

HW Note: Fishing

In-Class Quiz

1. light passes into two different media, deflects at two different angles (one smaller, one larger). In which media is the light traveling *faster*?

(a) the two things you consider are

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

so

$$\theta_1 > \theta_2 \implies n_1 < n_2$$

and

$$n = \frac{c}{v}$$

so

$$n_1 = \frac{c}{v_1} < n_2 = \frac{c}{v_2}$$

and

$$v_1 > v_2$$

2. to shoot a fish, where should you aim?

(a) aim slightly below. The light, entering the liquid of higher index of refraction than air, will deflect from the vertical, implying that the fish is lower. Your brain just extrapolates it to be where the light would go un-refracted.

3. Now you're shooting a laser gun. Where do you aim w/r/t where you see the fish?

(a) aim it at the real image. It'll deflect the same way the visible light does and hits the fish. You can assume the laser's wavelength is similar to visible light, so it doesn't affect index of refraction $n(\lambda)$. And even if a difference in indices of refraction did exist, it wouldn't be extreme enough to miss the fish.

4. quiz grade: $3/3 = 100\%$

Moral of story: brains can't infer the correct angle, which often leads to misunderstandings.

Examples

1. Light travels through a material with a speed $0.85c$. What is the critical angle for total internal reflection of a light ray at the interface between the material and a vacuum?

Well, $\sin \theta_2 = 90 \text{ deg}$, so

$$\sin \theta_L = \frac{n_2}{n_1} \quad (1)$$

with

$$n = \frac{c}{v}$$

$$v_1 = c$$

$$v_2 = 0.85c$$

use to solve.

2. ray of light with two wavelengths hits piece of acrylic at angle 30 from surface (red herring: that isn't the angle of incidence!). What's the angular separation between red and blue light rays that pass through the acrylic? (Second distraction: the index of refraction of acrylic doesn't matter.)

Just calculate the two angles of refraction and calculate their difference. To tell which one is which: shorter wavelength means smaller angle. Angle of incidence is found by

$$\theta_i = 90 - 30 = 60 \text{ deg}$$

3. light ray passing through two media; infer relative magnitudes of indices of refraction from the relative angle sizes (i.e. it deflects more coming out of the material than it does going in).

$$n_2 > n_1$$

$$n_3 < n_2$$

$$n_1 > n_3$$

Everything is measured with respect to a surface normal axis/vector; that's really important to remember.

Polarization

Line Spectra and Atoms

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