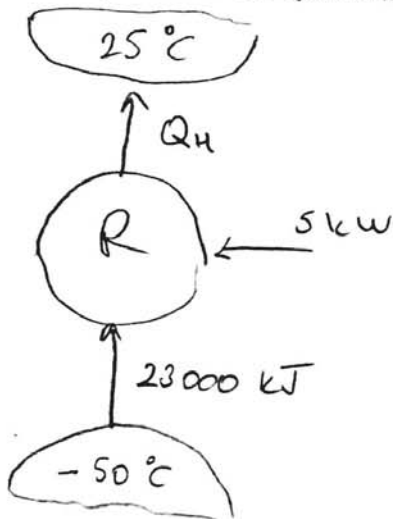


## AE 209 THERMODYNAMICS

## QUIZ 7

During an experiment conducted in a room at  $25^\circ\text{C}$ , a researcher measures that a refrigerator that draw  $5\text{ kW}$  of power has removed  $23.000\text{ kJ}$  of heat from the refrigerated space, which is maintained at  $-50^\circ\text{C}$ . The running time of the refrigerator during the experiment was  $15\text{ min}$ . Draw the schematic representation of this system and determine;

- COP of the system,
- COP of the Carnot cycle for the same reservoirs,
- Whether the system is valid or not.



$$T_H = 25 + 273 = 298 \text{ K}$$

$$T_L = -50 + 273 = 223 \text{ K}$$

$$\dot{w}_{\text{net,in}} = 5 \text{ kW}$$

$$Q_L = 23.000 \text{ kJ}$$

$$\Delta t = 15 \text{ min} \times 60 = 900 \text{ s}$$

$$\dot{Q}_L = \frac{23.000 \text{ kJ}}{900 \text{ s}} = 25,5 \text{ kW}$$

$$\text{a) } \text{COP}_R = \frac{\dot{Q}_L}{\dot{w}_{\text{net,in}}} = \frac{25,5 \text{ kW}}{5 \text{ kW}} = 5,11$$

$$\text{b) } \text{COP}_{R,\text{rev}} = \frac{1}{\frac{T_H}{T_L} - 1} = \frac{1}{\frac{298}{223} - 1} = 2,97$$

c) COP of the Carnot refrigerator (which is reversible) is the maximum COP value. In this case COP of the system is greater than maximum and system is not valid.