NAFYAD SCHOOL

PHYSICS DEPARTEMENT

SHORT NOTE FOR GRADE 10TH

2ND SEMESTER

UNIT 4

ELECTROMAGNETISM

PART ONE

INTRODUCTION TO ELECTROMAGNETISM

OBJECTIVE OF LESSON

- **At the end of this lesson the student should summarized the following points**:.

  -Define the term of electromagnetism.

  -Merging the main concepts of electricity and magnetism.

  -Investigating the concept of magnetic domain.

  -Describes magnetic field and electric field.

  -Uses and applies right hand rule to know the direction of magnetic field.

  -Calculate the magnetic field strength(intensity) due to a straight current carrying wire, around acicular loop wire current carrying wire and around at the center of the solenoid.

ELECTROMAGNETISM

- Electromagnetism :is a branch of physics that deals about the relationship between electricity and magnetism.
- Electricity :is also a branch of electromagnetism that concerns about the flow of electric charge(current) and the effect of current when it flow through the wire such as:

  -Electric charge -Electric field

  -Electric current -Electric field line

  -The law of electrostatics and etc
- **Magnetism: is** the branch of electromagnetism that deals about the effect of magnet in any electronics equipment.
- With out merging the concepts of electricity and magnetism(Electromagnetism) it is impossible to consider the operation of the following device such as:

ELECTROMAGNETISM

- Electric motor
- Transformer
- Generator
- Electric bell
- Electric meters
- The operation of computer
- Compass
- Video and audio recorder tape

All this device can operates based on the concept of electromagnetism

ELECTROMAGNETISM

- with out electromagnetism we would not even see for light(optics) it self. Because it can originates in the interaction between magnetism and electricity.
- Electric current is the source of all magnetism
- Further experimentation shows that it is impossible to separate north and south poles in the manner that + and –charges can be separated.
- **MAGNET**: is a piece of iron ,steel. alloy .ore and etc that has the property of attracting iron and points approximately north-south when suspended.
- The fist magnetic phenomena is observed from a natural magnet called "lodestone”
- The lodestone was found near the ancient city of magnesia and the name of this region is the source of words like "magnetic”

example: *Iron
*Nickel
*Steel

ELECTROMAGNETISM

- Depending on magnetism substance can be categorized into two parts.

substance

Magnetic substance

The substance that are attracted by magnet is called magnetic substance

examples

- ✓ Steel
- ✓ Iron
- ✓ cobalt

Nonmagnetic substance

The substance that do not attracted by magnet is called Non magnetic substance

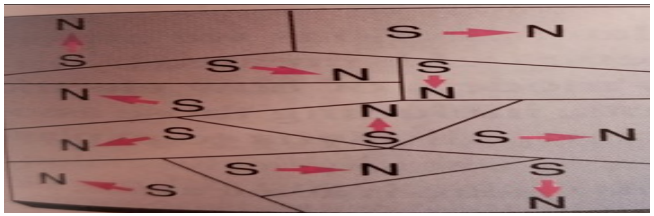
examples

- ✓ rubber
- ✓ gold
- ✓ Mica
- ✓ Plaster
- ✓ Glass
- ✓ Wood
- ✓ Aluminum

Magnetic domain:

- regions called domains act like small bar magnets.
- within domain the pole of individual atoms are aligned.
- Each atom acts like a tiny bar magnet.
- Depending the orientation of magnetic domain the material becomes .magnetized or unmagnetized.
- When the magnetic domain are aligned ,the material becomes highly magnetized as shown below.

- When the magnetic domain are points randomly, the material becomes unmagnetized as shown below.



- **Magnetic shielding**:
- It is the process of limiting the penetration of magnetic field using a barrier of conductive material.

  example:-metal sheet

  -metal foam

  -plasma(ionized gas)
- Magnetic shielding can prevent or stops the equipment from being affected by a magnet.
- **Property of magnet**
- Every Magnet can attract a magnet substance.
- Every Magnet can contain two distinct points called" poles" I,e north pole and south pole.
- The pole of the magnet never to be separated like electric charge.(There is no magnet that contain identical pole)
- Like pole always repel to each other and unlike pole always attract to each other this is called the law of magnetism.

MAGNETIC FIELD:

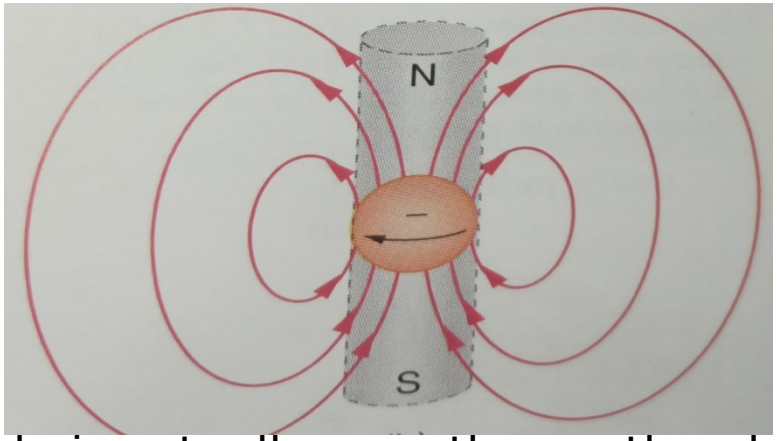
- It is region(place where the magnetic force are experienced and the law of magnetism is implement.
- It is vector physical quantity.
- It can represented by “$\vec{B}$ “

MAGNETIC FIELG LINE:

- They are an imaginary lines that originate from the north pole and terminate to south pole outside of the magnet and reverses inside the magnet.
- Magnet field line never cross to each other. meaning the field is unique at any point in space.
- Magnetic field lines are continuous, forming closed loops with out beginning or end.
- The strength of the field is proportional to the closeness of the line.
- The direction of the magnetic field is tangent to the field line at any point in space.
- A small compass will point in the direction of the field line.

ELECTROMAGNETISM

- In planetary model of the atom, an electron orbits a nueclus forming a closed current loop and creating a magnetic field with a north and south pole as shown below



- The north geographic pole is actually near the south pole of the earth's magnetic field
- **Magnetic field lines a round a current carrying wire**

***The direction of magnetic field can be determine by using the right hand rule.**

***According to right hand rule"if you grasp the wire with your right hand in such way that your thumb is pointing in the direction of the current ,then your fingers will curl in the direction of magnetic field .**

ELECTROMAGNETISM

- The magnitude of the magnetic field due to a current carrying wire becomes,

$$\vec{B} = \frac{\mu I}{2\pi r}$$

WHERE * I=ELECTRIC CURRENT

B=MAGNETIC FIELD

r=distance to point

μ=permability of free space

$\mu = 4\pi \times 10^{-7}$ Tm/A

- The magnitude of magnetic field strengths at the center of circular loop wire becomes,

$$\vec{B} = \frac{N\mu I}{2R}$$

WHERE *N=no of turns

R=radius of circular loop

- **Solenoid:** is a coil that contain many turns with an electric currents. So that the magnitude of the magnetic field strengths in side the solenoid becomes

$$\vec{B} = \frac{\mu N I}{l} = \mu n I$$

WHERE *l=length of solenoid

n=no of turn per length

The SI unit of magnetic field strength is Tesla.

QUESTION

- 1. Compute magnitude of a magnetic field strength in air at a point 6cm from a long straight wire carrying a current of36A.
- 2. Five very long straight insulated wires are closely bound together to form a small cable. Currents carried by the wires are $I_1=I_2=I_3=I_4=I_5=18A$ then find the magnetic field at a distance of 10cm from the cables?
- 3. At what perpendicular distance from a long straight wire carrying a current of 10Ain a magnetic field of 5μT?
- 4. A solenoid of 20 turn per millimeter can carries a current of 15A through the wire. Calculate the magnetic field inside the solenoid?

Ends of part one