

# task\_rj0r6j4apumukrj6\_with\_calculation

## Student Group

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### Exercise E1.1 Resistance of a Wire by Resistivity (written test, approx. 6 % of a 60-minute written test, WS2022)

2. Heating elements are used to heat wires with a temperature of  $180^\circ\text{C}$ . Electric power dissipation (= heat flow) of  $P=40\text{ W}$  is necessary. Calculate the current  $I$  needed to operate it.

The Nichrome wire has a resistivity of  $1.10 \cdot 10^{-6}\ \Omega\text{ m}$ .

The heating element is  $3\text{ m}$  long and has a diameter of  $3.57\text{ mm}$ .

Solution:  $R = 10^{-3}\ \Omega$

1. Calculate the resistance  $R$  of the heating element.

Solution: 
$$P = U \cdot I = R \cdot I^2 \quad \rightarrow \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{40\text{ W}}{0.33\ \Omega}}$$

$$R = \rho \cdot \frac{l}{A} \quad | \quad A = r^2 \cdot \pi = \frac{1}{4} d^2 \cdot \pi \quad \parallel \quad R = \rho \cdot \frac{l}{\frac{1}{4} d^2 \cdot \pi} \quad \parallel \quad R = 1.10 \cdot 10^{-6}\ \Omega\text{ m} \cdot \frac{4 \cdot 3\text{ m}}{(3.57 \cdot 10^{-3}\text{ m})^2 \cdot \pi}$$

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