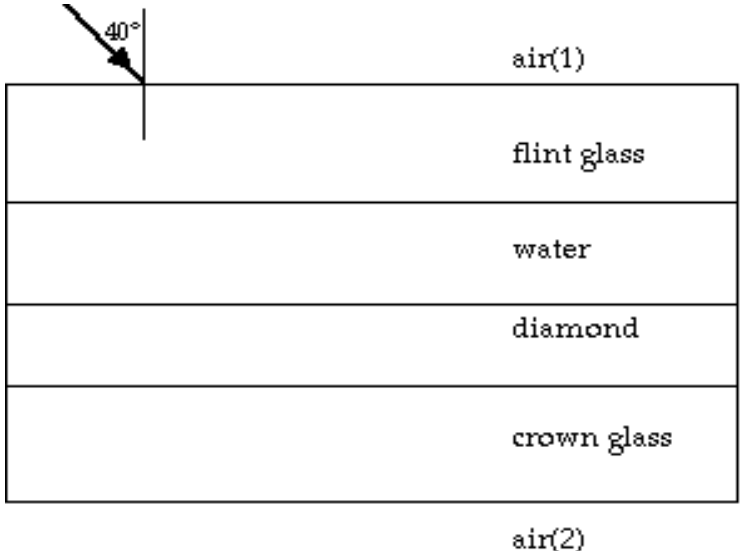
More Refraction Action

Read from **Lesson 2** of the **Refraction and Lenses chapter** at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/refrn/u14l2b.html
http://www.physicsclassroom.com/Class/refrn/u14l2c.html
http://www.physicsclassroom.com/Class/refrn/u14l2d.html

MOP Connection: Refraction and Lenses: Mission RL4

1. Index of refraction values are given in the table below. Use these values to determine angles of incidence and refraction and to trace the ray of light from air, into and through the four layers and again into air. For each boundary, begin by writing Snell's Law.



Material	n
air	1.0
flint glass	1.9
water	1.33
diamond	2.4
crown glass	1.5

2. Put in order, from least to greatest, the angles the light ray makes to the normal in the different mediums ($ø_{A1}$, $ø_{fg}$, $ø_{w}$, $ø_{d}$, $ø_{cg}$) shown above.

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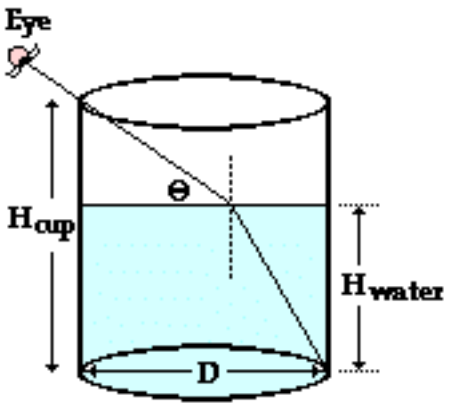
3. Use Snell's law and algebraic substitutions to show how the angle in diamond could be calculated without calculating all the angles in between.

4. What seems to be the important variable effecting the above pattern for angles? _____ Is this order of angle measures dependent on the order of the layers above? _____ Explain.

5. If the flint glass and crown glass layers were switched how would the angle in air(2) be effected? _____

6. A tall cup is partially filled with water (n=1.33) to a height of 7.80 cm (H_{water}). The diameter (D) of the cup is 14.64 cm. A student looks downward just over the left rim of the cup at an angle of 40.47 degrees with the water's surface (theta). At this angle, the refraction of light at the water's surface just barely allows her to see the bottom-right corner of the cup. A sketch (not drawn to scale) of the path of light is shown at the right. Determine the height of the cup (H_{cup}) in centimeters.



7. Ray Zuvlite is playing with his underwater laser. He descends beneath the water surface in his backyard pool to a vertical depth of 7.09 feet and directs the laser beam at an angle towards the pool's edge. The beam emerges from water (n=1.33) into air <u>at the pool's very edge</u> and projects onto a pool house which is located 17.21 feet horizontally from the pool's edge. The dot on the pool house is observed to be located at a vertical height of 8.75 feet. Determine the distance which Ray is located horizontally out from the edge of the pool.