(5)

$V_0 = 2{,}35\ dm^3 = 2{,}35 \cdot 10^{-3}\ m^3$

$T = 31^\circ C = 304{,}15\ K$

$M_{mol} = 28\ \frac{g}{mol} = 28 \cdot 10^{-3}\ \frac{kg}{mol}$

$p = 965\ mbar = 0{,}965\ bar = 0{,}965 \cdot 10^5\ Pa$

(a) $pV = nRT$

$$n = \frac{pV}{RT} = \frac{0{,}965 \cdot 10^5\ Pa \cdot 2{,}35 \cdot 10^{-3}\ m^3}{8{,}3144\ \frac{J}{mol\,K} \cdot 304{,}15\ K}$$

$n = 0{,}0896754\ mol$

$m = n \cdot M_{mol} = 0{,}0896754\ mol \cdot 28\ \frac{g}{mol}$

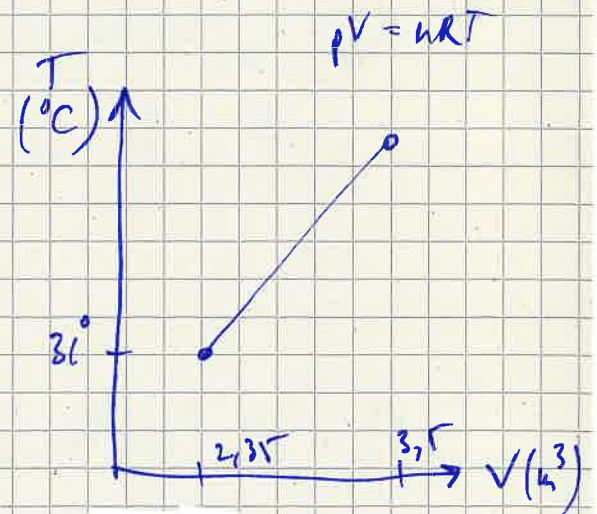
$m = 2{,}510911\ g$

$m = 2{,}5\ g$

(b) $pV = nRT$

$p_1 R_1 T = const$

$\rightarrow p \sim T$



(c) $W = -\int_{V_0}^{V_F} p(V)\,dV = -\int_{V_0 = 2{,}35\,dm^3}^{V_F = 3{,}5\,dm^3} 965\ mbar\ dV$

$W = -965\ mbar\ (3{,}5\ dm^3 - 2{,}35\ dm^3)$

$W = -1{,}10975\ bar\ dm^3$

$W = -1{,}1 \cdot 10^2\ J$

$bar\ dm^3 = 10^5\ \frac{kg}{m\,s^2} \cdot 10^{-3}\ m^3 = 10^2\ J$

(6) S_1: $p_1 = 2{,}2\ \text{atm} = 2{,}22926 \cdot 10^5\ \text{Pa}$

$T_1 = 150\ \text{K}$

$V = \text{cost}$ ↓ $V_1 = 6{,}5\ \text{m}^3$

S_2 $V_2 = 6{,}5\ \text{m}^3$

$T_2 = 240\ \text{K}$

$p_2 =$

$T = \text{cost}$ ↓

S_3 $V_3 = 12\ \text{m}^3$

$T_3 = 240\ \text{K}$

$p_3 =$

(a) $S_1 \to S_2$ (isoterma) : $\frac{p}{T} = \text{cost}$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2} \to p_2 = p_1 \cdot \frac{T_2}{T_1} = 2{,}2\ \text{atm} \cdot \frac{240\ \text{K}}{150\ \text{K}}$$

$$p_2 = 3{,}52\ \text{atm}$$

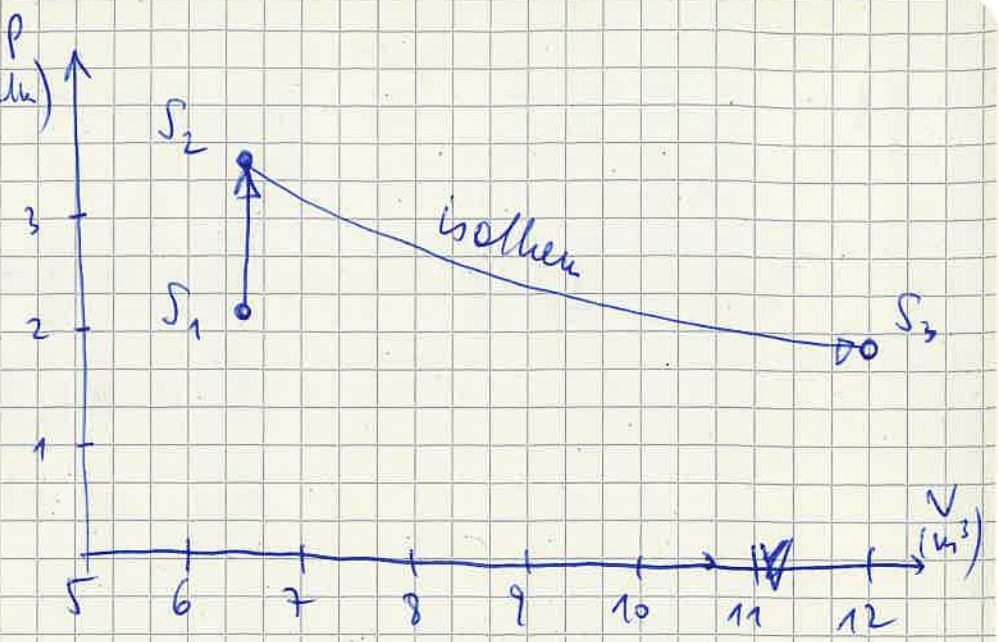
$S_2 \to S_3$ (izoterma) : $p \cdot V = \text{cost}$

$$p_2 V_2 = p_3 V_3 \to p_3 = p_2 \cdot \frac{V_2}{V_3} = 3{,}52\ \text{atm} \cdot \frac{6{,}5\ \text{m}^3}{12\ \text{m}^3}$$

$$p_3 = 1{,}906\ \text{atm}$$

$$p_3 = 1{,}9\ \text{atm}$$

(6) (1)



(7) $r = 145\,cm = 1{,}45\,m \rightarrow V = \frac{4}{3} r^3 \pi = 12{,}7700507\,m^3$

$M_{H_2} = 2{,}02\ g/mol$

(8) $T = 25°C = 298{,}15\,K$

$p = 2\,bar = 2 \cdot 10^5\,Pa$

$pV = nRT \rightarrow n = \frac{pV}{RT}$

$$n = \frac{2 \cdot 10^5\,Pa \cdot 12{,}7700507\,m^3}{8{,}31446\ \frac{J}{mol\,K} \cdot 298{,}15\,K} = 1030{,}27639\,mol$$

$n = 1{,}03\ kmol$

(b) $F_A \overset{!}{>} F_G$ → Grenzfall $F_A = F_G$

$F_A = V \cdot \rho_{Luft} \cdot g$

$F_G = m \cdot g + m_{Hülle} g$

$F_G = m_{H_2} g + m_{Hülle} g$

$F_G = n \cdot M_{H_2} \cdot g + m_{Hülle} g$

→ $n M_{H_2} g + m_{Hülle} g = V \rho_{Luft} g$

$m_{Hülle} = V \rho_{Luft} - n M_{H_2}$

$= 12{,}7700105\,m^3 \cdot 1{,}22 \frac{kg}{m^3} - 1030{,}276395\,mol \cdot 2{,}02 \frac{g}{mol}$

$= 15{,}57946\,kg - 2{,}081158\,kg = 13{,}498304\,kg$

$m_{Hülle} = 13{,}4\,kg$ (abrunden! damit der Ballon aufsteigt)

(8) $n = 2{,}12\ mol$

$T = 25°C = 298{,}15\ K$

S_1: $p_1 = 2{,}71\ bar = 2{,}71 \cdot 10^5\ Pa$

$T = const$ ↓

S_2: $p_2 = 7{,}6\ bar$

(a) $V_1 = \frac{nRT}{p_1} = \frac{2{,}12\ mol \cdot 8{,}3146 \frac{J}{mol\,K} \cdot 298{,}15\ K}{2{,}71 \cdot 10^5\ Pa}$

$V_1 = 0{,}0193925\ m^3$

$pV = const \rightarrow p_1 V_1 = p_2 V_2$

$V_2 = V_1 \frac{p_1}{p_2} = 0{,}0193925\ m^3 \cdot \frac{7{,}6}{2{,}71}$

$V_2 = 0{,}0691498\ m^3$

$W = -\int_{V_1}^{V_2} p(V)\,dV = -nRT \cdot \ln \frac{V_2}{V_1}$

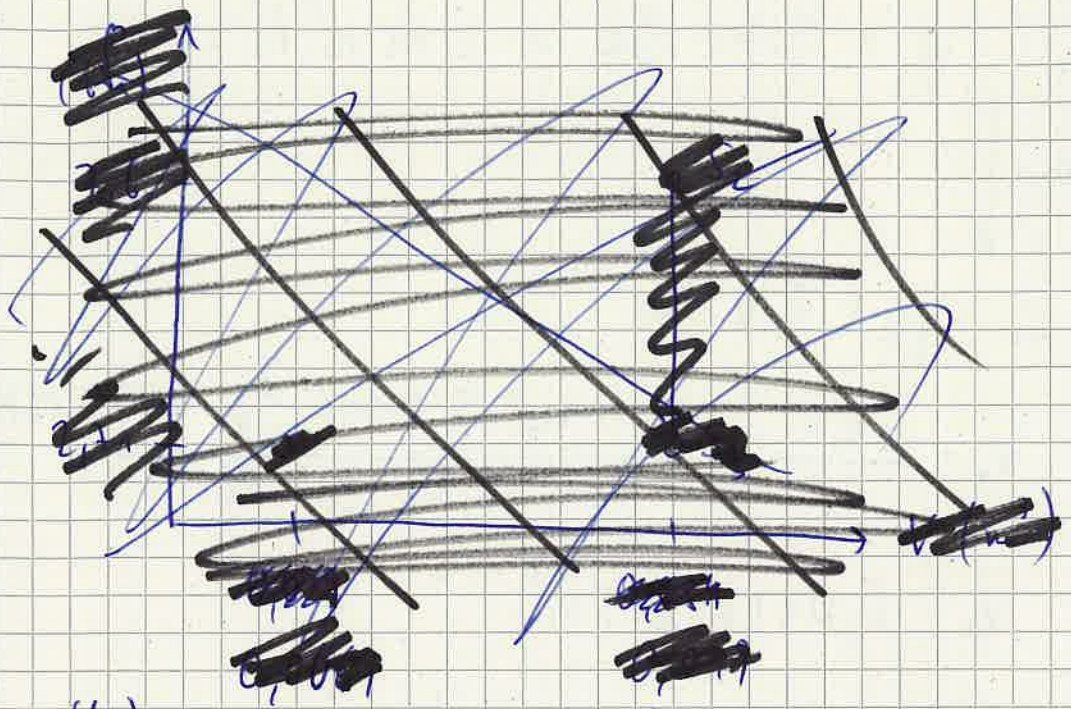
$= -2{,}12\ mol \cdot 8{,}3146 \frac{J}{mol\,K} \cdot 298{,}15\ K \ln \frac{0{,}0691498\ m^3}{0{,}0193925\ m^3}$

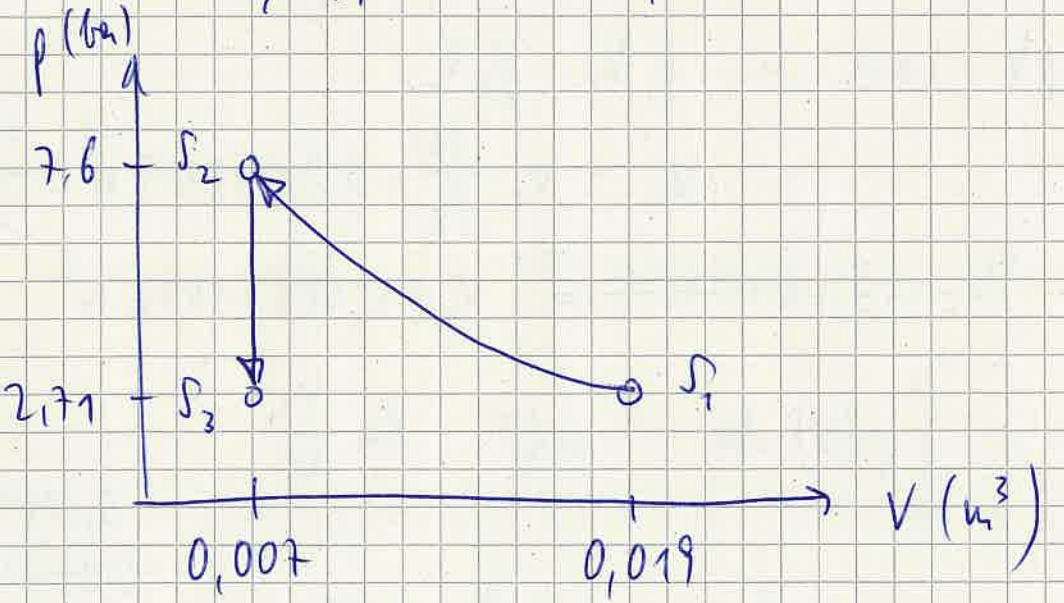
$W = 5419{,}3533\ J$

$W = 5{,}4\ kJ$

(b) $p_3 = 2{,}71\ \text{bar}$

$V_3 = V_2 =$ [redacted] $0{,}00691498\ m^3$





(c) $pV = nRT$

$$T_3 = \frac{p_3 V_3}{nR} = \frac{2{,}71 \cdot 10^5\ Pa \cdot 0{,}00691498\ m^3}{2{,}12\ mol \cdot 8{,}31446\ \frac{J}{mol\,K}}$$

$T_3 = 106{,}314\ K$

$T_3 = 1{,}1 \cdot 10^2\ K$