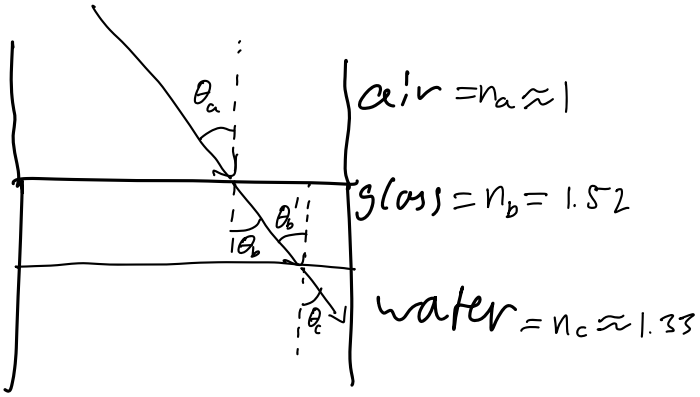
Physics 1C - Discussion 7 Name: TESAS KAMTAM UID: 305749402

Problem 1. Snell's Law

A horizontal, parallel-sided plate of glass having a refractive index of 1.52 is in contact with the surface of water in a tank. A ray coming from above in air makes an angle of incidence of 35.0° with the normal to the top surface of the glass. (a) What angle does the ray refracted into the water make with the normal to the surface? (b) What is the dependence of this angle on the refractive index of the glass?



Snells

$n_a \sin\theta_a = n_b \sin\theta_b$

$\theta_b = \arcsin\left[\frac{n_a}{n_b}\sin 35^\circ\right] \Rightarrow \theta_b' = \theta_b$

$n_c \sin\theta_c = n_b \sin\theta_b' = n_b \sin\theta_b$

$\Rightarrow n_a \sin\theta_a = n_b \sin\theta_c$

$\therefore \theta_c = \arcsin\left[\frac{n_a}{n_b}\sin\theta_a\right]$

a) $\theta_c = \arcsin\left[\frac{n_a}{n_b}\sin(35^\circ)\right]$

b) θ_c does not depend on n_b

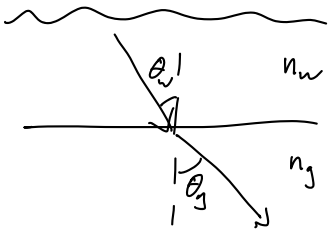
Problem 2. Total Internal Reflection

A ray of light is traveling in a glass cube that is totally immersed in water. You find that if the ray is incident on the glass–water interface at an angle to the normal larger than 48.7°, no light is refracted into the water. What is the refractive index of the glass?

Total reflection

$$n_g \sin\theta_g = n_w \underbrace{\sin\theta_w}_{=1 \text{ for}}$$

$$\Rightarrow \boxed{n_g = \frac{n_w}{\sin\theta_g}}$$



Problem 3. Polarization

Three polarizing filters are stacked, with the polarizing axis of the second and third filters at 23.0° and 62.0°, respectively, clockwise to that of the first. If unpolarized light is incident on the stack, the light has intensity 55.0 W/cm2 after it passes through the stack. If the incident intensity is kept constant but the second polarizer is removed, what is the intensity of the light after it has passed through the stack?

$$I_0 = \frac{2I_3}{\cos^2(23^\circ)\cos^2(62^\circ - 23^\circ)}$$

$$\Rightarrow I_a = \frac{1}{2} I_0 \cos^2(62^\circ) = \frac{I_3 \cos^2(62^\circ)}{\cos^2(23^\circ)\cos^2(62^\circ - 23^\circ)}$$

$$\Rightarrow I_a \approx 23.6878 \text{ W/cm}^2$$