

task_70jg4yzznocarsq_with_calculation

Student Group

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temperature dependent resistance, power, heat, exam ee1 WS2022

Exercise E2 Temperature-dependent Resistance (written test, approx. 6 % of a 60-minute written test, WS2022)

A refrigerator exhibits a temperature-dependent resistance in its refrigeration system. The circuit has a resistance of $10 \text{ k}\Omega$ at 25°C . Its temperature coefficients are: $\alpha = 0.01 \text{ } \frac{1}{\text{K}}$ and $\beta = 71 \cdot 10^{-6} \text{ } \frac{1}{\text{K}^2}$.

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

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

Resistance of the resistor
The power transferred to the resistor is $P = U^2 / R$. Therefore, a solution is to heat 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.

$$R = R_0 \cdot (1 + \alpha \cdot \Delta T + \beta \cdot \Delta T^2)$$

with $\Delta T = T_{\text{end}} - T_{\text{start}}$

$$R = 10 \text{ k}\Omega \cdot (1 + 0.01 \frac{1}{\text{K}} \cdot (-40^\circ\text{C} - 25^\circ\text{C}) + 71 \cdot 10^{-6} \frac{1}{\text{K}^2} \cdot (-40^\circ\text{C} - 25^\circ\text{C})^2)$$

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