Übersicht: Elektrostatik & Magnetostatik

Elektrostatik
(statische Ladungsverteilung)

$\mathrm{rot}\,\underline{E} = \underline{0}$ (wirbelfrei)

$\Updownarrow$

$\underline{E} = -\nabla\phi$

$\Updownarrow$

$\oint_{\partial F} \underline{E}\cdot d\underline{s} = 0$

$\varepsilon_0\,\mathrm{div}\,\underline{E} = \rho$

$\varepsilon_0 \oint_{\partial V} \underline{E}\cdot d\underline{f} = Q$ (Gauß)

$\Delta\phi = -\frac{1}{\varepsilon_0}\rho$

$$\phi(\underline{r}) = \frac{1}{4\pi\varepsilon_0}\int_{\mathbb{R}^3} d^3r'\,\frac{\rho(\underline{r}')}{|\underline{r}-\underline{r}'|}$$

$$\underline{E}(\underline{r}) = \frac{1}{4\pi\varepsilon_0}\int_{\mathbb{R}^3} d^3r'\,\rho(\underline{r}')\frac{\underline{r}-\underline{r}'}{|\underline{r}-\underline{r}'|^3}$$

Magnetostatik
(stationäre Ströme)

$\mathrm{div}\,\underline{B} = 0$ (quellenfrei)

$\Updownarrow$

$\underline{B} = \nabla\times\underline{A}$

$\Updownarrow$

$\oint_{\partial V} \underline{B}\cdot d\underline{f} = 0$

$\mathrm{rot}\,\underline{B} = \mu_0\,\underline{j}$ — differenzielle Form

$\oint_{\partial F} \underline{B}\cdot d\underline{s} = \mu_0 I$ (Ampère) — Integralform

$\Delta\underline{A} = -\mu_0\,\underline{j}$ — Poisson-Gleichung

falls $\mathrm{div}\,\underline{A} = 0$

$$\underline{A}(\underline{r}) = \frac{\mu_0}{4\pi}\int_{\mathbb{R}^3} d^3r'\,\frac{\underline{j}(\underline{r}')}{|\underline{r}-\underline{r}'|}$$

$$\underline{B}(\underline{r}) = \frac{\mu_0}{4\pi}\int_{\mathbb{R}^3} d^3r'\,\underline{j}(\underline{r}')\times\frac{\underline{r}-\underline{r}'}{|\underline{r}-\underline{r}'|^3}$$