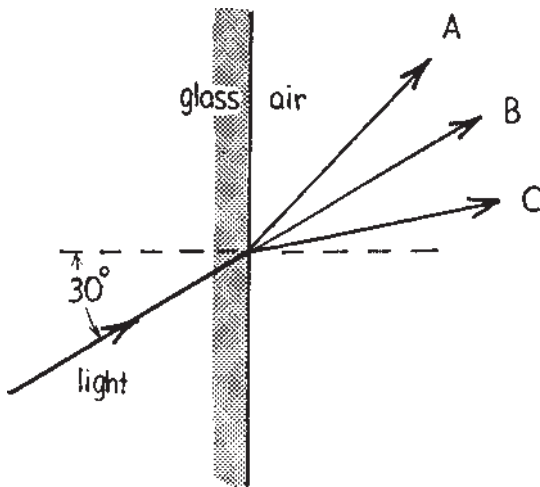
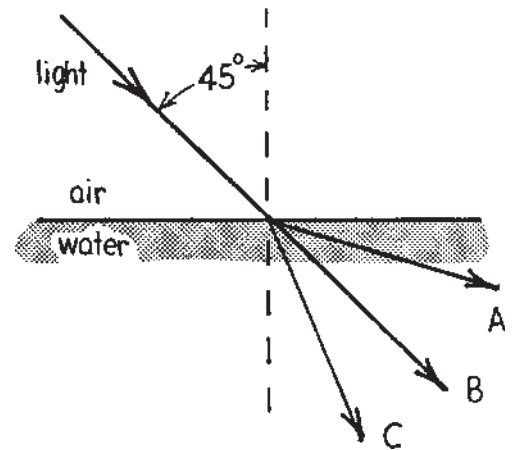


**Concept-Development Practice Page 29-4**

**Refraction**

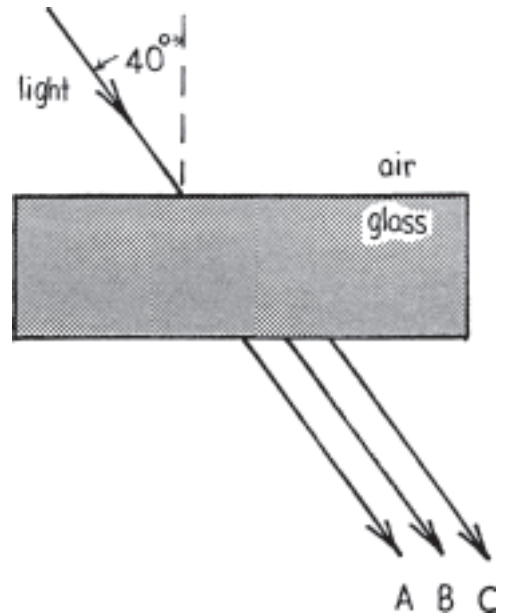
1. The sketch to the right shows a light ray moving from air into water at  $45^\circ$  to the normal. Which of the three rays indicated with capital letters is most likely the light ray that continues inside the water?

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

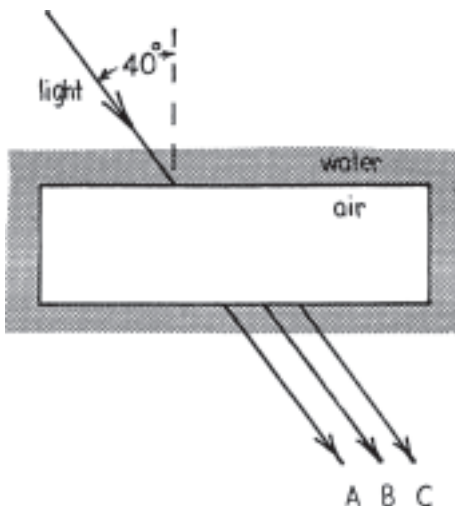
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3. To the right, a light ray is shown moving from air into a glass block at  $40^\circ$  to the normal. Which of the three rays is most likely the light ray that travels in the air after emerging from the opposite side of the block?

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Sketch the path the light would take inside the glass.



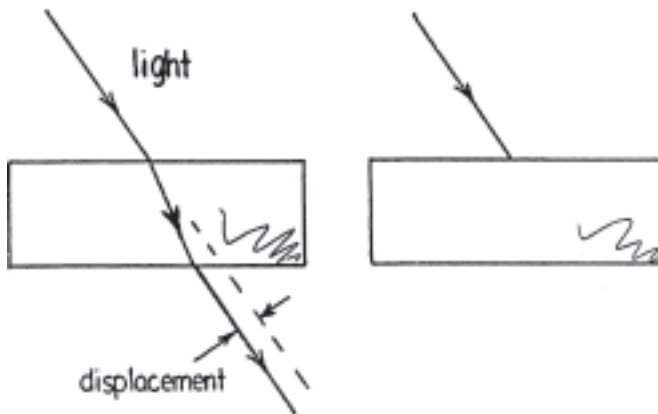
4. To the left, a light ray is shown moving from water into a rectangular block of air (inside a thin-walled plastic box) at  $40^\circ$  to the normal. Which of the three rays is most likely the light ray that continues into the water on the opposite side of the block?

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Sketch the path the light would take inside the air.

thanx to Clarence Bakken

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?

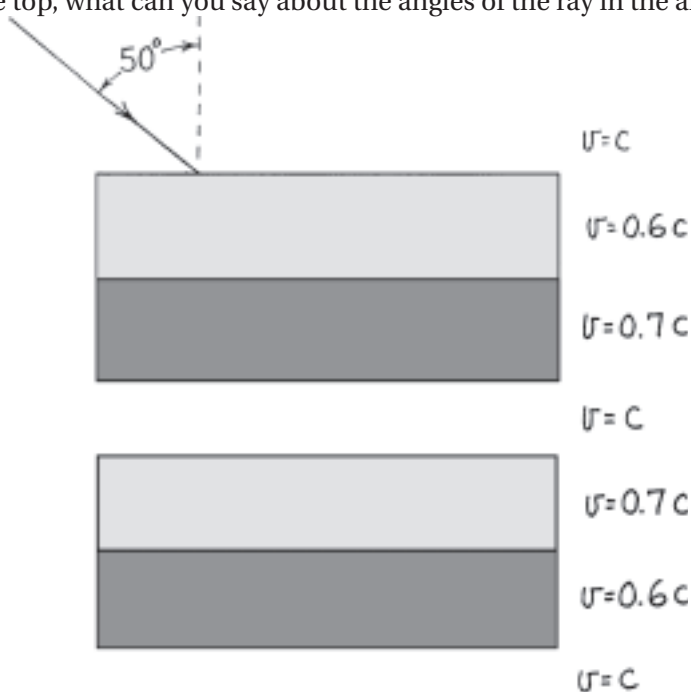


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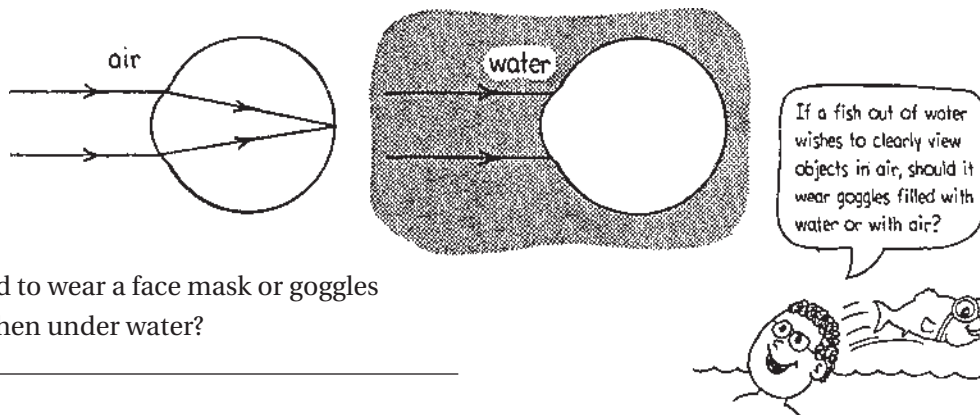
6. Light from the air passes through plates of glass and plastic below. The speeds of light in the different materials is shown to the right (these different speeds are often implied by the “index of refraction” of the material). Construct a rough sketch showing an appropriate path through the system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

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

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



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

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### CONCEPTUAL PHYSICS