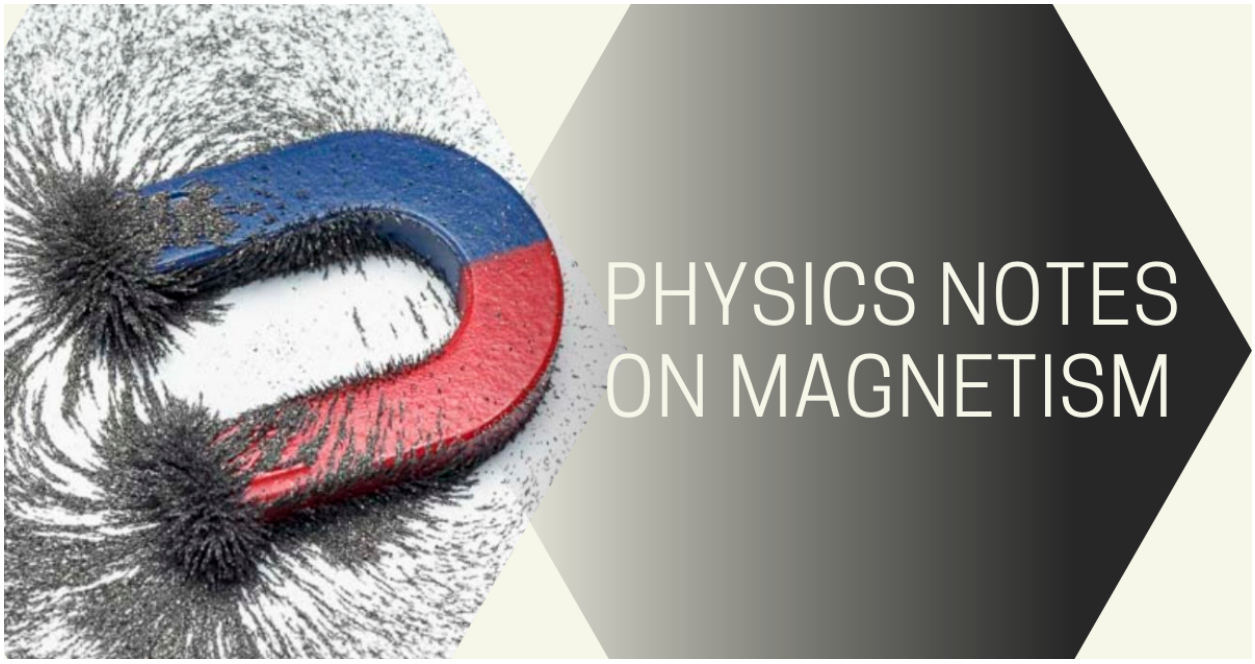


Physics Notes on Magnetism

• In magnetism, we study about the magnet and its properties

➤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.

➤For Example

• A bar magnet, a horseshoe magnet etc.

• A freely suspended magnet always aligns itself into North-South direction. Like magnetic poles repel and unlike magnetic poles attract each other.

• A current-carrying coil containing a soft iron core is called an electromagnet.

• An electromagnet is utilised in the electric bell, telegraph receiver, telephone diaphragm, transformer, dynamo etc.

• Permanent magnets are made of steel and temporary magnet or electromagnets are made of soft iron because steel cannot be magnetised easily but when it is magnetised

one time, cannot be demagnetised easily. The soft iron can be magnetised or demagnetised easily.

➤Properties of Magnet

• Attractive property A magnet can attract small pieces of magnetic substances like iron, steel, cobalt, nickel etc. The attraction is maximum at poles. Unlike poles attract and like poles repel.

• Directive property A magnet, when suspended freely, aligns itself approximately along the geographical N-S line.

• Magnetic poles exist in pairs If a magnet is cut into two equal parts transverse to its length, then N and S-poles of the magnet do not get separated.

➤Magnetic Field

• The space in the surrounding of a magnet or a current-carrying conductor in which its magnetic effect can be experienced is called magnetic field.

• Magnetic lines of force is an imaginary line drawn in the magnetic field at which a magnetic North pole will move if it is free to do so.

• A tangent drawn at any point of a magnetic line of force represents the direction of magnetic field at that point.

• The magnetic flux linked with a surface is equal to the total number of magnetic lines of force passing through that surface normally. Its unit is Weber.

• Magnetic flux, f = A. = BA cos q

• Magnetic Force Acting on a Charge

• Moving in Uniform Magnetic Field

• The magnetic force on a moving charge in a magnetic field is given by F = Bqv sin q

where, B = magnetic field, q = charge, v = speed

q = angle between the direction of motion and magnetic field.

Magnetic Force Acting on a Current-Carrying Conductor Placed in Uniform Magnetic Field

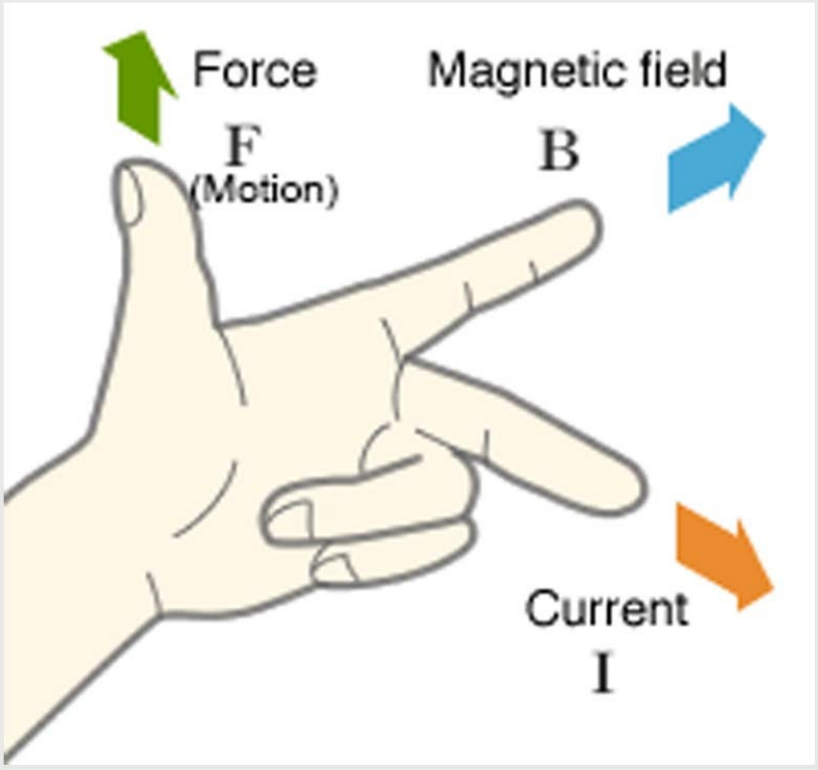
• If a conductor carrying element / is placed in a magnetic field, the magnetic force on it is given by F = Bill sin q

where, I = electric current flowing through the conductor q = angle between the direction of the current and magnetic field.

The direction of this force can find out by Fleming's left-hand rule which is given below.

FLEMING'S LEFT HAND RULE

Fleming's left hand rule states that, when u keep the thumb, index finger and middle finger of the left hand right angle to each other, if the middle finger shows the direction of current, index finger shows the direction of magnetic field, then the thumb will show the direction of motion. This law explains the working of a DC motor.



• If we stretch the thumb, then the forefinger and the middle finger of the left hand in such a way that all three are perpendicular to each other and if forefinger represents the direction of magnetic field, middle finger represents the direction of current flowing through the conductor, then thumb will represent the direction of magnetic force.

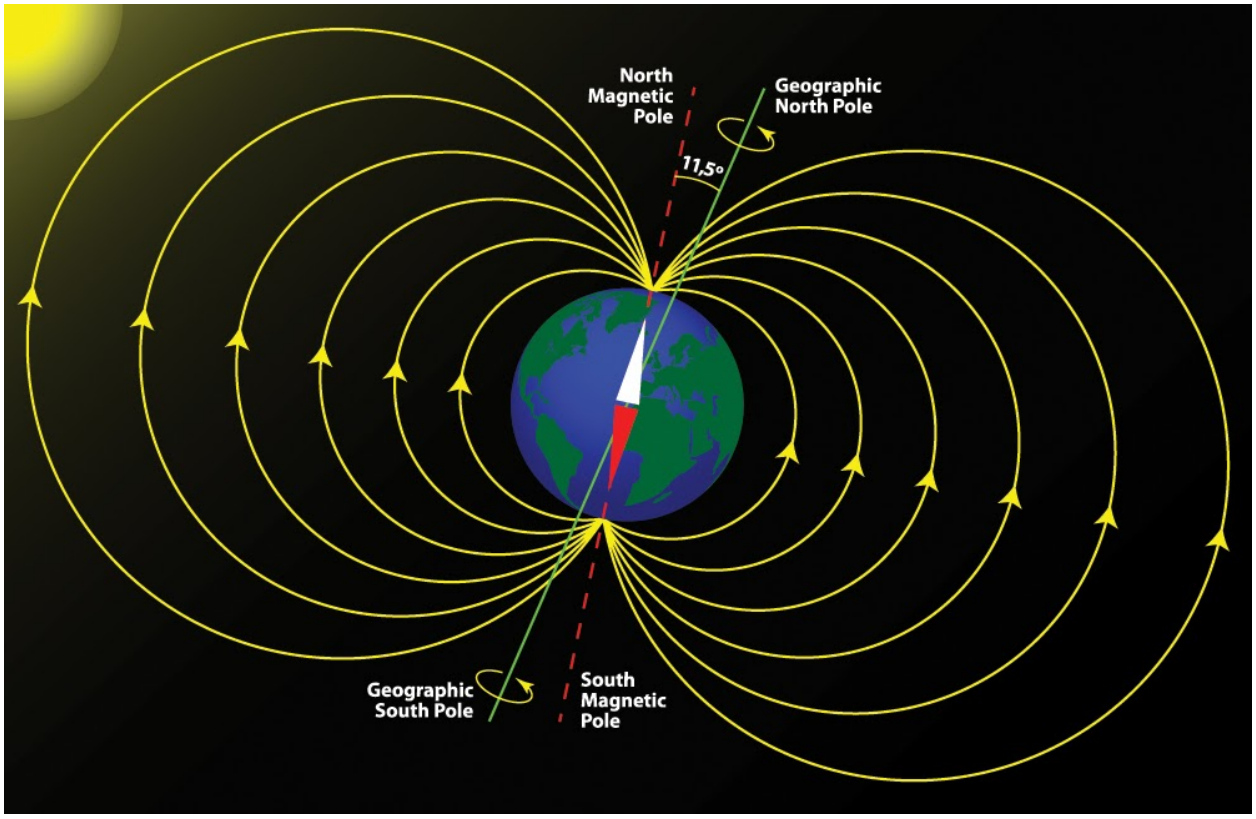
➤Earth's Magnetism

• The earth has its own magnetic field and it resembles that of a magnetic dipole located at the centre of the earth. The pole near the geographic North of the earth is called the magnetic North pole. Similarly, the pole near the geographic South pole is called the magnetic South pole.

• The Earth's magnetic field diverts charged particle coming from space towards its poles and saves living beings from being severely harmed.

• Magnetic compass A magnetic needle which always directs in North-South (N-S) direction.

• Neutral point A point in a magnetic region where the net magnetic field is zero.



➤Magnetic Storm

•Local disturbances in the earth's magnetic field which can damage telecommunication which is probably caused by a lump of charged particles emanating from the sun is known as the magnetic storm.

➤Coil Places in Uniform Magnetic Field

When a coil having N number of turns, each of area of cross-section A carrying current *I* is placed in a uniform magnetic field B, then a torque acts on it, which tries to rotate it.

Torque, $\tau = NB/A \sin q$

➤Moving Coil Galvanometer

• A moving coil galvanometer is used to detect the presence of current and the direction of current in any circuit.

• When current is passed through a coil, suspended in a magnetic field, a torque acts on it. As coil rotates, a restoring torque acts on phosphor bronze strip due to twist produce in it. In equilibrium, both torques become equal the pointer stops for a short moment and coil starts to rotate in opposite direction.

➤Ammeter and Voltmeter

• An ammeter is an instrument used to measure electric current. It is always connected in series. The resistance of an ideal ammeter is zero.

• A galvanometer can be converted into an ammeter by connecting a low resistance in parallel.

• A voltmeter is a device used to measure the potential difference between two points in an electric circuit.

• The resistance of an ideal voltmeter is infinity. It is always connected in parallel.

• A galvanometer can be converted into a voltmeter by connecting a high resistance in series.

• A small resistance connected in parallel with the load resistance to reduce the amount of electric current through the resistor is called a shunt.