task_70jjg4yzznocarsq_with_calculation

Student Group

First Name	Surname	Matrikel Nr.

Table of Contents

Exercise E 1 Temperature-dependent Resistance (written test, approx. 6 % of a 60-minute written test, WS2022) 2

temperature dependent resistance, power, heat, exam ee1 WS2022

Exercise E 1 Temperature-dependent Resistance
(written test, approx. 6 % of a 60-minute written test, WS2022)

A thermistor is used as a temperature sensor in a refrigeration system. The thermistor has a resistance of $10 ~\rm{k}\Omega$ at $+25 ~°\rm{C}$.
Its temperature coefficients are: $\alpha=0.01 ~{{1}\over{\rm{K}}}$ and $\beta=71 \cdot 10^{-6}~{{1}\over{\rm{K}^2}}$
The temperature inside the refrigeration system can reach down to $-40 ~°\rm{C}$.

1. Calculate the resistance of the thermistor at $-40 ~°\rm{C}$.

Solution

\begin{align*} R &= R_0 \cdot (1 + \alpha \cdot \Delta T + \beta \cdot \Delta T^2) && | \text{with } \Delta T = T_{\rm end} - T_{\rm start}\\ R &= 10 ~\rm{k}\Omega \cdot \left(1 + 0.01 ~{{1}\over{\rm{K}}} \cdot (-40~°\rm{C} - 25~°\rm{C}) + 71 \cdot 10^{-6}~{{1}\over{\rm{K}^2}} \cdot (-40~°\rm{C} - 25~°\rm{C})^2 \right) \\ \end{align*}

Result

\begin{align*} R &= 6.5 ~\rm{k}\Omega \\ \end{align*}

2. Additionally, explain whether the thermistor's current or heat output in the refrigeration system becomes better or worse? Give an explanation for your answer.

Result

The resistor transfers electrical energy out of the circuit and generates heat. Therefore, a resistor can heat up the refrigeration system.
The power of the resistor is $P = U \cdot I = R \cdot I^2 = {{U^2}\over{R}}$ and equivalent to the heat flow.
Therefore, with constant U and increasing R the power decreases. Ten times more resistance decreases the heat flow to one-tenth.