Faraday's Law

Faraday's Law of Induction

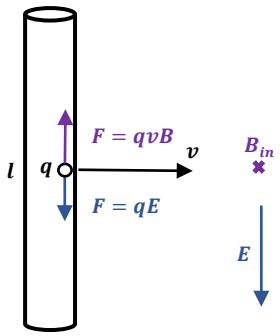
an induced emf is produced in the loop by the changing magnetic field

$$\boxed{\varepsilon = -\frac{d\Phi_B}{dt}}$$

the total emf induced by N-loop coil:

$$\varepsilon = -N\frac{d\Phi_B}{dt}$$

Motional Emf



the electron in the conductor experiences the

force $\vec{F} = q\vec{v} \times \vec{B}$

when the force is balanced:

$qE = q\vec{v} \times \vec{B}$

$\Delta V = El$

$\Rightarrow \boxed{\Delta V = Blv}$

sliding conducting bar with constant velocity v

$$\varepsilon = -\frac{d\Phi_B}{dt} = -\frac{d}{dt}(Blx)$$

$$= -b = Bl\frac{dx}{dt}$$

$$= \boxed{-Blv}$$

$$I = \frac{Blv}{R}$$

rotating conducting bar with constant angular velocity ω

$$d\varepsilon = Bvdr$$

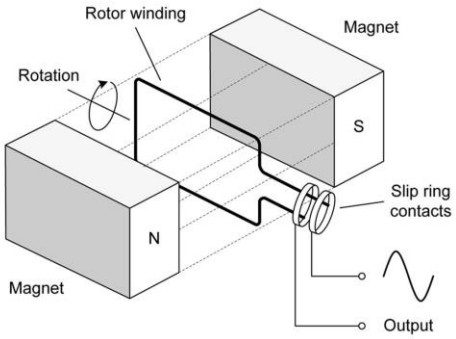
$$\varepsilon = \int_0^l d\varepsilon = \int_0^l Bvdr = B\omega\int_0^l rdr$$

$$= \boxed{\frac{1}{2}B\omega l^2}$$

Lenz's Law

the induced current in a loop is in the direction of creating a magnetic field that opposes the change in magnetic flux

Generator



begin when the plane of coil is perpendicular to the magnetic field

$$\varepsilon = -N\frac{d\Phi_B}{dt}$$

$$= -NBA\frac{d}{dt}(\cos \omega t)$$

$$= \boxed{\omega NBA \sin \omega t}$$