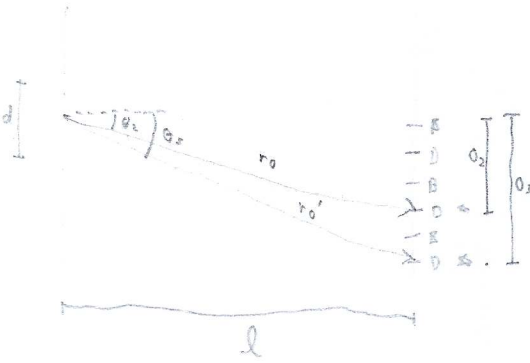
1.

$d = 4.50 \times 10^{-4}\ m$

$l = 0.750\ m$

$\lambda = 5.00 \times 10^{-7}\ m$



$d \sin\theta_2 = \left(\frac{1}{2} + 1\right)\lambda$

$\theta_2 = \sin^{-1}\left(\frac{3\lambda}{2d}\right)$

$\theta_2 = 0.00167$

$d \sin\theta_3 = \left(\frac{1}{2} + 2\right)\lambda$

$\theta_3 = \sin^{-1}\left(\frac{5\lambda}{2d}\right)$

$\theta_3 = 0.00278$

$\tan\theta_2 = \frac{O_2}{l}$

$\tan\theta_3 = \frac{O_3}{l}$

$O_3 - O_2 = l(\tan\theta_3 - \tan\theta_2)$

$\boxed{O_3 - O_2 = 8.33 \times 10^{-4}\ m}$

2.

$d = 7.20 \times 10^{-5}\ m$

$\ell = 0.800\ m$

$y = 3.00 \times 10^{-3}\ m$

$I_{max} = 0.0600\ W/m^2$

$y_a = 2.00 \times 10^{-3}\ m$

$y_b = 1.30 \times 10^{-2}\ m$

a. $\tan\theta_a = \frac{y_a}{\ell}$

$\theta_a = \frac{y_a}{\ell}$ - SAA

$\tan\theta = \frac{y}{\ell}$

$\sin\theta = \frac{y}{\ell}$ - SAA

$d \sin\theta = \frac{\lambda}{2}$ - SAA

$\lambda = \frac{2dy}{\ell}$

$I(\theta_a) = I_{max} \cos^2\left(\frac{\pi d \theta_a}{\lambda}\right)$

$= I_{max} \cos^2\left(\pi d \cdot \frac{y_a}{\ell} \cdot \frac{\ell}{2dy}\right)$

$= I_{max} \cos^2\left(\frac{\pi y_a}{2y}\right)$

$I(\theta_a) = 0.0150\ W/m^2$

b. $I(\theta_b) = I_{max} \cos^2\left(\frac{\pi y_b}{2y}\right)$

$I(\theta_b) = 0.0300\ W/m^2$

3.

$\theta_1 = 35.20°$

$n_1 = 1$

$\theta_2 = 19.46°$

$n_2 = ?$

$$d \sin\theta_1 = \frac{\lambda_1}{2}$$

$$= \frac{c}{2f}$$

$$d\sin\theta_2 = \frac{\lambda_2}{2}$$

$$= \frac{v}{2f}$$

$$= \frac{c}{2n_2 f}$$

$$= \frac{1}{n_2} \cdot \frac{c}{2f}$$

$$d\sin\theta_2 = \frac{1}{n_2} \cdot d\sin\theta_1$$

$$n_2 = \frac{\sin\theta_1}{\sin\theta_2}$$

$$\boxed{n_2 = 1.73}$$

4.

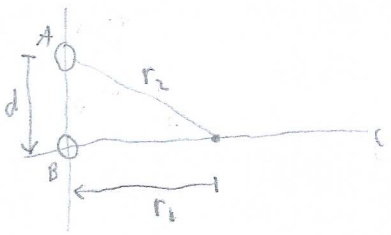
$d = 200$ m

$f = 5{,}80 \times 10^6\ s^{-1}$

$c = 3 \times 10^8$ m/s

Destructive interference when $\Delta r = \left(\frac{1}{2} + m\right)\lambda$

$m \in \mathbb{Z}$



$\Delta r = r_2 - r_1$

$\left(\frac{1}{2}+m\right)\lambda = \sqrt{r_1^2 + d^2} - r_1$

$\left(\frac{1}{2}+m\right)\frac{c}{f} + r_1 = \sqrt{r_1^2 + d^2}$

$r_1^2 + d^2 = r_1^2 + \frac{2 r_1 c}{f}\left(\frac{1}{2}+m\right) + \left(\frac{1}{2}+m\right)^2 \frac{c^2}{f^2}$

$\frac{2 r_1 c}{f}\left(\frac{1}{2}+m\right) = d^2 - \left(\frac{1}{2}+m\right)^2 \frac{c^2}{f^2}$

$r_1 = \frac{d^2 f}{2c\left(\frac{1}{2}+m\right)} - \frac{\left(\frac{1}{2}+m\right) c}{2f}$

$r_1 = 760,\ 219,\ 90.0,\ 20.0$ m

5.

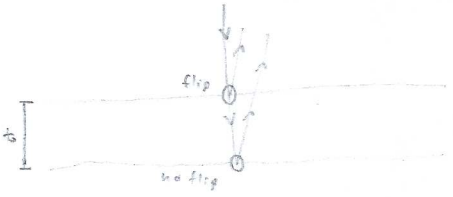
$n = 1.52$

$\lambda_1 = 4.770 \times 10^{-7}\ m$

$\lambda_2 = 5.406 \times 10^{-7}\ m$

$t = ?$

$2t_n = \left(\frac{1}{2} + m\right)\lambda_2 \qquad 2t_n = \left(\frac{1}{2} + m + 1\right)\lambda_1$



$$\left(\frac{1}{2} + m\right)\lambda_2 = \left(\frac{1}{2} + m + 1\right)\lambda_1$$

$$\frac{1}{2}\lambda_2 + m\lambda_2 = \frac{3}{2}\lambda_1 + m\lambda_1$$

$$m(\lambda_2 - \lambda_1) = \frac{3}{2}\lambda_1 - \frac{1}{2}\lambda_2$$

$$m = \frac{3\lambda_1 - \lambda_2}{2(\lambda_2 - \lambda_1)}$$

$$m = 7$$

$$t = \frac{\left(\frac{1}{2} + m\right)\lambda_2}{2n}$$

$$\boxed{t = 1.334 \times 10^{-6}\ m}$$

6.

$d = 7.50 \times 10^{-4}\ m$

$l = 2.00\ m$

$x = 1.35 \times 10^{-3}\ m$

$\lambda = a \sin\theta$

$= a \tan\theta$ - SAA

$= \frac{ax}{l}$

$\boxed{\lambda = 5.06 \times 10^{-7}\ m}$

7.

$\lambda = 6.20 \times 10^{-7}$ m

$a = 4.50 \times 10^{-4}$ m

$\ell = 3.00$ m

$y_a = 1.00 \times 10^{-3}$ m

$y_b = 3.00 \times 10^{-3}$ m

$y_c = 5.00 \times 10^{-3}$ m

a. $\alpha_a = \frac{\pi a}{\lambda} \sin\theta$

$= \frac{\pi a}{\lambda} \tan\theta$ - SAA

$= \frac{\pi a y_a}{\lambda \ell}$

$I = I_0 \frac{\sin^2 \delta_a}{\delta_a^2}$

$I_a = 0.822 \; I_0$

b. $\alpha_b = \frac{\pi a y_b}{\lambda \ell}$

$I = I_0 \frac{\sin^2 \alpha_b}{\alpha_b^2}$

$I = 0.111 \; I_0$

c. $\alpha_c = \frac{\pi a y_c}{\lambda \ell}$

$I = I_0 \frac{\sin^2 \alpha_c}{\alpha_c^2}$

$I = 0.0259 \; I_0$

8.

$d \sin\theta_1 = \lambda$

$\theta_1 = 11.3°$

$d \sin\theta_4 = 4\lambda$

$d \sin\theta_4 = 4\, d \sin\theta_1$

$\theta_4 = \sin^{-1}(4 \sin\theta_1)$

$\boxed{\theta_4 = 51.6°}$

9.

$I_3 = \frac{9}{4} I_2$ — all constructive interference and square proportionality