Warm Up

1. How much work was done if two students exert a combined force of 825 N to push a car 1500 cm?
2. What is the displacement of a spring, in cm, that contains 9670 J of energy with a spring constant of 598 N/m?
3. What is the period of a wave with a wavelength of 49.8 m traveling at a velocity of 2.59 km/s?
4. What is the mass, in g, of a 95.0 N force accelerated at 1.54 m/s^2?
5. What is the velocity of a 230. g ball that is 45.0 m high if the total energy in the system is 8950 J?

Target

- I can explain the index of refraction is, Snell's Law, and total internal reflection.

Refraction of Light

Refraction

- The binding of light as it crosses the boundary between two different media.
- If the media are transparent, the angle at which the light will bend can be determined.
- Remember that the angle of light is determined based off the normal.

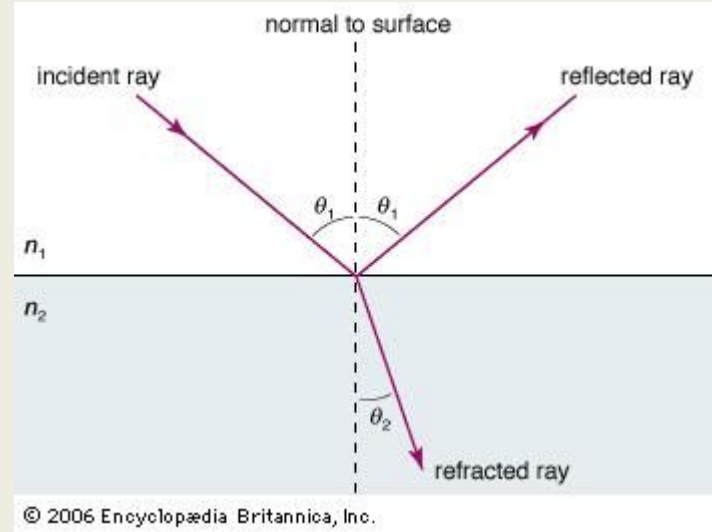http://spmphysics.onlinetuition.com.my/2013/07/refraction-of-light-wave.html
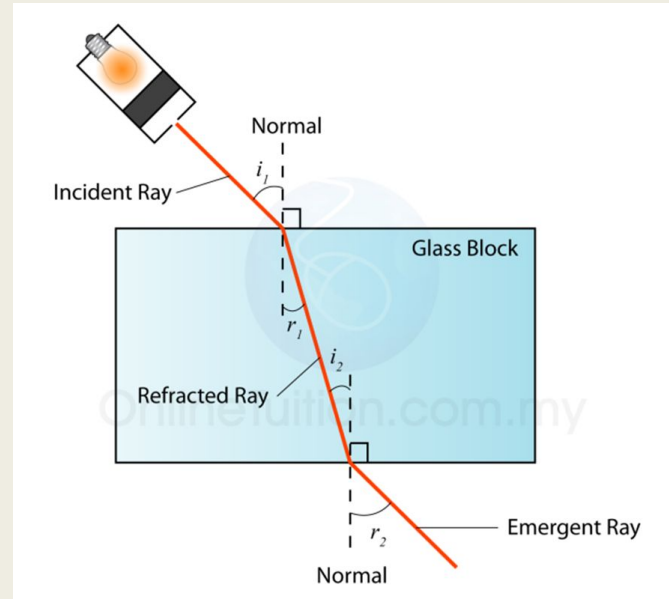
Snell's Law

- When light passes from one medium into another, it can cause the light to bend at a different angle to the angle light entered.
- The angle of incidence, Θ_1, is the angle light strikes the surface.
- The angle of refraction, Θ_2, is the angle light leaves the surface.
- The index of refraction (n) is a constant that depends on the substance.

- When light enters a transparent object, the angles could be determined using the equation $n_1 \sin \Theta_1 = n_2 \sin \Theta_2$.
- A light beam in air hits a sheet of crown glass at an angle of 30.0º. At what angle is the light beam refracted?
- 19.2º.

normal to surface

incident ray

reflected ray

θ_1 | θ_1

n_1

n_2

θ_2

refracted ray

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- The index of refraction of a medium is equal to the speed of light in vacuum divided by the speed of light in the medium.
- $n = c/v$
- If the medium that light is traveling through is not a vacuum, the speed of light in the medium can be determined using the index of refraction and the speed of light in that medium.
- $n_1 v_1 = n_2 v_2$

- What is the index of refraction of an unknown substance with light traveling at a velocity of 2.84 x 10^8 m/s if light travels through diamond at 1.24 x 10^8 m/s and has an index of refraction of 2.42?
- 1.056
- What is the velocity of light that is passing through fused quartz?
- 2.05 x 10^8 m/s
- What is the index of refraction of an unknown substance with light traveling at a velocity of 2.57 x 10^8 m/s?
- 1.167

Total Internal Reflection

- The angle of refraction is larger than the angle of incidence when light passes into a medium of a lower index of refraction.
- At the critical angle, Θ_c, the refracted light ray lies along the boundary of the two media.

Figure 1
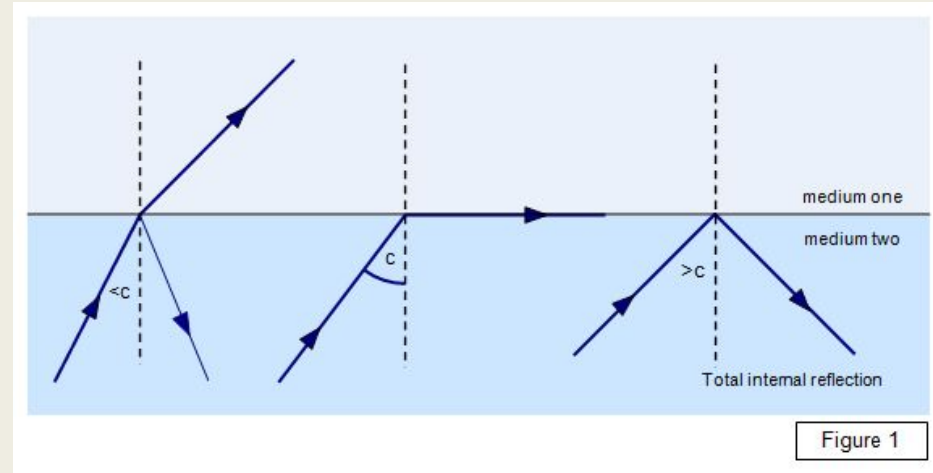
http://www.schoolphysics.co.uk/age16-19/Optics/Refraction/text/Total_internal_reflection/index.html

- $\sin \Theta_c = n_2/n_1$
- What would be the critical angle for total internal reflection for crown glass to water?
- 61.0^o
- What would be the critical angle for total internal reflection for water to air?
- 48.8^o

Assignment

- Snell's Law calculations