PHYS 1444 - Lecture 10
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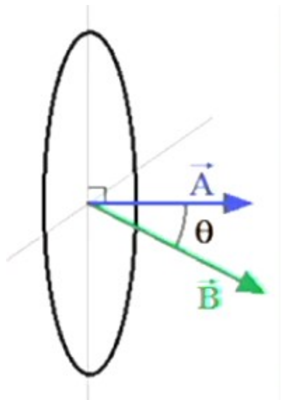
1 Magnetic Flux and Faraday's Law

We can find magnetic flux just like how we find electric flux. The dot product of the area vector and the magnetic field vector gives us magnetic flux.

$$\underbrace{\Phi_B}_{\text{Magnetic flux}} = \overrightarrow{B} \cdot \overrightarrow{A}$$



Constant magnetic flux does nothing, but changing magnetic flux (by changing B, A, or θ) creates electric potential (emf).

1.1 Faraday's Law

$$|\text{emf}| = N\frac{d\Phi_B}{dt}$$

A longer form of Faraday's law is

$$|\text{emf}| = N\frac{d(BA\cos(\theta))}{dt} = N\frac{dB}{dt}A\cos(\theta) + NB\frac{dA}{dt}\cos(\theta) + NBA\frac{d(\cos(\theta))}{dt}$$

But if only one thing at a time is changing (B, A, or θ), then two of those terms will go to 0.

Currents and emfs created in this manner are called "induced". Remember that $d\Phi_B$ might be written as a difference

$$|\text{emf}|_{AVG} = N\frac{\Delta\Phi_B}{\Delta t} = N\frac{(\Phi_B)_{Final} - (\Phi_B)_{Initial}}{\Delta t}$$

2 Electric Generators

Electric generators are the opposite of electric motors. If you have a loop of wire in a magnetic field and you run current through it, it will create force. If you apply force on a loop of wire in an electric field, it will create current.

He derives from Faraday's law, but here's the result:

$$\text{emf} = \omega NBA \sin(\omega t)$$

(You can remember it because it spells "women's NBA")

In a **back EMF**, the current through a motor's coil experiences a force opposing the motion.

$$I = \frac{V - \text{emf}_{back}}{R}$$