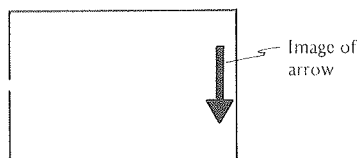
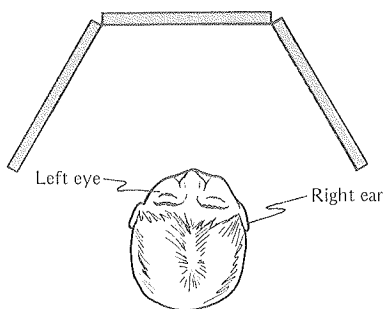


- P7** The figure shows a pinhole camera photographing two arrows. (a) Which arrow will have the largest image? (b) Which arrow's image will be pointing up?
- P8** The light of the pinhole image of the sun comes from the sun, reflects off the white screen, and gets to your eye. The eye, thus, still gets the sun's light. Why is the pinhole image less likely to hurt your eyes?
- P9** If a cloud drifts over the sun from right to left, which way will it seem to drift over the sun's image in a pinhole camera?
- P10** The figure shows a pinhole camera with the image of an arrow. The actual arrow is located somewhere outside the camera, is 2-cm long, and is vertical. Use a ruler to redraw the figure and construct suitable rays to (a) draw the position of the actual arrow that would result in the image drawn, and (b) draw two arrows, each of length 3 cm, that would result in the same image.



- P13** The man in the figure is looking at himself in a triple mirror found in a clothing store. Redraw the figure and show two *different* rays of light that go from his right ear to his left eye. One ray should hit only one mirror, the other ray should hit the other two mirrors. At each reflection, draw the normal to the mirror, and label θ_i and θ_r .



- P14** Briefly explain how an oceanographer might use sonar to measure the depth of the ocean.
- P15** In some places, housepersons like to "spy" on what is going on in the street without leaning out the window. They attach a mirror to the window frame on a bracket so it sticks a little way into the street. (Look for these the next time you're in Europe.) (a) Draw a diagram showing how houseperson *H*, without getting up from his or her chair, can see the visitor *V* at the neighbor's home. Draw how the mirror must be placed, and show how light gets from *V* to *H*'s eye. (b) Suppose *H* has no mirror, but does have a large 45° - 45° - 90° prism. *H* mounts the long face of the prism in the same position as you have drawn the mirror, and obtains a good reflection of *V*. What phenomenon is *H* using to get this

reflection? (c) Why can *H* hear *V* ringing the neighbor's bell when *H* cannot see *V* directly?

- P16** At nighttime, we can often pick up radio stations from cities very far away. (a) Why? (b) Why does this occur for AM radio, but not FM radio?
- P17** As you look at an ordinary bathroom mirror at large (grazing) angle, you can often see three, four, or more images of an object. Why?
- P18** A student, who obviously didn't read this book, had a van whose window he had covered with half-silvered mirrors (actually aluminum on plastic). When he checked it out during the day, he assured himself that, while he could see out, no one could see in. That night he parked his van in a dark parking lot, climbed inside with his lantern and a friend, and enjoyed what he thought was the privacy of his own home. A passing police officer saw him through the half-silvered mirrors, and promptly busted him. Why could the police officer see in?
- P19** When peering into a dark house from outside, you often get right up to the window and cup your hands around the side of your head. Why?
- P20** In Figure 2.37, we have shown how light from the headlights of a car gets to the driver's eye. Redraw the figure for a very foggy day. (Fog consists of many small droplets of water. Draw some of these droplets.) Draw how the light now gets to the driver's eye, and explain why it is harder for her to see the road ahead.
- P21** Blue light bends more than red light when entering glass from air because: (a) red light travels faster than blue light in glass, (b) blue light travels faster than red light in glass, (c) red light travels faster than blue light in air, or (d) blue light travels faster than red light in air. (Choose one.)
- P22** (a) Relate the fire, flash, and brilliance of a diamond to physical properties of the diamond. (b) Why does a diamond look black when you attempt to look through it from the back at the only light in an otherwise dark room?
- P23** (a) What is the critical angle? (b) Which pair of materials has the greater critical angle, air-water or air-diamond?
- P24** Why does the sun appear above the horizon when it is actually below the geometric horizon during a sunset?
- P25** James Morris, in *Heaven's Command*, describes a view from Grosse Isle in the Gulf of St. Lawrence as follows: "in the early morning sun the islands are inverted in mirage, and seem to hang there suspended between sky and water." In the early morning, the air gets warm faster than the water, so there is warmer air above the cooler air that is lying just above the

