1-1 解：∵ $\Delta y = y_{j+1} - y_j = \dfrac{r_0}{d}\lambda$

∴ $\Delta y_1 = \dfrac{180}{0.022} \times 5000 \times 10^{-8} \approx 0.409$ cm

$\Delta y_2 = \dfrac{180}{0.022} \times 2000 \times 10^{-8} \approx 0.573$ cm

又∵ $y = j\dfrac{r_0}{d}\lambda$ ， $j = 2$

∴ $\Delta y = j\dfrac{r_0}{d}(\lambda_2 - \lambda_1) = 2 \times \dfrac{180}{0.022} \times (7000 - 5000) \times 10^{-8}$

≈0. 327 cm

or: $\Delta y = 2\Delta y_2 - 2\Delta y_1 \approx 0.328$ cm

1-2 解：∵ $\left(\Delta y = \dfrac{r_0}{d}\lambda\right).\quad y = j\dfrac{r_0}{d}\lambda$ j=0, 1

∴ (1) $\Delta y = (1-0) \times \dfrac{50}{0.04} \times 6.4 \times 10^{-5} = 0.08\,\text{cm}$

(2)

$$\Delta\varphi = j \cdot 2\pi = 2\pi \cdot \frac{dy}{r_0\lambda} = 2\pi \times \frac{0.04 \times 0.001}{50 \times 6.4 \times 10^{-5}} = \frac{\pi}{4}$$

(3) $\bar{I} = 4A_1^2 \cos^2 \dfrac{\varphi_2 - \varphi_1}{2}$ $\qquad \bar{I}_0 = 4A_1^2$

$\varphi_2 - \varphi_1 = \dfrac{\pi}{4}$

$$\frac{I_p}{I_0} = \cos^2 \frac{\pi/4}{2} = \cos^2 \frac{\pi}{8} \approx 0.854$$

1-3 解：∵ $\delta = nd - d = (n-1)d$ $\quad (\Delta\varphi = \dfrac{2\pi}{\lambda}\delta = j \cdot 2\pi)$

而：$\delta = j\lambda$

$$\therefore \quad d=\frac{j\lambda}{n-1}=\frac{5\times 6\times 10^{-7}}{1.5-1}=6\times 10^{-6}m=6\times 10^{-4}cm$$

1-4 解:

$$\Delta y=\frac{r_0}{d}\lambda=\frac{50}{0.02}\times 5000\times 10^{-8}=0.125 \quad cm$$

$$I=A^2 \quad \because I_1=2I_2 \quad \therefore A_1=\sqrt{2}A_2$$

$$V=\frac{I_{\max}-I_{\min}}{I_{\max}+I_{\min}}=\frac{2\left(A_1/A_2\right)}{1+\left(A_1/A_2\right)^2}=\frac{2\sqrt{2}}{1+2}=\frac{2}{3}\sqrt{2}\approx 0.943$$

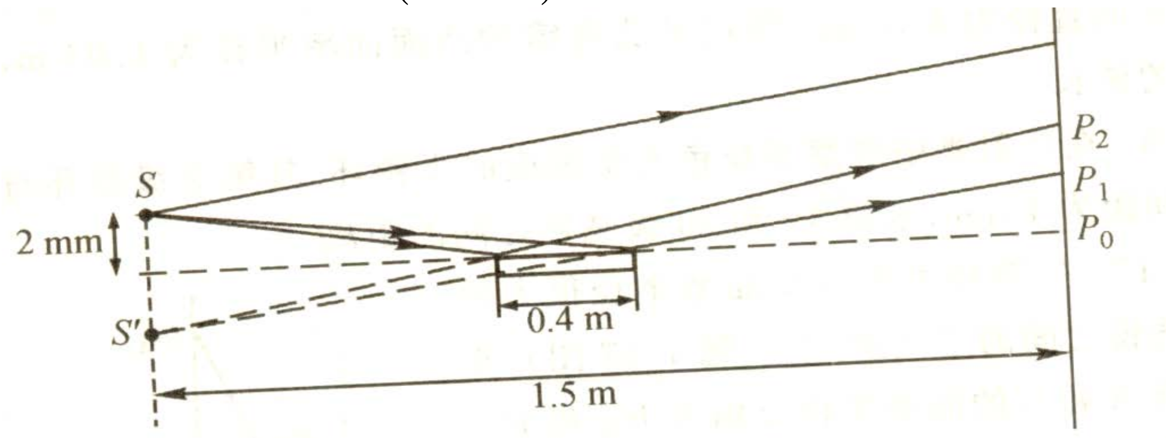
$$or: \quad V=\frac{2\sqrt{I_1I_2}}{I_1+I_2}=\frac{2\sqrt{2}}{1+2}=\frac{2}{3}\sqrt{2}$$

1-5 解:

$$\because \quad \Delta y=\frac{r+l}{2r\sin\theta}\lambda$$

$$\therefore \quad \sin\theta=\frac{r+l}{2r\Delta y}\lambda=\frac{20+180}{2\times 20\times 0.1}\times 7000\times 10^{-8}=0.0035$$

$$\theta=\sin^{-1}(0.0035)\approx 0.2^o=12'$$



1-6 解:(1)

$$\Delta y=\frac{r_0}{d}\lambda=\frac{1500}{2\times 2}\times 500\times 10^{-7}=0.1875mm\approx 0.19mm$$

[利用 $\Delta\varphi = \frac{2\pi}{\lambda}\delta = j\cdot 2\pi$， $\delta = \frac{d}{r_0}y - \frac{\lambda}{2}$ 亦可导出同样结果。]

（2）图

$$\because \quad \overline{p_0 p_1} = Btg\theta_1 = B\cdot\frac{a}{A+C} = \frac{0.55\times 2}{0.55+0.4} = \frac{1.1}{0.95} \approx 1.16\,(mm)$$

$$\overline{p_0 p_2} = (C+B)tg\theta_2 = (C+B)\cdot\frac{a}{A} = \frac{(0.55+0.4)\times 2}{0.55} \approx 3.45\,(mm)$$

$$\therefore \overline{p_1 p_2} = \Delta l = \overline{p_0 p_2} - \overline{p_0 p_1} = 3.45 - 1.16 = 2.29\,(mm)$$

$$\Delta N = \frac{\Delta l}{\Delta y} = \frac{2.29}{0.19} \approx 12\,(\text{条})$$

即：离屏中央 1.16mm 的上方的 2.29mm 范围内，可见 12 条暗纹。（亮纹之间夹的是暗纹）

1-7．解：$\because \quad 2h\sqrt{n_2^2 - n_1^2\sin^2 i_1} = (2j+1)\frac{\lambda}{2}$ 二级 $j = 0,1,$

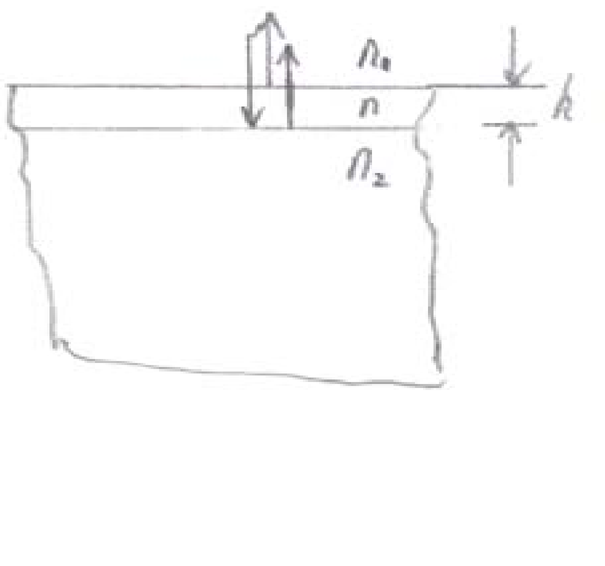
$$\therefore \quad h = \frac{2j+1}{\sqrt{n_2^2 - n_1^2\sin^2 i_1}}\frac{\lambda}{4}$$

$$= \frac{2\times 1+1}{\sqrt{1.33^2 - 1^2\times\sin^2 30^o}} \times \frac{700}{4} \approx 4260\,\overset{0}{A}$$

$$or:\ \delta = 2h\sqrt{n_2^2 - n_1^2\sin^2 i_1} + \frac{\lambda}{2}$$

$$2h\sqrt{n_2^2 - n_1^2\sin^2 i_1} = (2j-1)\frac{\lambda}{2}$$

$$h = \frac{2j-1}{\sqrt{n_2^2 - n_1^2\sin^2 i_1}}\frac{\lambda}{4} \quad \text{取}j = 2,\text{合题意}$$

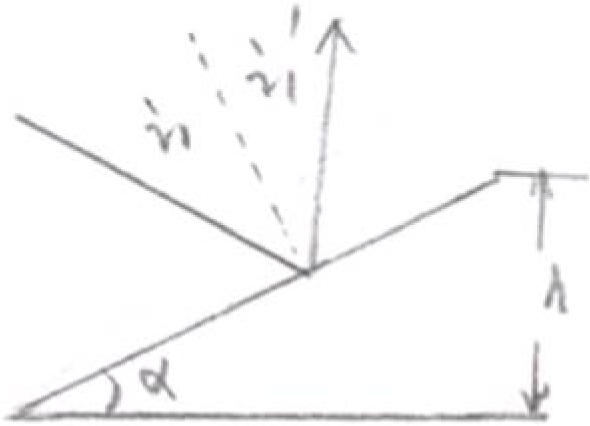


1-8.解：$\because 2d_0 n_0 \cos i_2 = (2j+1)\dfrac{\lambda}{2}$

$$i_2 = 0 \quad j = 0$$

$$or: 2h\sqrt{n_0^2 - n_1^2 \sin^2 i_1} = (2j+1)\frac{\lambda}{2}. \quad i_1 = 0$$

$$\therefore \quad d_{0\min} = \frac{\lambda}{4n} = \frac{5500\times 10^{-7}}{4\times 1.38} \approx 10^{-5}cm$$



1-9.解：薄膜干涉中，每一条级的宽度所对应

的空气劈的厚度的变化量为：

$$\Delta h = h_{j+1} - h_j = \left[(j+1)+\frac{1}{2}\right]\frac{\lambda}{2\sqrt{n_2^2 - n_1^2\sin^2 i_1}} - \left(j+\frac{1}{2}\right)\frac{\lambda}{2\sqrt{n_2^2 - n_1^2\,\mathrm{s}}}$$

$$= \frac{\lambda}{2\sqrt{n_2^2 - n_1^2\sin^2 i_1}}$$

若认为薄膜玻璃片的厚度可以略去不计的情况下，

$n_1 = n_2 = 1$，又因 $i_1 = i_1' = 60^\circ$，则

$$\Delta h = \frac{\lambda}{2\sqrt{1-\left(\sqrt{3}/2\right)^2}} = \lambda$$

则可认为

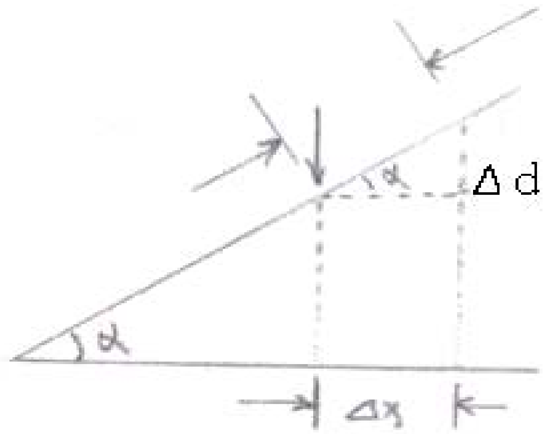
Or：$\Delta h = \dfrac{\lambda}{2\cos i_2} = \dfrac{\lambda}{2\cos 60^\circ} = \lambda$

而厚度 h 所对应的斜面上包含的条纹数为：

$$N = \frac{h}{\Delta h} = \frac{0.05}{5000 \times 10^{-7}} = 100\,(\text{条})$$

故玻璃片上单位长度的条纹数为：

$$N' = \frac{N}{l} = \frac{100}{10} = 10\,\text{条}/cm$$



1-10．解：∵对于空气劈，当光垂直照射时，

有 $d_0 = (j + \frac{1}{2})\frac{\lambda}{2}$

$$\therefore \quad \Delta d_0 = d_{02} - d_{01} = \frac{\lambda}{2}$$

又∵ $\Delta d \approx \alpha \cdot \Delta x \approx \alpha \cdot \Delta l$

而 $\alpha \approx d_0 / l$

$$\therefore \quad \frac{d_0 \cdot \Delta l}{l} = \frac{\lambda}{2}$$

$$\lambda = \frac{2d_0 \cdot \Delta l}{l} = \frac{2 \times 0.036 \times 1.4}{179}$$

$$= 5.631 \times 10^{-4}\ (mm) = 563.1\,nm$$

1-11．解：∵是正射，$i_1 = 0$,

$$\therefore \quad \delta = 2n_2 d_0 - \frac{\lambda}{2} = j\lambda \qquad \text{相长(最强)}$$

$$\therefore \quad 2n_2 d_0 = (2j+1)\frac{\lambda}{2}$$

$$\lambda = \frac{4n_2 d_0}{2j+1} = \frac{4\times 1.5\times 1.2\times 10^{-6}}{2j+1}$$

$$= \frac{72000\ \overset{0}{A}}{2j+1}$$

$$or:\ 400nm \le \frac{7200\,nm}{2j+1} \le 760\,nm$$

$$1 \le \frac{18}{2j+1} \le 1.9$$

$$\therefore j = 5, 6, 7, 8$$

若用$\delta = 2n_2 d_0 + \dfrac{\lambda}{2} = j\lambda$

则 $j = 6, 7, 8, 9$

当 $j=1$时， $\lambda_1 = 2400nm$

当 $j=2$时， $\lambda_2 = 1440nm$

当 $j=3$时， $\lambda_3 = 1028nm$

当 $j=4$时， $\lambda_4 = 800nm$

当 $j=5$时， $\lambda_5 = 654.5nm$

当 $j=6$时， $\lambda_6 = 553.8nm$

当 $j=7$时， $\lambda_7 = 480nm$

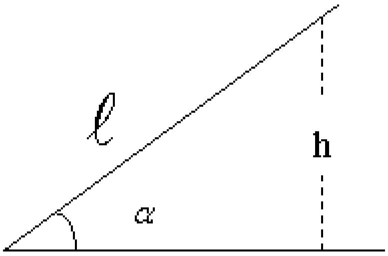
当 $j=8$时， $\lambda_8 = 423.5nm$

当 $j=9$时， $\lambda_9 = 378.9nm$

可见，在$400nm \to 760nm$中心有$654.5nm$、$553.8nm$、$480nm$、$423.5nm$。

1-12．解：$\because \quad \Delta h = N\cdot\dfrac{\lambda}{2}$

$$\therefore \quad \lambda=\frac{2\Delta h}{N}=\frac{2\times 0.25\times 10^{6}}{909}\approx 5500\,\mathring{A}=550\,nm$$



1-13． 解：

$$\because \quad \Delta d_0=\frac{\lambda}{2}\approx \alpha\,\Delta\chi \doteq \alpha\,\Delta\ell$$

$$\Delta\ell=\frac{\ell}{N}$$

即： $\frac{\lambda}{2}=\alpha\cdot\frac{\ell}{N}$

$$\Delta d_0=N\cdot\frac{\lambda}{2}$$

$$\Delta d_0\doteq\alpha\cdot\ell$$

$$\therefore\ \alpha=\frac{N\lambda}{2\ell}$$

$$\therefore\ \alpha=\frac{\lambda}{2\Delta\ell}=\frac{\lambda N}{2\ell}$$

$$=\frac{5890\times 10^{-8}\times 20}{2\times 4}$$

$$=1.4725\times 10^{-4}\ (rad)$$

$$=0.00844^{\circ}$$

$$\doteq 30.384'$$

$$\doteq 30.4''$$

取两棱镜之间的夹角为$\beta=90^{\circ}-\alpha=89^{\circ}59'29.6''$

1-14．解: (1) $\Delta h = N \cdot \frac{\lambda}{2} = 1000 \times \frac{5000 \times 10^{-7}}{2} = 0.25 \quad mm$

(2) ∵ $2nh\cos\theta_j = \begin{cases} j\lambda \\ (j+\frac{1}{2})\lambda \end{cases}$

中心亮斑的级别由下式决定：（$\cos\theta_j = 1$）

$$2nh = j_0\lambda$$

所以，第 j 个亮环的角半径θ_j满足

$$\cos\theta_j = \frac{(j_0 - j)\lambda}{2nh} = 1 - \frac{j\lambda}{2nh};$$

第j个暗环的角半径θ_j满足

$$\cos\theta_j = \frac{[j_0 - (j - \frac{1}{2})]\lambda}{2nh} = 1 - \frac{(j - \frac{1}{2})\lambda}{2nh} .$$

$\left\lfloor \text{若中心是暗斑，则第}j\text{个暗斑的角半径}\theta_j \right\rfloor$

满足 $\cos\theta_j = 1 - \frac{(j + \frac{1}{2})\lambda}{2nh}$

于是： 第 1 级暗环的角半径 θ 为

(对于第 1 级暗环，每部分 j=0 时亮斑)

$$\cos\theta = 1 - \frac{\lambda}{4nh} = 1 - \frac{\lambda}{4\Delta h} \qquad \text{（此处}n=1, h=\Delta h\text{移动距离）}$$

$$= 1 - \frac{5000 \times 10^{-7}}{4 \times 0.25}$$

$$= 1 - 5 \times 10^{-7}$$

$$= 0.9995$$

$$\therefore \quad \theta \doteq 1.8^{\circ}$$

$$or:(2)解:\because\quad 2h\cos\theta_j=\begin{cases} j\lambda \\ (j+\frac{1}{2})\lambda \end{cases}$$

中心亮斑对应于$\theta_j=0$处，即 $2h=j\lambda$ (1)

对第一暗环而言，立有 $2h\cos\theta_j=(2j+1)\frac{\lambda}{2}$ (2)

由(1)－(2)：$2h(1-\cos\theta_j)=-\frac{\lambda}{2}$ $\quad 1-\cos\theta_j=-\frac{\lambda}{4h}$

$\because$ θ_j很小，将$\cos\theta_j$展开为：$\cos\theta_j=1-\frac{\theta_j^2}{2!}+\frac{\theta_j^4}{4!}\cdots$

略去高次项，有：$1-(1-\frac{\theta_j^2}{2!})=-\frac{\lambda}{4h}$

即：$\theta_j^2=\frac{\lambda}{2h}$ (这里应取＋号)

$$\theta_j=\sqrt{\frac{\lambda}{2h}}=\sqrt{\frac{500\times10^{-7}}{2\times0.25}}=\sqrt{10\times10^{-4}}$$

$$=3.2\times10^{-2}=0.032\,(rad)\doteq1.8^{\circ}$$

$$\because\quad 2h\cos\theta_j=\begin{cases} j\lambda & 相长\ 亮 \\ (j-\frac{1}{2})\lambda & 相消\ 暗 \end{cases}$$

（2）解之：

依题意（同上）有：$\begin{cases} 2h = j\lambda & (1) \\ 2h\cos\theta_j = (j-\frac{1}{2})\lambda & (2) \end{cases}$

(1) − (2)： $2h(1-\cos\theta_j) = \frac{\lambda}{2}$， $1-\cos\theta_j = \frac{\lambda}{4h}$.

$\because$ θ_j很小， $\theta_j \approx \sin\theta_j$ $\therefore$ $\cos\theta_j = \sqrt{1-\sin^2\theta_j} = [1-\theta_j]^{\frac{1}{2}}$

$$= 1 - \frac{1}{2}\theta_j^2 + \frac{1}{4}\theta_j^4 \cdots$$

略去高次项，有：

$$1-\cos\theta_j = 1-(1-\theta_j^2)^{\frac{1}{2}} = 1-(1-\frac{1}{2}\theta_j^2) = \frac{\theta_j^2}{2} = \frac{\lambda}{4h} \quad 即：\theta_j^2 = \frac{\lambda}{2h}$$

$$\therefore \quad \theta_j = \sqrt{\frac{\lambda}{2h}} = \cdots = 1.8^{\circ} .$$

1-15．解：$\because$ $r_{亮} = \sqrt{(2j+1)\frac{\lambda}{2}R}$ 即：$r_{亮}^2 = (2j+1)\frac{\lambda}{2}R$

亦即：$r_1^2 = (2j+1)\frac{\lambda}{2}R$， $r_2^2 = [2(j+5)+1]\frac{\lambda}{2}R$

于是：$r_2^2 + r_1^2 = \frac{10}{2}\lambda R = 5\lambda R$

$$\therefore \quad \lambda = \frac{r_2^2 - r_1^2}{5R} = \frac{D_2^2 - D_1^2}{20R}$$

$$= \frac{(4.6\times10^{-3})^2 - (3\times10^{-3})^2}{20\times1.03}$$

$$= 0.5903\times10^{-6} \quad (m)$$

$$= 590.3 \quad nm$$

1-16．解：$\because$ $r_{亮} = \sqrt{(2j-1)\frac{\lambda}{2}R}$. j=1、2、3……

即：
$$\begin{cases} r_3 = \sqrt{\dfrac{5}{2}\lambda R} \\ r_2 = \sqrt{\dfrac{3}{2}\lambda R} \end{cases} \qquad \begin{cases} r_{20} = \sqrt{\dfrac{39}{2}\lambda R} \\ r_{19} = \sqrt{\dfrac{37}{2}\lambda R} \end{cases}$$

而：
$$r_3 - r_2 = \sqrt{\frac{5}{2}\lambda R} - \sqrt{\frac{3}{2}\lambda R} = 1 \quad (mm)$$

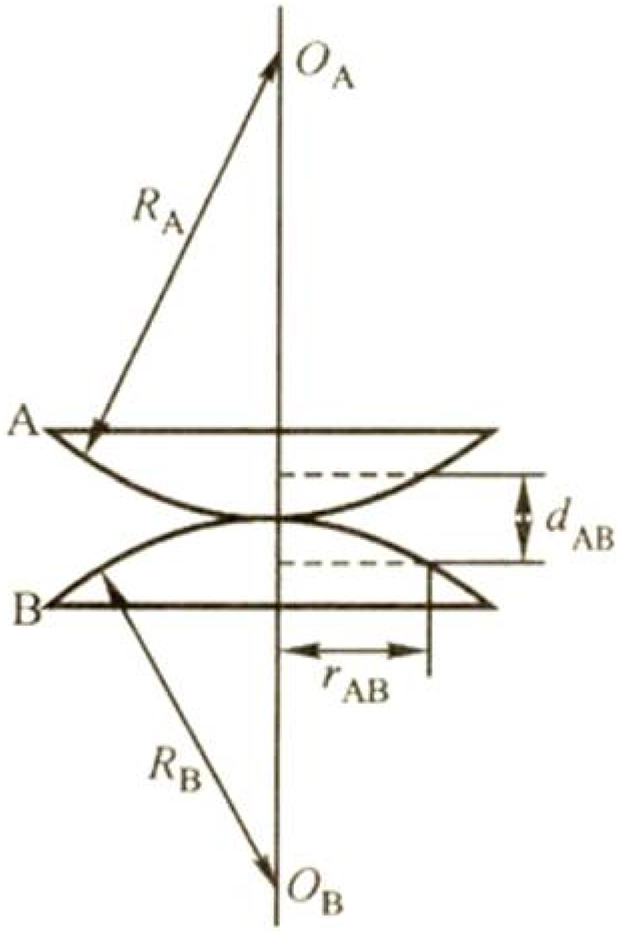
即：
$$\frac{5}{2}\lambda R + \frac{3}{2}\lambda R - 2\sqrt{\frac{5}{2}\lambda R} \cdot \sqrt{\frac{3}{2}\lambda R} = 1$$

$$4\lambda R - \sqrt{15}\lambda R = 1$$

$$\therefore \quad \lambda R = \frac{1}{4 - \sqrt{15}} \approx 7.873$$

而
$$\begin{aligned} r_{20} - r_{19} &= \sqrt{\frac{39}{2}\lambda R} - \sqrt{\frac{37}{2}\lambda R} \\ &= \sqrt{\frac{39}{2} \times 7.873} - \sqrt{\frac{37}{2} - 7.873} \\ &= 0.322 \quad (mm) \end{aligned}$$

$$\therefore \quad \Delta r = r_{20} - r_{19} \approx 0.322 \quad mm \quad (= 0.039cm)$$



1-17．解： $\because \quad h=\dfrac{r^2}{2R}$

$$\therefore \quad h_{AB}=h_A+h_B=\frac{r_{AB}^2}{2R_A}+\frac{r_{AB}^2}{2R_B}$$

$$=\frac{r_{AB}^2}{2}\left(\frac{1}{R_A}+\frac{1}{R_B}\right)$$

同理：$h_{BC}=\dfrac{r_{BC}^2}{2}\left(\dfrac{1}{R_B}+\dfrac{1}{R_C}\right)$

$$h_{AC}=\frac{r^2{}_{AC}}{2}\left(\frac{1}{R_A}+\frac{1}{R_C}\right)$$

又 $\because$ 对于暗环来说，有

$$\delta=2h-\frac{\lambda}{2}=(2j+1)\frac{\lambda}{2},$$

即： $h=j\lambda/2$

∴ 对于A、B组合，第10个暗环有

$$10\lambda=r_{AB}^2(\frac{1}{R_A}+\frac{1}{R_B})$$

同样： $10\lambda=r_{BC}^2(\frac{1}{R_A}+\frac{1}{R_B})$

$$10\lambda=r_{AC}^2(\frac{1}{R_A}+\frac{1}{R_C})$$

于是：$\frac{1}{R_A}+\frac{1}{R_B}=\frac{10\lambda}{r_{AB}^2}$ (1)

$\frac{1}{R_B}+\frac{1}{R_C}=\frac{10\lambda}{r_{BC}^2}$ (2)

$\frac{1}{R_A}+\frac{1}{R_C}=\frac{10\lambda}{r_{AC}^2}$ (3)

由(1)−(2)+(3) 得：

$$\frac{2}{R_A}=10\lambda\left(\frac{1}{r_{AB}^2}-\frac{1}{r_{BC}^2}+\frac{1}{r_{AC}^2}\right)$$

即： $\frac{2}{R_A}=5\lambda\left(\frac{1}{r_{AB}^2}-\frac{1}{r_{BC}^2}+\frac{1}{r_{AC}^2}\right)$

$$=5\times6000\times10^{-10}\left[\frac{1}{(4\times10^{-3})^2}-\frac{1}{(4.5\times10^{-3})^2}+\frac{1}{(5\times10^{-3})^2}\right]$$

$\doteq3\times0.0531=0.15935 \quad (m^{-1})$ (4)

$$\therefore \quad R_A=6.275\doteq6.28 \quad (m)$$

(4)代入(1)：$\frac{1}{R_B}=\frac{10\lambda}{r_{AB}^2}-\frac{1}{R_A}$

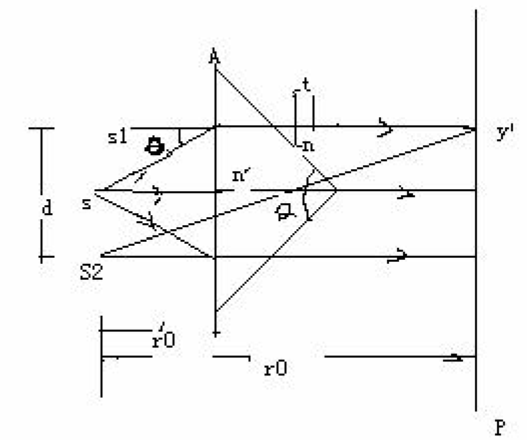
$$=\frac{10\times6000\times10^{-10}}{(4\times10^{-3})^2}-0.15935=0.21565 \quad (m^{-1})$$

$$\therefore \quad R_B=4.637\doteq4.64 \quad (m)$$

(4)代入(1)：$\frac{1}{R_C}=\frac{10\lambda}{r_{AC}^2}-\frac{1}{R_A}$

$$=\frac{10\times6000\times10^{-10}}{(5\times10^{-3})^2}-0.15935=0.08065 \quad (m^{-1})$$

$$\therefore \quad R_C=12.399\doteq12.4 \quad (m)$$



18,解：光源和双棱镜

的性质相当于虚光源 S_1,S_2 由近似条件 $\theta \approx (n'-1)A$ 和几何关系：$\theta = tg\theta = d/2r^{2}$ 得：
$d = 2r^{2}(n'-1)A$ 而 2A+ $\alpha = \pi$

所以：A= $(\pi-\alpha)/2 = (180^\circ - 179^\circ 32') = 14' = 14\times\pi/(60\times180)$（rad）

又因为：为插入肥皂膜前，相长干涉的条件为：

$dy/r_0 = i\lambda$

插入肥皂膜后，相长干涉的条件为：

$d\,y'/r_0 - (n-1)t = i\lambda$

所以：$d(y'-y)/r_0 - (n-1)t = 0$

$$t = d(y'-y)/(n-1)r_0 = 2r'_0(n'-1)A(y'-y)/(n-1)r_0$$
$$= 2\times5\times(1.5-1)\times14\times0.08\pi/(60\times180)(1.35-1)(5+95)$$

故：$= 4.65\times10^{-5}(cm) = 4.65\times10^{-7}m$

1-19,（1）图（b）中的透镜由 A，B 两部分胶合而成，这两部分的主轴都不在该光学系统的中心轴线上，A 部分的主轴 OAF'_A 在系统中心线下 0.5cm 处，B 部分的主轴 OBF'_B 则在中心线上方 0.5cm 处，F'_A，F'_B 分别为 A，B 部分透镜的焦点。由于单色点光源 P 经凸透镜 A 和 B 后所成的像是对称的，故仅需考虑 P 经 B 的成像位置 P_B 即可。

所以：$1/s' - 1/s = 1/f'$，所以：$1/s' = 1/f' + 1/s = 1/50 + 1/-25 = -1/50$

所以：$s' = -50(cm)$

又因为：$\beta \equiv y'/y = s'/s$，所以：$y' = s'y/s = 2\times0.5 = 1.0(cm)$

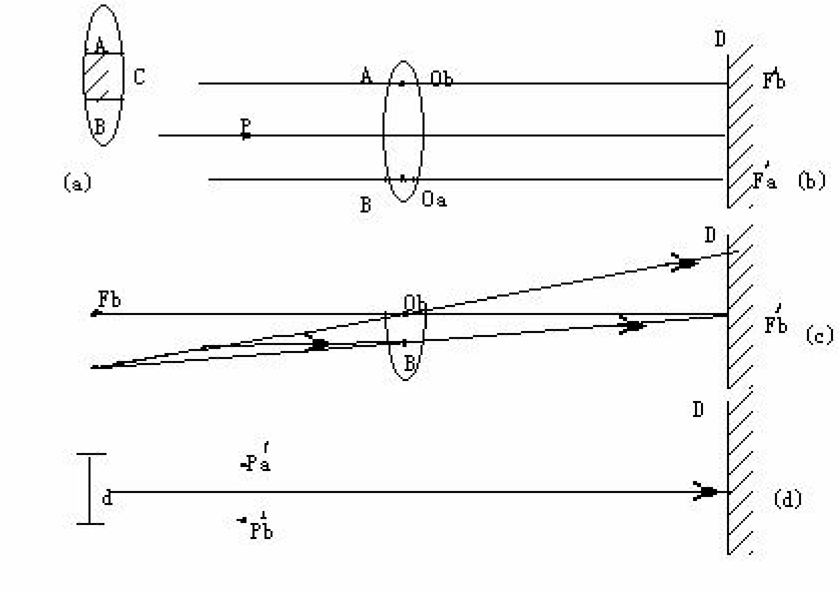
故所成的虚像 P_B 在透镜Bd的主轴下方 1cm 处，也就是在光学系统的对称轴下方 0.5cm 处。同理，单色点光源 P 经透镜 A 所成的虚像 P_A 在光学系统对称轴上方 0.5cm 处，其光

路图仅绘出点光源 P 经凸透镜 B 的成像，此时，虚像P'_A和P'_B就构成想干光源。它们之间的距离为 1cm，

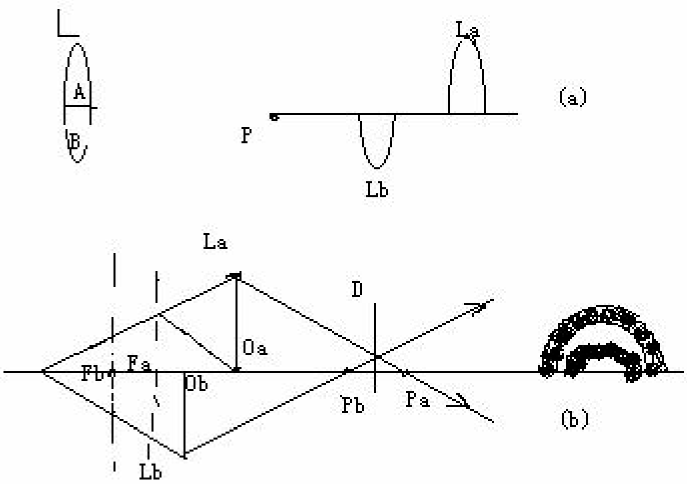
所以：想干光源P'_A, P'_B发出的光束在屏上形成干涉条纹，其相邻条纹的间距为：

$\Delta y = r_0 \lambda / d = 100 \times 692 \times 10^{-3} (cm)$

（2）光屏上呈现的干涉条纹是一簇双曲线。 1-19 题图：



1-20，解，（1）如图（a）所示，对透镜 L 的下半部分L_B，其光心仍在O_b，故成像位置P_B不变，即$S_1 = 10cm$但对透镜得上半部分L_A，其光心不在O_b，而移到O_A，则成像位置将在P_A处，像距



$s'_2 = s_2 f / (s_2 + f) = -12.5 \times 5 / (-12.5 + 5) = 25/3 = 8.33 (cm)$

这样，两个半透镜L_A，L_B，所成的实像P_A和P_B位于主轴上相距 0.83cm 的两点，光束在P_A和P_B之间的区域交叠。

（2）由于实像P_A和P_B购车国内一对想干光源，两想干光束的交叠区域限制在P_A和P_B之间，依题意，光屏 D 至于离透镜L_B10.5cm 处，恰好在P_A和P_B之间，故可以观察到干涉条纹，其条级为半圆形。根据光程差和相位差的关系可以进一步计算出条级的间距。

1-21，解，（1）因为:在反射光中观察牛顿环的亮条纹，

$\delta = 2h - \lambda/2 = i\lambda,,,,,(r_t = \sqrt{(2j+1)R\lambda/2} = \sqrt{2hR})$

及干涉级 j 随着厚度 h 的增加而增大，即随着薄膜厚度的增加，任意一个指定的 j 级条纹将缩小其半径，所以各条纹逐渐收缩而在中心处消失，膜厚 h 增加就相当于金属　的长度在缩短。

所以，但到牛顿环条纹移向中央时，表明 C　的长度在减少。

（2）因为：$\Delta h = N\lambda/2 = (\Delta j)\lambda/2$

$\Delta h = 10 \times 632.8 \div 2 = 3164(nm)$

所以，$= 3.164 \times 10^{-3} mm$

2-1. 解：　$R = \sqrt{k\lambda r_0}$　　详见书 P74~75

$$\rho_1 = \sqrt{1 \times 4500 \times 10^{-10} \times 1} = 6.7 \times 10^{-4}(m)$$

$$= 0.67(mm) \qquad = 0.067(cm)$$

2-2. 解：　（1）$R_\lambda = \sqrt{k\lambda r_0}$

$$= \sqrt{k \cdot 5000 \times 10^{-10} \times 4}$$

$$= \sqrt{2k} \times 10^{-3}(m)$$

$$= 1.414\sqrt{k} \quad mm$$

$$= 0.1414\sqrt{k} \quad cm$$

k 为奇数时，P 点总得极大值，

k 为偶数时，P 点总得极小值。

书 P103 倒 12~11 行

（2）$d_1 = 2\rho_1 = 0.2828(cm)$

2-3. 解：　$\because \quad k = \frac{\rho_k^2}{\lambda}\left(\frac{1}{r_0} + \frac{1}{R}\right)$

$$\therefore \quad k_1 = \frac{\left(0.5\times10^{-3}\right)^2}{5000\times10^{-10}}\left(\frac{1}{1}+\frac{1}{1}\right)=1$$

$$k_2 = \frac{\left(1\times10^{-3}\right)^2}{5000\times10^{-10}}\left(\frac{1}{1}+\frac{1}{1}\right)=4$$

即：实际上仅露出 3个带

$$\text{即：}\quad A=\frac{1}{2}\left(a_1+a_3\right)\approx a_1$$

$$\text{而}\quad A_\infty=\frac{a_1}{2}$$

$$\therefore \quad \frac{I}{I_0}=\frac{A^2}{A_\infty^2}=\frac{a_1^2}{\left(a_1/2\right)^2}=4$$

2-4. 解：（1）$\because \quad \rho_k=\sqrt{k\lambda r_0}$

$$\therefore \quad k=\rho_k^2/\lambda r_0=\frac{\left(\frac{2.76}{2}\times10^{-3}\right)^2}{6328\times10^{-10}\times1}\approx3$$

$\because \quad k=3$为奇数，$\therefore$中央为亮点。

（2）欲使其与（1）相反，即为暗点，K 为偶数

$$\because \quad r_0=\rho_k^2/k\lambda$$

$$\therefore \quad r_0'=\frac{\rho_k^2}{(k-1)\lambda}=\frac{\left(\frac{2.76}{2}\times10^{-3}\right)^2}{(3-1)\times6328\times10^{-10}}=\frac{3}{2}=1.5$$

$$\Delta r_1=r_0'-r_0=1.5-1.0=0.5(m)$$

$\because \quad \Delta r_1>0$, $\therefore$向后移动。

$$\text{又}\because \quad r_0''=\frac{\rho_k^2}{(k+1)\lambda}=\frac{\left(\frac{2.76}{2}\times10^{-3}\right)^2}{(3+1)\times6328\times10^{-10}}=\frac{3}{4}=0.75$$

$$\therefore \quad \Delta r_2 = r_0'' - r_0 = 0.75 - 1.0 = -0.25(m)$$

$$\because \quad \Delta r_2 < 0, \quad \therefore \text{向前移动。}$$

故;　　应向前移动 0.25m，或向后移动 0.25m

2-5. 解：（1） $\because \quad r_1 : r_2 : r_3 : r_4 = 1 : \sqrt{2} : \sqrt{3} : \sqrt{4}$

$$r_0 = 1(m), \quad \lambda = 5000\mathring{A}$$

$$r = \sqrt{k\lambda r_0}$$

$$r_1 : r_2 : r_3 : r_4 = \sqrt{k_1} : \sqrt{k_2} : \sqrt{k_3} : \sqrt{k_4}$$

$$\therefore \quad k_1 = 1, \quad k_2 = 2, \quad k_3 = 3, \quad k_4 = 4,$$

$$r_1 = \sqrt{1 \times 5000 \times 10^{-10} \times 1} = 0.707(mm)$$

（2） 由题意知，该屏对于所参考的点只让偶数半波带透光，故：

$$A = \sum_k a_{2k} = a_2 + a_4 \approx 2a_2$$

$$\text{而} \quad A_\infty = \frac{a_2}{2}$$

$$\therefore \quad I = A^2 = 4a_2^2 = 16A_\infty^2 = 16I_0$$

（3） $\because \quad f' = r_0 = \dfrac{\rho_k^2}{k\lambda} = 1(m)$——主焦点

它还有次焦点：$\pm f'/3, \quad \pm f'/5,$

$\pm f'/7 \quad \ldots\ldots$

故，光强极大值出现在轴上

$1/3, \quad 1/5, \quad 1/7, \quad \ldots\ldots \quad 1/(2k+1)$等处

2-6. 解： $\because$ 此即将所有偶数半波带挡住了，

而只有所有奇数的半波带透过

∴ 在考察点的振幅为

$$A_k=\frac{1}{2}(a_1+a_{199})\approx a_1$$

即：$I_0=A_k^2=a_1^2$

当换上同样焦距的口径的透镜时，

$$A_\mu=A_\infty=\frac{a_1}{2} \qquad \left(f=r_0'=\frac{\rho_k^2}{k\lambda}\right)$$

即：$I=A_{f'}^2=a_1^2/4$

$$\therefore \frac{I}{I_0}=\frac{a_1^2/4}{a_1^2}=\frac{1}{4}$$

$$\therefore \quad A=a_1+a_3+a_5+\cdots+a_{199}\approx 100a_1$$

$$I=A^2=10^4a_1^2$$

当移去波带片使用透镜后，透镜对所有光波的相位延迟一样，所以a_1,a_2,a_3，… $,a_{200}$的方向是一致的，即：

$$A_0=a_1+a_2+a_3+\cdots+a_{200}\approx 200a_1$$

$$I_0=A_0^2=4\times10^4a_1^2$$

$$\therefore \frac{I}{I_0}=\frac{10^4a_1^2}{4\times10^4a_1^2}=\frac{1}{4}$$

2-7. 解

$$\because \quad \Delta\varphi=\frac{2\pi}{\lambda}\delta=\frac{2\pi}{\lambda}b\sin\theta\approx\frac{2\pi}{\lambda}b\,tg\theta=\frac{2\pi}{\lambda}b\frac{y}{f'}$$

$$\therefore \quad y = \frac{\lambda}{2\pi} \cdot \frac{f'}{b} \cdot \Delta\varphi$$

$$\begin{aligned} y_1 &= \frac{\lambda}{2\pi} \cdot \frac{f'}{b} \cdot \Delta\varphi_1 \\ &= \frac{4800\times10^{-7}\times600}{2\pi\times0.4} \cdot \frac{\pi}{2} \\ &= 0.18(mm) \\ &= 0.018(cm) \end{aligned}$$

$$\begin{aligned} y_2 &= \frac{\lambda}{2\pi} \cdot \frac{f'}{b} \cdot \Delta\varphi_2 \\ &= \frac{4800\times10^{-7}\times600}{2\pi\times0.4} \cdot \frac{\pi}{6} \\ &= 0.06(mm) \\ &= 0.006(cm) \end{aligned}$$

2-8. 解： $\because$ 次最大值公式：

$$\sin\theta_{20} = \pm 2.46\frac{\lambda}{b} \approx \frac{5}{2}\frac{\lambda}{b}$$

$$\sin\theta_{30} = \pm 3.47\frac{\lambda}{b} \approx \frac{7}{2}\frac{\lambda}{b}$$

$$\therefore \quad \pm\frac{7}{2}\frac{\lambda_1}{b} = \pm\frac{5}{2}\frac{\lambda_2}{b}$$

$$\therefore \quad \lambda_1 = \frac{5}{7}\lambda_2 = \frac{5}{7}\times6000 \approx 4286\,\text{Å}$$

或： $\lambda_1 = \frac{2.46}{3.47}\times6000 \approx 4254\,\text{Å}$

2-9. 解： （1） $\because \quad \sin\theta_k = k\frac{\lambda}{b}$

$$y = tg\,\theta_1 \cdot f'$$

$$tg\,\theta_1 \approx \sin\theta_1$$

$$\therefore \quad y = k\frac{\lambda}{b}f$$

$$\therefore \quad y_1 = tg\,\theta_1 \cdot f' = \sin\,\theta_1 \cdot f' = 1 \times \frac{\lambda}{b}f'$$

$$= \frac{5461 \times 10^{-7}}{1} \times 100$$

$$= 0.05461(cm)$$

$$\approx 0.055(cm)$$

（2）
$$\because \quad \sin\theta_{10} = \pm 1.43\frac{\lambda}{b} \approx \pm\frac{3}{2}\frac{\lambda}{b}$$

$$y = tg\,\theta \cdot f', tg\,\theta \approx \sin\,\theta$$

$$\therefore \quad y_{10} = 1.43\frac{\lambda}{b}f'$$

$$= 1.43 \times \frac{5461 \times 10^{-7}}{1} \times 100$$

$$\approx 0.078(cm)$$

$$or: \quad = \frac{3}{2} \cdot \frac{\lambda}{b}f'$$

$$= \frac{3}{2} \times \frac{5461 \times 10^{-7}}{1} \times 100$$

$$\approx 0.082(cm)$$

（3）
$$\because \quad \sin\,\theta_k = k\frac{\lambda}{b}, \quad k = 3, \quad y = k\frac{\lambda}{b}f'$$

$$\therefore \quad y_3 = tg\,\theta_3 \cdot f' \approx \sin\,\theta_3 \cdot f'$$
$$= 3 \times \frac{\lambda}{b} f$$
$$= 3 \times \frac{5461 \times 10^{-7}}{1} \times 100$$
$$\approx 0.164(cm)$$

2-10. 解：（1）$\because \quad \sin\,\theta_k = k\frac{\lambda}{b}$

$$y = tg\,\theta \cdot f'$$
$$tg\,\theta \approx \sin\,\theta$$
Y= kλ f'/b

即： $\Delta y = y_2 - y_1 = (tg\,\theta_2 - tg\,\theta_1) \cdot f'$
$$= (\sin\,\theta_2 - \sin\,\theta_1) \cdot f'$$
$$= \left(2 \times \frac{\lambda}{b} - 1 \times \frac{\lambda}{b}\right) \cdot f'$$
$$= \frac{\lambda}{b} f'$$
$$\therefore \quad \lambda = \frac{b}{f'} \times (y_2 - y_1) = \frac{0.2 \times 0.885}{300}$$
$$= 5.9 \times 10^{-4}(mm) = 5900\ \mathring{A}$$

（2）$\Delta y' = y_2' - y_1' = \frac{\lambda'}{b} f' = \frac{1 \times 10^{-7}}{0.2} \times 300$
$$= 1.5 \times 10^{-4}(cm)$$

2-11. 解： $\because \quad N = 3,$ 缝宽为b,相邻缝间不透明

的距离$a = d = 3b$

光栅常数　$d' = a + b = 4b$

∴　最小值有 $N-1 = 3-1 = 2$个

次最大有 $N-2 = 3-2 = 1$ 个

缺级级次为

$$j = k\frac{d'}{b} = 4k = \pm 4, \pm 8, \pm 12, \cdots$$

$$又\because A_j = \frac{A_0 N}{\pi j} \times \frac{d'}{b} \times \sin\left(j\pi \times \frac{d'}{b}\right)$$

$$\frac{I_j}{I_0} = \frac{A_j^2}{(A_0 N)^2} = \left(\frac{4}{\pi j}\right)^2 \sin^2\left(j\frac{\pi}{4}\right)$$

$$\approx \frac{1.6}{j^2}\sin^2\left(j\frac{\pi}{4}\right)$$

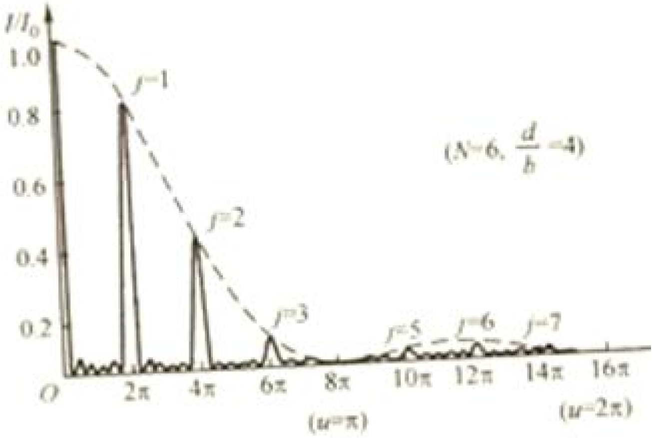
$$\therefore \quad \frac{I_1}{I_0} \approx 0.80$$

$$\frac{I_2}{I_0} = 0.40$$

$$\frac{I_3}{I_0} = 0.09$$

$$\frac{I_4}{I_0} = 0$$

$$\frac{I_5}{I_0} = 0.03$$



$$\frac{I_6}{I_0} = 0.04$$

$$\frac{I_7}{I_0} = 0.02$$

$$\frac{I_8}{I_0} = 0$$

其大致图形如上所示（仅画出正值）

2-12. 解： $\because \quad d\sin\theta = j\lambda$

$$\therefore \quad \sin\theta = \frac{j\lambda}{d} \qquad \left(d = \frac{1}{N}\right)$$

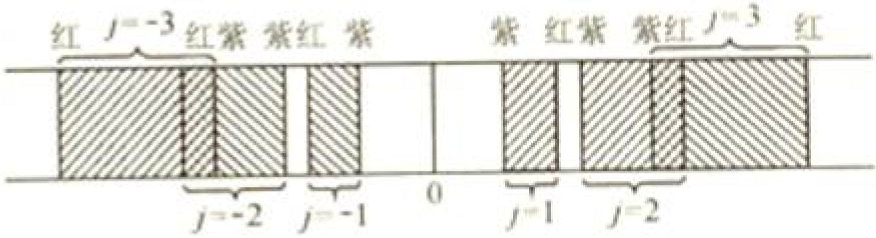
$$\therefore \quad \sin\theta_1 = \frac{j_1\lambda_1}{d} = 50\times1\times7600\times10^{-7} = 0.038$$

$$\theta_1 \approx 2.18^\circ$$

$$\sin\theta_2 = \frac{j_2\lambda_2}{d} = 50\times2\times4000\times10^{-7} = 0.04$$

$$\theta_2 \approx 2.29^\circ$$

$$\begin{aligned}\Delta\theta &= \theta_2 - \theta_1 \\ &= 2.29^\circ - 2.18^\circ \\ &= 0.11^\circ \\ &\approx 6.7' \\ &\approx 7'\end{aligned}$$



2-13. 解： $\because \quad d\sin\theta = j\lambda$ 即 $\sin\theta = \dfrac{j\lambda}{d}$

对 $j=1,\quad \sin\theta_1=\frac{\lambda_{红}}{d}=\frac{7600\,\mathring{A}}{d}$

$j=2,\quad \sin\theta_2=2\frac{\lambda_{紫}}{d}=\frac{8000\,\mathring{A}}{d}$

由于 $\theta_2>\theta_1$,故第一级和第二级不会重叠

而 $j=2,\quad \sin\theta_2=2\frac{\lambda_{红}}{d}=\frac{15200\,\mathring{A}}{d}$

$j=3,\quad \sin\theta_3=3\frac{\lambda_{紫}}{d}=\frac{12000\,\mathring{A}}{d}$

由于 $\theta_3<\theta_2$,故第二级和第三级可以重叠。

其重叠范围计算如下:

对重叠部分，有: $j_2\lambda_1=j_3\lambda_2$

即: $2\lambda_1=3\lambda_2$

$$2\times(4000\sim7600)=3\times(4000\sim7600)$$

$$8000\sim15200=12000\sim22800$$

可见重叠部分是:

$12000\sim15200=12000\sim15200$

其相交的波长是:

$6000\sim7600$ 与$4000\sim5076$

即:二级光谱的$6000\sim7600\,\mathring{A}$

与三级光谱的$4000\sim5067\,\mathring{A}$重叠

2-14. 解: $\because\quad d\sin\theta=j\lambda\quad,\sin\theta=\frac{j\lambda}{d}$

对中央最大值，$j=0, \sin\theta=0, \theta_0=0$

对第二十级主最大，$\sin\theta_{20}=\dfrac{j_{20}\lambda}{d}$

$$\therefore\quad \Delta\theta=\theta_{20}-0=\sin^{-1}\frac{j_{20}\lambda}{d}$$

即：$\dfrac{j_{20}\lambda}{d}=\sin\Delta\theta$

$$\therefore\quad d=\frac{j_{20}\lambda}{\sin\Delta\theta}=\frac{20\times5890\times10^{-8}}{\sin15^{\circ}10'}\approx4.5\times10^{-3}(cm)$$

故：$N=\dfrac{1}{d}=\dfrac{1}{4.5\times10^{-3}}\approx222(条/cm)$

2-15. 解： $\because\ d(\sin\theta\pm\sin\theta_0)=j\lambda$

(1) 当垂直入射时，$\sin\theta_0=0$，有 $d\sin\theta=j\lambda$

j取最大值，$\sin\theta=1$，即 $\theta=\theta_{max}=90^{\circ}$ 而$d=\dfrac{1}{N}$

$$\therefore\ j_{max}=\frac{d}{\lambda}=\frac{1}{\lambda N}=\frac{1}{5980\times10^{-7}\times400}=\frac{1}{0.2356}=4.24\approx4(级)$$

(2) $j_{max} = \dfrac{d(\sin\theta_0 + 1)}{\lambda}$

$$= \frac{1}{\lambda N}(\sin 30^\circ + 1)$$

$$= 4 \times \left(1 + \frac{1}{2}\right)$$

$$= 6(\text{级})$$

2-16. 解：$\because\ d(\sin\theta + \sin\theta_0) = j\lambda,\ \sin\theta_0 = 1,\ d = \dfrac{1}{N}$

$$\therefore\ j\lambda = d\sin\theta = \frac{\sin\theta}{N} = \frac{\sin 30^\circ}{250} = \frac{1}{2\times 250}$$

$$= \frac{1}{500} = 0.002(mm) = 20000\mathring{A}$$

故：当$j = 2$时，$\lambda = 10000\mathring{A}$

当$j = 3$时，$\lambda = 6667\mathring{A}$

当$j = 4$时，$\lambda = 5000\mathring{A}$

当$j = 5$时，$\lambda = 4000\mathring{A}$

当$j = 6$时，$\lambda = 333\mathring{A}$

$\therefore$ 可出现的光有：

$\lambda_1 = 4000\mathring{A}$ 紫（色）

$\lambda_2 = 5000\mathring{A}$ 绿（色）

$\lambda_3 = 6667\mathring{A}$ 红（色）

2-17. 解：（1）$2\theta = 2\dfrac{\lambda}{b} = 2\times\dfrac{6240\times 10^{-7}}{0.012} = 0.104(rad)$

（2）$\because\ d\sin\theta = j\lambda,\ \sin\theta \approx \theta$

$$\therefore\ j=\frac{d\cdot\theta}{\lambda}=\frac{0.041\times(0.104/2)}{6240\times10^{-7}}\approx3.4=3\text{级}$$

或：单缝衍射花样包络下的范围内

共有光谱级数由下式确定：

$$\frac{d}{b}=\frac{0.041}{0.012}\approx3.42=3\text{级}$$

即：$j=0,\ \pm1,\ \pm2,\ \pm3$

$\therefore$ 共有7条条纹

（3）

$$\Delta\theta=\frac{\lambda}{Nd\cos\theta}$$

$$=\frac{6240\times10^{-7}}{10^{3}\times0.041\times\cos\left(\frac{0.104}{2}\times\frac{180}{\pi}\right)}$$

$$=\frac{6240\times10^{-7}}{10^{3}\times0.041\times0.9986}$$

$$\approx1.524\times10^{-5}(rad)$$

或：$\because\theta$角极小，可令$\cos\theta=1$，则：

$$\Delta\theta=\frac{\lambda}{Nd}=\frac{6240\times10^{-7}}{10^{3}\times0.041}=1.52\times10^{-5}(rad)$$

2-18. 解：　（1）

$$d=\sqrt[3]{\frac{M}{2N\rho}}$$

$$=\sqrt[3]{\frac{58.5}{2\times 6.02\times 10^{23}\times 2.17}}$$

$$=\sqrt[3]{2.239\times 10^{-23}}$$

$$\approx 2.8185\times 10^{-8}(cm)$$

$$\approx 2.819\,\mathring{A}$$

$$\because\ \rho=\frac{M}{V},\ V=2Nd^{3}$$

$$\therefore\ d^{3}=\frac{M}{2N\rho},\ d=\sqrt[3]{\frac{M}{2N\rho}}$$

（2）$\because\ 2d\sin\alpha_{0}=j\lambda$

$$\therefore\ \lambda=\frac{2d\sin\alpha_{0}}{j}$$

$$=\frac{2\times 2.819\times\sin 1^{\circ}}{2}$$

$$\approx 0.049\,\mathring{A}$$

219. 解：　$\because\ 2d\sin\alpha_{0}=j\lambda$

$\therefore\ \sin\alpha_0 = \dfrac{j\lambda}{2d}$

$= \dfrac{2\times 0.0147\times 10^{-10}}{2\times 0.28\times 10^{-9}}$

$= 0.00525$

$\alpha_0 \approx 0.3^\circ = 18'$

注：若将单位换一下，

即：$\lambda = 0.0147nm, d = 0.28\mathring{A}$

则：$\sin\alpha_0 = \dfrac{2\times 0.0147\times 10^{-9}}{2\times 0.28\times 10^{-10}} = 0.525$

$\alpha_0 \approx 31.67^\circ \approx 31^\circ 40'$

or

$\alpha_0 \approx \varepsilon\alpha_0 = 0.3^\circ = 18$

2-20. 证：设单缝衍射的振幅为 a_θ ,三缝衍射的总振幅为 A_θ ，则 $A_{\theta x} = a_\theta$ （1 ＋cos $\Delta\Phi$ +cos $\Delta\varphi$ ）

$A_{\theta y} = a_\theta$ （1 ＋sin $\Delta\Phi$ +sin $\Delta\varphi$ ）, $I_\theta = A_\theta^{\ 2} = A_{\theta x}^{\ 2} + A_{\theta y}^{\ 2}$

$= a_\theta^{\ 2}$[（1 ＋cos $\Delta\Phi$ +cos3 $\Delta\varphi$ ）^{2}+（1 ＋sin $\Delta\Phi$ +sin3 $\Delta\varphi$ ）^{2}]

$= a_\theta^{\ 2}$[3+2 (cos $\Delta\Phi$ +cos2 $\Delta\Phi$ +cos3 $\Delta\varphi$)]

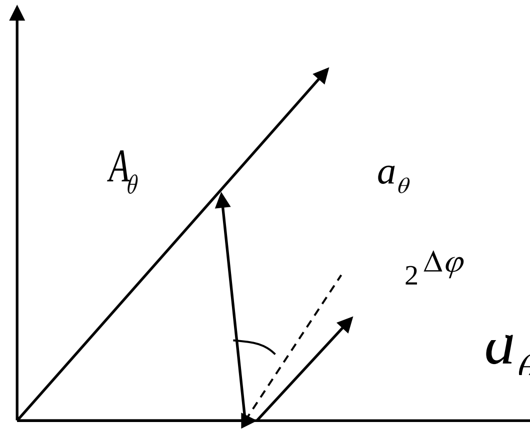
又∵ $a_\theta = a_0 \dfrac{\sin u}{u}$, u= $\dfrac{\pi b\sin a}{\lambda}$

$\Delta\varphi = \dfrac{2\pi d\sin\theta}{\lambda} = 2u$, v= $\dfrac{\pi d\sin\theta}{\lambda}$

∴ $I_\theta = a_0^{\ 2}(\dfrac{\sin u}{u})^2$[3+2(cos2v+cos4v+cos6v)]

$= I_0(\dfrac{\sin u}{u})^2$[3+2(cos2v+cos4v+cos6v)]

其中 u= $\dfrac{\pi b\sin a}{\lambda}$, v= $\dfrac{\pi d\sin\theta}{\lambda}$ ，得证.



2-21.解：∵ A $\approx \mu A \approx \frac{1.0-0.5}{20}$ =0.025（rad）

（=0.025 $\times\frac{180}{\pi}$ =1.433°）

而单色平行光距劈后的偏向角 $\theta_0 \approx$（n-1）A=(1.5-1) ×0.025=0.0125（rad）

未知劈波前　　dsinθ=jλ

当 j=±1 时，　$\sum\theta = \pm\frac{\lambda}{d}$

$\therefore \theta = \sin^{-1}\left(\pm\frac{\lambda}{d}\right) = \sin^{-1}\left(\pm\frac{500\times10^{-7}}{2}\times12000\right)$

$= \sin^{-1}(\pm0.3) = \pm17.46^0$

加上劈泼后，d（sin$\theta^{/}$+ $\sum\theta_0$）=±λ

即：　$\sum\theta^{/} = \pm\frac{\lambda}{d} - \sum\theta_0 = \pm\lambda - \sin[(n-1)A]$

$$\approx \pm\lambda-(n-1)A=\pm0.3-0.0125=\begin{cases}+0.2875\\-0.3125\end{cases}$$

$$\theta^{/}=\sin\begin{bmatrix}+0.2875\\-0.3125\end{bmatrix}=\begin{cases}+16.17^o\\-18.21^o\end{cases}$$

$$\Delta\theta=\theta^{/}-\theta\quad\begin{cases}+16.17^o\\-18.21^o\end{cases}\mp\ 17.46^o=-0.75^o=-45^{/}$$

2-22.（1）以题意得：

$\because$ d($\sum\theta+\sum\theta_0$)=jλ (同侧)

d($\sum\theta^{/}-\sum\theta$)=j$\lambda$ (异侧)

$\therefore$2sinθ_0=($\sum\theta-\sum\theta_0$)

$\sum\theta_0$ = $\frac{1}{2}$($\sum\theta^{/}-\sum\theta$)= $\frac{1}{2}$(sin53^o-sin11^o)

= $\frac{1}{2}$×(0.7986-0.1908)=0.3039

$\theta_0=\sin^{-1}0.3039=17.69^o\approx17.7^o$

(2). $\because$ 当位于法线两侧时 ： d($\sum\theta-\sum\theta_0$)=jλ

即 $\sum\theta=\sum\theta_0+j\frac{\lambda}{d}$

对于 j=1 谱线 ， $\sum53^o=\sum17.7^o+\frac{\lambda}{d}$, $\frac{\lambda}{d}=\sum53^o-\sum17.7^o$

对于 j=2 谱线 ， $\sum\theta=\sum\theta_0+2\frac{\lambda}{d}=\sum17.7^o+2(\sum53^o-\sum17.7^o)$

$=2\sum53^o-\sum17.7^o=2\times0.7989-0.3039=1.29>1$

$\therefore$在法线两侧时,观察不到第二级谱线

$\because$当位于法线同侧时, d($\sum\theta+\sum\theta_0$)=jλ

j=2 时 $\sum\theta=2\frac{\lambda}{d}-\sum\theta_0=2\times(\sum53^o-\sum17.7^o)$

$=2\sum53^o-3\sum17.7^o=2\times0.7989-3\times0.3039=0.6861<1$

在法线同侧时,能观察到第二谱线..。

2-23. （1） $\because$dsinθ=jλ

即 $\begin{cases} d\sin\theta_1=j_1\lambda \\ d\sin\theta_2=j_2\lambda \end{cases}$

$d(\sum\theta_2-\sum\theta_1)=(j_2-j_1)\lambda=\Delta j\lambda$

$\therefore$

$d=\frac{\Delta j_1\lambda}{\sum\theta_2-\sum\theta_1}=\frac{1\times600}{.0.3-0.2}=6000(nm)$

$=6.0\times10^{-3}(mm)$

(2) $\because d=4b$

$\therefore \quad b = \frac{d}{4} = 1.5 \times 10^{-3} (mm)$

(3) $\because \quad \sum \theta_m = \sum \frac{\pi}{2}, \qquad j_m = \frac{d}{\lambda} = \frac{6000}{600} = 10$

并考虑到 $j = \pm 4, \pm 8$ 缺级

$\therefore$ 屏上实际呈现的系数级次为

$j = 0, \pm 1, \pm 2, \pm 3, \pm 4, \pm 5, \pm 6, \pm 7, \pm 9$。