This is pages 15 – 16. It is a continuation of Refraction, Regents level

Last time we said FAST (into a faster away, into a slower toward).

Today we're going to learn how to categorize faster versus slower – it's called the index of refraction.

Determining the Speed of Light in Various Media

- Absolute Index of Refraction (n) - the ratio of speed of light in a vacuum (c), to the speed of light in a material medium (v).

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

n is unitless

Take out your reference tables. There is a chart on page 2, under the electromagnetic spectrum of “common science materials” that they give you the index of refraction.

- Calculate the speed of light in water to the correct number of significant digits.

Oh no, a question with no numbers. Whatever shall we do?

Use the reference tables!

- Calculate the speed of light in water to the correct number of significant digits.

$$v = \frac{c}{n} = \frac{3.00 \times 10^{8} m/s}{1.33} = 2.26 \times 10^{8} m/s$$

- Light travels at a speed of 2.04×10^8 m/s in an unknown medium. What could this material be?

What is this really asking for?

Index of refraction, then check your chart.

- Light travels at a speed of 2.04×10^8 m/s in an unknown medium. What could this material be?

$$n = \frac{c}{v} = \frac{3.00 \times 10^8 \text{ m/s}}{2.04 \times 10^8 \text{ m/s}} = 1.47$$

(Corn Oil or Glycerol)

Both materials would be accepted on the test or Regents.

- Why does the chart of Absolute Indices of Refraction indicate (f = 5.09 x 10^{14} Hz)?

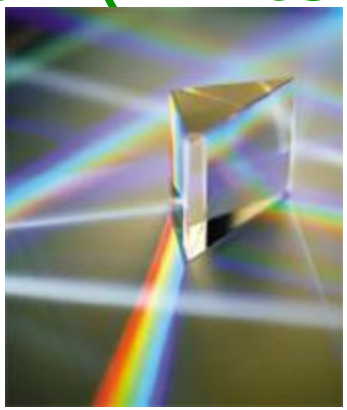
Different colors (frequencies) refract differently

First that frequency is yellow light, in the middle of the spectrum.
Second they are saying this chart ONLY works for this color.
Third this is high school, this chart will ALWAYS work, no matter what color they give you.

Determining the Speed of Light in Various Media

- Monochromatic: light that is described by only one frequency. (laser light)

- Polychromatic: light that is described by many different frequencies. (white light)



- What is the speed of light in air? Is this exact?

$$v=\frac{c}{n}=\frac{3.00\text{x}10^{8}\ \text{m/s}}{1.00}=3.00\text{x}10^{8}\ \text{m/s}$$

No, variations in temperature, humidity, and air pressure could alter air's value for index of refraction.

From now on you can just know that the speed of light in air is the same as a vacuum without calculating it.

5. Which material will cause light to slow down the most? Diamond

6. Which material will cause light to refract the most? Diamond

7. Will light bend if it travels from corn oil to glycerol? Explain.

No, they both have the same index of refraction.

We know that the speed (v) of the wave changes as it passes into a different medium. HOWEVER, when a wave passes into a medium, whether more dense or less dense, the

frequency (f) **DOES NOT** change.

Frequency determines how many waves are created each second, that doesn't change when we switch materials.

Complete the chart.

Determining the Wavelength of Light in Various Media

Wave travels into…	Change in Wave Speed	Direction of Bending with Respect to the Normal	Change in Wavelength
More Dense Medium	Decrease	Towards	Decrease
Less Dense Medium	Increase	Away	Increase
Equally Dense Medium	RTS	No Bend	RTS

Relative Index of Refraction

$$\frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$

Be careful with subscripts, I look this up every time I use it to make sure I have the subscripts in the right spot.

A beam of monochromatic orange light having a wavelength of 6.09×10^{-7} m enters a denser medium from air.

The trick is that frequency doesn't change. So the f in air equals the f in the block.

A beam of monochromatic orange light having a wavelength of 6.09×10^{-7} m enters a denser medium from air.

a. What is the frequency of the orange light in the block?

$f_{air} = f_{block}$

$$f = \frac{v}{\lambda} = \frac{3.00 \times 10^{8}\ m/s}{6.09 \times 10^{-7}\ m} = 4.93 \times 10^{14}\ Hz$$

b. As the light passes from air into the denser medium, the wavelength will decrease to 4.06×10^{-7} m. Determine the absolute index of refraction of this medium.

$$\frac{n_2}{n_1} = \frac{\lambda_1}{\lambda_2}$$

$$n_2 = \frac{\lambda_1 n_1}{\lambda_2} = \frac{(6.09 \times 10^{-7} m)(1.00)}{(4.06 \times 10^{-7} m)} = 1.50$$

c. What is this material?

Lucite