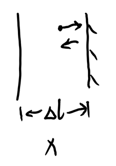
单原子理想气体，在T,p一定时
处于平衡，n_T个原子



考虑x方向，$\bar{v}_x$均方根
Δt时间内
$\Delta l = |\bar{v}_x|\Delta t$，在$\Delta t$时间内运动的距离

没找到出处。

Cv的推导公式

截面积A，体积$A\bar{v}_x\Delta t$

密度$\frac{n_T}{V}$，动量$m\bar{v}_x$，反弹后$-m\bar{v}_x$

冲量 $F\Delta t = A\bar{v}_x\Delta t\frac{n_T}{V}(2m\bar{v}_x)\cdot\frac{1}{2}$

$p = \frac{F}{A} = \frac{n_T}{V}(m\bar{v}_x^2)$，$n_T = nN_A$

$$\begin{cases} pV = m\cdot nN_A\cdot\bar{v}_x^2 \\ pV = nRT \end{cases} \Rightarrow m\bar{v}_x^2 = \frac{pV}{nN_A} = \frac{RT}{N_A} = kT \qquad R = N_A k$$

三维 $\bar{v}^2 = \bar{v}_x^2 + \bar{v}_y^2 + \bar{v}_z^2$

$$\bar{v}^2 = 3\bar{v}_x^2$$

$$\frac{1}{3}m\bar{v}^2 = kT$$

$$\langle E\rangle = \frac{1}{2}m\bar{v}^2$$

$$\langle E\rangle = \frac{3}{2}kT$$

$$U = N_A\cdot\langle E\rangle = \frac{3}{2}RT$$

$$C_V = \left(\frac{\partial U}{\partial T}\right)_V = \frac{3}{2}R$$

300K时 $\bar{v}^2 = 23.4\times10^4\ m^2/s^2$

$\bar{v} = 483\ m/s$

某个性质的宏观平均值

1) 微观状态的性质
2) 系统可以处于的微观状态(微观状态数)
3) 每个微观状态的几率(系统在各个微观状态出现的几率)

Ⅰ Ⅱ 4个球ABCD

Ⅰ放4个，Ⅱ为0个 宏观状态

Ⅰ ABCD Ⅱ 0 1种

微观状态数Ω

Ⅰ放N_1，Ⅱ放N_2，N个球

$$\Omega = \frac{N!}{N_1!N_2!}$$

与Ω有关的量S

S为广延量，满足加和性，$S = S_1 + S_2$

微观状态数 $\Omega = \Omega_1\times\Omega_2$ 如何通过这两个式子来推出f（x）到底=？，也就是熵到底是什么东西

满足相乘性 $S = f(\Omega)$

$$\left.\begin{aligned} &W_{A,B} = W_A\cdot W_B \\ &S = f(W) \\ &f(W_{A,B}) = f(W_A) + f(W_B) \end{aligned}\right\}$$

$f(1) = 2f(1) = 0$

$f(x\cdot\frac{1}{x}) = f(x) + f(\frac{1}{x})$

$$f'(x) = \lim_{h\to0}\frac{f(x+h)-f(x)}{h} = \lim_{h\to0}\frac{f(x+h)+f(\frac{1}{x})}{h} = \lim_{h\to0}\frac{f(1+\frac{h}{x})}{h} = \lim_{h\to0}\frac{f(1+\frac{h}{x})-f(1)}{h} = \lim_{h\to0}\frac{\frac{1}{x}[f(1+\frac{h}{x})-f(1)]}{\frac{h}{x}} = \frac{1}{x}f'(1) = \frac{C}{x}$$

$$\Rightarrow f'(x) = \frac{C}{x} \qquad f(x) = k\ln x$$

N_A N_B N

$$\Omega = \frac{N!}{N_A!N_B!}$$

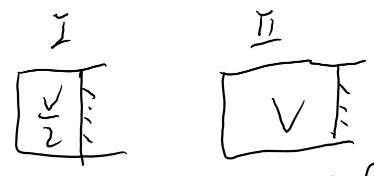
$$S = k\ln\Omega = k\ln\frac{N!}{N_A!N_B!} = -k\ln N\left[\frac{N_A}{N}\ln\left(\frac{N_A}{N}\right) + \frac{N_B}{N}\ln\left(\frac{N_B}{N}\right)\right]$$

$$= -R[x_A\ln x_A + x_B\ln x_B]$$

$$= -R\sum_i x_i\ln x_i$$

1mol 理想气体

Ⅰ Ⅱ



它的定义式就是这个

证1. $$\Delta S(\mathrm{I}\to\mathrm{II}) = \frac{\Delta Q(\mathrm{I}\to\mathrm{II})}{T} = \frac{\int_{\mathrm{I}}^{\mathrm{II}} p\,dV}{T}$$

$$= \int_{\mathrm{I}}^{\mathrm{II}}\frac{R}{V}dV = R\ln V\Big|_{\frac{V}{2}}^{V} = R\ln 2$$

证2. 微观

$R = N_A k$ 微观组织热力学上2.2.2第26页有

$$\Delta S = k\ln 2^{N_A}$$

$$= k\ln 2^{2N_A} - k\ln 2^{N_A}$$