# Übungsaufgaben II, von 03.05.2001

## Musterlösungen

1. Ideales Gas, Isotherme Kompression

$$p_1 V_1 = p_2 (V_1 + \Delta V) = p_2 V_2$$

$$\Rightarrow p_1 = p_2 \left( \frac{V_1 + \Delta V}{V_1} \right) = 3.8 \ \text{atm} \cdot \frac{[6.5 + (-2.2)]}{6.5} = \frac{4.3}{6.5}$$

$$= 2.514 \, \text{atm} = 2.547 \times 10^5 \ \text{Pa}$$

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2.

a)

$$\frac{dp}{dV_m} = -\frac{RT}{(V_m - b)^2} + \frac{2a}{V_m^3} = 0 \quad (1)$$

$$\frac{d^2 p}{dV_{V_m}^2} = \frac{2RT}{(V_m - b)^3} - \frac{6a}{V_m^4} = 0 \quad (2)$$

$$\& \ p_k = \frac{RT_k}{(V_{mk} - b)} - \frac{a}{V_{mk}^2} \quad (3)$$

Daraus folgt (...):

$$V_k = 3b, \quad T_k = \frac{8a}{27Rb} \quad \text{und} \quad p_k = \frac{a}{27b^2}$$

b)

$$b = \frac{RT_k}{8p_k}, \quad a = \frac{27}{p_k} \left( \frac{RT}{8} \right)^2$$

| | **a** ($L^2$ atm $mol^{-2}$) | **b** ($10^{-2}$ L $mol^{-1}$) |
|---|---|---|
| $H_2$ | 0,25 | 2,66 |
| $CO_2$ | 3,64 | 4,27 |

3.

$$C_p = \frac{1}{m}\cdot\left(\frac{\partial Q}{\partial T}\right)_P = \frac{1}{m}\cdot\left(\frac{\Delta Q}{\Delta T}\right)$$

$$\Rightarrow \Delta Q = m \cdot C_p \cdot \Delta T$$

$$V = 250\ ml \quad \Rightarrow \quad m = 250\ g$$

$$C_p = 1\frac{cal}{g\cdot K} = 4.1868\frac{J}{g\cdot K}$$

$$\Delta T = 100°C - 10°C = 90 K\ \ (!)$$

$$\Rightarrow \Delta Q = 250\,g \cdot 90\,K \cdot 4.1868\frac{J}{g\cdot K} = 94.2\,KJ$$

$$P = \frac{\Delta E}{\Delta t} \quad \Rightarrow \quad \Delta t = \frac{\Delta E}{P} = \frac{\Delta Q}{P}$$

$$\Delta t = \frac{94.2\ KJ}{200\ W} = \frac{94.2\ KJ}{200\ J\cdot s^{-1}} = 471\ s$$

$$P = U\cdot I \Rightarrow I = \frac{P}{U} = \frac{200\ W}{220\ V} = 0.909\,A$$

$$I = \frac{\Delta L}{\Delta t}; \qquad L: \text{Ladung}$$

$$\Rightarrow \Delta L = I\cdot\Delta t$$

$$\boxed{\Delta L = 0.909\ A \cdot 471\ s = 428.182\ C}$$

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4.

$$C_p(H_2O) = 1\,cal\ g^{-1}K^{-1}$$

$$C_p(Hg) = 0{,}034\ cal\ g^{-1}K^{-1}$$

Thermisches Gleichgewicht $T_G$

$$\Rightarrow Q_{Kal} + Q_{H_2O} = -Q_{Hg}$$

$$C_{Kal}\times(T_G - T_i^{Kal}) + m_{H_2O}\times C_{H_2O}\times(T_G - T_i^{H_2O}) = -m_{Hg}\times C_{Hg}\times(T_G - T_i^{Hg})$$

$$\Rightarrow T_G \approx 25°C$$

Das Quecksilber hat $Q_{Hg}$ abgegeben

$$Q_{Hg} = m_{Hg}\times C_{Hg}\times(T_G - T_i^{Hg})$$

$$\boxed{\approx -510\,cal}$$