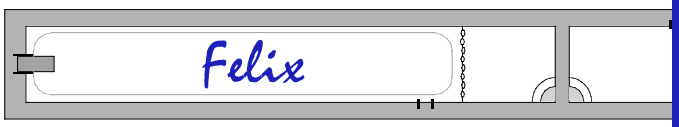
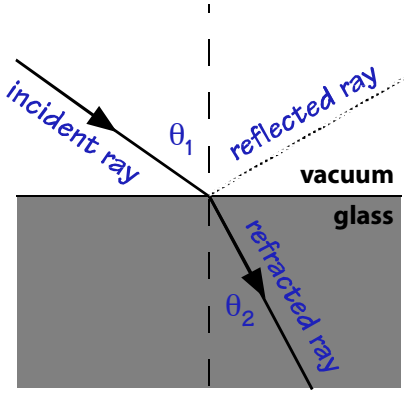
PhyzSpringboard: Snell's Law



1. Remember 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. Add the reflected ray to complete the diagram.

c. An experiment is performed in which light is directed from a vacuum to glass at a variety of angles (θ_1) and the subsequent angles of refraction (θ_2) are measured. The results are shown below.

i. Complete the table. Use only as many significant figures as you are given.

θ_1	θ_2	θ_1/θ_2	$\sin\theta_1/\sin\theta_2$	$\cos\theta_1/\cos\theta_2$	$\tan\theta_1/\tan\theta_2$
37°	24°	1.5	1.5	0.9	1.7
53°	32°	1.7	1.5	0.7	2.1
75°	40°	1.9	1.5	0.3	4.4

ii. Which of the following ratios—if any—represent the index of refraction?

___θ_1/θ_2 ___$\sin\theta_1/\sin\theta_2$ ___$\cos\theta_1/\cos\theta_2$ ___$\tan\theta_1/\tan\theta_2$

iii. Express your conclusion in part ii. as an equation.

$n = \sin\theta_1/\sin\theta_2$

d. If 524 nm light had been incident from a vacuum to deucenaquarterium (n = 2.25) at 60°,

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

$c/v = n$

$v = c/n = 3E+8/2.25$

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

$\lambda_1/\lambda_2 = n$

$\lambda_2 = \lambda_1/n = 524nm/2.25 = 233nm$

iii. at what angle would it have passed through the deucenaquarterium?

$n = \sin\theta_1/\sin\theta_2$ $\theta_2 = \sin^{-1}(\sin\theta_1/n) = \theta_2 = \sin^{-1}(\sin 60°/2.25) = 23°$

$\sin\theta_2 = \sin\theta_1/n$