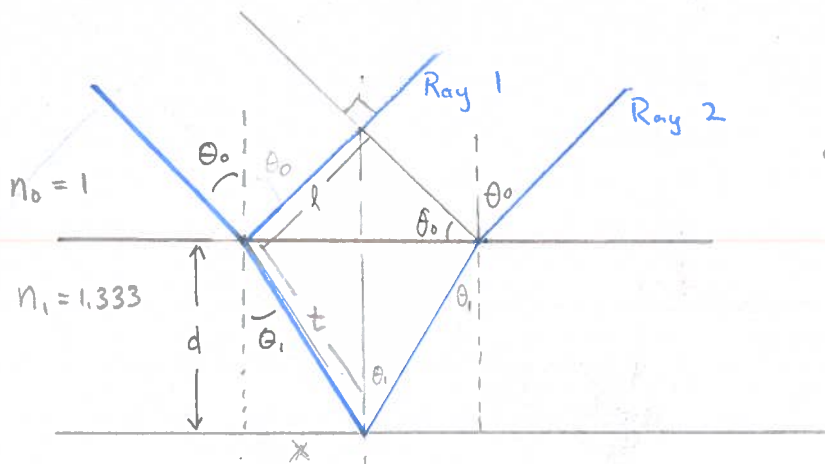




d is film thickness
(100 nm for this case)

Snell's Law: $n_0 \sin \theta_0 = n_1 \sin \theta_1$

$$\cos \theta_1 = \frac{d}{t} \quad \text{thus } t = \frac{d}{\cos \theta_1}$$

Geometric path for Ray 2 is thus $2t = \frac{2d}{\cos \theta_1}$

Geometric path for Ray 1 is l :

$$\sin \theta_0 = \frac{l}{2x} \quad \therefore \tan \theta_1 = \frac{x}{d}$$

$$\therefore l = 2x \sin \theta_0 = 2d \tan \theta_1 \sin \theta_0$$

But we want to compare the optical path difference

$$\Delta = n_1 2t - \underbrace{n_0 l}_{\text{Snell's law}}$$

$$\begin{aligned} n_0 (2d \tan \theta_1 \sin \theta_0) &= 2d \tan \theta_1 n_1 \sin \theta_1 \\ &= 2d \frac{\sin \theta_1}{\cos \theta_1} n_1 \sin \theta_1 = \frac{2dn_1 \sin^2 \theta_1}{\cos \theta_1} \\ n_1 \frac{2d}{\cos \theta_1} \end{aligned}$$

$$\therefore \Delta = \frac{n_1 2d}{\cos \theta_1} - \frac{2dn_1 \sin^2 \theta_1}{\cos \theta_1} = \frac{2dn_1 (1 - \sin^2 \theta_1)}{\cos \theta_1} = \frac{2dn_1 \cos^2 \theta_1}{\cos \theta_1}$$

$$= 2dn_1 \cos \theta_1$$

If $\Delta = \frac{1}{2}\lambda, \frac{3}{2}\lambda$, then we have constructive interference

$$\frac{1}{2}\lambda = 2dn \cos \theta_1 \rightarrow \text{plug this in } \lambda = 452 \text{ nm (Blue)}$$