

# task\_70jig4yzznocarsq\_with\_calculation

## Student Group

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temperature dependent resistance, power, heat, exam ee1 WS2022

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

A. The circuit diagram shows a thermistor with a temperature-dependent resistance. The thermistor has a resistance of  $R_0 = 10 \text{ k}\Omega$  at  $T_0 = 25^\circ\text{C}$ . 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  $-40^\circ\text{C}$ .

Calculate the resistance of the thermistor at  $-40^\circ\text{C}$ .

**Resistance of the resistor**  
The power of the resistor  $P$  depends on the current  $I$  and the voltage  $U$ . 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.

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

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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