Formula Sheet
LC Electromagnetism 1 / Temperature & Matter / Electric Circuits

Useful Formulae for Electromagnetism 1

Force between two charges

$$\mathbf{F} = \frac{q_1 q_2}{4\pi\epsilon_0 r^2}\hat{\mathbf{r}}_{\mathbf{12}}$$

Coulomb's Law

$$\mathbf{E} = \frac{Q}{4\pi\epsilon_0 r^2}\hat{\mathbf{r}}$$

Coulomb potential

$$V = \frac{Q}{4\pi\epsilon_0 r}$$

Gauss' Law

$$\int_S \mathbf{E} \cdot d\mathbf{S} = \frac{Q_{enc}}{\epsilon_0}$$

Field and potential relation

$$\mathbf{E} = -\nabla V$$

Electric Dipole

$$\mathbf{p} = q\mathbf{a}$$

Torque on Electric Dipole

$$\boldsymbol{\tau} = \mathbf{p} \wedge \mathbf{E}$$

Energy of Electric Dipole

$$U = -\mathbf{p} \cdot \mathbf{E}$$

Capacitance

$$C = \frac{Q}{V}$$

Stored energy in capacitor

$$U = \frac{1}{2}CV^2$$

Energy density of E-field

$$u_E = \frac{1}{2}\epsilon_0 E^2$$

Lorentz Force

$$\mathbf{F} = q\left(\mathbf{E} + \mathbf{v} \wedge \mathbf{B}\right)$$

Force on current length

$$\mathbf{F} = I\boldsymbol{\ell} \wedge \mathbf{B}$$

Magnetic dipole

$$\boldsymbol{\mu} = I\mathbf{A}$$

Torque on magnetic dipole

$$\boldsymbol{\tau} = \boldsymbol{\mu} \wedge \mathbf{B}$$

Energy of magnetic dipole

$$U = -\boldsymbol{\mu} \cdot \mathbf{B}$$

Biot Savart law

$$\delta\mathbf{B} = \frac{\mu_0 I}{4\pi}\frac{\delta\mathbf{l} \wedge \hat{\mathbf{r}}}{r^2}$$

Ampere's Law

$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I$$

E.M.F

$$\epsilon = -N\frac{d\Phi_m}{dt}$$

Faraday's Law

$$\oint \mathbf{E} \cdot d\mathbf{l} = -\frac{d\Phi_m}{dt}$$

Inductance

$$N\Phi_m = LI$$

Stored energy in inductor

$$U_L = \frac{1}{2}LI^2$$

Energy denisty of B-field

$$u_B = \frac{1}{2}\frac{B^2}{\mu_0}$$