$$\mathbf{F}_{12} = \frac{Q_1Q_2}{4\pi\varepsilon}\frac{(\mathbf{r}_2-\mathbf{r}_1)}{|\mathbf{r}_2-\mathbf{r}_1|^3} = \frac{Q_1Q_2}{4\pi\varepsilon R_{12}^2}\widehat{\mathbf{a}}_{R_{12}} \quad \text{[N]}$$

$$\mathbf{E} = \frac{Q}{4\pi\varepsilon}\frac{(\mathbf{r}-\mathbf{r}')}{|\mathbf{r}-\mathbf{r}'|^3} \quad \text{[V/m]}$$

$$\mathbf{E} = \frac{1}{4\pi\varepsilon}\int_L \frac{\rho_L(\mathbf{r}-\mathbf{r}')}{|\mathbf{r}-\mathbf{r}'|^3}\,dl' \quad \text{[V/m]}$$

$$\mathbf{E} = \frac{1}{4\pi\varepsilon}\int_S \frac{\rho_S(\mathbf{r}-\mathbf{r}')}{|\mathbf{r}-\mathbf{r}'|^3}\,dS' \quad \text{[V/m]}$$

$$\mathbf{E} = \frac{1}{4\pi\varepsilon}\int_v \frac{\rho_v(\mathbf{r}-\mathbf{r}')}{|\mathbf{r}-\mathbf{r}'|^3}\,dv' \quad \text{[V/m]}$$

$$\oint_S \mathbf{D}\cdot d\mathbf{S} = Q_{enc} \quad \text{[C]}$$

$$Q = \int_v \rho_v\,dv$$

$$\nabla\cdot\mathbf{D} = \rho_v \quad \text{[C/m}^3\text{]}$$

$$\nabla\times\mathbf{E} = 0$$

$$W = -Q\int_{P_1}^{P_2}\mathbf{E}\cdot d\mathbf{l} \quad \text{[J]}$$

$$V = -\int_{P_1}^{P_2}\mathbf{E}\cdot d\mathbf{l} \quad \text{[V]}$$

$$V = \frac{1}{4\pi\varepsilon}\int_L \frac{\rho_L}{|\mathbf{r}-\mathbf{r}'|}\,dl' \quad \text{[V]}$$

$$V = \frac{1}{4\pi\varepsilon}\int_S \frac{\rho_S}{|\mathbf{r}-\mathbf{r}'|}\,dS' \quad \text{[V]}$$

$$V = \frac{1}{4\pi\varepsilon}\int_v \frac{\rho_v}{|\mathbf{r}-\mathbf{r}'|}\,dv' \quad \text{[V]}$$

$$\mathbf{E} = -\nabla V \quad \text{[V/m]}$$

$$V = \frac{Qd\cos\theta}{4\pi\varepsilon r^2} \quad \text{[V]}$$

$$\mathbf{E} = \frac{Qd}{4\pi\varepsilon r^3}(2\cos\theta\widehat{\mathbf{a}}_r + \sin\theta\widehat{\mathbf{a}}_\theta) \quad \text{[V/m]}$$

$$w_E = \frac{1}{2}\varepsilon E^2 \quad \text{[J/m}^3\text{]}$$

$$W_E = \frac{1}{2}\int_v \varepsilon E^2\,dv \quad \text{[J]}$$

$$I = \int_S \mathbf{J}\cdot d\mathbf{S} \quad \text{[A]}$$

$$\mathbf{J} = \rho_v\mathbf{u} \quad \text{[A/m}^2\text{]}$$

$$\mathbf{J} = \sigma\mathbf{E} \quad \text{[A/m}^2\text{]}$$

$$R = \frac{\rho l}{S} = \frac{l}{\sigma S} \quad [\Omega]$$

$$P = \int_v \mathbf{J}\cdot\mathbf{E}\,dv \quad \text{[W]}$$

$$\mathbf{D} = \varepsilon\mathbf{E} \quad \text{[C/m}^2\text{]}$$

$$\varepsilon = \varepsilon_r\varepsilon_0 \quad \text{[F/m]}$$

$$\varepsilon_0 = 8.854\times10^{-12} \quad \text{[F/m]}$$

$$\nabla\cdot\mathbf{J} = -\frac{\partial\rho_v}{\partial t} \quad \text{[A/m}^3\text{]}$$

$$\rho_v(t) = \rho_{v_0}e^{-t/T_r} \quad \text{[C/m}^3\text{]}$$

$$T_r = \varepsilon/\sigma \quad \text{[s]}$$

$$E_{1t} = E_{2t},\ D_{1n} - D_{2n} = \rho_s \quad \text{(diel-diel)}$$

$$E_{1t} = 0,\ D_{1n} = \rho_s \quad \text{(diel-cond)}$$

$$C = \frac{Q}{V} \quad \text{[F]}$$

$$C = \frac{\varepsilon S}{d} \quad \text{[F]}$$

$$C = \frac{2\pi\varepsilon L}{\ln(b/a)} \quad \text{[F]} \quad b > a$$

$$C = \frac{4\pi\varepsilon}{1/a - 1/b} \quad \text{[F]} \quad b > a$$

$$\nabla^2 V = -\frac{\rho_v}{\varepsilon}$$

$$\nabla^2 V = 0$$

$$\int \frac{dx}{[x^2+a^2]^{3/2}} = \frac{x}{a^2\sqrt{x^2+a^2}}$$

$$\int \frac{x\,dx}{[x^2+a^2]^{3/2}} = -\frac{1}{\sqrt{x^2+a^2}}$$