kritischer Punkt im van der Waals Gas

$$(V-b)\left(p+\frac{a}{V^2}\right)=RT$$

am kritischen Punkt: $\frac{\partial p}{\partial V} = 0 \qquad \frac{\partial^2 p}{\partial V^2} = 0$

$$p = \frac{RT}{V-b} - \frac{a}{V^2} \Rightarrow \frac{\partial p}{\partial V} = -\frac{RT}{(V-b)^2} + \frac{2a}{V^3} = 0$$

$$\frac{\partial^2 p}{\partial V^2} = \frac{2RT}{(V-b)^3} - \frac{6a}{V^4} = 0$$

$$\boxed{\frac{RT}{(V-b)^2} = \frac{2a}{V^3}} \qquad \frac{3a}{V^4} = \frac{RT}{(V-b)^3} = \frac{2a}{V^3}\cdot\frac{1}{V-b}$$

$$\frac{3}{2V} = \frac{1}{V-b} \qquad V-b = \frac{2}{3}V \qquad \frac{1}{3}V = b \rightarrow \boxed{V_c = 3b}$$

$$\frac{RT_c}{4b^2} = \frac{2a}{27b^3} \Rightarrow RT_c = \frac{8a}{27b} = \frac{8 N_A \cdot b \cdot \varepsilon}{27 b}$$

$$k_B T_c = \frac{8}{27}\cdot\varepsilon$$

Dampfdruck-Kurve

id. Gas

$$\frac{dp_D}{dT} = \frac{L_D}{T(V_D - V_F)} \hat{=} \frac{L_D}{TV} \overset{!}{=} \frac{p_D L_D}{RT^2}$$

$$\int \frac{dp_D}{p_D} = \int \frac{L_D \, dT}{RT^2}$$

$$\ln p_D = -\frac{L_D}{RT} \rightarrow p_D(T) \sim e^{-\frac{L_D}{RT}}$$

Für den Übergang fest–flüssig gilt analog

$$\frac{dp_S}{dT} = \frac{L_S}{T(V_{Fl} - V_{Fest})}$$

Wasser: $V_{Fl} - V_{fest} \underline{\underline{< 0}}$

Mensch $m = 70\,kg$ Fläche $A \hat{=} 500\,cm^2 = 5 \cdot 10^{-2}\,m^2$

$$p = \frac{7}{5} 10^4\,Pa$$

$$\Delta T = \frac{T(V_{Fl} - V_{Fest}) \cdot \Delta p}{L_S} \cong -\frac{300\,K \cdot 0.1 \cdot 10^{-3}\,m^3 \cdot 10^4\,Pa}{300\,kJ} \cong -10^{-3}\,K$$