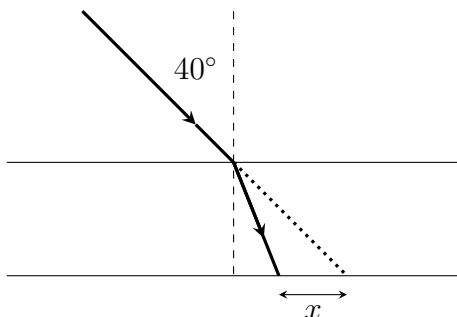


## Refraction and Snell's Law

- Calculate the speed of light in
  - water ( $n=1.33$ )  $(2.26 \times 10^8 \frac{m}{s})$
  - glass ( $n=1.50$ )  $(2.00 \times 10^8 \frac{m}{s})$
  - diamond ( $n=2.42$ )  $(1.24 \times 10^8 \frac{m}{s})$
- A ray of light enters glass ( $n = 1.60$ ) at an angle of incidence of  $20^\circ$ . What is the angle of refraction?  
Suppose the ray *leaves* the glass with an angle of incidence of  $20^\circ$ ; what is the angle of refraction?  $(12^\circ, 33^\circ)$
- An incident ray of light makes an angle of  $30^\circ$  with the surface of a glass plate with index of refraction 1.55. What is the angle between the refracted ray and the surface of the glass?  $(56^\circ)$
- A ray of light traveling in water ( $n=1.33$ ) strikes a surface of glass at an angle of incidence of  $36^\circ$ . What is the angle of refraction in the glass ( $n=1.80$ )?  $(26^\circ)$
- Light strikes a glass plate at an angle of incidence of  $65^\circ$ , part of the beam being reflected and part being refracted. It is observed that the reflected and the refracted portions make an angle of  $80^\circ$  with each other. What is the index of refraction of the glass?  $(1.6)$
- A rectangular tank 8.0 cm deep is filled with water,  $n=1.33$ . A light ray enters the top surface of the water at a point just touching the side of the tank. After refraction it falls on a point on the bottom of the tank 3.0 cm from the same side. What is the angle of incidence of the entering ray?  $(28^\circ)$
- Suppose that the same tank were filled with another liquid, such that in order for the ray of light to hit the same point on the bottom, the angle of incidence of the entering ray had to be  $31^\circ$ . What is the index of refraction of this liquid?  $(1.5)$
- A ray of light is incident at an angle of  $40^\circ$  on one surface of a glass plate ( $n=1.50$ ) which is 2.0 cm thick. On either side of the glass plate is air. Draw a ray diagram of the path of the ray through the glass. What is the horizontal displacement ( $x$  in the diagram below) between the incident ray and the emerging ray?  $(0.73 \text{ cm})$



- What is the critical angle for light traveling from glass into water ( $n=1.50$  for glass, 1.33 for water)?  $(62.5^\circ)$