

task_70jjg4yzznocarsq_with_calculation

Student Group

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Exercise E1 Temperature-dependent Resistance (written test, approx. 6 % of a 60-minute written test, WS2022)

A thermistor, which exhibits a linear effect, is sensitive to temperature variations. The thermistor has a resistance of $10 \text{ k}\Omega$ at 25°C . Its temperature coefficients are: $\alpha = 0.01 \text{ } ^\circ\text{C}^{-1}$ and $\beta = 71 \cdot 10^{-6} \text{ } ^\circ\text{C}^{-2}$.

Result
The temperature inside the refrigeration system can reach down to -40°C .

Calculate the resistance of the thermistor at -40°C .

$$R = 6.5 \text{ k}\Omega$$

The power transfer resistor P is $P = U^2 / R$ and $Q = P \cdot t$. Therefore, a solution is to increase the heat flow up the refrigeration system.

Therefore, with constant U and increasing R the power decreases. Ten times more resistance decreases the heat flow to one-tenth.

$$R = R_0 \cdot (1 + \alpha \cdot \Delta T + \beta \cdot \Delta T^2) \quad | \quad \Delta T = T_{\text{end}} - T_{\text{start}} \\ R = 10 \text{ k}\Omega \cdot \left(1 + 0.01 \cdot (-40^\circ\text{C} - 25^\circ\text{C}) + 71 \cdot 10^{-6} \cdot (-40^\circ\text{C} - 25^\circ\text{C})^2\right)$$

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