Class 33 Lenz's Law

Lenz's Law

Direction of the induced emf (clockwise or counter clockwise) is determined by the Lenz's Law:

1. Make a sketch of the situation for use in visualizing and recording directions.
2. Identify the direction of the magnetic field B.
3. Ask yourself, *with respect to the external magnetic field B*, whether the flux is increasing or decreasing.

Lenz's Law →

4. The induced magnetic field B opposes the change in flux, i.e. The induced magnetic field is in opposite direction to the external field if the flux is increasing and it will be in the same direction as the external field if the flux is decreasing.

Biot-Savart →

5. Now determine the direction of the induced current I that is responsible for the induced magnetic field B.
6. The direction (or polarity) of the induced emf will now drive a current in this direction and can be represented as current emerging from the positive terminal of the emf and returning to its negative terminal.

Faraday's Law for changing θ: Generator

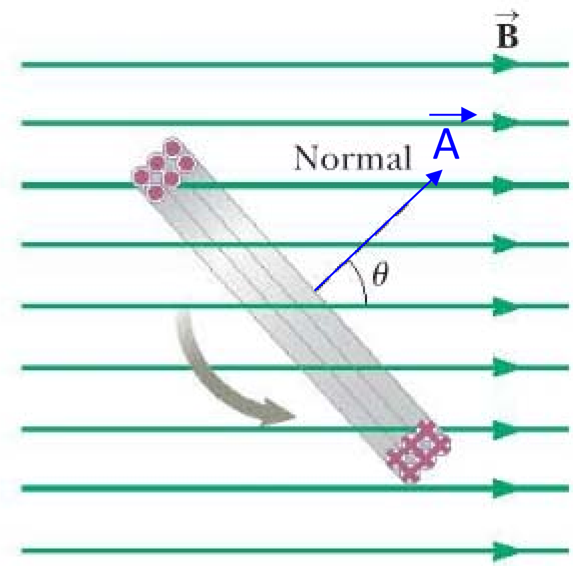


Figure 31.18 A cutaway view of a loop enclosing an area A and containing N turns, rotating with constant angular speed ω in a magnetic field. The emf induced in the loop varies sinusoidally in time.

$$\theta = \omega t$$

$$\theta = 0 \text{ at } t = 0$$

$$\oint_{\text{loop}} \vec{E} \cdot d\vec{s} = -\frac{d}{dt}\left(\int \vec{B} \cdot d\vec{A}\right)$$

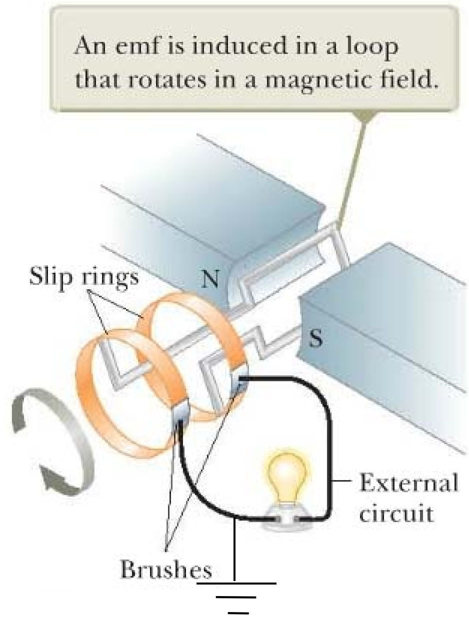
$$= -\frac{d}{dt}\left(\int B \cdot N dA \cos \omega t\right)$$

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

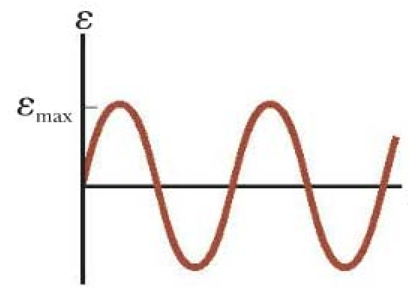
$$= NBA\omega \frac{d}{dt} \cos \omega t$$

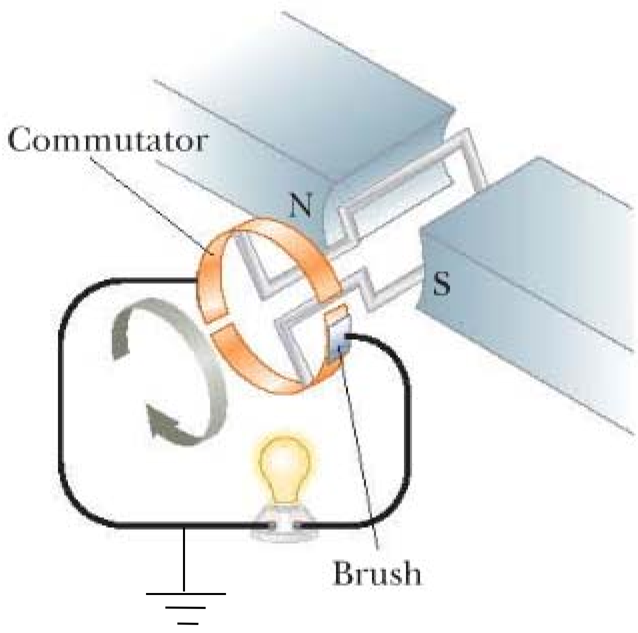
$$\therefore \boxed{\varepsilon = NBA\omega \sin \omega t}$$

AC and DC Generators



AC Generator





DC Generator