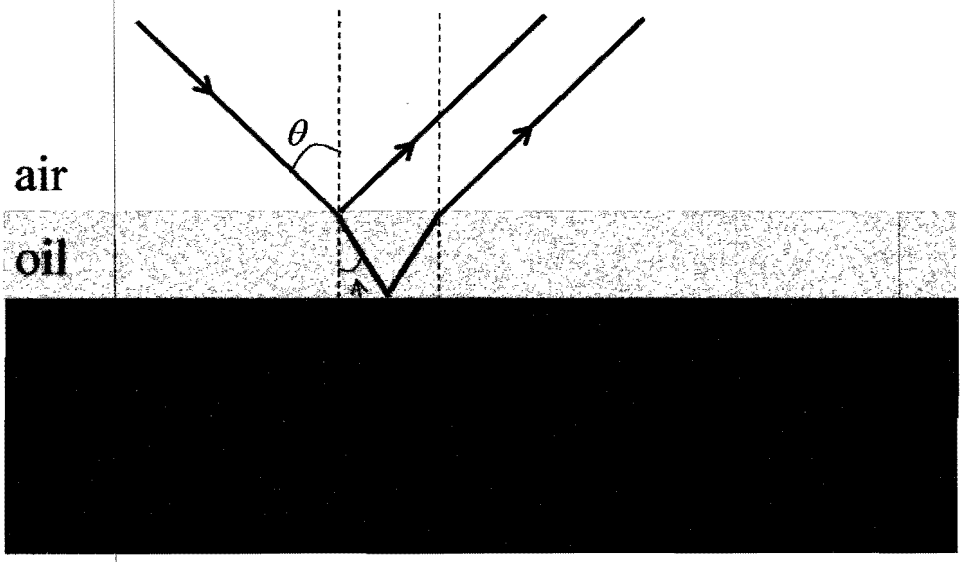
NAME:_____

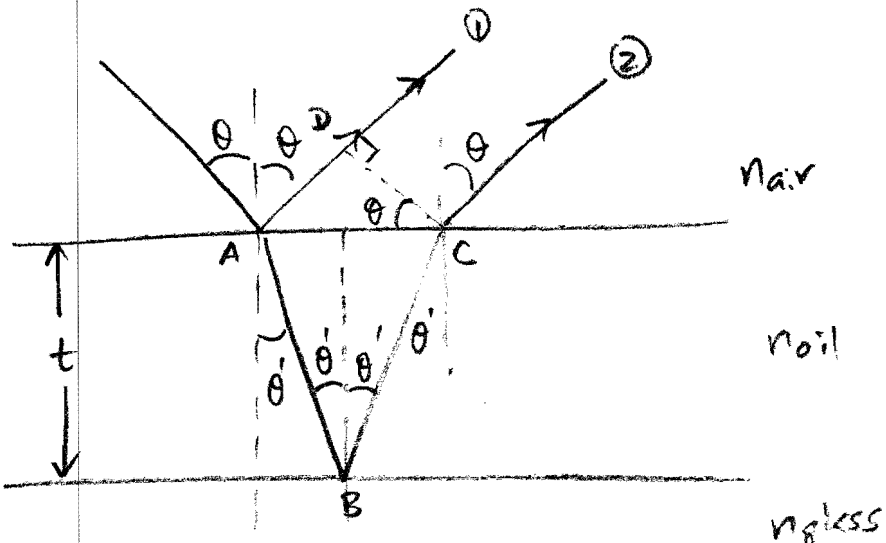
Physics 262 DUE: April 7, 2011

Quiz #8.3 (Extra Credits)

Please show all steps in your solution

In lecture, we have considered only the simple case of interference from thin film at normal incidence. For this extra credit, you need to derive the explicit condition for constructive interference for the following situation with a general angle of incidence θ. (assume that $n_{oil} > n_{glass}$)





At air/oil interface, wave #1 will acquire a π phase shift

At oil/glass interface, wave #2 will not.

⇒ For constructive interference, the net phase shift must be a multiples of 2π.

- To calculate the path different δ between wave #1 & wave #2, there are two pieces:

$\rightarrow \delta_{\overline{AD}}$ & $\delta_{\overline{ABC}}$

$$\delta_{\overline{AD}} = \left(2(t)\tan\theta'\right)\sin\theta$$

$$\delta_{\overline{ABC}} = 2\left(\frac{t}{\cos\theta'}\right)$$

- So, the total phase difference for #1 & #2 is

$$\underbrace{\frac{\delta_{\overline{ABC}}}{\lambda_{oil}}(2\pi)}_{\text{wave \#2}} - \underbrace{\left[\frac{\delta_{\overline{AD}}}{\lambda}(2\pi) + \pi\right]}_{\text{wave \#1}} = m(2\pi) \qquad \lambda_{oil} = \frac{\lambda}{n_{oil}}$$

$$\frac{2n_{oil}t}{\cos\theta'\lambda} - \frac{2t\tan\theta'\sin\theta}{\lambda} = \left(m+\tfrac{1}{2}\right)$$

using Snell's Law, $n_{oil}\sin\theta' = n_{air}\sin\theta = \sin\theta$,

$$2n_{oil}t\left(\frac{1}{\cos\theta'} - \tan\theta'\sin\theta'\right) = \left(m+\tfrac{1}{2}\right)\lambda$$

$$2n_{oil}t\left(\frac{1-\sin^2\theta'}{\cos\theta'}\right) = (m+\tfrac{1}{2})\lambda$$

$$\boxed{2n_{oil}t(\cos\theta') = (m+\tfrac{1}{2})\lambda}$$