§17.

$pV = \nu RT$ $\nu = \frac{m}{M}$ (量)

$p = nkT$ $k = R/N_A$

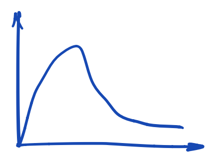
$$\bar{\lambda} = \frac{\bar{v}}{\bar{z}} = \frac{1}{\sqrt{2}\pi d^2 n} = \frac{kT}{\sqrt{2}\pi d^2 p}$$

$$p = \frac{1}{3} n m \bar{v}^2 = \frac{2}{3} n \bar{\varepsilon}_t$$

$$\begin{cases} \bar{\varepsilon}_t = \frac{1}{2} m \bar{v}^2 = \frac{3}{2} kT \\ \bar{\varepsilon}_k = \frac{i}{2} kT \end{cases}$$

$$E = \frac{i}{2} \nu RT$$

$$f(v) = \frac{dN_v}{N \cdot dv}$$



$$\begin{cases} \bar{v} = \int_0^\infty v f(v)\, dv \\ \bar{v^2} = \int_0^\infty \bar{v}^2 f(v)\, dv \end{cases}$$

(期望)

不用记 $\begin{cases} v_p = 1.41\sqrt{\frac{RT}{M}} & \sqrt{2} \\ \bar{v} = 1.6\sqrt{\frac{RT}{M}} & \sqrt{\frac{8}{\pi}} \\ \sqrt{\bar{v}^2} = 1.73\sqrt{\frac{RT}{M}} & \sqrt{3} \end{cases}$

§18.

$dA = p\, dV$ $A > 0$ 对外

$dE = \nu C_{v,m} dT$ $\Delta E = \nu C_{v,m} \Delta T$ $\Delta E > 0$ 内增

$Q = \Delta E + A$ $Q > 0$ 吸

$$C_{v,m} = \frac{i}{2} R$$

$$C_{p,m} = \frac{i}{2} R + R$$

$$\gamma = \frac{i+2}{i}$$

$\boxed{Q = \nu C_{V,m} \Delta T}$ （等体） $P_1 / P_2 = T_1 / T_2$

$\boxed{Q = \nu C_{p,m} \Delta T}$ （等压） $V_1 / V_2 = T_1 / T_2$

$pV^{\gamma} = c$ $\left\{ \begin{array}{l} TV^{\gamma-1} = c \\ p^{\gamma-1} V^{-\gamma} = c \end{array} \right.$

（绝热）

△ $A = \dfrac{P_1 V_1 - P_2 V_2}{\gamma - 1}$

↻ $\eta = \dfrac{A}{Q_1}$

↺ $\omega = \dfrac{Q_2}{A}$

卡诺正 $\eta_c = 1 - \dfrac{T_2}{T_1}$

卡诺反 $\omega_c = \dfrac{T_2}{T_1 - T_2}$

§19.

$S = k \ln \Omega$

$dS = \dfrac{đQ}{T}$ （可逆） $\Delta S = {}_R\int_1^2 \dfrac{đQ}{T}$

可逆才是等号

$C_m = \dfrac{đQ}{dT}$ $c = \dfrac{dQ}{dT}$

准静态过程 > 可逆过程 > 等熵过程

§20. $x = A\cos(\omega t + \varphi)$

$$\omega = \frac{2\pi}{T} = 2\pi\nu = \sqrt{\frac{k}{m}}$$

单摆：$\omega = \sqrt{\frac{g}{l}}$

$$E = \frac{1}{2}kA^2$$

§21. $y = A\cos\omega\left(t \mp \frac{x}{u}\right)$ $= A\cos(\omega t \mp kx)$

$k = \frac{2\pi}{\lambda}$ $u = \frac{\lambda}{T}$

$$u = \sqrt{\frac{G}{\rho}} = \sqrt{\frac{E}{\rho}} = \sqrt{\frac{K}{\rho}} = \sqrt{\frac{F}{\rho_l}}$$

$\bar{w} = \frac{1}{2}\rho\omega^2A^2$ $I = \bar{w}u$.

(能量密度)

$$y = 2A\cos\frac{2\pi}{\lambda}x \cdot \cos\omega t$$

$$n_{21} = \frac{\sin i}{\sin r}$$

§22. $\delta = n_2r_2 - n_1r_1$ $\Delta\varphi = \frac{2\pi}{\lambda}\cdot\delta$

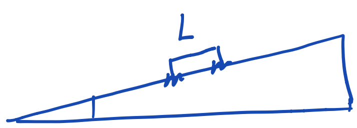
双孔干涉. 明 $\delta = k\lambda n_1$

暗 $\delta = (2k-1)\frac{\lambda}{2}n_1$

普适

$$x = \delta\cdot\frac{D}{d}$$

劈尖. $\delta = 2n_2h + n_1\frac{\lambda}{2}$ $(n_2 > n_1)$



$2n_2\Delta h = \lambda \Rightarrow 2n_2L\theta = \lambda$

$L = \frac{\lambda}{2n_2\theta}$ $N = \frac{\Delta H}{\Delta h}$

等倾： $\delta = \boxed{2h\sqrt{n_2^2 - n_1^2\sin^2 i} + \frac{\lambda}{2}n_1}$

麦克耳孙： $\begin{cases} \Delta L = \dfrac{N\lambda}{2} \\ \Delta h = m \cdot \dfrac{\lambda}{2} \end{cases}$

§23. 单缝衍射 $\delta = a\sin\theta$.

$\delta = \pm k\lambda$ （暗）

$\delta = \pm(2k+1)\frac{\lambda}{2}$ （明） $k=1,2,\cdots$

$\theta = 0$是中央明纹.

$\begin{cases} \Delta\theta_0 = 2\dfrac{\lambda}{a} & \text{（角）} \\ \Delta x_0 = 2f\dfrac{\lambda}{a} & \text{（线）} \end{cases}$

K级明纹： $\theta = \frac{k\lambda}{a}$

$x = f\frac{k\lambda}{a}$

最小分辨角： $\boxed{\delta\theta = 1.22\frac{\lambda}{D}}$ D是"瞳孔"距离.

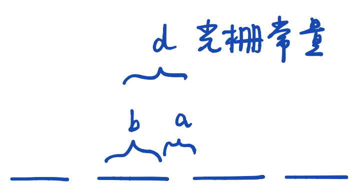
分辨率： $R = \frac{1}{\delta\theta}$ $R = \frac{\lambda}{\delta\lambda} = kN$

多缝干涉. $\delta = d\sin\theta = \pm k\lambda$ d（孔间距）.

（明） $\begin{cases} \Delta\theta = \dfrac{\lambda}{d} \\ \Delta x = f\dfrac{\lambda}{d} \end{cases}$

（暗） $\delta = Nd\sin\theta = \pm m\lambda$

$\begin{cases} \Delta\theta = \dfrac{\lambda}{Nd} \\ \Delta x = f\dfrac{\lambda}{Nd} \end{cases}$

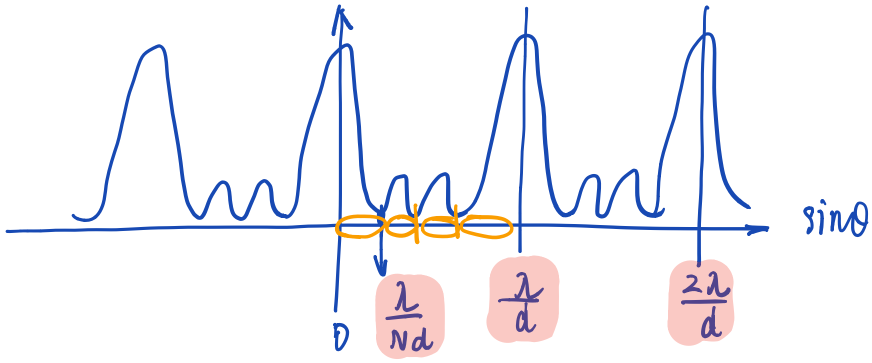


N缝，N-1极小，N-2次极大，

缺级：$k = \pm \frac{d}{a} k'$

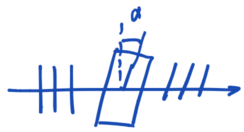
$\boxed{\text{条纹最高级次：} \theta = \pm \frac{\pi}{2}}$

强度：$I = N^2 I_{单}$



服从 d 的多光干涉
服从 a 的单光衍射

§24. 偏振. $I = I_0 \cdot \cos^2\alpha$



☆ 自然光通过，$I = \frac{1}{2} I_0$.

$\tan i_b = \frac{n_2}{n_1}$ （完全偏振）

§26. $M = \int_0^\infty M_\nu(T)\, d\nu$

$$M_\nu = \frac{2\pi h}{c^2} = \frac{\nu^3}{e^{h\nu/kT} - 1}$$

$$M(T) = \sigma T^4$$

光电效应. $\frac{1}{2} m v_m^2 = eU_c$

$= ek(\nu - \nu_0)$

$= h\nu - A$

频率 $\nu = \frac{1}{T} = \frac{c}{\lambda}$

$\nu_0 = \frac{A}{h} = \frac{U_0}{k}$

$p = \frac{h}{\lambda}$

$$\boxed{\begin{cases} E = h\nu \\ p = \dfrac{h}{\lambda} \end{cases}}$$

$$\Delta\lambda = \lambda - \lambda_0 = \frac{h}{m_0 c}(1-\cos\varphi)$$

$$= 2\lambda_c \sin\left(\frac{\varphi}{2}\right)^2 \qquad \lambda_c = \frac{h}{m_0 c}$$

$\downarrow$

$$\begin{cases} \nu = \dfrac{E}{h} = \dfrac{mc^2}{h} \\ \boxed{\lambda = \dfrac{h}{p}} = \dfrac{h}{m\nu} \end{cases}$$

实物粒子.

(n=1时为基态波函数)

不含时

$\downarrow$

$$\boxed{\Delta x \cdot \Delta p_x \geq \frac{1}{2}\hbar}$$

$$\boxed{\psi_n = \sqrt{\frac{2}{a}} \sin \frac{n\pi}{a} x} \quad (\text{波函数.})$$

$$\boxed{\Psi(x,t) = \psi(x) e^{-i(Et - px)/\hbar}} \quad (\text{本征波函数})$$

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\Psi + U\Psi = i\hbar\frac{\partial \Psi}{\partial t}$$

$$P = \int_0^{a_0} \psi^2 dx = \sim$$

$$-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\psi + U\psi = E\psi$$

$$\boxed{E_n = \frac{\pi^2}{a^2}\frac{\hbar^2}{2m}n^2 \quad n = 1, 2, \cdots} \quad \text{能量}$$

$$E_1, E_2 \cdots \qquad \underline{E_n = n^2 E_1}$$

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