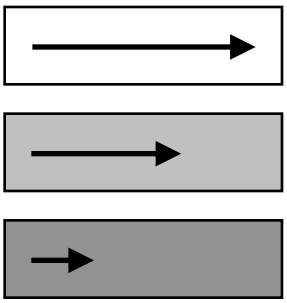
PhyzSpringboard: Index of Refraction 1

1. Speed

When light travels through a vacuum, it propagates at 3.0×10^8 m/s.

When light travels through glass, it propagates at 2.0×10^8 m/s.

When light travels through gallium phosphide, it propagates at 0.86×10^8 m/s.



a. If the speed of light in a vacuum is *c* and the speed of light in a transparent material is *v*, write and name the ratio of the speed of light in a vacuum to the speed of light in the transparent material.

b. Show calculations to determine the value of this ratio for

i. glass.

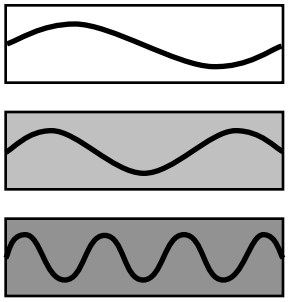
ii. gallium phosphide.

2. Wavelength

When light from a laser pointer travels through a vacuum, its wavelength is 670 nm.

When light from a laser pointer travels through glass, its wavelength is 447 nm.

When light from a laser pointer travels through gallium phosphide, its wavelength is 191 nm.



MARGINAL QUESTIONS
1. How long are the three rectangles above?
2. How many waves are contained in each rectangle?

a. What is the ratio of the wavelength of light in a vacuum to the wavelength of light

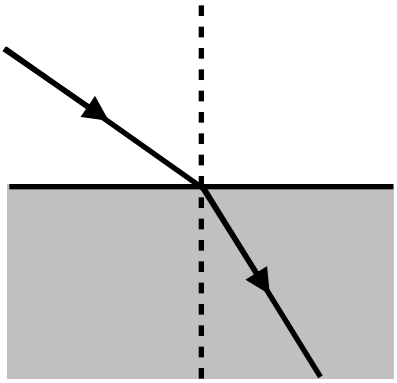
i. in glass?

ii. in gallium phosphide?

b. What is the expression and name of the ratio of the wavelength of light in a vacuum (λ_1) to the wavelength of light in a transparent material (λ_2)?

3. The Bends

The diagram to the right shows a beam of light incident from a vacuum to glass at an oblique angle.



a. Label the following:
- incident ray
- refracted ray
- normal
- angle of incidence (θ_1)
- angle of refraction (θ_2)

b. Not all of the light from the incident beam is refracted into the glass.

i. Which ray is missing from the diagram above?

ii. Add it to complete the diagram.

c. For light passing from a vacuum to glass, what is the general relationship between the angle incidence and the angle of refraction?

d. If 524 nm light had been incident from a vacuum to deucenaquarterium ($n = 2.25$),

i. how fast would the light travel in the deucenaquarterium?

ii. what wavelength would the light have in the deucenaquarterium?