Electromagnetic Induction

Electricity and Magnetism

Laws of Electromagnetic Induction

Faraday's law of electromagnetic induction

The magnitude of the electromotive force (e.m.f) induced in a closed circuit is directly proportional to the rate of change of the magnetic flux linkage through the area bounded by the circuit.

- Thus, the magnitude of the electromotive force (e.m.f) induced in a conductor is directly proportional to the rate at which magnetic field lines and the conductor cut each other.
- If the conductor is part of a closed circuit, the induced e.m.f produces an induced current through the conductor.

Lenz's Law

The direction of the induced electromotive force (and hence the direction of the induced current in a closed circuit) is such that its magnetic effect opposes the motion or change producing it.

- If the conductor is part of a closed circuit, the induced current produces induced magnetic poles that oppose the cause of the induced emf.

Electromagnetic induction when magnetic field strength changes

Faraday's experiments demonstrate electromagnetic induction by moving a pole of a magnet moves nearer or further away from a solenoid, such that magnetic field lines cut through the solenoid.

Case 1: S moves towards solenoid

1. The South pole of the magnet moves towards the solenoid
2. (By Faraday's law of induction,) the changing magnetic flux linkage through the solenoid (or the magnetic field lines cutting the solenoid) induces an e.m.f in the solenoid.
3. Since the circuit is closed, the induced e.m.f produces an induced current.
4. By Lenz's law, the magnet is repelled by the south pole induced on the right of the solenoid produced by the clockwise induced current when viewed from the right (using the right hand grip rule) that flows from B to A.