_2$

Resistivity (प्रतिरोधकता)

* $r_1 = 5cm, \rightarrow R_1 = 10\Omega$

$r_2 = 12cm, \rightarrow R_2 = ?$

$R \propto l$

$R \propto \frac{1}{A}$

$R \propto \frac{1}{A}$

$R \propto \rho$

$\frac{R_1}{R_2} = \frac{A_2}{A_1} = \frac{\pi r_2^2}{\pi r_1^2}$

$\Rightarrow \frac{R_1}{R_2} = \left(\frac{r_2}{r_1}\right)^2$

$\Rightarrow \boxed{\frac{R_1}{R_1} = \left(\frac{r_2}{r_1}\right)^2}$

$\frac{1}{R_2} = \frac{144x}{25x10} \Rightarrow R_2 = \frac{250}{144} = 1.73\Omega$

- **Conductance** (चालकता)

• Conductance or conductivity is the reciprocal of resistance and the resistivity of the material respectively.

• Its SI unit is mho. म्हो Ω

⇒ Spec. Resistance (विशिष्ट प्रतिरोध) ⇒ चांदी (Silver)

- **Resistivity** (प्रतिरोधकता) $R = \rho \frac{l}{A}$

- The resistivity of a material is equal to the electrical resistance of its wire unit length and of the unit area of cross-section.

- Its unit is ohm-meter. ($\Omega - m$)

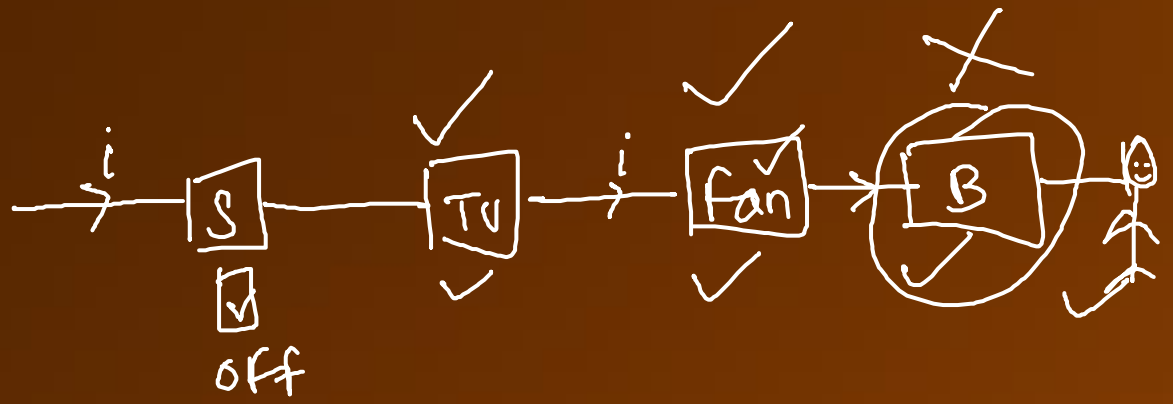
- The resistivity of a material depends on the temperature and nature of the material.

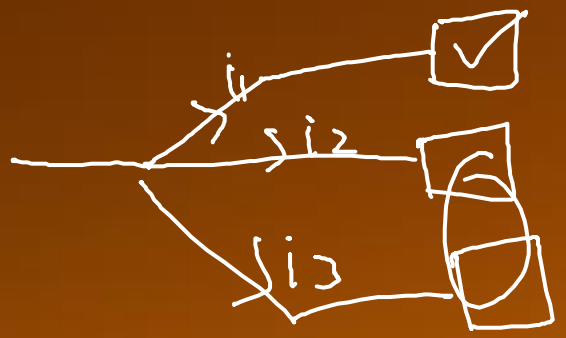
- It is independent of dimensions of the conductor, i.e. length, area of cross-section.

- The resistivity of metals increases with increase in temperature.

- Resistivity is low for metals, more for semiconductors and very high for alloys.

- **प्रतिरोधकता**
- • किसी सामग्री की प्रतिरोधकता उसके तार इकाई की लंबाई और क्रॉस-सेक्शन के इकाई क्षेत्र के विद्युत प्रतिरोध के बराबर होती है।
- • इसकी इकाई ओम-मीटर है।
- • एक सामग्री की प्रतिरोधकता सामग्री के तापमान और प्रकृति पर निर्भर करती है।
- • यह कंडक्टर के आयामों से स्वतंत्र है, अर्थात् लंबाई, क्रॉस-सेक्शन का क्षेत्र।
- • तापमान में वृद्धि के साथ धातुओं की प्रतिरोधकता बढ़ती है।
- • प्रतिरोधकता धातुओं के लिए कम, अर्धचालकों के लिए अधिक और मिश्र धातुओं के लिए बहुत अधिक है।


i
S
TV
i
Fan
B
off


i
i2
i3

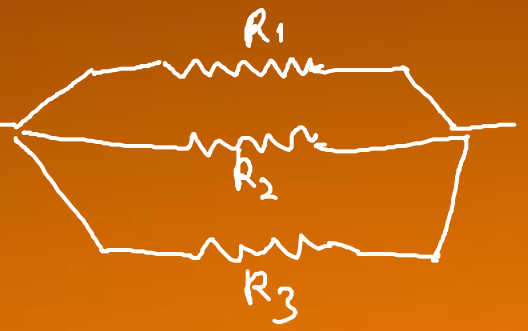
Combination of Resistances

- Resistance can be connected in two ways i.e. in parallel and in series.
- (a) Series If resistance R1, R2 and R3 are connected in series their equivalent resistance is given by

$R = R1+R2+R3$ In series combination equal current flows through each resistor.

- (b) Parallel If resistance R1, R2 and R3 are connected in parallel then equivalent resistance is given by.

$$1/R = 1/R1 + 1/R2 + 1/R3 + \dots$$



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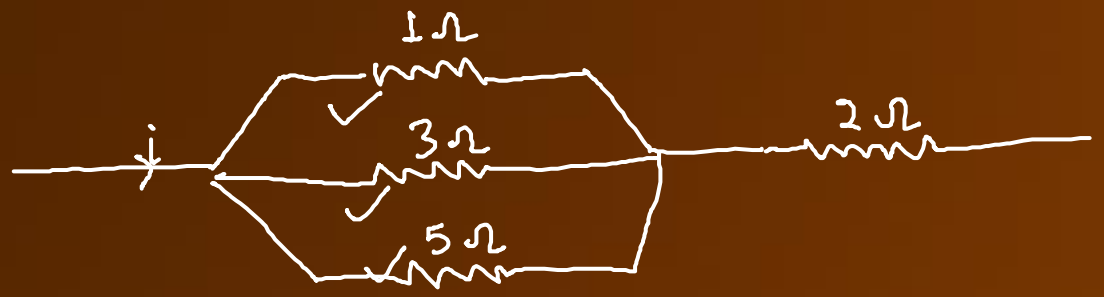


$R_{Final} = ?$

$$\frac{1}{R} = \frac{1}{1} + \frac{1}{3} + \frac{1}{5}$$

$$\frac{1}{R} = \frac{15+5+3}{15} = \frac{23}{15}$$

$$R = \frac{15}{23}$$

$$\frac{15}{23} + 2 \Rightarrow \frac{15+46}{23} = \frac{61}{23} = 2.$$

SUPERCONDOCTORS

A superconductor is a material that can conduct electricity or transport electrons from one atom to another with no resistance. This means no heat, sound or any other form of energy would be released from the material when it has reached "critical temperature" (T_c), or the temperature at which the material becomes superconductive.

एक अतिचालक एक ऐसा पदार्थ है जो बिना किसी प्रतिरोध के एक परमाणु से दूसरे में बिजली या परिवहन इलेक्ट्रॉनों का संचालन कर सकती है। इसका मतलब यह है कि जब कोई सामग्री "महत्वपूर्ण तापमान" (Tc), या जिस तापमान पर पदार्थ अतिचालक हो जाती है, तब कोई भी ऊष्मा, ध्वनि या ऊर्जा का कोई अन्य रूप पदार्थ से मुक्त नहीं होगा।

- **Electric Power** (विद्युत शक्ति):
- The work done in pushing a charge round an electrical circuit is given by w.d = VIt
- So that power, P = w.d /t = VI $P = \frac{W}{t} = J/sec$
- P = V2 /R = I2R Here P= Electric Power, V= Voltage, R= Resistance

$1 KW = 3.6 \times 10^6 J$

$P = \frac{W}{t} = VI = I^2R = V^2/R$

$1 J/sec = 1 watt$

$1 KW = 1000 watt$

1 KW → Power (शक्ति)

1 KW-hr → Energy (ऊर्जा)

- An electrical bulb is labeled 100W, 240V. Calculate:

a)The current through the filament when the bulb works normally

b)The resistance of the filament used in the bulb.

- **Solution**

$I = P/V = 100/240 = 0.4167A$

$R = P/I^2 = 100/ 0.4167^2 = 576.04\Omega$ or $R = V^2/P = 240^2/100 = 576\Omega$

HEATING EFFECT OF CURRENT

Tungston, Nichrome

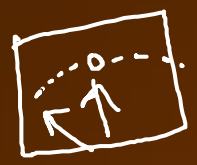
When current flows through a conductor, heat energy is generated in the conductor. The heating effect of an electric current depends on three factors:

- The resistance, R of the conductor. A higher resistance produces more heat.
- The time, t for which current flows. The longer the time the larger the amount of heat produced
- The amount of current, I. the higher the current the larger the amount of heat generated.

GALVANOMETER (धारामापी)

Current + Voltage

- A galvanometer is converted into an ammeter by connecting a low resistance in parallel with the galvanometer. This low resistance is called shunt resistance S.



- A galvanometer is converted into a voltmeter by connecting high resistance R_h in series with galvanometer

Ammeter → (G) → Low Rest (कम प्रतिरोध) → Parallel (समान्तरक्रम)

Voltmeter → (G) → High " → Series

- • यदि हम एक गैल्वेनोमीटर के समानांतर शंट जोड़ते हैं, तो गैल्वेनोमीटर एक एमीटर की तरह काम करता है।

यदि हम गैल्वेनोमीटर के साथ श्रृंखला में उच्च प्रतिरोध जोड़ते हैं, तो गैल्वेनोमीटर वोल्टमीटर की तरह कार्य करता है

- **Electric Cell:**

• An electric cell is a device which converts chemical energy into electrical energy.

• Electric cell is of two types:

(a) Primary cell: cannot be charged. Voltaic, Daniell and Leclanche cells are primary cells.

(b) Secondary Cell: can be charged again & again. Acid and alkali accumulators are secondary cells.

- # Kirchoff's Law:

- **Kirchoff current law:** states that the net current on a junction in an electrical circuit will be zero. It is based on the conservation of charge.

- **Kirchoff's Voltage Law:** states that the algebraic sum of all potential difference along a closed loop is Zero. It is based on conservation of energy.

Electric Fuse

- Used to protect electric appliances from high current.
- Fuse wire made of the alloy of copper, tin and lead.
- The material of fuse wire should be low melting point and high resistance.
- Shunt : It is the wire of very small resistance.
- If we add shunt parallel to a galvanometer, then galvanometer acts like an ammeter.

Note: If we add high resistance in series with the galvanometer, then galvanometer acts like a voltmeter.

- इलेक्ट्रिक फ्यूज
- • बिजली के उपकरणों को उच्च धारा से बचाने के लिए उपयोग किया जाता है।
- • तांबे, टिन और सीसे के मिश्रधातु से बने फ्यूज तार।
- • फ्यूज वायर की सामग्री कम गलनांक और उच्च प्रतिरोध होनी चाहिए।
- • शंट: यह बहुत छोटे प्रतिरोध का तार है।

Q1. The actual flow of electrons which constitute the current is from:

(a) Negative to positive terminal
(b) Positive to negative terminal
(c) Flow at random
(d) None of the above

Q2. What is the effect of changing the wire in a circuit from a straight thick wire to a longer (coiled) thick wire?

(a) The bulbs become dimmer
(b) The bulbs become brighter
(c) The bulbs stay at the same level of brightness
(d) none of the above

Q6. Nichrome and copper wires of the same length and same radius are connected in series. Current I is passed through them. Which of the two get heated first?

(a) copper wire
(b) Nichrome wire
(c) None of these
(d) Both

Q7. What is the SI unit of electrical conductance?

(a) Volt
(b) Watt
(c) Siemens
(d) Ampere

Q9. What should be present in a substance to make it a conductor of electricity?

(a) Strongly held electrons
(b) Free electrons
(c) Strongly held protons
(d) Free protons

Q10. Which of the following is a conductor of electricity?

(a) Silver
(b) Copper
(c) Aluminium
(d) All of the above

- **Q1. Safety fuse wire used in domestic electrical appliances is made of metal of low**
  घरेलू विद्युत उपकरणों में उपयोग की जाने वाली सुरक्षा फ्यूज तार कम_____ धातु से बना होता है

- (a) resistance/ प्रतिरोध
  (b) melting point/ गलनांक
  (c) specific gravity/ विशिष्ट गुरुत्व
  (d) conductance/ प्रवाहकत्त्व

- **Q8. The metal whose electrical conductivity is more, is**
  वह धातु जिसका विद्युत चालकता अधिक है, है

- (a) copper/ तांबा
  (b) aluminium/ एल्युमीनियम
  (c) silver/ चांदी
  (d) lead/ लेड

- **Q9. Water cannot be used to extinguish fire caused by electric current, because**
  विद्युत प्रवाह के कारण लगी आग बुझाने के लिए पानी का उपयोग नहीं किया जा सकता है, क्योंकि

- (a) it may cause electrocution/ यह विद्युत प्रक्षेपण का कारण बन सकता है
  (b) it may cause hydrolysis/ यह जल-विश्लेषण का कारण बन सकता है
  (c) it may cause electrolysis/ यह विद्युतपघटन का कारण बन सकता है
  (d) it may spoil the wiring/ यह तारों को खराब कर सकता है

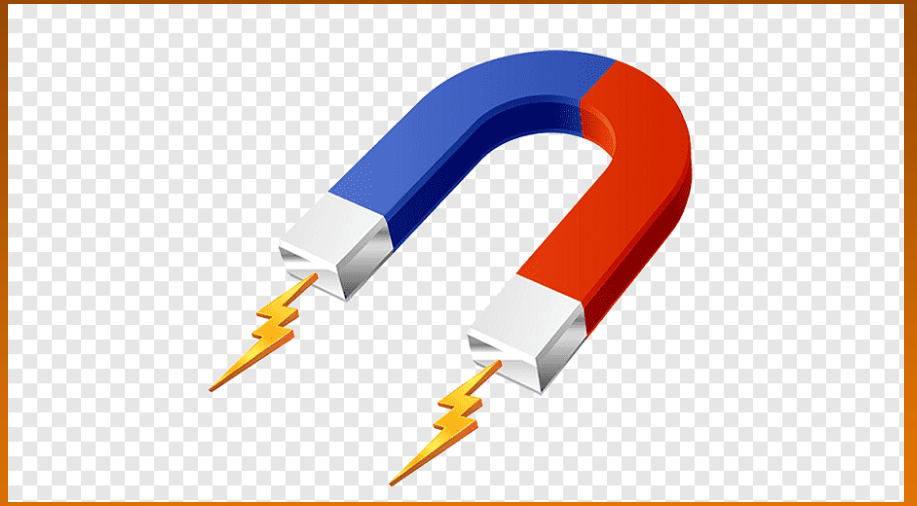
MAGNETISM

(चुम्बकत्व)

MAGNET

Magnet

- A magnet is a material which can attract iron objects.
- A **natural magnet** is an ore of iron (Fe_3O_4) called magnetite or lodestone.
- A magnet which is prepared artificially is called an **artificial magnet**.



TYPES :

There are three types of magnets, and they are as follows:

1. Permanent magnet

2. Temporary magnet

3. Electromagnets

- मैग्नेट तीन प्रकार के होते हैं, और वे इस प्रकार हैं:

- 1. स्थायी चुंबक

- 2. अस्थायी चुंबक

- 3. इलेक्ट्रोमैग्नेट्स

Permanent Magnet:

Permanent magnets are those magnets that are commonly used. They are known as permanent magnets because they do not lose their magnetic property once they are magnetized.

Following are the ways to demagnetize the permanent magnets:

1. Exposing magnets to extreme temperatures.

2. The magnetic attraction between the magnet's atoms gets loosen when they are hammered.

3. Stroking one magnet with the other in an inappropriate manner will reduce the magnetic strength.

- **<u>स्थायी चुंबक</u>**:
- स्थायी मैग्नेट वे मैग्नेट होते हैं जो आमतौर पर उपयोग किए जाते हैं। उन्हें स्थाई चुम्बक के रूप में जाना जाता है क्योंकि वे चुम्बकित होने के बाद अपनी चुंबकीय संपत्ति नहीं खोते हैं।

- स्थाई चुम्बकों को निष्क्रिय करने के तरीके निम्नलिखित हैं:

- 1. अत्यधिक तापमान पर मैग्नेट का एक्सपोजर।

- 2. चुंबक के परमाणुओं के बीच चुंबकीय आकर्षण ढीला होने पर ढीला हो जाता है।

- 3. एक चुंबक को दूसरे के साथ अनुचित तरीके से मारने से चुंबकीय शक्ति कम हो जाएगी।

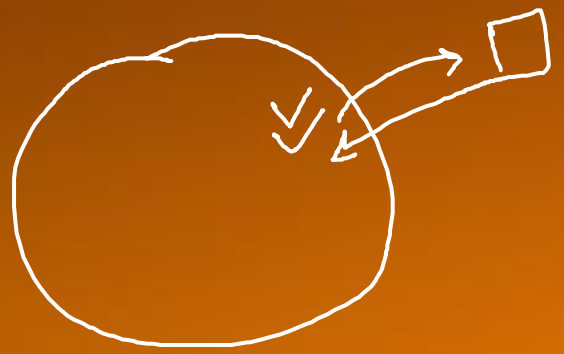
There are four types of permanent magnets:

- Ceramic or ferrite
- Alnico
- Samarium Cobalt (SmCo)
- Neodymium Iron Boron (NIB)

• Temporary Magnet :

Temporary magnets can be magnetized in the presence of a magnetic field. When the magnetic field is removed, these materials lose their magnetic property. Iron nails and paper-clips are examples of the temporary magnet

चुंबकीय क्षेत्र की उपस्थिति में अस्थायी चुम्बकों को चुम्बकित किया जा सकता है। जब
चुंबकीय क्षेत्र हटा दिया जाता है, तो ये पदार्थ अपनी चुंबकीय संपत्ति खो देती हैं। लौहे के
कील और पेपर-क्लिप अस्थायी चुंबक के उदाहरण हैं



- **Electromagnets:**

Electromagnets consist of a coil of wire wrapped around the metal core made from iron. When this material is exposed to an electric current, the magnetic field is generated making the material behave like a magnet. The strength of the magnetic field can be controlled by controlling the electric current.

इलेक्ट्रोमैग्नेट्स में लोहे से बने धातु कोर के चारों ओर तार के एक तार होते हैं। जब यह

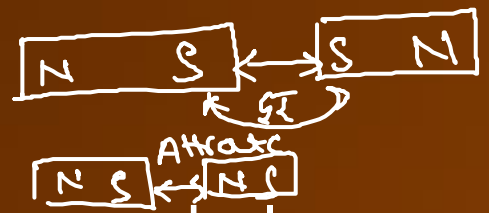
पदार्थ एक विद्युत प्रवाह के संपर्क में होती है, तो चुंबकीय क्षेत्र उत्पन्न होता है जिससे

पदार्थ चुंबक की तरह व्यवहार करती है। विद्युत धारा को नियंत्रित करके चुंबकीय क्षेत्र की

ताकत को नियंत्रित किया जा सकता है

Characteristics of Magnet

Attractive property: This property proves that the magnetic strength at the ends of the poles is strong.



Directive property: This property helps to understand which pole of the magnet is north and south by suspending the magnet in mid-air.

Law of magnetic poles: Like poles repel while unlike poles attract.

Pair property: When a magnet is cut into two pieces, both the pieces will have the North Pole and the South Pole.

Sure test of magnetization: This test is conducted to check if a given rod is magnetized or not by checking either the attraction or the repulsion of the iron rod and magnet.

Uses of Magnets

Magnets are used for constructing magnetic needles and mariner's compass.

Permanent magnets find applications in generators, electric accelerators, and electric motors.

Electromagnets find application in speakers, electric bells, and electric cranes.

Magnets are used for the separation of iron filling from other solid mixture.

- मैग्नेट का उपयोग
- मैग्नेट का उपयोग चुंबकीय सुई और मेरिनर के कम्पास के निर्माण के लिए किया जाता है।
- स्थायी मैग्नेट जेनरेटर, इलेक्ट्रिक एक्सेलेरेटर और इलेक्ट्रिक मोटर्स में अनुप्रयोग पाते हैं।
- इलेक्ट्रोमैग्नेट्स स्पीकर, इलेक्ट्रिक बेल्स और इलेक्ट्रिक क्रेन्स में एप्लिकेशन ढूंढते हैं।
- अन्य ठोस मिश्रण से लोहे के भराव को अलग करने के लिए चुंबक का उपयोग किया जाता है।

MAGNETIC FIELD

- Magnetic Field is the region around a magnetic material or a moving electric charge within which the force of magnetism acts.

- Symbol B or H
- Unit Tesla
- Base Unit (Newton Second)/Coulomb

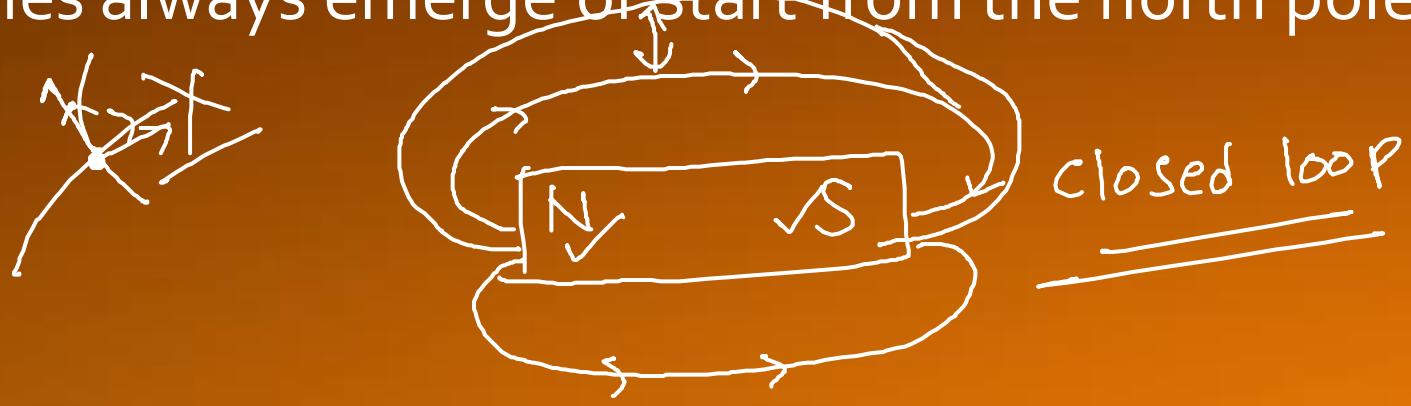
Properties of Magnetic Field Lines

Magnetic field lines never cross each other

The density of the field lines indicates the strength of the field

Magnetic field lines always make closed-loops

Magnetic field lines always emerge or start from the north pole and terminate at the south pole.



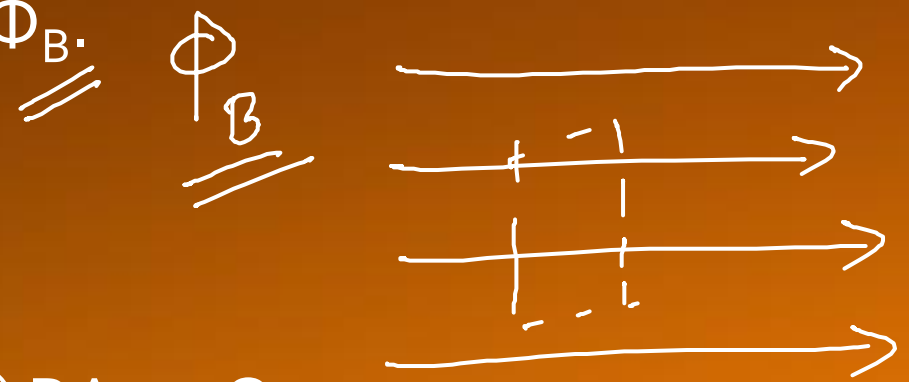
MAGNETIC FLUX

- **Magnetic flux** is defined as the number of magnetic field lines passing through a given closed surface. It provides the measurement of the total magnetic field that passes through a given surface area.

Symbol

Magnetic flux is commonly denoted using Greek letter Phi or Phi suffix B.

Magnetic flux symbol: Φ or Φ_B.



Formula

$$\varphi B = \vec{B} \cdot \vec{A} = BA\cos\Theta$$

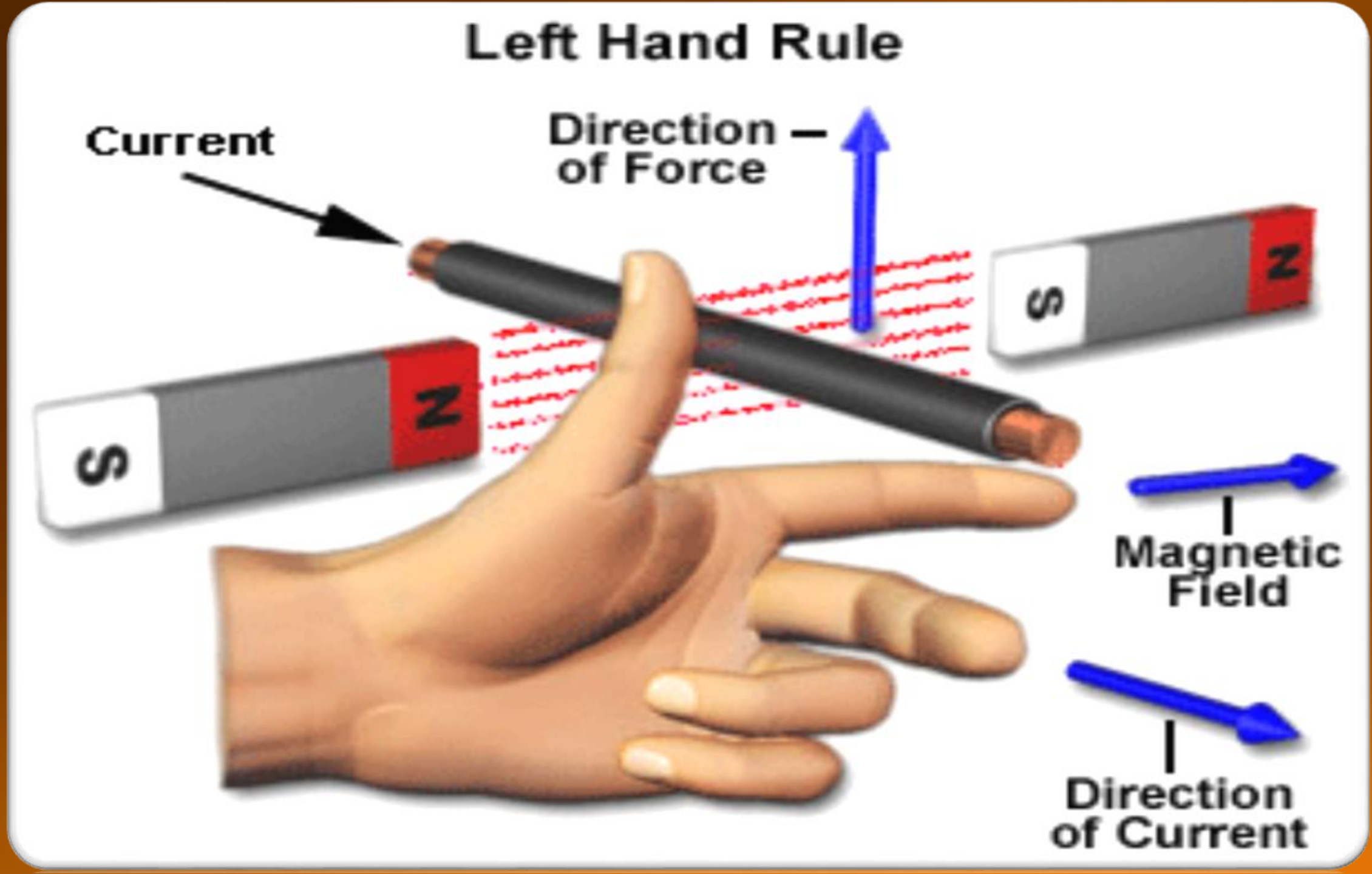
Magnetic Flux Unit

Magnetic flux is usually measured with a **flux meter**.

SI unit of magnetic flux is **Weber (Wb).**

The fundamental unit is **Volt-seconds.**

The CGS unit is **Maxwell.**


Left Hand Rule
Current
Direction of Force
S
N
S
N
Magnetic Field
Direction of Current

Introduction

- **Magnetic Materials** are those materials in which a state of magnetization can be induced. In other words, The materials which can be magnetized are known as Magnetic Materials.
- **Magnetic Moment** is a measure of the strength of a magnet. It is the product of strength of one of the poles and the distance between the two poles of a magnet.

Classification Of Magnetic Material

- Magnetic materials are classified into different categories based on their magnetic parameters. And also on the basis of effect of temperature and magnetic field on the magnetic properties.
- So, all materials are classified broadly into the following three categories
  - Diamagnetic Materials
  - Paramagnetic Materials
  - Ferromagnetic Materials
  - Antiferromagnetic Materials
  - Ferrimagnetic Materials

These are having very close structure to ferromagnetic materials but posses different magnetic effect.

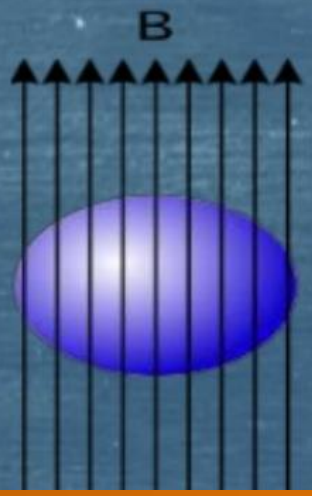
Diamagnetic Materials

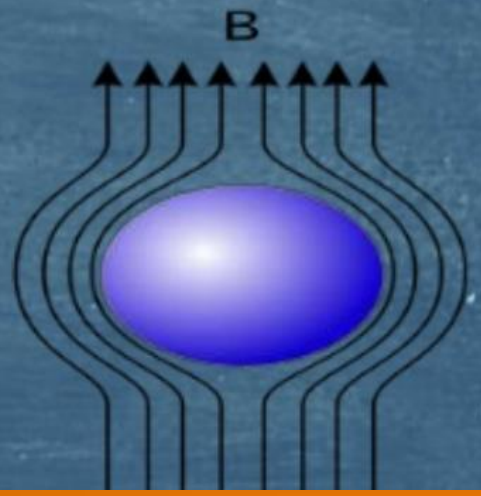
(प्रतिचुम्बकीय)

e.g.

Bi
Zn
Cu
Ag
Au
NaCl
H_2O
Hg
N_2
:

- **Diamagnetic** materials create an induced magnetic field in a direction opposite to an externally applied magnetic field.
- They are repelled by the applied magnetic field.
- The permanent dipoles are absent in Diamagnetic materials





General Properties of Diamagnetic Materials

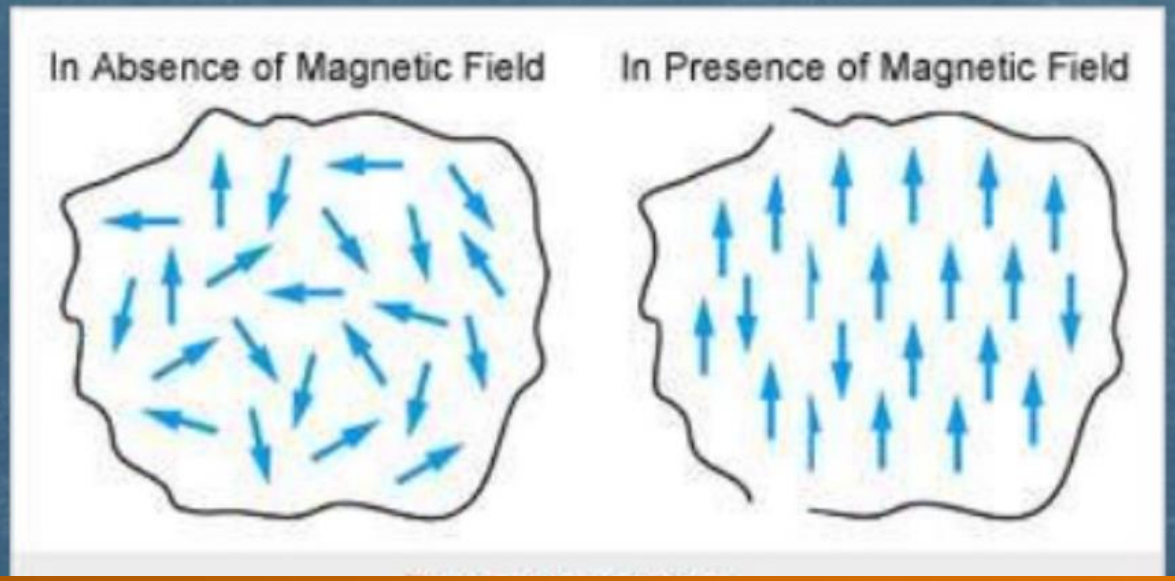
- Diamagnetic Materials experiences a repelling force when brought near the pole of a strong magnet.
- The magnetic susceptibility χ of these materials is always negative.
- The relative permeability μr is always less than one.
- In the absence of external magnetic field ,The net magnetic dipole moment over each atom or molecule of a diamagnetic material is zero. This is due to pairing of electrons.
- Examples:-Bismuth,Copper,Lead,Zinc etc.

Paramagnetic Material

(अनुचुम्बकीय)

Cr
Al
Na
Pt
Mn

- Paramagnetic materials exhibit magnetism when the external magnetic field is applied. Paramagnetic materials loose magnetization in the absence of an externally applied magnetic field. These materials are weakly attracted towards magnetic field.

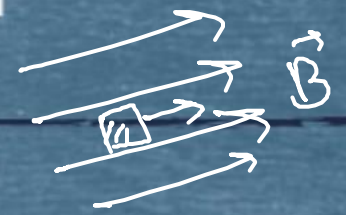


General Properties of Paramagnetic materials

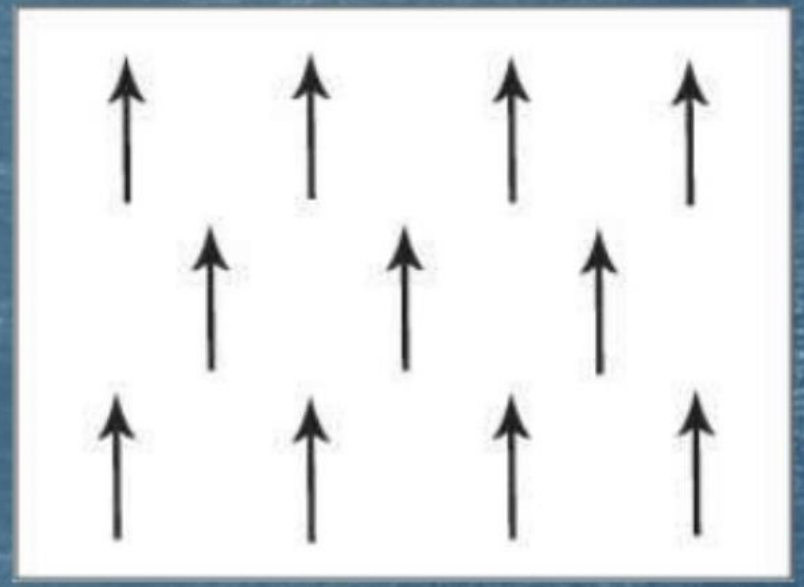
- Paramagnetic materials experiences a feeble attractive force when brought near the pole of a magnet
- These materials possess some permanent dipole moment which arise due to some unpaired electrons.
- The magnetic susceptibility χ is small and +ve.
- Examples:-Platinum,Aluminium,Copper sulphate etc.

Ferromagnetic Material

(लौह चुम्बकीय)



- It is the phenomenon in which a material gets magnetized to a very large extent in the presence of an external field.
- The direction in which the material gets magnetized is the same as that of the external field.



Fe, Ni, Co,

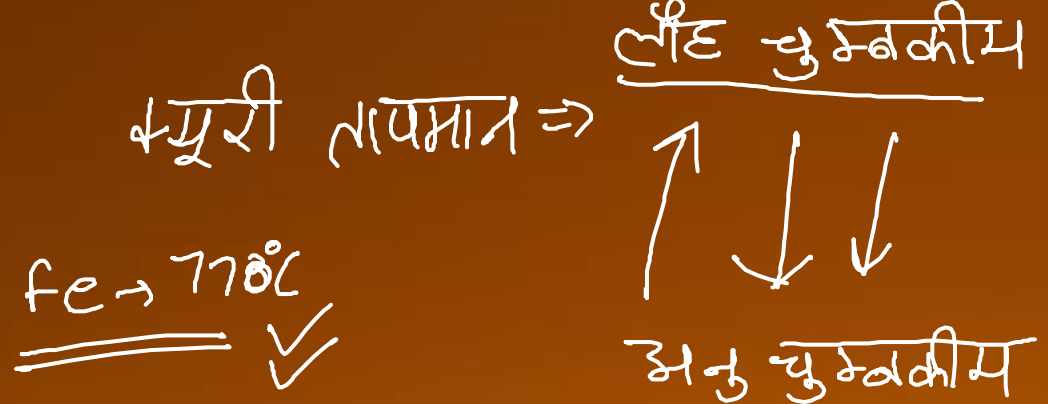
Fe_3O_4

General Properties of ferromagnetic materials

- Ferromagnetic materials experience a very strong attractive force when brought near the pole of a magnet.
- Permeability is very much greater than one.
- Susceptibility is +ve and high.
- Examples:-Fe,Co,Ni,MnAs etc.

CURIE TEMPERATURE

- The Curie temperature is the one at which ferromagnetic material turns to paramagnetic o heating. This kind of transition is used in optical storage media for erasing and inserting new data.



INDUCED EMF

- It can be defined as the generation of a potential difference in a coil due to the changes in the magnetic flux through it.

- In simpler words, electromotive Force or EMF is said to be induced when the flux linking with a conductor or coil changes.

Electromotive forces can be induced in two different ways –

- The first way involves the placement of an electric conductor in a magnetic field that is moving.
- The second way involves the placement of a constantly moving conductor of electricity into a magnetic field that is static in nature.

Applications

Used in generators

Used in galvanometers

Used in transformers

LENZ'S LAW

- The induced electromotive force with different polarities induces a current whose magnetic field opposes the change in magnetic flux through the loop in order to ensure that original flux is maintained through the loop when current flows in it.

Lenz's Law Formula

$$Emf = -N(\Delta\varphi/\Delta t)$$

Where,

Emf is the induced voltage (also known as electromotive force).

N is the number of loops.

$\Delta\varphi$ Change in magnetic flux.

Δt Change in time

Lenz's Law Applications

Eddy current balances

Metal detectors

Eddy current dynamometers

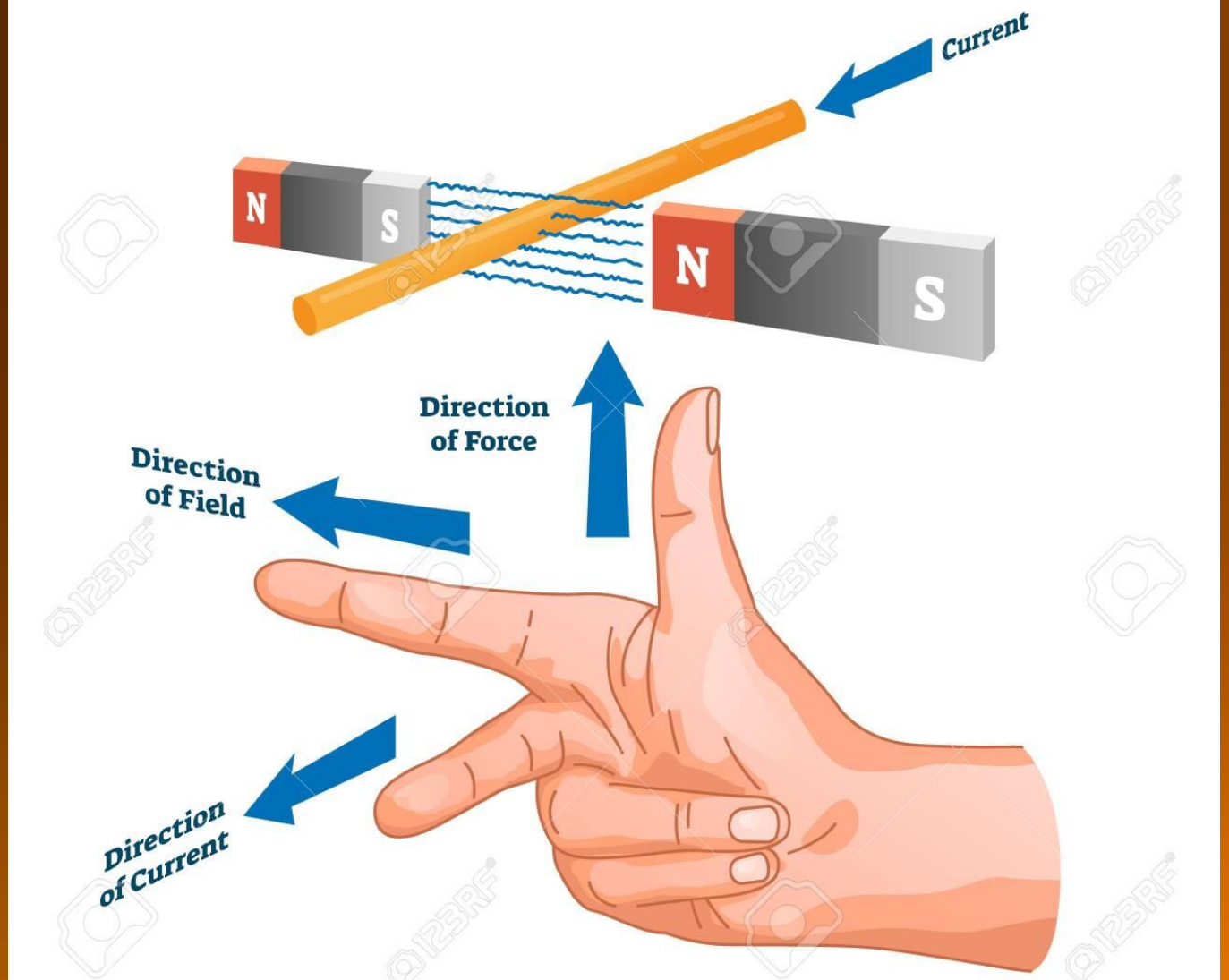
Braking systems on train

AC generators

Card readers

Microphones

FLEMING'S
RIGHT HAND RULE



Induction

Induction is the magnetic field which is proportional to the rate of change of the magnetic field.

Induction is also known as inductance. L is used to represent the inductance and Henry is the SI unit of inductance.

Factors Affecting Inductance

The number of turns of the wire used in the inductor.

The material used in the core.

The shape of the core.

- **Types of Inductance**

Self Induction

Mutual Induction

www.Youtube.com/safaltaclass

www.Facebook.com/safaltaclass

www.Instagram.com/safaltaclass

Google Play Store

SAFALTACLASS