ELECTROMAGNETIC INDUCTION

Electromagnetic induction
If there is a change in the connection between the magnetic field and a conductor, an emf is induced across the conductor. If the conductor is part of a completed circuit, a current is induced.

Faraday's law of electromagnetic induction
If a conductor and a magnetic field move relative to each other, an emf is induced across the ends of the conductor.
Induced emf ∝ rate of change in magnetic flux.

number of turns/ windings; change in magnetic flux (Wb); induced emf (V); elapsed time (s)

$$\varepsilon = \frac{-N\Delta\Phi}{\Delta t}$$

Lenz's law
The induced current flows in such a direction that it sets up a second magnetic field which counteracts the change in flux.

Fig. 1

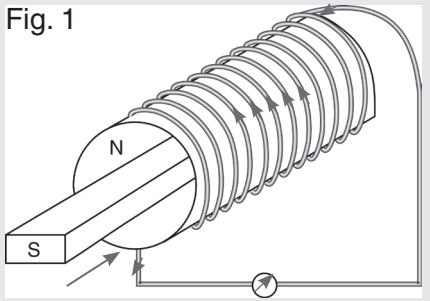
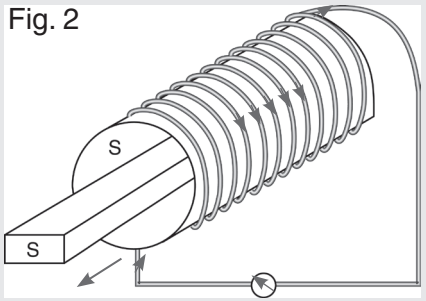


Fig. 2



- Hold the solenoid in your right hand.
- Determine where the N pole is induced.
- Indicate the direction of the N pole using your thumb.
- The direction that you curled fingers show is then the direction of the induced conventional current (+ to -).

Magnetic flux density

- number of turns in the coil; magnetic flux density (T); magnetic flux (Wb)

$$B = N\Phi$$

- Magnetic flux (ϕ)
  The product of the number of turns (N) on the coil and the magnetic flux (Φ) through the coil.
  SI unit: weber (Wb)

$$\Phi = BA\cos\theta$$
$$\therefore \Phi = B_{\perp}A$$

surface (m^2); magnetic flux (Wb); magnetic field strength (T)

- Induced emf (ε)
  SI unit: volt (V)

$\Phi = BA\cos\theta$; magnetic flux (Wb); magnetic field strength (T); surface (m^2); θ = angle between B and the normal to surface A

Strength of induced current
Determined by:
- number of turns in solenoid (N);
- magnetic field strength (B);
- area (A) of coil moving in magnetic field;
- rate at which the magnetic flux changes.

- **Right hand rule to determine the direction of the induced current in a solenoid.**

Determine the induced N pole using Lenz's law.
Thumb: direction of N pole
Curled fingers: direction of induced conventional current direction