Formula Sheet:

$$\vec{E}=\frac{1}{4\pi\epsilon_0}\frac{q}{r^2}\hat{r} \qquad \oint \vec{E}.d\vec{A}=\frac{q_{enclosed}}{\epsilon_0}$$

$$\Delta U=q\Delta V=-q\int_a^b \vec{E}.d\vec{s} \ , \quad V=\frac{1}{4\pi\epsilon_0}\frac{q}{r}$$

$C=\frac{\epsilon_0 A}{d}$, parallel-parallel capacitor $\qquad C=2\pi\epsilon_0\frac{L}{\ln(b/a)}$, cylindrical capacitor

$C=4\pi\epsilon_0\frac{ab}{b-a}$, spherical capacitor $\qquad U_E=\frac{q^2}{2C}=\frac{1}{2}CV^2 \qquad u_E=\frac{1}{2}\epsilon_0 E^2$

$$\kappa_e=\frac{C}{C_{vacuum}}$$

$$\vec{E}=\rho\vec{j}=\frac{1}{\sigma}\vec{j} \ , \quad R=\frac{V_{ab}}{i}=\frac{\int_a^b \vec{E}.d\vec{s}}{\int_a^b \vec{j}.d\vec{A}} \ , \quad R=\frac{\rho L}{A} \text{ for a cylindrical resistor}$$

$$\vec{j}=-ne\vec{v}_d$$

$$\vec{F}_B=q\vec{v}\times\vec{B} \ , \qquad d\vec{B}=\frac{\mu_0}{4\pi}\frac{id\vec{s}\times\vec{r}}{r^3} \ , \qquad \oint \vec{B}\cdot\vec{d}s=\mu_0 i$$

$B=\frac{\mu_0 i}{2\pi r}$, for an infinitely long straight wire

$B=\frac{\mu_0 i R^2}{2(R^2+z^2)^{\frac{3}{2}}}$, at a distance z above the center of a loop with radius R

$B=\mu_0 n i$, inside a solenoid $\qquad B=\frac{\mu_0 i_0 N}{2\pi r}$, inside a toroid

$$\Phi_B=\int \vec{B}\cdot\vec{d}A \ , \quad \epsilon=-\frac{d\Phi_B}{dt} \ , \quad \oint \vec{E}\cdot d\vec{s}=-\frac{d\Phi_B}{dt} \ , \quad \epsilon_L=L\frac{di}{dt} \ , \quad L=\frac{N\Phi_B}{i}$$

$L=\mu_0 n^2 lA$, inductance of a solenoid $\qquad L=\frac{\mu_0 N^2 h}{2\pi}\ln\frac{b}{a}$, inductance of a toroid

$$w=\sqrt{(\frac{1}{LC})} \ , \quad U_B=\frac{1}{2}Li^2, u_B=\frac{1}{2\mu_0}B^2 \ , \quad \int \frac{dx}{(x^2+R^2)^{\frac{3}{2}}}=\frac{x}{R^2(x^2+R^2)^{\frac{1}{2}}}$$

$$e=1.6\times10^{-19}C \qquad \epsilon_0=8.85\times10^{-12}C^2N^{-1}m^{-2}=8.85\times10^{-12}Fm^{-1}$$

$$\mu_0=4\pi\times10^{-7}\frac{T\cdot m}{A}=4\pi\times10^{-7}\frac{H}{m}$$