FORMULÆ
Physics 1020 Exam 2

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

$$\mathbf{E} = \frac{\mathbf{F}}{q_0}$$

$$\Phi_E = \mathbf{E}\cdot\mathbf{A} = EA\cos\theta$$

$$\Phi_E = \frac{q_{\text{encl}}}{\varepsilon_0}$$

$$R = \rho\frac{L}{A}$$

$$\rho = \rho_0[1+\alpha(T-T_0)]$$
$$R = R_0[1+\alpha(T-T_0)]$$

$$R_s = R_1 + R_2 + R_3 + \cdots$$
$$R_p = \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots\right)^{-1}$$

$$V = IR$$

$$P = IV = I^2R = \frac{V^2}{R}$$

$$C = \frac{Q}{V}$$

$$C = K\,\frac{\varepsilon_0 A}{d} \qquad \text{(parallel plate cap.)}$$

$$C_s = \left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots\right)^{-1}$$
$$C_p = C_1 + C_2 + C_3 + \cdots$$

$$Q = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$$

$$\tau = RC$$

$$L_s = L_1 + L_2 + L_3 + \cdots$$
$$L_p = \left(\frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \cdots\right)^{-1}$$

Circle:

$$C = 2\pi r = \pi d$$
$$A = \pi r^2 = \tfrac{\pi}{4}d^2$$

Sphere:

$$A = 4\pi r^2 = \pi d^2$$
$$V = \tfrac{4}{3}\pi r^3 = \tfrac{\pi}{6}d^3$$

Constants:

$c = 2.99792458 \times 10^8$ m/s
$e = 1.602176565 \times 10^{-19}$ C
$\varepsilon_0 = 8.85418781762038985\ldots \times 10^{-12}$ F/m
$\mu_0 = 4\pi \times 10^{-7}$ N/A^2
$k_c = 1/(4\pi\varepsilon_0) = 8.9875517873681764 \times 10^9$ m/F
$m_e = 9.10938291 \times 10^{-31}$ kg (electron mass)
$m_p = 1.672621777 \times 10^{-27}$ kg (proton mass)

Units:

$$1\text{ eV} = 1.602176565 \times 10^{-19}\text{ J}$$

Resistivities and temp. coeffs. (at $T_0 = 20°$C)

Material	Resistivity ρ (Ω m)	Temp. coeff. α (°C)$^{-1}$
Silver	1.59×10^{-8}	0.0061
Copper	1.68×10^{-8}	0.0068
Gold	2.44×10^{-8}	0.0034
Aluminum	2.65×10^{-8}	0.00429
Tungsten	5.6×10^{-8}	0.0045
Platinum	10.6×10^{-8}	0.003927

Dielectric constants

Material	Dielectric const.
Vacuum	1.0000
Air (1 atm)	1.0006
Paraffin	2.2
Polystyrene	2.6
Paper	3.7
Quartz	4.3

$$F = \frac{\mu_o}{4\pi}\frac{q_1^* q_2^2}{r^2}$$

$$\mathbf{B} = \frac{\mathbf{F}}{q^*}$$

$$\Phi_B = \mathbf{B}\cdot\mathbf{A} = BA\cos\theta$$

$$\Phi_B = 0$$

$$\Delta\mathbf{B}(\mathbf{r}) = \frac{\mu_0}{4\pi}\frac{I\Delta\mathbf{l}\times\hat{\mathbf{r}}}{r^2}$$

$$B(r) = \frac{\mu_0}{2\pi}\frac{I}{r} \qquad \text{(long wire)}$$

$$B = \mu_0 nI \qquad \text{(solenoid)}$$

$$n = N/\ell = \text{turns/length}$$

$$\mathbf{m} = NIA\hat{\mathbf{n}} \qquad \text{(coil of wire)}$$

$$\boldsymbol{\tau} = \mathbf{m}\times\mathbf{B} \qquad \text{(torque)}$$

$$\mathbf{F} = q(\mathbf{E} + \mathbf{v}\times\mathbf{B})$$

$$r_g = \frac{mv_\perp}{|q|B} \qquad \text{(gyroradius)}$$

$$\omega_g = \frac{|q|B}{m} \qquad \text{(gyrofrequency)}$$

$$\mathrm{F} = I\mathbf{l}\times\mathbf{B} \qquad \text{(wire in a mag. field)}$$

$$\frac{F}{\ell} = \frac{\mu_0}{2\pi}\frac{I_1 I_2}{d} \qquad \text{(force between two long wires)}$$

$$\sum B_{||}\Delta\ell = \mu_0 I$$

$$\mathcal{E} = -N\frac{\Delta\Phi_B}{\Delta t}$$

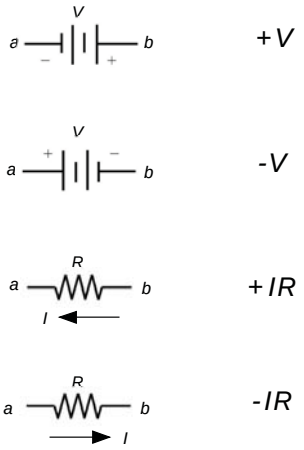

Figure 1: Terms for use in Kirchhoff's voltage rule. The evaluation direction is always from a to b.