Formula sheet

· $m_\mathrm{e} = 9.11 \times 10^{-31}\mathrm{kg}$ $m_\mathrm{p} = 1.67 \times 10^{-27}\mathrm{kg}$ $e = 1.60 \times 10^{-19}\mathrm{C}$
· $K = \frac{1}{4\pi\epsilon_0} = 9.0 \times 10^9 \frac{\mathrm{Nm}^2}{\mathrm{C}^2}$ $\epsilon_0 = 8.85 \times 10^{-12} \frac{\mathrm{F}}{\mathrm{m}}$ $1\,\mathrm{eV} = 1.60 \times 10^{-19}\mathrm{J}$
· $\vec{F}_\mathrm{C} = \frac{Kq_1q_2}{r^2}\hat{\mathbf{r}}$ $\vec{F}_\mathrm{E} = q\vec{E}$
· $\phi_E = \oint_S \vec{E} \cdot d\vec{A} = \frac{Q_\mathrm{enclosed}}{\epsilon_0}$
· $E_\mathrm{line} = \frac{2K|\lambda|}{r} = \frac{2K|Q|}{Lr}$ $E_\mathrm{plane} = \frac{|\eta|}{2\epsilon_0} = \frac{|Q|}{2A\epsilon_0}$ $\vec{E}_\mathrm{cap} = \left(\frac{Q}{\epsilon_0 A}, \mathrm{pos} \to \mathrm{neg}\right)$
· $\frac{mv^2}{2} + U_\mathrm{el}(s) = \frac{mv_0^2}{2} + U_\mathrm{el}(s_0),\ (U \equiv PE_\mathrm{el})$ $U_\mathrm{el} = qEx$ for $\vec{E} = -E\,\hat{i}$
· $V_\mathrm{el} = U_\mathrm{el}/q$ $E_x = -\frac{dV_\mathrm{el}}{dx}$
· $Q = C\Delta V_C$ $\mathrm{farad} = \mathrm{F} = \frac{\mathrm{C}}{\mathrm{V}}$ $C = \frac{\epsilon_0 A}{d}$ $\epsilon_0 = 8.85 \times 10^{-12} \frac{\mathrm{C}^2}{\mathrm{Nm}^2}$
· parallel C_1, C_2: $C_\mathrm{eq} = C_1 + C_2$ series C_1, C_2: $C_\mathrm{eq}^{-1} = C_1^{-1} + C_2^{-1}$
· $\Delta V_\mathrm{loop} = \sum_i \Delta V_i = 0$ $\sum I_\mathrm{in} = \sum I_\mathrm{out}$
· $P = \Delta V I$ $\mathrm{watt} = \mathrm{W} = \mathrm{VA}$ $P_R = \Delta V_R I = I^2 R$
· $\tau = RC$ $Q(t) = Q_0 e^{-t/\tau}$ $I(t) = -\frac{dQ}{dt} = \frac{\Delta V_0}{R} e^{-t/\tau}$
· $\oint_C \vec{B} \cdot d\vec{s} = \mu_0 I_\mathrm{enclosed}$
· $B_\mathrm{wire} = \frac{\mu_0}{2\pi}\frac{I}{d}$ (use RH rule) $\mu_0 = 4\pi \cdot 10^{-7} \frac{\mathrm{Tm}}{\mathrm{A}}$ $\mathrm{tesla} = \mathrm{T} = \frac{\mathrm{N}}{\mathrm{Am}}$
· short coil, $R >> L$ (N turns): $B_\mathrm{coil,centre} = \frac{\mu_0 NI}{2R}$ solenoid, $L >> R$: $B_\mathrm{sol,inside} = \frac{\mu_0 NI}{L}$
· $\vec{F}_\mathrm{m} = q(\vec{v} \times \vec{B})$ force on current $\perp$ to $\vec{B}$: $F_\mathrm{wire} = ILB$
· force betw. parallel wires: $F_\mathrm{2wires} = \frac{\mu_0 L I_1 I_2}{2\pi d}$