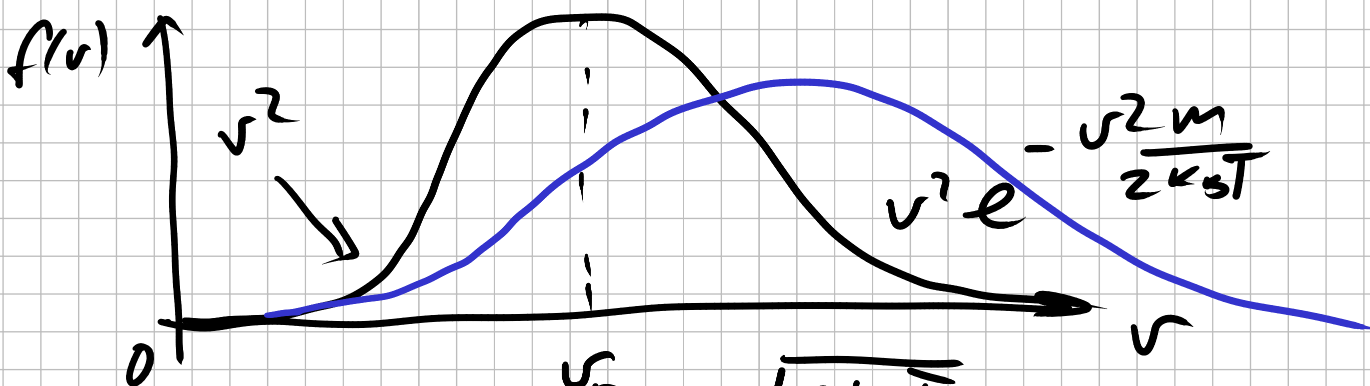
Maxwell - Boltzmann distribution

$$f(v) = 4\pi v^2 \left(\frac{m}{2\pi k_B T}\right)^{3/2} e^{-\frac{m}{2k_BT}v^2}$$



$$v_p = \sqrt{\frac{2k_BT}{m}}$$

$$\langle v\rangle = \int_0^\infty v \cdot f(v)\,dv$$

$$\langle v^2\rangle = \int_0^\infty v^2 f(v)\,dv$$

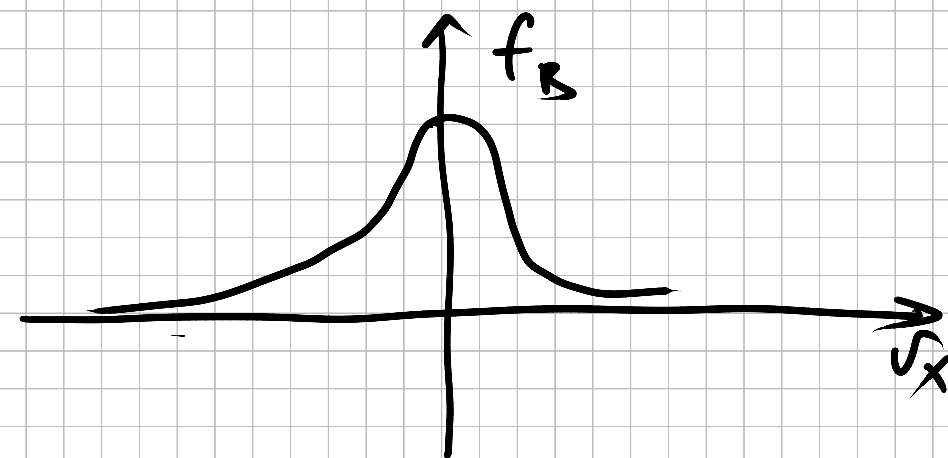
$$v_p(O_2) = \sqrt{\frac{2\cdot 1.38\cdot 10^{-23}\cdot 300}{\frac{30\cdot 10^{-3}\,kg}{6\cdot 10^{23}}}} = \sqrt{\frac{2\cdot 1.38\cdot 10^{-23}\cdot 6\cdot 10^{23}}{3\cdot 10^{-2}}}$$

$$= \sqrt{6\cdot 100\cdot 300}$$

$$\simeq 500\ m/s$$

Boltzmann

$$f_B(v_x) \sim e^{-\frac{m v_x^2}{2 k_B T}}$$



1 mole at $P = 1\,\text{atm}$, $T = 0°C$

$V = 22.4$ liters

$$PV = N \cdot k_B T$$

$$V = \frac{N_a \cdot k_B T}{P} = \frac{\overbrace{6 \cdot 10^{23} \cdot 1.38 \cdot 10^{-23}}^{\approx 8.31 = R} \cdot 273}{10^5\,\text{Pa}} =$$

$$\approx \frac{8 \cdot 300}{10^5\,\text{Pa}} = 24 \cdot 10^{-3}\,m^3$$

$$\approx 24\,L$$

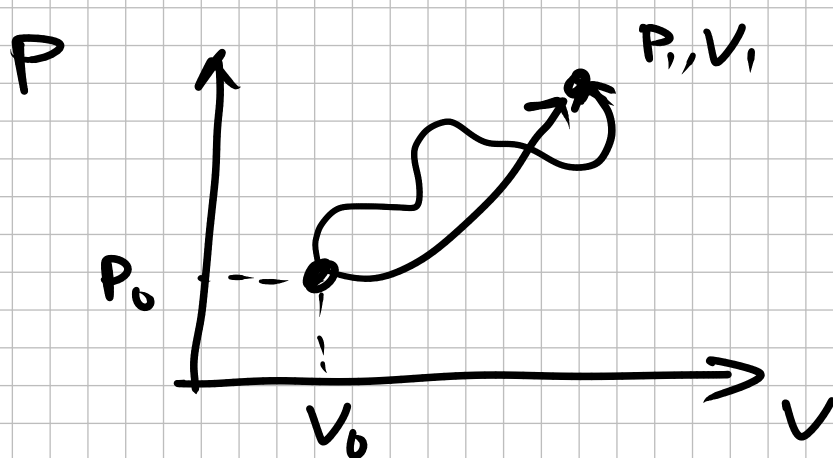
$\frac{V}{N_a} = d^3$, d - is average spacing

$d \sim 3\,nm$

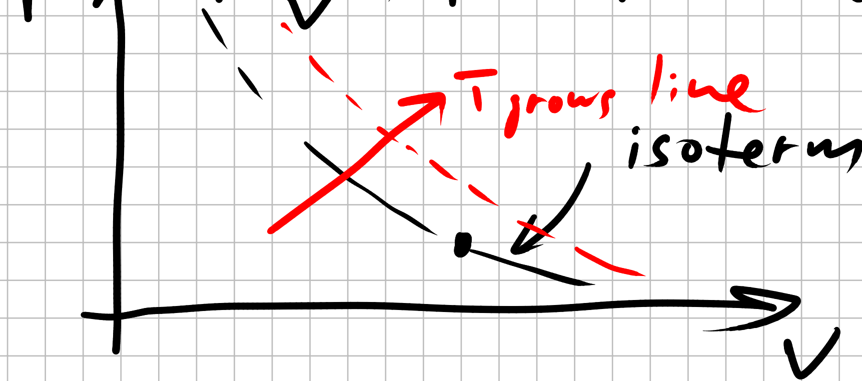
Equation of states

F (state variables) = 0

$$\boxed{PV = N k_B T} \Rightarrow F(P, V, T) = PV - N k_B T = 0$$



$p \sim \frac{1}{V}$, for T = const



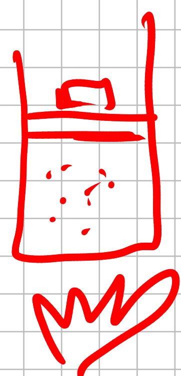
Isobaric process

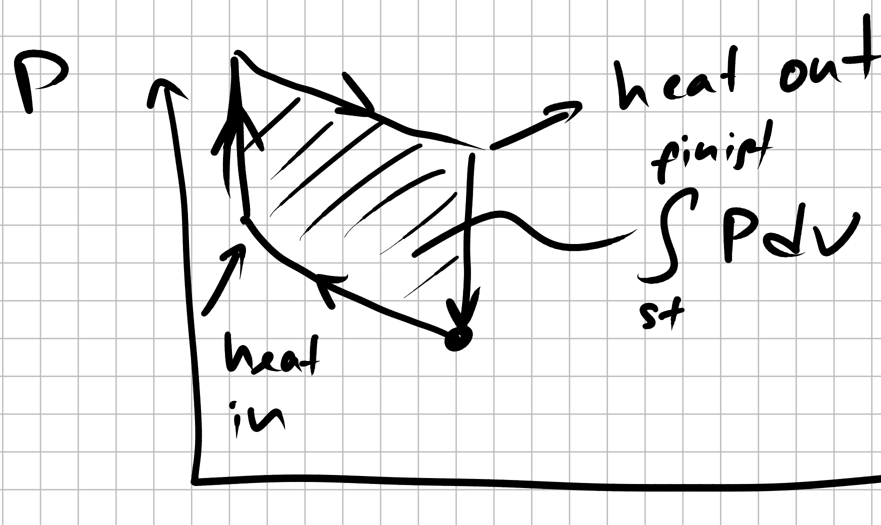
P= const

Iso volume

Isochoric

V= const





$$\int_{st}^{finish} P\,dV = W$$