例2 四元有理化 (MKSA)

$k' \equiv \frac{\mu_0}{4\pi}$ μ_0：真空の透磁率

[I]：アンペア (A)

$\left\{\begin{array}{l} L=1m \\ R=1m \\ I=1A \\ \| \\ I_1=I_2 \end{array}\right\}$ $F=2\times10^{-7}N$

$\therefore \mu_0 = 4\pi\times10^{-7}NA^{-2}$

- $1A = ?$ abampere (emu)

$\left\{\begin{array}{l} L=100\,cm \\ R=100\,cm \\ F=2\times10^{-7}N=2\times10^{-2}dyn \end{array}\right\}$ $F_{(dyn)} = 2\frac{\alpha^2}{100}100 = 2\times10^{-2}$

$\therefore \alpha = 10^{-1}$ emu (degree)

$1A = \frac{1}{10}$ abampere

- cgs 二元系についての補足

$[q_{esu}] = [F]^{1/2}L$

電荷間 $F=\frac{q_1q_2}{r^2}$ $\left\{\begin{array}{l} F=1\,dy \\ r=1cm \end{array}\right\}$ $q_1=q_2=1$ esu

電流間 $F=\frac{2I_1I_2}{R}$ $\left\{\begin{array}{l} l=1cm \\ R=1cm \\ F=2dyn \end{array}\right\}$ $I_1=I_2=1$ emu

$[I_{emu}] = [F]^{1/2}$

一方、$[I_{esu}] = [q_{esu}]/T$

$[I_{esu}] = [q_{esu}]/T = [F]^{1/2}L/T$

$[I_{emu}] = [F]^{1/2}$

$\frac{[I_{esu}]}{[I_{emu}]} = L/T \equiv v_0$ → いくつか？

- MKSA系から V_0 を求めてみる.

$1\,dyn = 10^{-5}\,N$

$1\,cm = 10^{-2}\,m$

(クーロンの法則)

$$10^{-5} = \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{(10^{-2})^2}$$

1esu

$$Q = (4\pi\varepsilon_0 \times 10^{-9})^{1/2}\ C$$ ← クーロン

(アンペールの法則)

$$2\times 10^{-5} = 2\frac{\mu_0}{4\pi}\frac{I^2}{10^{-2}}10^{-2}$$

1emu

$$I = \left\{\left(\frac{4\pi}{\mu_0}\right)\times 10^{-5}\right\}^{1/2} A$$

$$1\,esu/sec = (4\pi\varepsilon_0 \times 10^{-9})^{1/2}\ C/s$$

$$1\,emu = \left\{\left(\frac{4\pi}{\mu_0}\right)\times 10^{-5}\right\}^{1/2} A$$

$$\frac{1\,esu/s}{1\,emu} = (\varepsilon_0\mu_0)^{1/2}\times 10^{-2}\ m/s$$

$$\left\{\begin{array}{l}\varepsilon_0 = \dfrac{10^{7}}{4\pi c^2}\\ \mu_0 = 4\pi\times 10^{-7}\end{array}\right\}\ \text{MKSA}$$

$\therefore\ \varepsilon_0\mu_0 = \dfrac{1}{c^2}$ in MKSA

$$(\varepsilon_0\mu_0)^{1/2}\times 10^{-2} = \frac{10^{-2}}{C_{(\text{in MKSA})}} = \frac{1}{C_{(cgs)}}$$

$$C\,j_{emu} = \rho_{esu}\,V$$

$$\frac{1\,esu/s}{1\,emu} = \frac{1}{C_{(cgs)}}$$