(25) $n = 3\ \text{mol}$

$C_{p,m} = 20{,}786\ \frac{J}{\text{mol K}}$

$T_A = 25{,}5\ °C = 298{,}65\ K$

$V_A = 475\ cm^3 = 4{,}75 \cdot 10^{-4}\ m^3$

↓ adiabatisch

$V_B = 1{,}87 \cdot 10^{-4}\ m^3$

(a) $pV^{\varkappa} = \text{const}$

$$\varkappa = \frac{C_p}{C_V} = \frac{C_{p,m}}{C_{V,m}}$$

ideales Gas: $C_p - C_V = nR$

$C_{p,m} - C_{V,m} = R$

$C_{V,m} = C_{p,m} - R$

$C_{V,m} = 20{,}786\ \frac{J}{\text{mol K}} - 8{,}31446\ \frac{J}{\text{mol K}}$

$\underline{C_{V,m} = 12{,}47154\ \frac{J}{\text{mol K}}}$

$\varkappa = 1{,}66667 \approx \frac{5}{3}$

$p_A V_A^{\varkappa} = p_B V_B^{\varkappa}$

$p\ \ \left(\frac{V_A}{\ }\right)^{\varkappa} \qquad \frac{nRT_A}{\ }$ ...

$$p_B = p_A \cdot \left(\frac{V_A}{V_B}\right)^{\varkappa}$$

$$p_A = \frac{nRT_A}{V_A}$$ (ideale Gasgleichung)

$$p_A = \frac{3\,\text{mol} \cdot 8{,}31446\,\frac{\text{J}}{\text{mol K}} \cdot 298{,}65\,\text{K}}{4{,}75 \cdot 10^{-4}\,\text{m}^3}$$

$$p_A = 1{,}56828 \cdot 10^{7}\,\text{Pa}$$

$$\left(\frac{\text{J}}{\text{m}^3} = \frac{\text{N m}}{\text{m}^3} = \frac{\text{N}}{\text{m}^2} = \text{Pa}\right)$$

$$(1\,\text{bar} = 10^{5}\,\text{Pa})$$

$$\underline{\underline{p_A = 157\,\text{bar}}}$$

$$p_B = 1{,}56828 \cdot 10^{2}\,\text{bar} \cdot \left(\frac{475\,\text{cm}^3}{187\,\text{cm}^3}\right)$$

$$p_B = 7{,}416123 \cdot 10^{2}\,\text{bar}$$

$$\underline{\underline{p_B = 742\,\text{bar}}}$$

(b) Gasgleichung $pV = nRT$

$$T_B = \frac{p_B V_B}{n R} = \frac{7{,}416123 \cdot 10^{7}\,\frac{\text{J}}{\text{m}^3} \cdot 1{,}87 \cdot 10^{-4}\,\text{m}^3}{3\,\text{mol} \cdot 8{,}31446\,\frac{\text{J}}{\text{mol K}}}$$

$$T_B = 555{,}985\,\text{K}$$

$$\underline{\underline{T_B = 556\,\text{K}}}$$

(c) $C_V = \left(\frac{\partial U}{\partial T}\right)_V$

ideales Gas $\longrightarrow$ $C_V = \frac{dU}{dT}$

$U = U(T)$

$dU = C_V \, dT$

$\Delta U = \int dU = \int C_V \, dT$

$\Delta U = C_V \, \Delta T$ (weil C_V = const)

1. HS: $\Delta U = W + Q$

adiabatisch $(Q = 0) \rightarrow \Delta U = W$

$$W = C_V \cdot \Delta T$$

$$W = n \cdot C_{V,m} \cdot \Delta T = 3 \, \text{mol} \cdot 12{,}47154 \, \frac{J}{\text{mol K}} \cdot 257{,}335 \, K$$

$$W = 9628{,}091 \, J$$

$$W = 9{,}63 \, kJ$$

(26) $n = 6{,}25$ mol

$C_{V,m} = 12{,}5 \, \frac{J}{\text{mol K}}$

adiabatische Kompression: $V_B = 0{,}94 \cdot V_A$

(a) $pV^{\varkappa} = \text{const}$ $\qquad \varkappa = \frac{C_p}{C_V} = \frac{C_{p,m}}{C_{V,m}}$

$\varkappa = \frac{C_{V,m} + R}{\ldots}$

$$\varkappa = \frac{C_{v,m} + R}{C_{v,m}}$$

$$\varkappa = \frac{12{,}5 \frac{J}{mol\,K} + 8{,}31446 \frac{J}{mol\,K}}{12{,}5 \frac{J}{mol\,K}}$$

$$\varkappa = 1{,}6651568$$

$$p_A V_A^{\varkappa} = p_B V_B^{\varkappa}$$

$$\frac{p_B}{p_A} = \left(\frac{V_A}{V_B}\right)^{\varkappa} = \left(\frac{V_A}{0{,}94 \cdot V_A}\right)^{1{,}6651568} = 1{,}108527$$

p steigt um 10,8527 %

p steigt um 11 %

(b) $pV^{\varkappa} = const$

$pV = nRT \longrightarrow V = nR\frac{T}{p}$

$$p \cdot (nR)^{\varkappa} \cdot \left(\frac{T}{p}\right)^{\varkappa} = const \quad \Big| : (nR)^{\varkappa}$$

$$p \cdot \frac{T^{\varkappa}}{p^{\varkappa}} = const$$

$$p^{1-\varkappa} \cdot T^{\varkappa} = const$$

$$p^{\frac{1-\kappa}{\kappa}} \cdot T = \text{const}$$

$$p_A^{\frac{1-\kappa}{\kappa}} \cdot T_A = p_B^{\frac{1-\kappa}{\kappa}} \cdot T_B$$

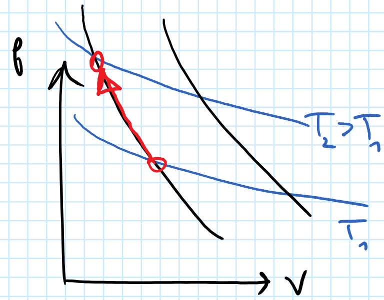
$$\frac{T_B}{T_A} = \left(\frac{p_A}{p_B}\right)^{\frac{1-\kappa}{\kappa}}$$

(c) $$\frac{T_B}{T_A} = (0{,}902098)^{-0{,}399456}$$

$$\frac{T_B}{T_A} = 1{,}042015$$

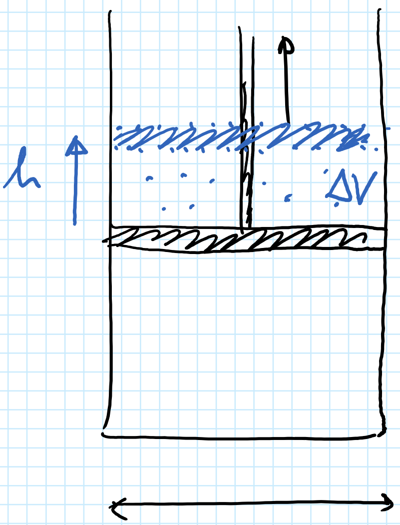
(T steigt 4,2015 %)

T steigt um 4,2 %



okay ✓

27



$d = 32{,}0$ mm

$\Delta n = 5{,}50 \cdot 10^{-3}$ mol

$T_E = 38{,}6\,°C = 311{,}75\,K$

$p_{ex} = 1\,\text{atm} = 101325\,\text{Pa}$ (= const)

(a) $h = ?$ ΔV durch neu entstandenes Gas (Δn)

$$pV = nRT$$

$$\Delta V = \frac{\Delta n R T}{p}$$

$\uparrow$ $p_{ex} = p_{in} = 1\,atm$

$$\Delta V = \frac{0{,}0055\,\cancel{mol} \cdot 8{,}31446\,\frac{J}{\cancel{mol}\,\cancel{K}} \cdot 311{,}75\,\cancel{K}}{101325\,\frac{kg}{m\,s^2}}$$

$$\left(\frac{J}{\frac{kg}{m\,s^2}} = \frac{\frac{kg\,m^2}{\cancel{s^2}}}{\frac{\cancel{kg}}{m\,\cancel{s^2}}} = m^3 \right)$$

$$\Delta V = 0{,}000140698\,m^3$$

$$\underline{\Delta V = 140{,}698\,cm^3}$$

$$\Delta V = h \cdot A \qquad A = \left(\frac{d}{2}\right)^2 \pi$$

$$A = (1{,}6\,cm)^2 \cdot \pi = 8{,}04248\,cm^2$$

$\downarrow$

$$h = \frac{\Delta V}{A} = \frac{140{,}698\,cm^{\cancel{3}}}{8{,}04248\,\cancel{cm^2}} = 17{,}4944\,cm$$

$$\underline{\underline{h = 17{,}5\,cm}}$$

(1b) $$W = -\int p_{ex}\,dV = -p_{ex}\int dV = -p_{ex}\,\Delta V$$

$$W = -101325\,\frac{kg}{\cancel{m}\,s^2} \cdot 140{,}698 \cdot 10^{-6}\,m^{\cancel{3}\,2}$$

$$W = -14{,}25622\,\frac{kg\,m^2}{s^2}$$

$W = -14,25622 \frac{kg\,m^2}{s^2}$

$\underline{\underline{W = -14,3\ J}}$