

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 .

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

Resistance of the resistor R depends on the current I and generated heat. Therefore, a solution is to slightly 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.

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\begin{align*} R &= R_0 \cdot (1 + \alpha \cdot \Delta T + \beta \cdot \Delta T^2) && | \\ \text{with } \Delta T &= T_{\text{end}} - T_{\text{start}} && \\ R &= 10 \text{ k}\Omega \cdot \left(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\right) && \\ \end{align*}
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Last update: 2023/04/02 00:44

