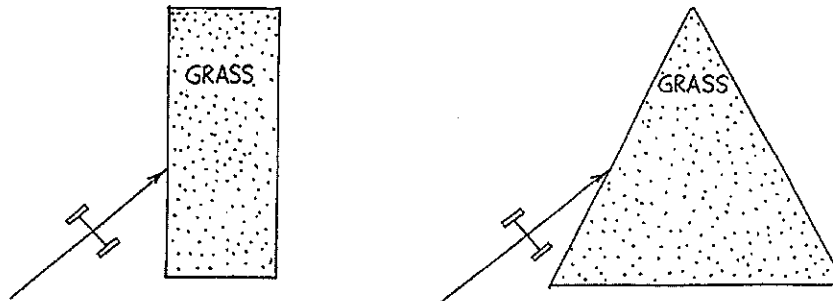


CONCEPTUAL *Physics* PRACTICE PAGE

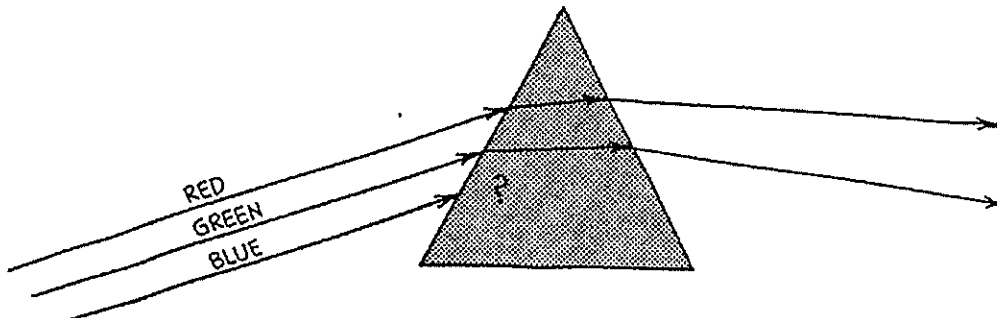
Chapter 28 Reflection and Refraction

Refraction

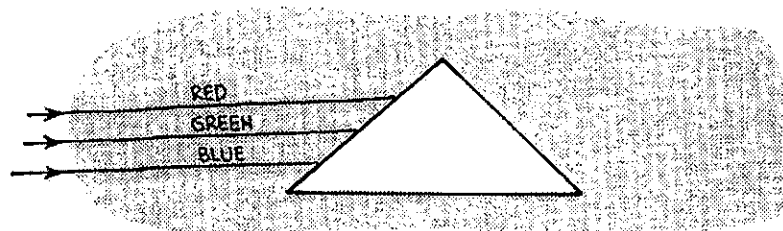
1. A pair of toy cart wheels are rolled obliquely from a smooth surface onto two plots of grass—a rectangular plot on the left and a triangular plot on the right. The ground is on a slight incline so that after slowing down in the grass, the wheels speed up again when emerging on the smooth surface. Finish each sketch and show some positions of the wheels inside the plots and on the other side. Clearly indicate their paths and directions of travel.



2. Red, green, and blue rays of light are incident upon a glass prism as shown below. The average speed of red light in the glass is less than in air, so the red ray is refracted. When it emerges into the air it regains its original speed and travels in the direction shown. Green light takes longer to get through the glass. Because of its slower speed it is refracted as shown. Blue light travels even slower in glass. Complete the diagram by estimating the path of the blue ray.



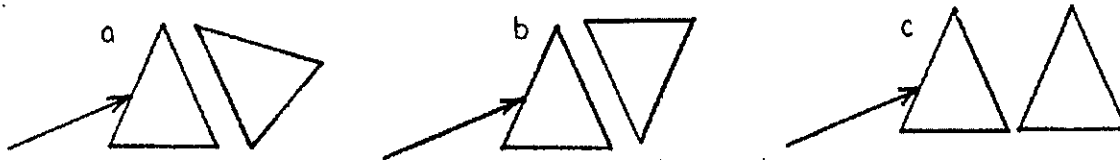
3. Below we consider a prism-shaped hole in a piece of glass—that is, an “air prism.” Complete the diagram, showing likely paths of the beams of red, green, and blue light as they pass through this “prism” and then into glass.



Hewitt
Ditwitt!

Chapter 28 Reflection and Refraction
Refraction—continued

4. Light of different colors diverges when emerging from a prism. Newton showed that with a second prism he could make the diverging beams become parallel again. Which placement of the second prism will do this?



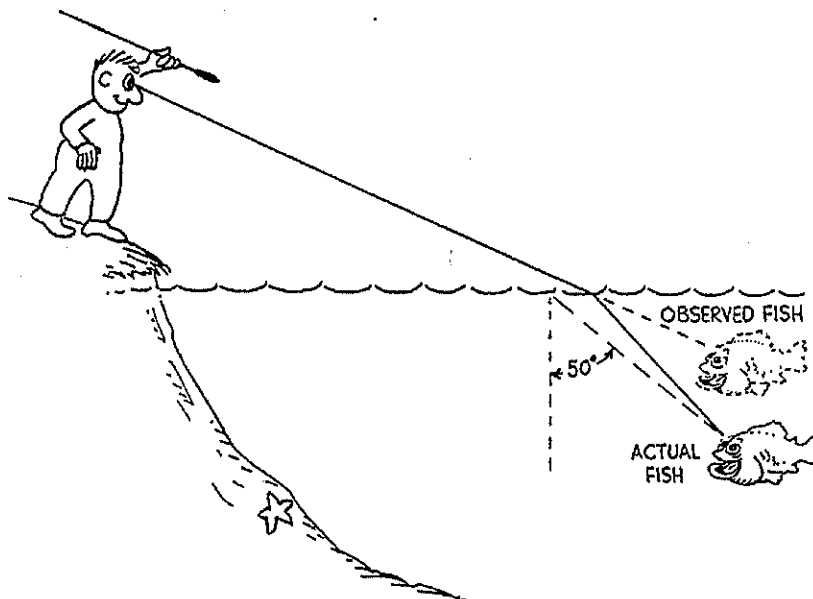
5. The sketch shows that due to refraction Huey Spearfisher sees the fish closer to the water surface than it actually is.

a. Draw a ray beginning at the fish's eye to show the line of sight of the fish when it looks upward at 50° to the normal at the water surface. Draw the direction of the ray after it meets the surface of water and continues in the air.

b. At the 50° angle, does the fish see Huey or does it see the reflected view of the starfish at the bottom of the pond? Explain.

c. To see Huey, should the fish look higher or lower than the 50° path?

d. If the fish's eyes were barely above the water surface, it would see the world above in a 180° view, horizon to horizon. The fisheye view of the world above as seen beneath the water, however, is very different. Due to the 48° critical angle of water, the fish sees a normally 180° horizon-to-horizon view compressed within an angle of _____.

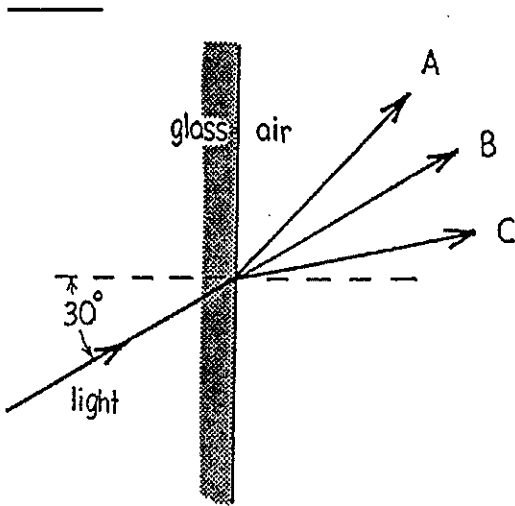
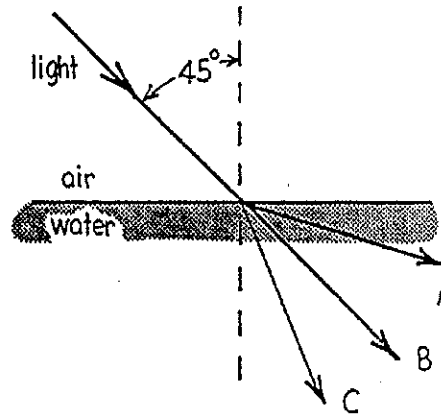


Hewitt
 Draw it!

CONCEPTUAL Physics PRACTICE PAGE

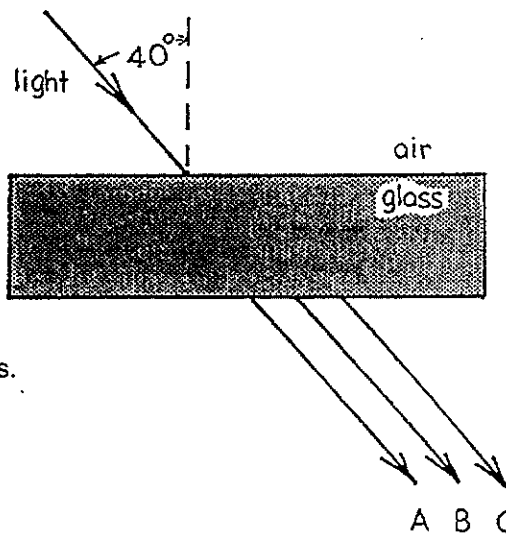
Chapter 28 Reflection and Refraction
More Refraction

1. The sketch to the right shows a light ray moving from air to water at 45° to the normal. Which of the three rays indicated with capital letters is most likely the light ray that continues inside the water?

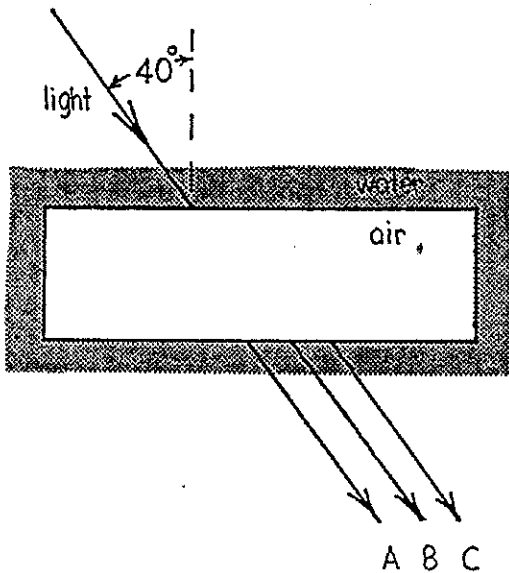


2. The sketch on the left shows a light ray moving from glass to air at 30° to the normal. Which of the three rays is most likely the light ray that continues in the air?

3. To the right, a light ray is shown moving from air to a glass block at 40° to the normal. Which of the three rays is most likely the light ray that travels in the air after emerging from the opposite side of the block?



Sketch the path the light would take inside the glass.



4. To the left, a light ray is shown moving from water to a rectangular block of air (inside a thin-walled plastic box) at 40° to the normal. Which of the three rays is most likely the light ray that continues into the water on the opposite side of the block?

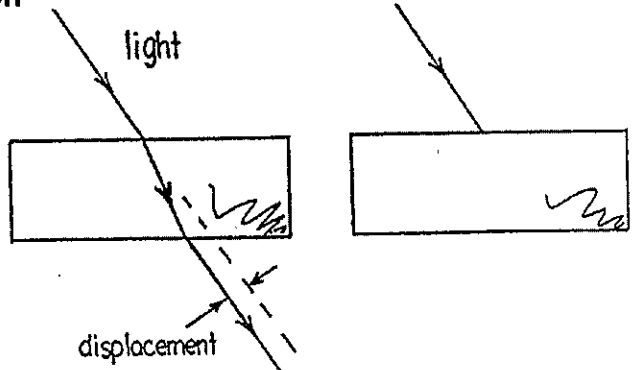
Sketch the path the light would take inside the air.

thanks to Clarence Bakken

Hewitt
Drewitt!

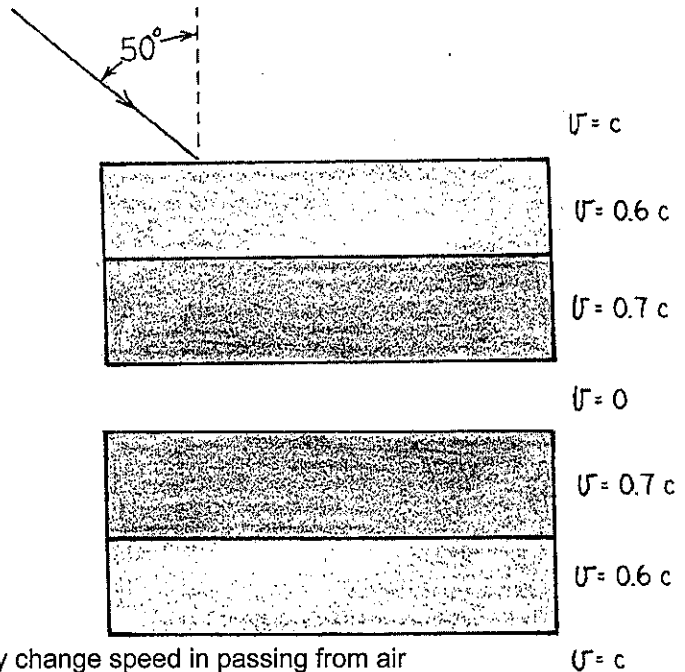
Chapter 28 Reflection and Refraction
More Refraction—continued

5. The two transparent blocks (right) are made of different materials. The speed of light in the left block is greater than the speed of light in the right block. Draw an appropriate light path through and beyond the right block. Is the light that emerges displaced more or less than light emerging from the left block?

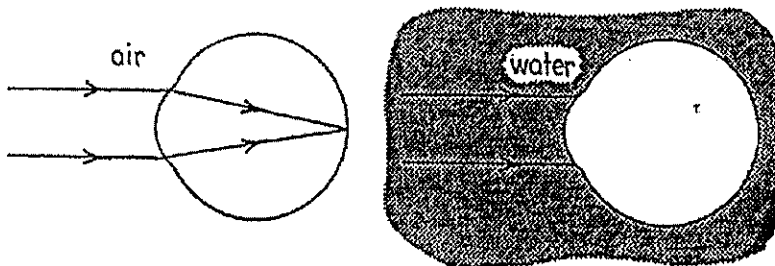


6. Light from the air passes through plates of glass and plastic below. The speeds of light in the different materials are shown to the right (these different speeds are often implied by the "index of refraction" of the material). Construct a rough sketch showing an appropriate path through the system of four plates.

Compared to the 50° incident ray at the top, what can you say about the angles of the ray in the air between and below the block pairs?



7. Parallel rays of light are refracted as they change speed in passing from air into the eye (left below). Construct a rough sketch showing appropriate light paths when parallel light under water meets the same eye (right below).



If a fish out of water wishes to clearly view objects in air, should it wear goggles filled with water or with air?



8. Why do we need to wear a face mask or goggles to see clearly when under water?

Hewitt
 Draw it!