1. Falsche Batterie

$$R = 100\ \Omega; \quad R_i = 0.1\ \Omega; \quad U_1 = U_2 = 1.5\ \text{V}$$

a)

$$\begin{aligned} M_1 &: \\ M_2 &: \\ M_3 &: \\ K_1 &: \end{aligned} \boxed{\begin{aligned} &U_1 - R_i(I_1 + I_2) - U_2 = 0 \\ &U_1 - R_i I_1 - RI = 0 \\ &U_2 - R_i I_2 - RI = 0 \\ &I_1 + I_2 = I \end{aligned}}$$

b)

$$I = \frac{2U_1}{R_i + 2R} = \underline{\underline{14.99\ \text{mA}}}$$
$$U = IR = \underline{\underline{1.499\ \text{V}}}$$
$$P = UI = \underline{\underline{22.48\ \text{mW}}}$$

c) $U_1 = 1.5$ V; $U_2 = 1.2$ V

$$I = \frac{U_1 + U_2}{R_i + 2R} = \underline{\underline{13.49\ \text{mA}}}$$
$$U = IR = \underline{\underline{1.349\ \text{V}}}$$
$$P = UI = \underline{\underline{18.21\ \text{mW}}}$$

d)

$$I_1 = \frac{U_1 + U_2}{4R + 2R_i} - \frac{U_2 - U_1}{2R_i} = \underline{\underline{1.51\ \text{A}}}$$
$$I_2 = I - I_1 = \underline{\underline{-1.49\ \text{A}}}$$

2. Umladen von Kondensatoren

a)

$$q_1 = \underline{\underline{\frac{qC_1}{C_1+C_2}}}$$
$$q_2 = \underline{\underline{\frac{qC_2}{C_1+C_2}}}$$
$$U_1 = U_2 = \underline{\underline{\frac{q}{C_1+C_2}}}$$
$$t = \frac{q_2}{I} = \underline{\underline{\frac{qC_2}{(C_1+C_2)I}}}$$

b)

$$U_1(t) = \underline{\underline{\frac{\mathrm{d}U_1(t)}{\mathrm{d}t}C_1 R + U_2(t)}}$$
$$U_2(t) = \underline{\underline{\frac{\mathrm{d}U_2(t)}{\mathrm{d}t}C_2 R + U_1(t)}}$$

c)

$$\Delta U(t) = U_2(t) - U_1(t) = \frac{\mathrm{d}\Delta U(t)}{\mathrm{d}t}R(C_2 - C_1) - \Delta U(t)$$
$$\frac{\mathrm{d}\Delta U(t)}{\mathrm{d}t} = \frac{2}{R(C_2-C_1)}\Delta U(t)$$
$$\Delta U(t) = \underline{\underline{c\,\mathrm{e}^{-\frac{2}{R(C_2-C_1)}t}}}$$

d) $C_1 = 1$ nF; $C_2 = 200$ pF; $R = 150\ \Omega$

$$\frac{\Delta U(t)}{\Delta U(0)} = \mathrm{e}^{-\frac{2}{R(C_2-C_1)}t} = 0.01$$
$$t = -\frac{\ln(0.01)R(C_2-C_1)}{2} = \underline{\underline{2.76 * 10^{-7}\ \mathrm{s}}}$$

e) $U_1(0) = 100$ V; $U_2(0) = 0$ V; $\Delta U(0) = U_0 = 100$ V

$$\Delta U(t) = U_0\, \mathrm{e}^{-\frac{2}{R(C_2-C_1)}t}$$
$$P(t) = \frac{\Delta U(t)^2}{R} = \frac{U_0^2}{R}\, \mathrm{e}^{-\frac{2}{R(C_2-C_1)}t}$$
$$P_{max} = P(0) = \underline{\underline{66.6 \text{ W}}}$$
$$E_{tot} = \int_0^\infty P(t)\,\mathrm{d}t = \frac{U_0^2}{R} \int_0^\infty \mathrm{e}^{-\frac{2}{R(C_2-C_1)}t}\,\mathrm{d}t = \underline{\underline{2\ \mu\text{J}}}$$

3. Wheatstone'sche Brucke

$$R_1 = 17 \text{ k}\Omega; \quad R_2 = 9 \text{ k}\Omega; \quad R_3 = 3.6 \text{ k}\Omega$$

a)

$$U_1 = \frac{R_1}{R_1+R_2} U$$
$$U_2 = \frac{R_x}{R_x+R_3} U$$
$$\Delta U = U_1 - U_2 = \underline{\underline{\left(\frac{R_1}{R_1+R_2} - \frac{R_x}{R_x+R_3}\right) U}}$$

b)

$$0 = U_1 - U_2$$
$$0 = \frac{R_1}{R_1+R_2} - \frac{R_x}{R_x+R_3}$$
$$R_2 = \underline{\underline{\frac{R_1 R_3}{R_x}}}$$

c)

$$R_x = \frac{R_1 R_3}{R_2} = \underline{\underline{6.8 \text{ k}\Omega}}$$