Lösungen – Kreisprozess

1. $\eta_{ideal} = 1 - \frac{T_2}{T_1} = 1 - \frac{(200 + 273)K}{(300 + 273)K} = 0,1745 = \underline{\underline{17.4\%}}$

2. $\eta_{ideal} = 1 - \frac{T_2}{T_1} \Rightarrow T_1 = \frac{T_2}{1-\eta} = \frac{(5 + 273)K}{1 - 0.8} =$

$= 1390.75K \simeq \underline{\underline{1\,kK}}$

3. $\eta_{ideal} = 1 - \frac{T_2}{T_1} \rightarrow T_2 = T_1 \cdot (1 - \eta)$

$\eta'_{ideal} = 1 - \frac{T_2'}{T_1} = 1 - \frac{0.9 \cdot T_2}{T_1} = 1 - \frac{0.9 \cdot T_1 \cdot (1-\eta)}{T_1}$

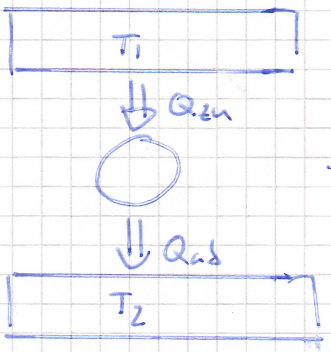
$\Rightarrow \eta'_{ideal} = 1 - 0.9 \cdot (1 - \eta) = 1 - 0.9 \cdot (1 - 0.3)$

$= 0,37 = \underline{\underline{37\%}}$

Relative Änderung vom Wirkungsgrad:

$\frac{\eta' - \eta}{\eta} = \frac{0.37 - 0.30}{0.30} = 0,23 \rightarrow \underline{\underline{+23\%}}$

4.



$\Rightarrow W$

a) $\eta = \frac{W}{Q_{zu}}$

$\Rightarrow Q_{zu} = \frac{W}{\eta} = \frac{P \cdot \Delta t}{\eta}$

$= \frac{15kW \cdot 60s}{0,26} = \underline{\underline{3.5\,MJ}}$

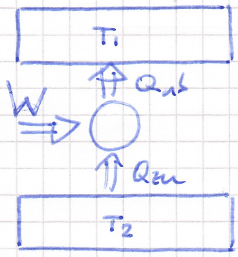
b) $\eta_{ideal} = 1 - \frac{T_2}{T_1} = 1 - \frac{(273 + 500)K}{(273 + 2000)K} = 0,6599 \hat{=} 66\%$

$P_{ideal} = \frac{Q_{zu} \cdot \eta_{ideal}}{\Delta t} = \frac{Q_{zu}}{\Delta t} \cdot \left(1 - \frac{T_2}{T_1}\right)$

$= \frac{3461538J}{60s} \left(1 - \frac{773K}{2273K}\right) = 38.071W \hat{=} \underline{\underline{38\,kW}}$

%

5.



$$\eta_{WP} = \varepsilon_{WP} = \frac{Q_{ab}}{W} = \frac{W + Q_{zu}}{W} = \frac{P \cdot \Delta t + Q_{zu}}{P \cdot \Delta t}$$

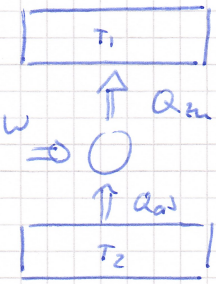
$$W + Q_{zu} = Q_{ab}$$

$$\Rightarrow \varepsilon_{WP} \cdot P \cdot \Delta t = P \cdot \Delta t + Q_{zu}$$

$$\Rightarrow P \cdot \Delta t \cdot (\varepsilon_{WP} - 1) = Q_{zu} = 50\,W \cdot 1\,s \cdot (1.5 - 1)$$

$$= \underline{25\,J}$$

6.



$$\eta_{KS} = \frac{Q_{ab}}{W} = \varepsilon_{KS} = \frac{Q_{ab}}{Q_{zu} - Q_{ab}} = \frac{T_2}{T_1 - T_2}$$

$$\Rightarrow Q_{ab} = W \cdot \varepsilon_{KS} = P \cdot \Delta t \cdot \frac{T_2}{T_1 - T_2}$$

$$= 20\,W \cdot 1\,s \cdot \frac{(273 + 4)\,K}{16\,K}$$

$$= 346.25\,J = \underline{346\,J}$$

7. $\underbrace{\varepsilon_{KS}}_{=\eta_{KS}} \leq \frac{T_2}{T_1 - T_2} = \frac{1}{T_1/T_2 - 1} \Rightarrow \frac{1}{\varepsilon_{KS}} = \frac{T_1}{T_2} - 1$

$$\Rightarrow \frac{T_1}{T_2} = \frac{1}{\varepsilon_{KS}} + 1 \leq 1 + 1 = 2$$

$$\Rightarrow \underbrace{T_1}_{\text{heiß}} \leq 2 \cdot \underbrace{T_2}_{\text{kalt}}$$

8. a) $Q_{zu} = m \cdot H = \rho_{öl} \cdot V \cdot H = 0{,}86 \cdot 10^3 \frac{kg}{m^3} \cdot 150 \cdot 10^{-3}\,m^3 \cdot 4{,}27 \cdot 10^7 \frac{J}{kg} = \underline{5{,}5\ GJ}$

$$\eta = \frac{W}{Q_{zu}} = \frac{P \cdot \Delta t}{Q_{zu}} = \frac{P \cdot \Delta t}{\rho_{öl} \cdot V \cdot H} = \frac{300 \cdot 10^3\,W \cdot 40 \cdot 60\,s}{5.508 \cdot 10^9\,J} = \underline{13\,\%}$$

b) FoTa s. 192 : $\vartheta \cong 200\,°C$ für $p = 16\,bar = 1600\,kPa$

$$\eta_{ideal} = 1 - \frac{T_2}{T_1} = 1 - \frac{(80 + 273)\,K}{(200 + 273)\,K} = \underline{25\,\%}$$