

Formulas:

$$F = k \frac{q_1 q_2}{r^2} \quad \text{Coulomb's law} ; k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \text{ N} \cdot \text{m}^2 / \text{C}^2 ; \epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 / \text{Nm}^2$$

$$\text{Electric field: } \vec{E} = \frac{q}{4\pi\epsilon_0 r^2} \hat{r} = \frac{kq}{r^2} \hat{r} ; \quad \vec{E}(\vec{r}) = k \int \rho(\vec{r}') \frac{\vec{r} - \vec{r}'}{|\vec{r} - \vec{r}'|^3} d^3 r' ; \quad \vec{F} = q_0 \vec{E}$$

$$\text{Linear, surface, volume charge density: } dq = \lambda d\ell \quad , \quad dq = \sigma da \quad , \quad dq = \rho dv$$

$$\text{Electric field of infinite: line of charge: } E = \frac{\lambda}{2\pi\epsilon_0 r} ; \quad \text{sheet of charge: } E = \frac{\sigma}{2\epsilon_0}$$

$$\text{Gauss law: } \Phi = \oint \vec{E} \cdot d\vec{a} = \frac{q_{enc}}{\epsilon_0} = \frac{1}{\epsilon_0} \int d^3 r \rho(\vec{r}) ; \quad \Phi = \text{electric flux}$$

$$\text{Energy: } U = k \frac{q_1 q_2}{r_{12}} \quad U = \frac{\epsilon_0}{2} \int E(\vec{r})^2 d^3 r$$