Refractive Index Experiment

I. Experiment purpose

By using glass, acrylic and water tank proves Shell's law and test the refractive index on solid and liquid.

II. Experiment device

1	laser launcher	1	5	semi-circular acrylic block	1
2	semi-circular transparent tank	1	6	semi-circular glass block	1
3	glass block	1	7	circle protractor	1
4	acrylic block	1	8		

III. Experiment theory

When light transmits to one object with two different mediums, one part of light will enter another medium and the other part will reflect to original medium. We call refractive index and reflection of light. The transmission speed of light in different mediums are different, so the itinerary direction will be changed. When light transmits from one medium to other medium, it causes reflection, and the itinerary direction will change. Image 1 shows that the light reflects into water. X axis is between vacuum and water. Y axis is normal line. L_i is the incident light when vacuum. L_r is refraction light in the water. The incident light, refractive light and normal line are called incident angle (θ_i) and refractive angle (θ_r). We can find from the result that the refractive phenomenon follows the three main law of refraction of light:

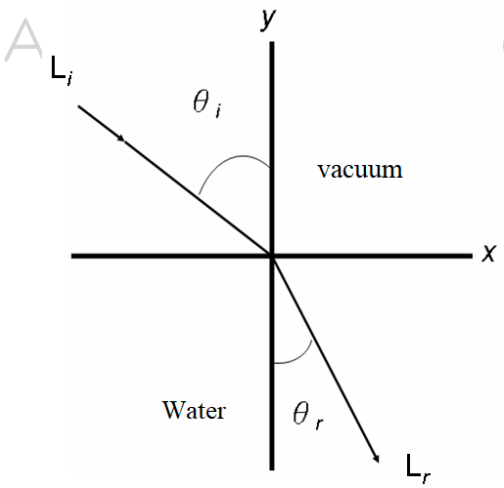

Image 1

1. **The refractive first law**

   Incident light, refractive light, and normal line are all in the same surface.

2. **The refractive second law**

   In any angle of incident angle, incident angle and the sine wave of the refractive angle are proportional, and it is constant. This constant is the refractive index of this medium. This relation between incident angle and refractive angle are found by Snell, so it is also called Snell's Law.

3. **The refractive third law**

   In any two mediums, the path of light is reversibility.

Light of refractive index in vacuum is 1. When light in vacuum refracts into any medium, the rate of the incident angle and the sine wave of the refractive angle that we call **absolute index of refraction** to this medium. Also, when light enters medium A to medium B, the rate of the incident angle and the sine wave of the refractive angle that we call **relative index of refraction** to medium A and B. It show n_{BA} usually. When light enters from medium B to medium A, the rate of the incident and sine wave of refractive angle that the relative index of refraction to medium B and A is n_{AB}. The function of refractive index is below:

$$n_{BA} \equiv \frac{\sin\theta_i(\text{medium A})}{\sin\theta_r(\text{medium B})} \quad ; \quad n_{AB} \equiv \frac{\sin\theta_i(\text{medium B})}{\sin\theta_r(\text{medium A})}$$

From the upper two relation function, we know that the two mediums of relative index of refractive is reciprocal.

If medium of the refractive index is larger, then light in this medium is slower that we call **Optically denser medium.** If medium of the refractive index is smaller, then we call **Optically thinner medium**. When light enters from optically denser medium to optically thinner medium, the refractive angle of the light in the path will be larger than the incident angle by the law of light refractive. If the incident angle is increased slowly, the refractive angle will also increase and when the increased incident angle reaches to a level, the refractive angle will be 90° accidentally. The incident will go along to the surface of two mediums. If the increased incident angle is keeping increasing, then there is no refractive light in two mediums. All of light will reflects by the medium. We call **total reflection**. We call **critical angle** when total reflection happens in the last incident angle. Total reflection shows on image 2 below.

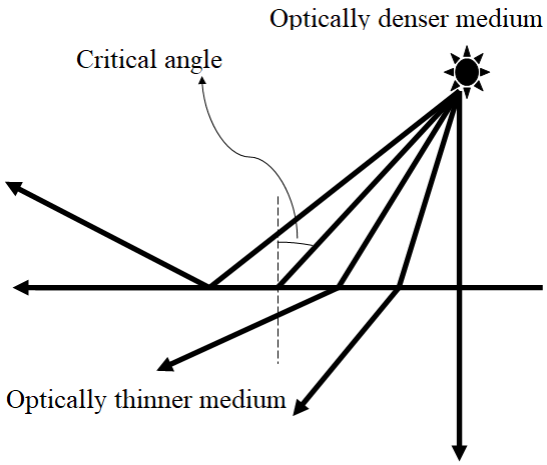

Image 2

This experiment uses two materials with different refractive index into two different shapes to understand direction of laser in different materials by different refractive index materials and shape.

IV. Experiment step

1. We can use two sides of scale in circle protractor to set needed refractive angle on the path of laser, as image 3 below.

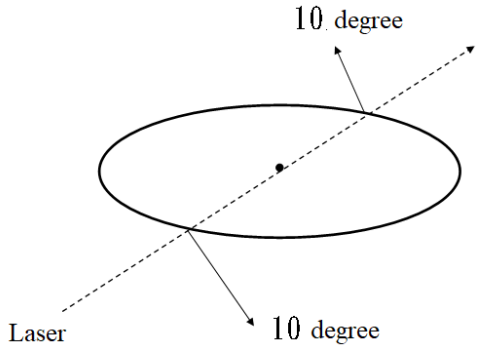

Image 3

2. We set glass block on the base line of protractor as image 4 and observe the changed angle of the light path inside of the glass block.

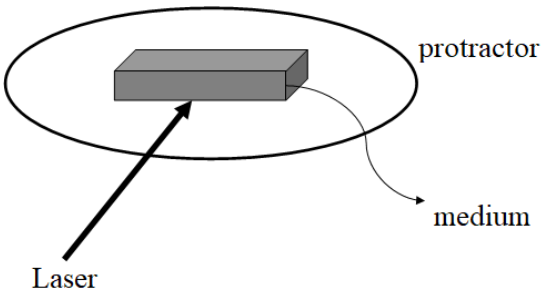

Image 4

3. We change different glass block, acrylic block and acrylic tank. We repeat the process and calculate the refractive index.

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