

Constants: $e = 1.6 \times 10^{-19}$ C $m_p = 1.67 \times 10^{-27}$ kg $m_e = 9.1 \times 10^{-31}$ kg micro = 10^{-6}
 $\epsilon_o = 8.85 \times 10^{-12}$ C²/N · m² $k = 1/(4\pi\epsilon_o) = 9 \times 10^9$ N · m²/C² $\mu_o = 4\pi \times 10^{-7}$ T · m/A nano = 10^{-9}

Coulomb's Law: $|\vec{F}| = \frac{|q_1||q_2|}{4\pi\epsilon_o r^2}$ (point charge)

Electric field: $\vec{E} = \frac{\vec{F}}{q}$ $\vec{E} = \frac{q}{4\pi\epsilon_o r^2} \hat{r}$ (point charge) $\vec{E} = \int \frac{dq}{4\pi\epsilon_o r^2} \hat{r}$ (general) $E = \frac{\sigma}{2\epsilon_o}$
(plane)

Gauss' law: $\Phi = \hat{n} \cdot \vec{E} A = \oint \hat{n} \cdot \vec{E} dA = \frac{q_{enc}}{\epsilon_o}$

Energy: $W = \int \vec{F} \cdot d\vec{s} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = K_f - K_i$

For conservative forces $U_f - U_i = - \int \vec{F} \cdot d\vec{s} \rightarrow K_i + U_i = K_f + U_f$

Electric potential: $V = \frac{U}{q}$ $V = \frac{q}{4\pi\epsilon_o r}$ (point charge) $V = \int \frac{dq}{4\pi\epsilon_o r}$ (general)

$V_b - V_a = - \int_a^b E_x dx = - \int_a^b \vec{E} \cdot d\vec{s}$ $E_x = -\frac{\partial V}{\partial x}$, $E_y = -\frac{\partial V}{\partial y}$, $E_z = -\frac{\partial V}{\partial z}$

Capacitors: $q = CV$ $C = \frac{K\epsilon_o A}{d}$ (parallel-plate) $C = C_1 + C_2$ (parallel)

$U = \frac{q^2}{2C}$ $u = \frac{1}{2}\epsilon_o E^2$ $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$ (series)

Resistors: $i = \frac{dq}{dt} = jA$ $R = \frac{V}{i}$ $R = \frac{\rho L}{A}$ (wire) $P = iV$ $R = R_1 + R_2$ (series)

$q = CV(1 - e^{-t/RC})$ (charging) $q = q_o e^{-t/RC}$ (discharging) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ (parallel)

Magnetism: $\vec{F} = q\vec{v} \times \vec{B}$ $\vec{F} = i\vec{L} \times \vec{B}$ $\mu = NiA$ $\vec{\tau} = \vec{\mu} \times \vec{B}$ $U = -\vec{\mu} \cdot \vec{B}$

$d\vec{B} = \frac{\mu_o}{4\pi} \frac{id\vec{s} \times \hat{r}}{r^2}$ $\oint \vec{B} \cdot d\vec{s} = \mu_o i_{enc}$ $B = \frac{\mu_o i}{2\pi R}$, (wire) $\frac{\mu_o i}{2R}$ (loop center), $\frac{\mu_o iN}{L}$ (solenoid)