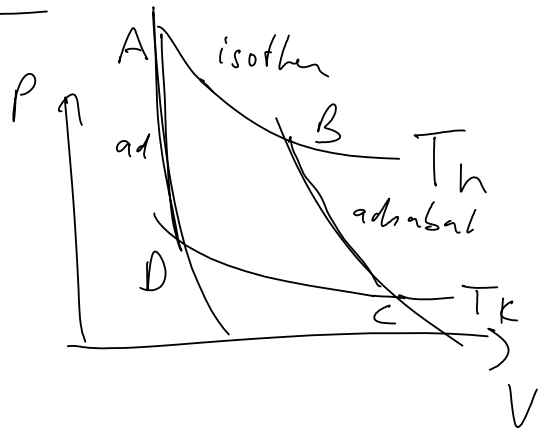
28 May, 2020 21:45

(37)



A · 20L

B 60L

$T_h = 50°C = 323.15\,K$

$T_K = -10°C = 263.15\,K$

$n = 2.00\ mol$

$\Delta U = W + Q$

$\Delta U_{AB} = \Delta U_{CD} = 0$ isotherm

$\Delta Q_{BC} = \Delta Q_{DA} = 0$ adiabat

$$\Delta Q_{AB} = -W_{AB} = +\int_{V_A}^{V_B} \frac{nRT_h}{V}\,dV =$$

$$= nRT_h \cdot \ln\left(\frac{V_B}{V_A}\right) =$$

$$= 2.00\ mol \cdot 8.31448 \frac{J}{K\ mol} \cdot 323.15K \cdot \ln\left(\frac{60L}{20L}\right)$$

$$= 5903.499\ J = \boxed{5.9\ kJ}$$

$$\boxed{W_{on} = -5.9\ kJ}$$

$$W_{AB} = -5.9\,kJ$$

$$\Delta U_{BC} = +W_{BC} = n\,C_{V,m}\cdot\Delta T = n\,\frac{3}{2}R\left(T_C - T_B\right) =$$

$$= 2.00\ mol \cdot \frac{3}{2} \cdot 8.31448\,\frac{J}{K\ mol} \cdot (-60\,K) =$$

$$= -1496.606\,J = \boxed{-1.5\,kJ}$$

$$\Delta U_{DA} = n\,C_{V,m}\cdot\left(T_A - T_D\right) = +1496.606\,J$$

$$\boxed{+1.5\,kJ}$$

$$\Delta Q_{CD} = n\,R\cdot T_K \cdot \ln\left(\frac{V_D}{V_C}\right)$$

$$\frac{V_D}{V_C} = ?$$

adiabatische Prozeß

$$p_B V_B^{5/3} = p_C \cdot V_C^{5/3}$$

$$\frac{nRT_B}{V_B}\cdot V_B^{5/3} = \frac{nRT_C}{V_C}\,V_C^{5/3}$$

$$\Rightarrow T_B \cdot V_B^{3/2} = T_C\,V_C^{3/2} \Rightarrow V_C = \left(\frac{T_B}{T_C}\right)^{2/3}\cdot V_B$$

$$\Rightarrow T_B \cdot V_B^{3/2} = T_C V_C^{3/2} \Rightarrow V_C = \left(\frac{T_B}{T_C}\right) \cdot V_B$$

$$T_A \cdot V_A^{3/2} = T_D \cdot V_D^{3/2} \Rightarrow V_D = \left(\frac{T_A}{T_D}\right)^{2/3} \cdot V_A$$

$$\Delta Q_{CD} = nRT_K \cdot \ln\left(\frac{\left(T_A/T_D\right)^{2/3} \cdot V_A}{\left(T_B/T_C\right)^{2/3} \cdot V_B}\right) =$$

$$= nRT_K \cdot \ln\left(\left(\frac{T_H \cdot T_K}{T_K \cdot T_H}\right)^{2/3} \cdot \frac{V_A}{V_B}\right) =$$

$$= 2.00\,\text{mol} \cdot 8.3144\,\frac{\text{J}}{\text{K mol}} \cdot 263.15\,\text{K} \cdot \ln\left(\frac{20\,\text{L}}{60\,\text{L}}\right)$$

$$= -4807.38\,\text{J} = \boxed{-4.8\,\text{kJ}}$$

$$\boxed{\Delta W_{CD} = +4.8\,\text{kJ}}$$

b) $\Delta Q_{ges} = \Delta Q_{AB} + 0 + \Delta Q_{CD} + 0 = 1.09612\,\text{kJ} = \boxed{1.1\,\text{kJ}}$

$$W_{ges} = W_{AB} + W_{BC} + W_{CD} + W_{DA} = -1.09612\,\text{kJ}$$

$$= \boxed{-1.1\,\text{kJ}}$$

$$\Delta U_{ges} = 0$$

c) $$\eta = 1 - \frac{T_K}{T_h} = 1 - \frac{263.15\,\text{K}}{323.15\,\text{K}} = 0.185672$$

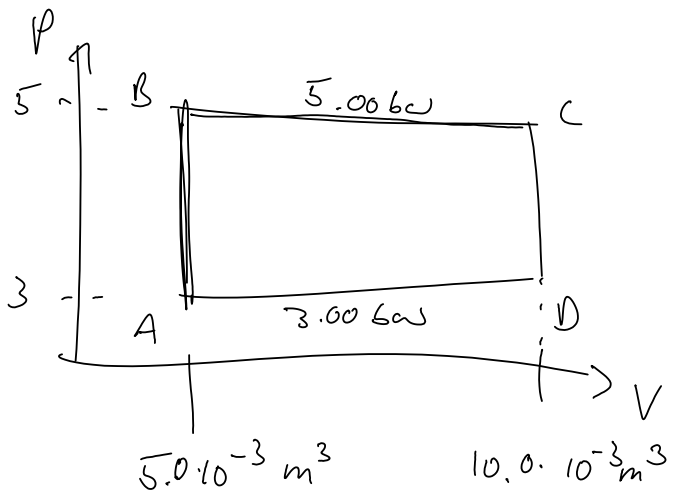
$$\boxed{19\,\%}$$

1 1h

19 %

$$\eta = \frac{W_{geleistet}}{\Delta Q_{AB}} = \frac{1.0961247\,J}{5.9034995\,J} = 0.185672$$

38



$n \simeq 0.300\ mol$

a) $\Delta S_{AC} = \Delta S_{AB} + \Delta S_{BC} =$

$$= \int_{T_A}^{T_B} \frac{C_V}{T}\,dT + \int_{V_A}^{V_B} \left(\frac{\partial p}{\partial T}\right) dV + \int_{T_B}^{T_C} \frac{C_p}{T}\,dT + \int_{p_B}^{p_C} \left(\frac{\partial V}{\partial T}\right) dV =$$

$V_A = V_B$ $\qquad$ $p_B = p_C$

$$= C_V \cdot \ln\left(\frac{T_B}{T_A}\right) + C_p \ln\left(\frac{T_C}{T_B}\right) =$$

$$= \frac{3}{2} nR \cdot \ln\left(\frac{p_B \cdot \frac{V_A}{nR}}{p_A \frac{V_A}{nR}}\right) + \frac{5}{2} nR \cdot \ln\left(\frac{V_C \cdot \frac{p_B}{nR}}{V_B \cdot \frac{p_B}{nR}}\right) =$$

$$= \frac{1}{2} nR \cdot \left(3 \cdot \ln\left(\frac{p_B}{p_A}\right) + 5 \ln\left(\frac{V_C}{V_B}\right)\right) =$$

$$= \frac{1}{2} n R \cdot \left(3 \cdot \ln\left(\frac{p_B}{p_A}\right) + 5 \ln\left(\frac{V_C}{V_B}\right)\right) =$$

$$= \frac{1}{2} \cdot 0.3 \text{ mol} \cdot 8.31448 \frac{J}{K\,\text{mol}} \cdot \left(3 \cdot \ln\left(\frac{56\,\omega}{36\,\omega}\right) + 5 \cdot \ln\left(\frac{10.0 \cdot 10^{-3} m^3}{5.00 \cdot 10^{-3} m^3}\right)\right)$$

$$= 6.233631 \frac{J}{K} = \boxed{6.2 \frac{J}{K}}$$

38b) $W_{ges} = W_{AB} + W_{BC} + W_{CD} + W_{DA} =$

$$W = -\int dV \cdot p(V)$$

$$= -p_B \cdot (V_C - V_B) - p_A \cdot (V_A - V_D) =$$

$$= -5.0 \cdot 10^5 Pa \,(10.0 - 5.0) \cdot 10^{-3} m^3 - 3.00 \cdot 10^5 Pa \cdot (5.0 - 10.0) \cdot 10^{-3} m^3 =$$

$$= -1000 Nm = \boxed{-1.0 kJ}$$

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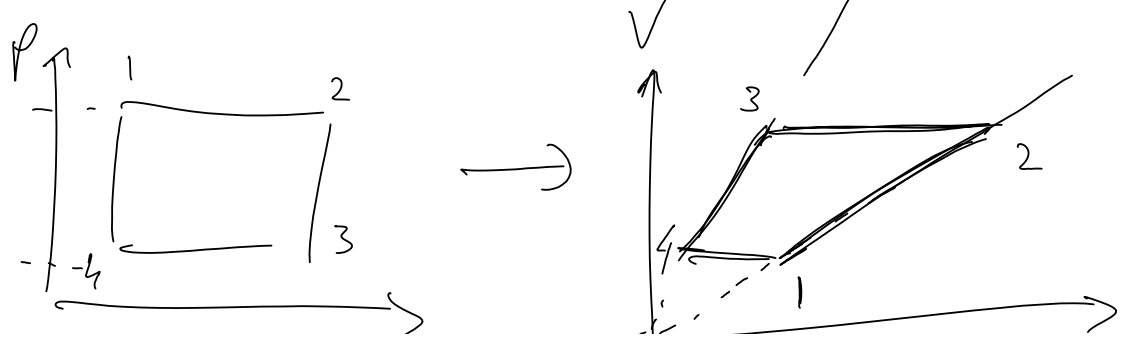
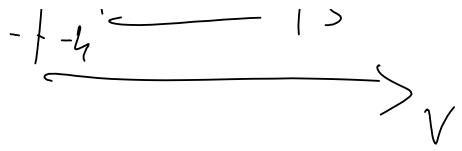
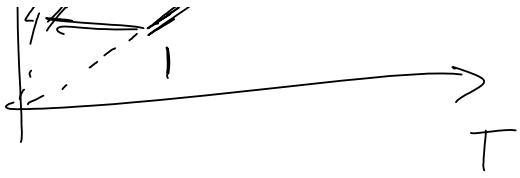
39) a)





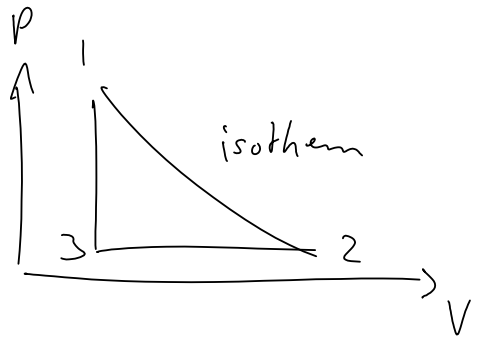


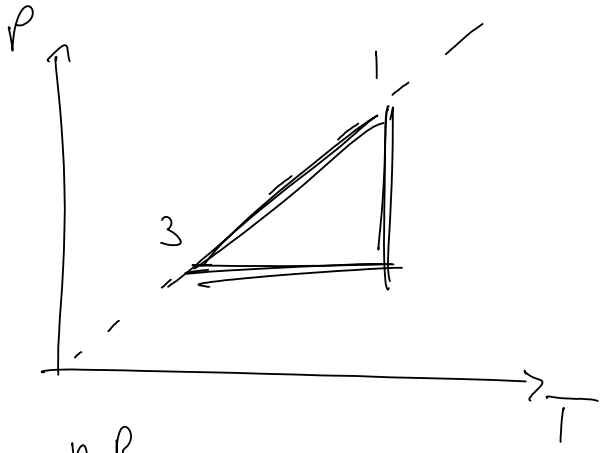
$pV = n \cdot R \cdot T$

$V = \frac{nR}{p} \cdot T$

p const $\Rightarrow V \propto T$

b)





$p = \frac{nR}{V} \cdot T$

c)