[例题6-4] $f(v)$为麦氏分布函数, 说明各式物理意义

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(1) $Nf(v)dv = dN$　　速率在 $v - v + dv$ 区间分子数

(2) $\int_{v_1}^{v_2} f(v)dv$　　$v_1 \to v_2$区间分子数占总分子数比率

$= \Delta N_{v_1 \to v_2} / N$　　Or. 分子速率在v_1至v_2间的概率

(3) $\int_{v_1}^{v_2} vf(v)dv \Big/ \int_{v_1}^{v_2} f(v)dv = \int_{v_1}^{v_2} vNf(v)dv \Big/ \int_{v_1}^{v_2} Nf(v)dv = \bar{v}\Big|_{v_1\sim v_2}$

$v_1 \to v_2$间分子的平均速率

(4) $\int_0^{\infty} vf(v)dv = \int_0^{\infty} vNf(v)dv / N = \bar{v}$

所有分子的平均速率

$$\boxed{f(v) = \frac{dN/dv}{N}}$$

(5) $\int_{v_1}^{v_2} N \frac{1}{2}\mu v^2 f(v)dv = \int_{v_1}^{v_2} \frac{1}{2}\mu v^2 dN$

速率在$v_1 \to v_2$间分子平动动能之和

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[讨论4] $f(v)$为麦氏分布函数, 写表达式

分子速率在$\bar{v}$与v_p之间的概率

速率不大于v_p分子平均平动动能

[例题6-5]求标况下空气分子$\overline{\lambda}$、$\overline{z}$(d=3.5$\overset{\circ}{\mathrm{A}}$)

解：$p = 1.013\times10^5 SI \quad T = 273.15K \quad M = 29\times10^{-3}Kg$

$$\overline{\lambda} = kT/(\sqrt{2}\pi d^2 p) = 6.9\times10^{-8}m = 690\overset{\circ}{\mathrm{A}}$$

$$\overline{z} = \overline{v}/\overline{\lambda} = \sqrt{8RT/(\pi M)}/\overline{\lambda} = 6.5\times10^9/S = 65亿次/s$$

[讨论5] p一定，(A)$\overline{Z}$与T无关(B)$\overline{Z}\propto\sqrt{T}$

(C)$\overline{Z}\propto\dfrac{1}{\sqrt{T}}$ (D)$\overline{Z}\propto T$

解：$\overline{Z} = \sqrt{2}n\pi d^2\overline{v} = \sqrt{2}\dfrac{p}{kT}\pi d^2\sqrt{\dfrac{8RT}{\pi M}} \propto \dfrac{1}{\sqrt{T}}$

第六部分　　气体动理论

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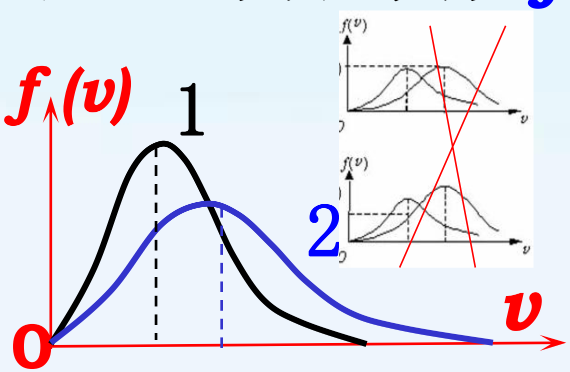
[1]理气状态方程 $\begin{cases} pV = \upsilon RT \\ p = nkT \end{cases}$ 　一定量　$\dfrac{p_1V_1}{T_1} = \dfrac{p_2V_2}{T_2}$

[2]理气的压强温度　$p = \frac{2}{3} n\bar{\varepsilon}_k$　　$\bar{\varepsilon}_k = \frac{3}{2} kT$

[3]理气的内能 $E = \upsilon N_A \dfrac{i}{2} kT = \upsilon \dfrac{i}{2} RT$ (单$3+0$; 双$3+2$; 多$3+3$)

能量均分原理：平衡态T，分子每自由度有$kT/2$平均动能

[4]麦氏速率分布律 $f(v) = \dfrac{dN/dv}{N}$　　$\bar{x} = \int_{v_1}^{v_2} x dN \Big/ \int_{v_1}^{v_2} dN$



$$v_p = \sqrt{2kT/\mu}$$
$$\bar{v} = \sqrt{8kT/\pi\mu}$$
$$\sqrt{\overline{v^2}} = \sqrt{3kT/\mu}$$

$\dfrac{k}{\mu} = \dfrac{R}{M}$　…

特例 $= \int_0^\infty x f(v) dv$

[5]"玻氏分布律"　$n = n_0 e^{-\frac{\mu g z}{kT}}$　　$p = p_0 e^{-\frac{\mu g z}{kT}}$

[6]平均碰撞频率 $\bar{z} = \sqrt{2}\pi d^2 \bar{v} n$　平均自由程 $\bar{\lambda} = \dfrac{1}{\sqrt{2}\pi d^2 n}$