

# 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 nichrome wire with a temperature coefficient of resistance of  $\alpha = 0.004 \text{ } ^\circ\text{C}^{-1}$  is used in an electric boiler. The power dissipation (= heat flow) of  $P = 40 \text{ W}$  is necessary. Determine the current  $I$  needed for heating elements. The nichrome wire has a resistivity of  $\rho = 1.10 \cdot 10^{-6} \text{ } \Omega \cdot \text{m}$ . The heating element is  $3 \text{ m}$  long and has a diameter of  $3.57 \text{ mm}$ .  
Solution:  $R = 10^{-3} \text{ } \Omega$   
∴ Calculate the resistance  $R$  of the heating element.

Solution

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

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

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Last update: 2023/04/02 00:44

