

Aufgabenblatt 1:
Carnot - Wirkungsgrad

① $T_K = 3^\circ\text{C} = 276.15\text{K}$

$T_W = 25^\circ\text{C} = 298.15\text{K}$

$$\varepsilon_c = \frac{T_W - T_K}{T_W} = \underline{\underline{7.38\%}}$$

WP: $c_L = \frac{1}{\varepsilon} = \underline{\underline{13.55}}$ KM: $c_L = \frac{1}{\varepsilon} - 1 = \underline{\underline{12.55}}$

② $T_W = 126.85^\circ\text{C} = 400\text{K}$

$\varepsilon_f = 40\%$, $\varepsilon = 12\%$

$$\varepsilon_f = \frac{\varepsilon}{\varepsilon_c} \Rightarrow \varepsilon_c = \frac{\varepsilon}{\varepsilon_f} = \frac{0.12}{0.4} = 0.3 = 30\%$$

$$\varepsilon_c = \frac{T_W - T_K}{T_W} = 0.3$$

$$T_W - T_K = 0.3 \cdot T_W$$

$$T_K = 0.7 T_W = \underline{\underline{280\text{K}}} = \underline{\underline{6.85^\circ\text{C}}}$$

③ $T_K = 0^\circ\text{C} = 273.15\text{K}$; $\varepsilon_c = 0.5$

$$\varepsilon_c = \frac{T_W - T_K}{T_W} = 0.5$$

$$T_W - T_K = 0.5 T_W$$

$$T_K = 0.5 T_W$$

$$T_W = 2 T_K = \underline{\underline{546.3\text{K}}} = \underline{\underline{273.15^\circ\text{C}}}$$

④ WKM: $\varepsilon = 0.15 = 15\%$; $Q_K = 51\text{J}$

$$\varepsilon_{\text{WKM}} = \frac{W}{Q_W} = 0.15; \quad W = Q_W - Q_K$$

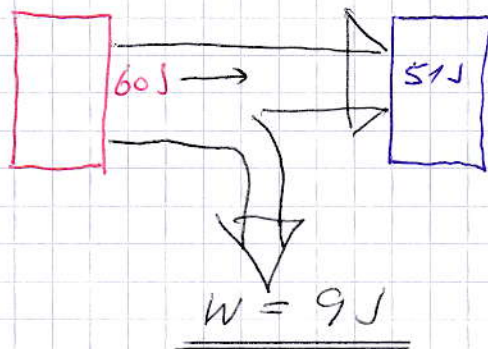
$$\frac{Q_W - Q_K}{Q_W} = 0.15$$

$$Q_W - Q_K = 0.15 Q_W$$

$$Q_K = 0.85 Q_W$$

$$Q_W = \frac{Q_K}{0.85} = \frac{51\text{J}}{0.85} = \underline{\underline{60\text{J}}}$$

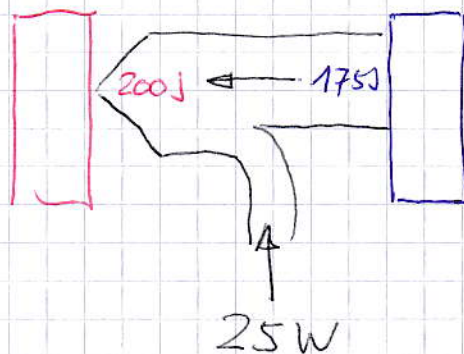
$$\Rightarrow W = 9\text{J}$$



⑤ KM: $C_L = 7$; $W = 25\text{J}$

$$C_L = \frac{Q_K}{W} = 7 \Rightarrow 7W = Q_K = \underline{\underline{175\text{J}}}$$

$$Q_W = Q_K + W = \underline{\underline{200\text{J}}}$$



c) $\varepsilon_{\text{WKM}} = \frac{W}{Q_W} = \frac{25}{200} = \frac{1}{8} = \underline{\underline{12.5\%}}$

direkt: $\varepsilon = \frac{1}{C_L + 1} = \frac{1}{7 + 1} = 12.5\%$

⑥ $\varepsilon_c = \frac{1}{3} = 33.\bar{3}\%$; $T_w = 147.075^\circ\text{C}$
 $= 420.225\text{K}$

$$\varepsilon_c = \frac{T_w - T_k}{T_w} = \frac{1}{3}$$

$$T_w - T_k = \frac{1}{3} T_w$$

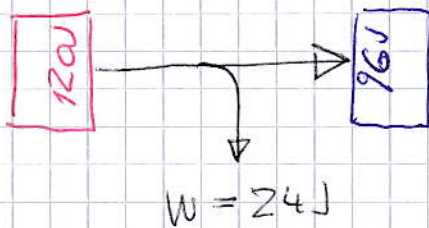
$$T_k = \frac{2}{3} T_w = \underline{\underline{280.15\text{K}}} = \underline{\underline{7^\circ\text{C}}}$$

b) $\varepsilon_r = 60\% = 0.6$; $Q_w = 120\text{J}$

$$\varepsilon_r = \frac{\varepsilon}{\varepsilon_c} \Rightarrow \varepsilon_r \cdot \varepsilon_c = \varepsilon = \frac{3}{5} \cdot \frac{1}{3} = \frac{1}{5} = \underline{\underline{20\%}}$$

$$\varepsilon = \frac{W}{Q_w} \Rightarrow \frac{1}{5} = \frac{W}{120\text{J}} \Rightarrow \underline{\underline{W = 24\text{J}}}$$

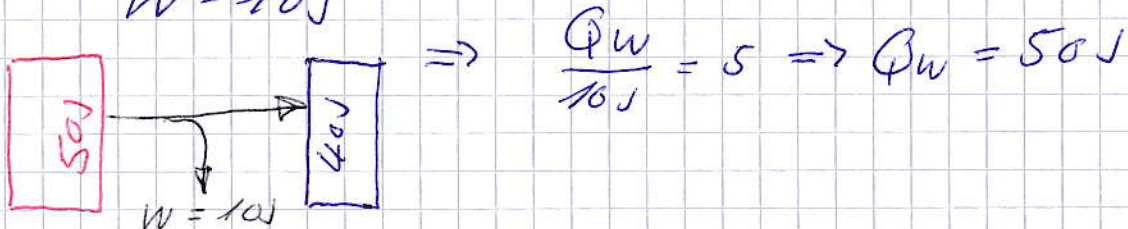
$$\Rightarrow \underline{\underline{Q_k = 96\text{J}}}$$



⑦ $\varepsilon_c = 0.45 = 45\%$, $\varepsilon_r = \frac{4}{9}$

a) $\varepsilon_r = \frac{\varepsilon}{\varepsilon_c} \Rightarrow \varepsilon = \varepsilon_r \cdot \varepsilon_c = \frac{4}{9} \cdot 0.45 = \frac{4}{9} \cdot \frac{9}{20} = \frac{4}{20} = \frac{1}{5} = \underline{\underline{20\%}}$

b) ~~$Q_k = 80\text{J}$~~ ; $\varepsilon = \frac{W}{Q_w} = \frac{1}{5} \Rightarrow \frac{10\text{J}}{Q_w} = \frac{1}{5}$
 $W = 10\text{J}$



c) $C_L = \frac{Q_k}{W} = \frac{40\text{J}}{10\text{J}} = 4$ oder $C_L = \frac{1}{\varepsilon} - 1 = \frac{1}{0.2} - 1 = 5 - 1 = \underline{\underline{4}}$

$$\textcircled{8} \quad T_k = -3^\circ\text{C} = 270.15\text{K}$$

$$T_w = 64.5375^\circ\text{C} = 337.6875\text{K}$$

$$a) \quad \varepsilon_c = \frac{T_w - T_k}{T_w} = 0.2 = 20\%$$

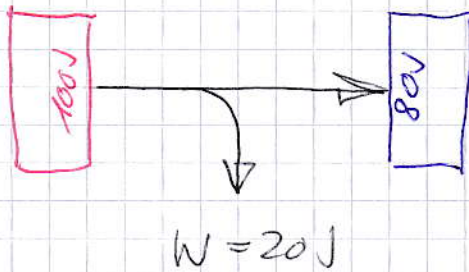
$$b) \quad Q_k = 80\text{J}; \quad \varepsilon = \frac{W}{Q_w}; \quad W = Q_w - Q_k$$

$$\Rightarrow \frac{1}{5} = \frac{Q_w - 80\text{J}}{Q_w}$$

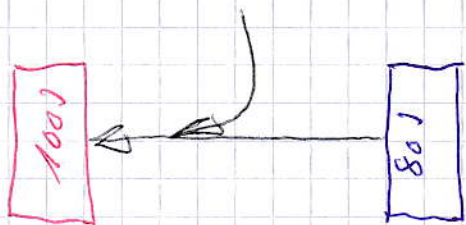
$$\frac{1}{5} Q_w = Q_w - 80\text{J}$$

$$\frac{4}{5} Q_w = 80\text{J}$$

$$Q_w = \frac{5}{4} \cdot 80\text{J} = 100\text{J}$$



$$\varepsilon = \frac{1}{5}$$
$$\Rightarrow C_2 = \frac{1}{\varepsilon} - 1 = 4$$



↳ Energie-Erhaltung!