Equations

$$\overrightarrow{F_{12}} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r_{12}^2}\,\hat{r}_{12} \quad (Point\ Charge) \quad \overrightarrow{E} = \overrightarrow{F}/q_{test} = \frac{1}{4\pi\epsilon_0}\frac{q}{r_{12}^2}\,\hat{r}_{12}$$

$$\Phi = \oint \overrightarrow{E}\cdot d\overrightarrow{A} = \oint \overrightarrow{E}\cdot \hat{n}dA = \frac{q_{enclosed}}{\epsilon_0}, \qquad \Phi = E\ A\ (special\ cases)$$

$$(Sphere)\ A = 4\pi r^2, (Cylinder)\ A = 2\pi rL, (Sheet)\ A = L^2 + L^2 (two\ sides)$$

$$\overrightarrow{F} = m\overrightarrow{a}, \qquad x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2, \qquad v_x = v_{0x} + a_x t$$

$$-\Delta U = W = \int \overrightarrow{F}\cdot d\overrightarrow{s}, \qquad Kinetic\ Energy = \frac{1}{2}mv^2$$

$$\overrightarrow{F}_{total} = \sum_i \overrightarrow{F_i} \qquad \overrightarrow{E}_{total} = \sum_i \overrightarrow{E_i} \qquad V_{total} = \sum_i V_i$$

$$Q = CV, \qquad U = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}, \qquad C = \kappa C_0, \quad E = \frac{E_0}{\kappa}, \quad \epsilon = \kappa\epsilon_0$$

$$(V_F - V_I) = -\int_I^F \overrightarrow{E}\cdot d\overrightarrow{s}, \qquad E_x = -\frac{\partial V}{\partial x},\ E_y = -\frac{\partial V}{\partial y},\ E_z = -\frac{\partial V}{\partial z},$$

$$C = \frac{\epsilon_0 A}{d}\ Parallel\ Plate, \quad C = \frac{2\pi\epsilon_0 L}{ln(b/a)}\ Cylindrical, \quad C = 4\pi\epsilon_0\frac{ab}{a-b}\ Spherical$$

$$(series) 1/C_{equiv} = 1/C_1 + 1/C_2 + ..., \qquad (parallel) C_{equiv} = C_1 + C_2 + ...$$

$$I = \frac{dq}{dt}, \quad I = \int \overrightarrow{J}\cdot d\overrightarrow{A}, \quad V = IR, \quad R = \frac{\rho l}{A}, \quad \rho = \frac{1}{\sigma}$$

$$\rho - \rho_0 = \rho_0\alpha(T - T_0), \qquad \rho = \frac{m}{e^2 n\tau}, \qquad P = IV$$

$$(series) R = R_1 + R_2 + R_3 ...\ , \qquad (parallel)\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$$

$$(charging) \quad Q = Q_0(1 - e^{-\frac{t}{RC}}), \quad \tau = RC, \quad CV = Q, \quad I = \frac{V}{R}e^{-\frac{t}{RC}}$$

$$(discharging) \quad Q = Q_0 e^{-\frac{t}{RC}}, \quad I = -\frac{Q_0}{RC}e^{-\frac{t}{RC}}$$

Constants

$$\epsilon_0 = 8.85\times 10^{-12}\ \frac{F}{m} = 8.85\times 10^{-12}\ \frac{C^2}{Nm^2}$$

$$e = 1.60\times 10^{-19}\ C \qquad M_{electron} = 9.11\times 10^{-31}\ kg$$