Refraction Cup

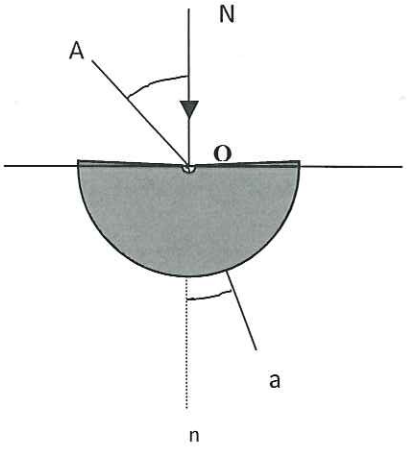
P2-1230

SETUP:

Fill the cup with a transparent liquid like water, oil, alcohol, or gelatin. Please use soft sponge to clean to avoid scratches

1. Shine a beam of light at the center of the flat side of the cup. (The Arbor Scientific Light Box and Optical set provides an excellent beam for this experiment.)

EXPERIMENTS-QUALITATIVE:



1. Create a diagram like that to the right, with all lines included except the refracted ray (a).
2. Fill several cups with different liquids.
3. Shine a beam of light along the incident ray (A) so that it strikes the cup.
4. Mark the location of the refracted ray (a) for each liquid.
5. (Optional) Using a straight edge, extend each ray. Then use a protractor to measure angles ∠AON (angle of incidence) and ∠aOn (angle of refraction).

$n_i \sin\theta_i = n_r \sin\theta_r$ where θ_i = angle of incidence θ_r = angle of refraction

n_i = index of refraction of the incident medium (for air,n=1.000)

n_r = index of refraction of the refractive medium

n_i = index of refraction of the incident medium (for air, n=1.000)

n_r = index of refraction of the refractive medium

6. List the different liquids in order from least to most refractive.

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EXPERIMENTS-QUANTITATIVE:

Measuring Index of Refraction

1. Create a diagram like that on the previous page, with all lines included except the refracted ray (a).
2. Fill the cup with a liquid.
3. Shine a beam of light along the incident ray (A) so that it strikes the cup.
4. Mark the location of the refracted ray (a) for each liquid.
5. Using a straight edge, extend each ray. Then use a protractor to measure angles ∠AON (angle of incidence) and ∠aOn (angle of refraction).
6. Use the formula to the right to determine the index of refraction for each liquid.

Total Internal Reflection—Critical Angle

1. Set up the cup as above, but shine the incident beam along line a, so that it strikes the curved side of the cup.
2. Aim the beam at the center of the straight side. The beam will not refract when it crosses the curved surface (because it is perpendicular to the surface). The beam will refract on its way out of the straight side, and bend away from the Normal (N)
3. Increase ∠aOn until the refracted ray is exactly parallel to the straight side. ∠aOn is the Critical Angle for the liquid in the cup.
4. Increase ∠aOn further and observe Total Internal Reflection.