Induced emk

$$\mathcal{E} = \oint (\boldsymbol{E} + \boldsymbol{v} \times \boldsymbol{B}) \cdot d\ell$$

$$\mathcal{E} = -\frac{d\Phi}{dt}$$

$$\mathcal{E} = -\frac{d\Lambda}{dt} \quad \text{(coil with multiple turns)}$$

Maxwell's equations

$$\boldsymbol{\nabla} \times \boldsymbol{E} = -\frac{\partial \boldsymbol{B}}{\partial t}$$

$$\boldsymbol{\nabla} \times \boldsymbol{H} = \boldsymbol{J} + \frac{\partial \boldsymbol{D}}{\partial t}$$

$$\boldsymbol{\nabla} \cdot D = \rho$$

$$\boldsymbol{\nabla} \boldsymbol{B} = 0$$

The Conservation Equation

$$\boldsymbol{\nabla} \cdot \boldsymbol{J} + \frac{\partial \rho}{\partial t} = 0$$

Potentials

$$V(\boldsymbol{r}, t) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho\left(\boldsymbol{r}', t - \frac{R}{c}\right)}{R} \, dv' = \frac{1}{4\pi\epsilon_0} \int \frac{\rho_{ret}}{R} \, dv'$$

$$\boldsymbol{A}(\boldsymbol{r}, t) = \frac{\mu_0}{4\pi} \int \frac{\boldsymbol{J}\left(\boldsymbol{r}', t - \frac{R}{c}\right)}{R} \, dv' = \frac{\mu_0}{4\pi} \int \frac{\boldsymbol{J}_{ret}}{R} \, dv'$$

$$\boldsymbol{B} = \boldsymbol{\nabla} \times \boldsymbol{A}$$

$$\boldsymbol{E} = -\boldsymbol{\nabla} V - \frac{\partial \boldsymbol{A}}{\partial t}$$

Magnetic Flow Density

$$\boldsymbol{B}(\boldsymbol{r}, t) = \frac{\mu_0}{4\pi} \int \frac{\boldsymbol{J}_{ret} \times \boldsymbol{e}_R}{R^2} \, dv' + \frac{\mu_0}{4\pi c} \int \frac{\boldsymbol{J}'_{ret} \times \boldsymbol{e}_R}{R} \, dv'$$

Filamentuos Antenna

$$\boldsymbol{B} = \frac{\mu_0}{4\pi} \int \frac{i(z, t - R/c) d\boldsymbol{l} \times \boldsymbol{e}_R}{R^2} + \frac{\mu_0}{4\pi c} \int \frac{i(z, t - R/c) d\boldsymbol{l} \times \boldsymbol{e}_R}{R}$$

Oscillating Electric Dipole

$$\boldsymbol{B} = \frac{\mu_0}{4\pi} \frac{\boldsymbol{p}'(t - R/c) \times \boldsymbol{e}_R}{R^2} + \frac{\mu_0}{4\pi c} \frac{\boldsymbol{p}''(t - R/c) \times \boldsymbol{e}_R}{R}$$

Oscillating Magnetic Dipole

$$\boldsymbol{B} = -\frac{\mu_0}{4\pi} \frac{\boldsymbol{m}'(t - R/c) \times \boldsymbol{e}_R}{R^2} - \frac{\mu_0}{4\pi c} \frac{\boldsymbol{m}''(t - R/c) \times \boldsymbol{e}_R}{R}$$

Pointing's Vector

$$\boldsymbol{P}_S(\boldsymbol{r}, t) = \boldsymbol{E}(\boldsymbol{r}, t) \times \boldsymbol{H}(\boldsymbol{r}, t)$$