

Refraction Examples

1. A water wave passes from a shallow to a deep section with an incident angle of 45° and a refracted angle of 60° .
 - (a) What is the ratio of the speeds in the two sections (shallow to deep)?
 - (b) If the wave speed is 0.25 m/s in the deep section, what is its speed in the shallow section?

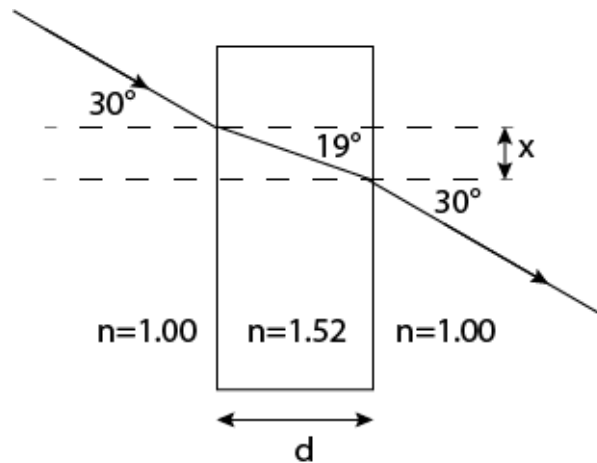
2. When certain light rays pass from a vacuum ($n = 1.0$) into a block of an unknown material, the measured index of refraction of the material is 3.50. What is the speed of light inside the unknown material?

3. Light travels from air ($n=1.0$) into an unknown material at an angle of incidence of 61.6° . The angle of refraction is 41.4° . Calculate the index of refraction of the unknown material.

4. Light travels from water ($n = 1.33$) into crown glass ($n = 1.52$). If the angle of incidence is 50.0° , what is the angle of refraction?

5. A scuba diver shines a flashlight from beneath the surface of water ($n = 1.33$) such that the light strikes the water-air boundary with an angle of incidence of 43.0° . At what angle is the beam refracted?

6. Light passes through a 2.38 mm thick window made of glass ($n=1.52$) at an angle of 30° as shown.



- (a) Calculate the offset, x , of the light on the other side of the window.
- (b) Calculate the offset, x , for a piece of leaded glass (for radiation protection) that is 36 mm thick and has an index of refraction of 1.8.

7. A scuba diver training in a pool looks at his instructor as shown.

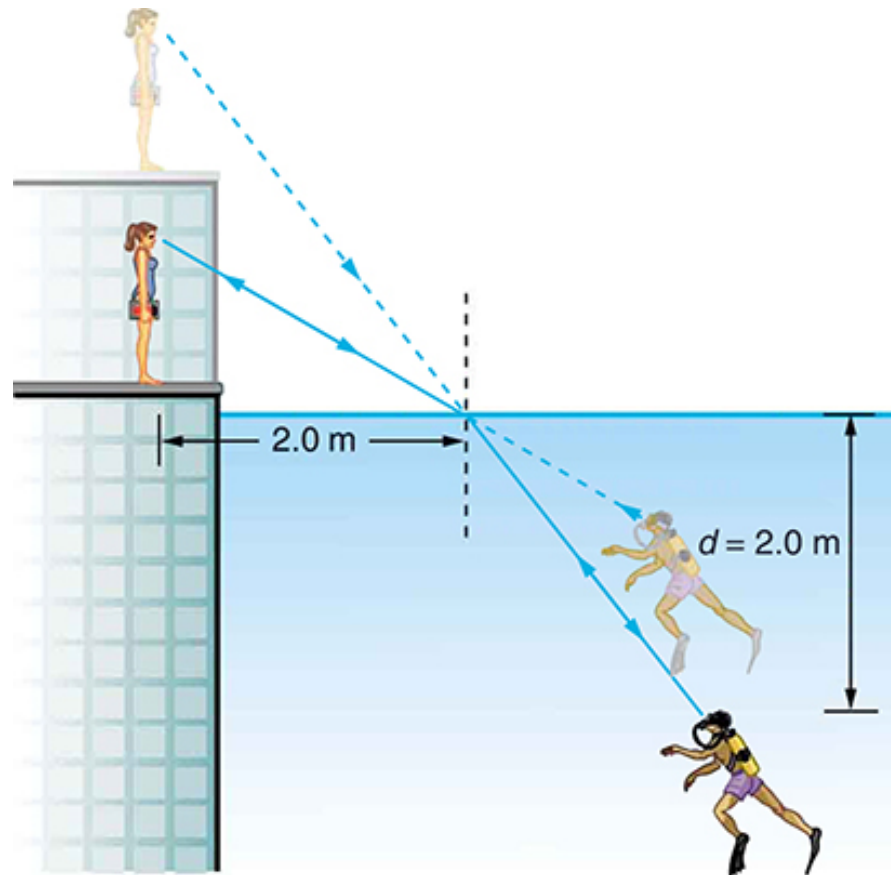


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- The angle between the ray in the water and the perpendicular to the water is 25.0° .
- Calculate the height of the instructor's head above the water.
 - the apparent height of the instructor's head above the water as seen by the diver.
 - the apparent depth of the diver's head below water as seen by the instructor.