BASICS FOR EMI

Lorentz force

- Lorentz force for electro- magnetism is
- $F = qE + q(v \times B).$

- If any charge moves in magnetic field it experiences the force i.e. Lorentz magnetic force

- $F = Q (V \times B) = QVB \sin\theta$

- . An interesting result of the Lorentz force is the motion of a charged particle in a uniform magnetic field. If v is perpendicular to B (i.e., with the angle θ between v and B of 90°), the particle will follow a circular trajectory with a radius of r = mv/qB.

- Charged particle accelerators like cyclotrons make use of the fact that particles move in a circular orbit when v and B are at right angles. For each revolution, a carefully timed electric field gives the particles additional kinetic energy, which makes them travel in increasingly larger orbits. When the particles have acquired the desired energy, they are extracted and used in a number of different ways, from studies of subatomic particles to the medical treatment of cancer.

- If the angle θ is less than 90°, the particle orbit will be a helix with an axis parallel to the field lines.

- If θ is zero, there will be no magnetic force on the particle, which will continue to move undeflected along the field lines.
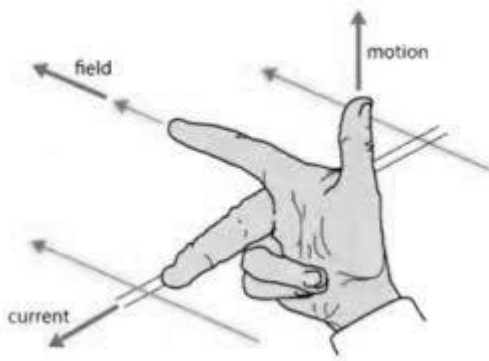
   How to determine direction of LORENTZ FORCE ON CHARGE PARTICLE?
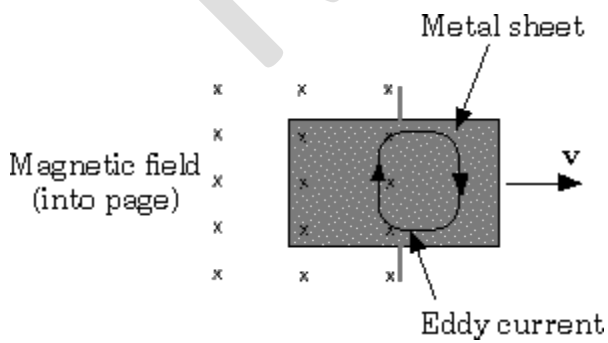- Answer is Flemings left hand rule
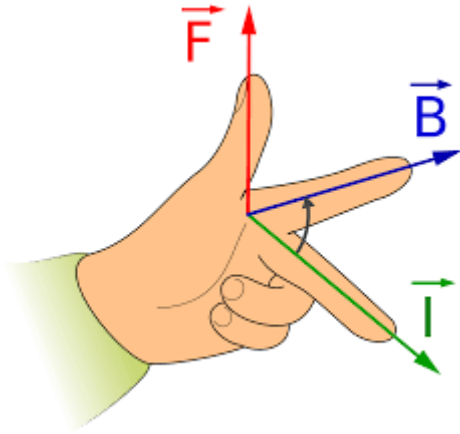
How to find direction of current in conductor placed in an uniform magnetic field?

- Answer is right hand rule

EDDY CURRENT

1. Eddy current is the outcome of Lorentz magnetic force, In above example V and B is perpendicular to each other hence charge is acted upon by magnetic force which make it move in circular orbit

2. MAGNETIC FORCE = CENTRIPITAL FORCE
3. QVB = MV^2/R
4. This circular path forms eddy like structure or whirlpool.

Lenz law shows conservation of energy?

Yes, lenz law holds conservation of energy.
Assume an ideal situation where the coil is rotating in the magnetic field. There is no friction, no force opposing the rotation of the coil in the field. From Newton's first law of motion, the coil will continue its motion unless it is acted upon by an external force.

As per Faraday's law, the EMF will be induced in the coil. Because it passes through the magnetic field and cuts the flux associated with it.

So now, if there is no external force acting on the coil, it will continue to rotate and produce an EMF, which is also a form of energy, out of nowhere. This will violate the law of conservation of energy as energy can neither be created nor be destroyed.

Lenz's law states that the current due to induced EMF will flow in such a way that it produces a magnetic field and force which will oppose the motion of a conductor in the magnetic field.

It simply means, to keep the coil rotating in the field, you will have to keep on applying the force on it. That implies that you need to keep on supplying the mechanical energy to the coil, which will be converted into electrical energy. And that's how electricity is produced.

What is generator?
A machine which converts mechanical energy into electrical energy is called generator. It works on the principle of EMI.
When a rectangular conductor is placed in an magnetic field and rotted by means of current or mechanical energy, it experiences a torque thus rotates.
According to Faraday law it cuts flux while rotating in magnetic field hence emf is generated.
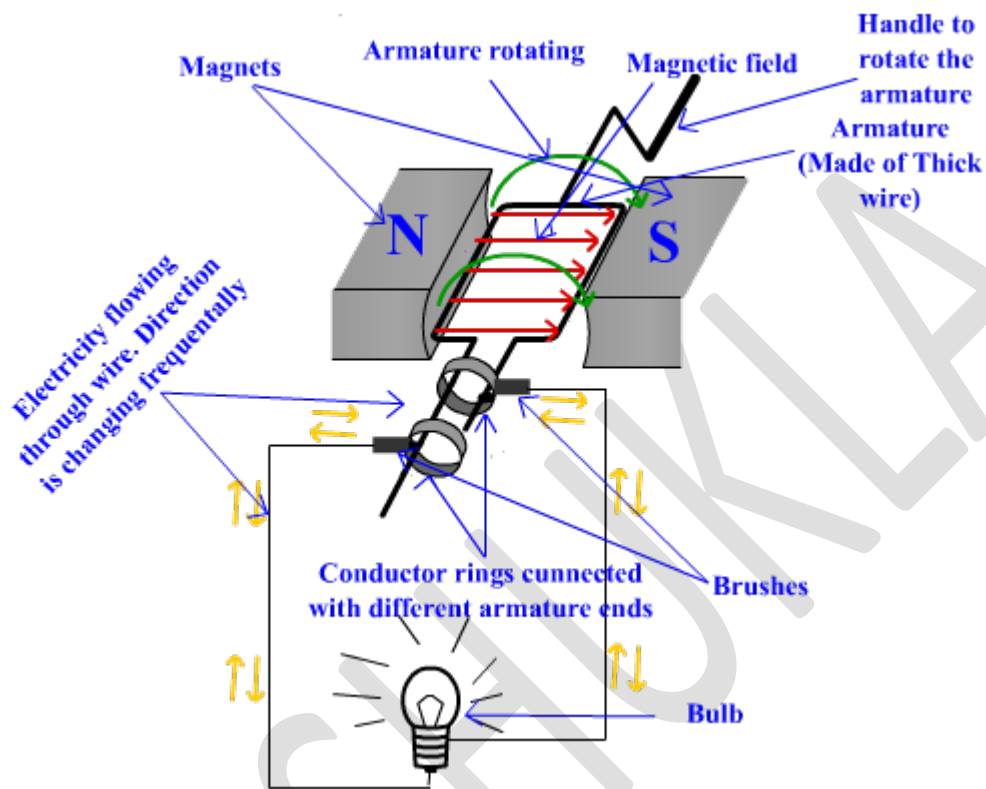
What is sinusoidal function?

Any function whose solution contains sin or cos term with it can be recognise as sinusoidal function

Which physical activity gives sinusoidal function?

When event is Periodic

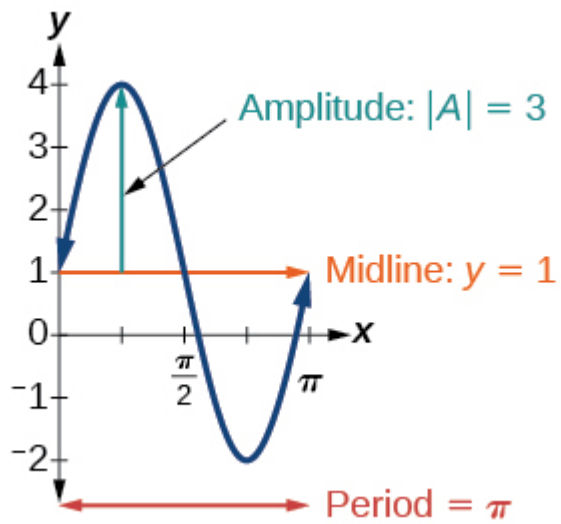When Restoring force is directly proportional to displacement but directed in opposite direction.

EEXAMPLE

X= ASinwt

Here displacement is said to be sinusoidal functional of time.
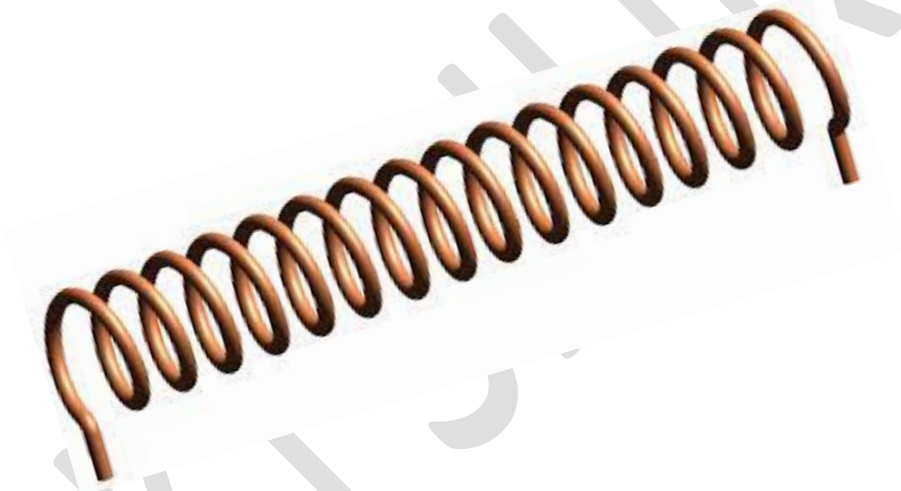
Alternating EMF

e = ESinwt

What is solenoid?

A cylindrical coil of wire acting as a magnet when carrying electric current.

What is function of solenoid?

Solenoid stores magnetic field inside its core. This magnetic field or energy can perform work and bring linear motion.