

task_rj0r6j4apumukrj6_with_calculation

Student Group

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

2. The heating element made of solid nichrome wire with a temperature coefficient of $1.80 \times 10^{-3} \text{ K}^{-1}$ is electrically connected to a power supply. The power dissipation (= heat flow) of $P = 40 \text{ W}$ is necessary. Calculate the current I needed to operate it. for heating elements. The Nichrome wire has a resistivity of $1.10 \times 10^{-6} \text{ } \Omega \text{ m}$. The heating element is 3 m long and has a diameter of 3.57 mm .
Solution: $R = 1.10 \times 10^{-6} \text{ } \Omega \text{ m} \cdot \frac{L}{A}$
∴ Calculate the resistance R of the heating element.

Solution

$$\begin{aligned} P &= U \cdot I = R \cdot I^2 \quad \rightarrow \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{40 \text{ W}}{0.33 \text{ } \Omega}} \end{aligned}$$

$$\begin{aligned} R &= \rho \cdot \frac{L}{A} \quad | \quad \text{with } A = r^2 \cdot \pi = \frac{1}{4} d^2 \cdot \pi \quad R = \rho \cdot \frac{4 \cdot L}{d^2 \cdot \pi} \quad \text{and } R = 1.10 \times 10^{-6} \text{ } \Omega \text{ m} \cdot \frac{4 \cdot 3 \text{ m}}{(3.57 \times 10^{-3} \text{ m})^2 \cdot \pi} \end{aligned}$$

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