

ML Aufgabenblatt El.-Lehre

1) $U = 12V, R = 10\Omega; t = 30h$

Kapazität in Ah ist $I \cdot t$

$$I = \frac{U}{R} = \frac{12V}{10\Omega} = \underline{1.2A}$$

$$\underline{I \cdot t} = 1.2A \cdot 30h = \underline{36Ah} \quad (\rightarrow \text{Autobatterie})$$

(Gesamtladung Q : $I = \frac{Q}{t} \Rightarrow Q = I \cdot t$)

$$Q = I \cdot t = 1.2A \cdot 30 \cdot 3'600s = \underline{129'600C}$$

(C = Coulomb)

Kapazität in Wh: Wh ist $P \cdot t$

$$P = U \cdot I = 12V \cdot 1.2A = 14.4W$$

$$P \cdot t = 14.4W \cdot 30h = \underline{432Wh}$$

(Wh = Energie!)

Kapazität in Joule (= Energie)

$$P = \frac{E}{t} \quad (\text{Energie pro Zeit})$$

$$E = P \cdot t = 14.4W \cdot 30 \cdot 3'600s = \underline{1.5552 \text{ MJ}}$$

(Mega-Joule)

2) $E = 56Wh, m = 0.4kg, U = 11.1V$

a) $E = P \cdot t = U \cdot I \cdot t \Rightarrow I \cdot t = \frac{E}{U}$

($I \cdot t$ ergibt Kapazität in Ah)

$$I \cdot t = \frac{E}{U} = \frac{56Wh}{11.1V} \approx 5.05Ah$$

$$\frac{Q}{t} = I \Rightarrow Q = I \cdot t = 5.05A \cdot 3'600s = \underline{18'162C}$$

$$2b) \quad E = Pt = 56W \cdot t = 56W \cdot 3600s \\ = 201.6 \text{ kJ} \\ \frac{40 \text{ MJ}}{201.6 \text{ kJ}} \cdot 0.4 \text{ kg} \approx \underline{\underline{79.4 \text{ kg}}} \quad (!)$$

↳ Batterien speichern wenig Energie!

$$3) \quad \ell = 2000 \text{ m}, \quad A = 1 \text{ mm}^2, \quad R = 34 \Omega \\ R = \rho \cdot \frac{\ell}{A} \Rightarrow \rho = \frac{R \cdot A}{\ell} \\ = \frac{34 \Omega \cdot 10^{-6} \text{ m}^2}{2000 \text{ m}} = \underline{\underline{1.7 \cdot 10^{-8} \Omega \cdot \text{m}}}$$

$$4) \quad \rho_{Ag} = 1.59 \cdot 10^{-8} \Omega \cdot \text{m}, \quad d = 5 \text{ mm}$$

$$\hookrightarrow A = \pi r^2 = \pi \left(\frac{d}{2}\right)^2$$

$$R = \rho_{Ag} \cdot \frac{\ell}{A} = \rho_{Ag} \cdot \frac{40'000'000 \text{ m}}{\pi \cdot (0.0025 \text{ m})^2} \\ = \underline{\underline{32.4 \text{ k}\Omega}}$$

↳ Strom über lange Strecken zu transportieren ist nicht einfach!

$$5) \quad \ell = 10^6 \text{ m}, \quad R = 10 \Omega, \quad \rho_{Cu} = 1.7 \cdot 10^{-8} \Omega \cdot \text{m} \\ R = \rho \cdot \frac{\ell}{A} \Rightarrow A = \rho \cdot \frac{\ell}{R} \\ A = 1.7 \cdot 10^{-8} \Omega \cdot \text{m} \cdot \frac{10^6 \text{ m}}{10 \Omega} = 0.0017 \text{ m}^2 \\ = \underline{\underline{17 \text{ cm}^2}}$$

Kabel müsste sehr dick sein!

$$6.) \quad l = 10'000 \text{ m}, \quad R = 5 \Omega, \quad \rho_{\text{Cu}} = 1.7 \cdot 10^{-8} \Omega \cdot \text{m}$$

$$R = \rho \cdot \frac{l}{A}; \quad A = \pi R^2 = \pi \left(\frac{d}{2}\right)^2$$

$$\Rightarrow R = \rho \cdot \frac{l}{\pi \left(\frac{d}{2}\right)^2} \Rightarrow \left(\frac{d}{2}\right)^2 = \rho \cdot \frac{l}{\pi \cdot R}$$

$$\Rightarrow \frac{d}{2} = \sqrt{\frac{\rho \cdot l}{\pi \cdot R}} \Rightarrow d = 2 \sqrt{\frac{\rho \cdot l}{\pi \cdot R}}$$

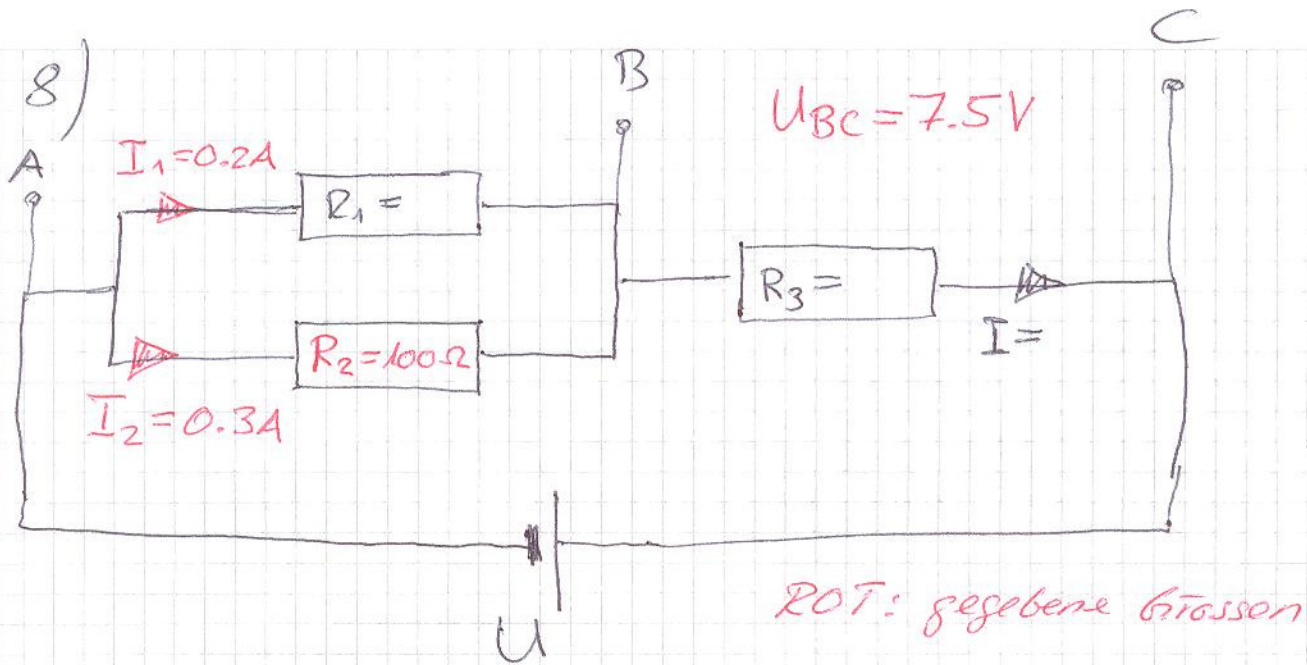
$$d \approx \underline{\underline{6.58 \text{ mm}}}$$

$$7.) \quad R_1 = 6 \Omega, \quad R_2 = 18 \Omega, \quad R_{\text{tot}} = 3 \Omega$$

$$\frac{1}{R_{\text{tot}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R_{\text{tot}}} - \frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{R_3}$$

$$\frac{1}{\frac{1}{R_{\text{tot}}} - \frac{1}{R_1} - \frac{1}{R_2}} = R_3 = \frac{1}{\frac{1}{3} - \frac{1}{6} - \frac{1}{18}} = \underline{\underline{9 \Omega}}$$



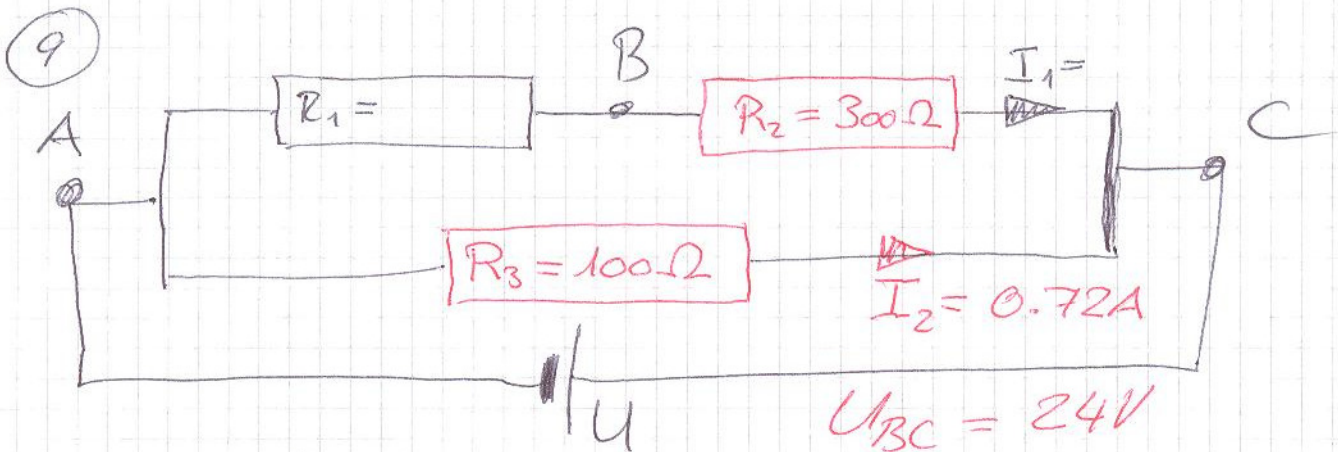
1. $U_{AB} = R_2 \cdot I_2 = 30V$

2. $U = U_{AB} + U_{BC} = 30V + 7.5V = \underline{\underline{37.5V}}$

3. $R_1 = \frac{U_{AB}}{I_1} = \frac{30V}{0.2A} = \underline{\underline{150\Omega}}$

4. $R_{AB} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} = \underline{\underline{60\Omega}}$

5. $I_{tot} = I_1 + I_2 = \underline{\underline{0.5A}}$



1) $I_1 = \frac{U_{BC}}{R_2} = \frac{24V}{300\Omega} = \underline{\underline{0.08A}}$

2) $I = I_1 + I_2 = \underline{\underline{0.8A}}$

3) $U = R_3 \cdot I_2 = 100\Omega \cdot 0.72A = \underline{\underline{72V}}$

4) $U_{AB} = U - U_{BC} = 48V$

5) $R_1 = \frac{U_{AB}}{I} = \frac{48}{0.8} = \frac{4800}{8} = \underline{\underline{600\Omega}}$