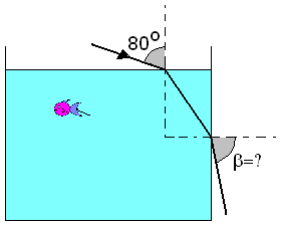
Physics II

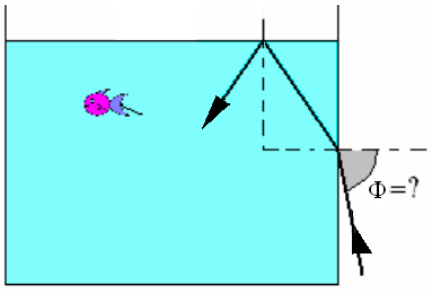
Snell's Law

Snell's Law $n_i \sin\theta_i = n_r \sin\theta_r$

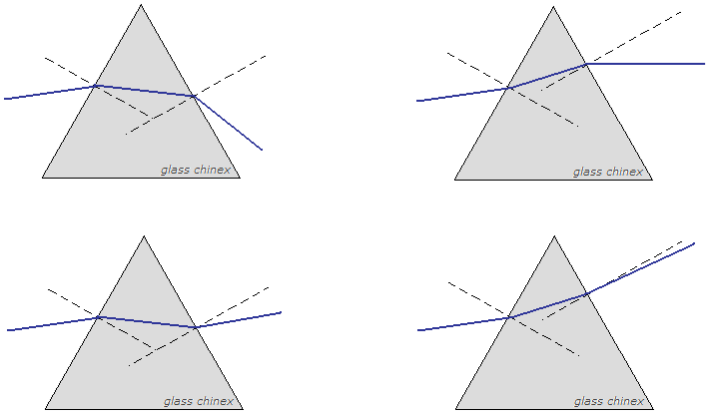
Problem 1.- You point a laser beam to the surface of a fish tank as shown in the figure. Find the angle β at which the beam exits through the side of the tank (you can ignore the effect of the glass wall). The index of refraction of water is 1.33



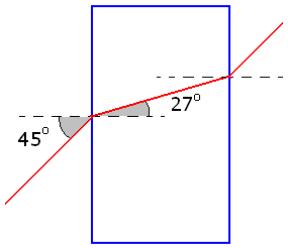
Problem 1a.- You point a laser beam to the surface of a fish tank as shown in the figure. Find the maximum angle Φ so the beam is totally internally reflected at the water-surface interface. You can ignore the effect of the glass wall.
The index of refraction of water is 1.33



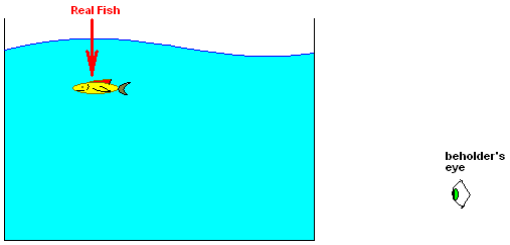
Problem 2.- A triangular prism made of glass (index of refraction n=1.5) is shown in the following figures together with the trajectory of a light ray. Indicate which figure corresponds to the correct trajectory considering refraction.
Justify your answer with a very short rationale.



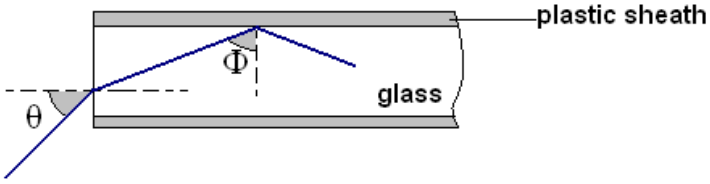
Problem 3.- An experiment with light rays shows the following trajectory through a rectangular glass. Find the index of refraction of the glass.



Problem 4.- The figure shows the actual position of a fish in a tank. Indicate the approximate position of the fish **image** as seen by the eye in the following figure:



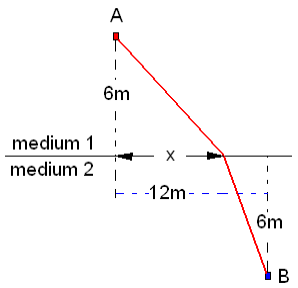
Problem 5.- For fiber optics to reflect light inside the medium, the angle of incidence on the glass-sheath interface (shown in the figure as Φ) must be greater than 50º. Based on this, calculate the maximum angle θ for incident light that will be reflected internally.
Index of refraction of glass = 1.54



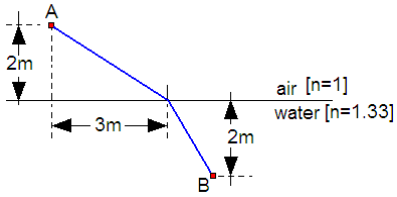
Problem 6.- You point a laser beam to the surface of a swimming pool, making an angle of 45º with respect to the vertical. What angle does the beam make inside the water with respect to the vertical?

Problem 6a.- A laser beam coming from a submarine exits the water at an angle of 33º to the vertical. What is the angle of incidence of the beam when it hits the air-water interface?
n_{water} = 1.33

Problem 7.- In the following geometry, find the path that gives the shortest time to get from A to B if the speed in region 1 is v_1=1m/s and the speed in region 2 is v_2=2m/s.



Problem 8.- Determine the time it takes for a beam of light to get from A to B.



Problem 9.- You point an ArF excimer laser (wavelength 193 nm in air) to the surface of a UV window with index of refraction 1.48 at an angle of incidence of 45º. Calculate the angle of refraction (θ_r).