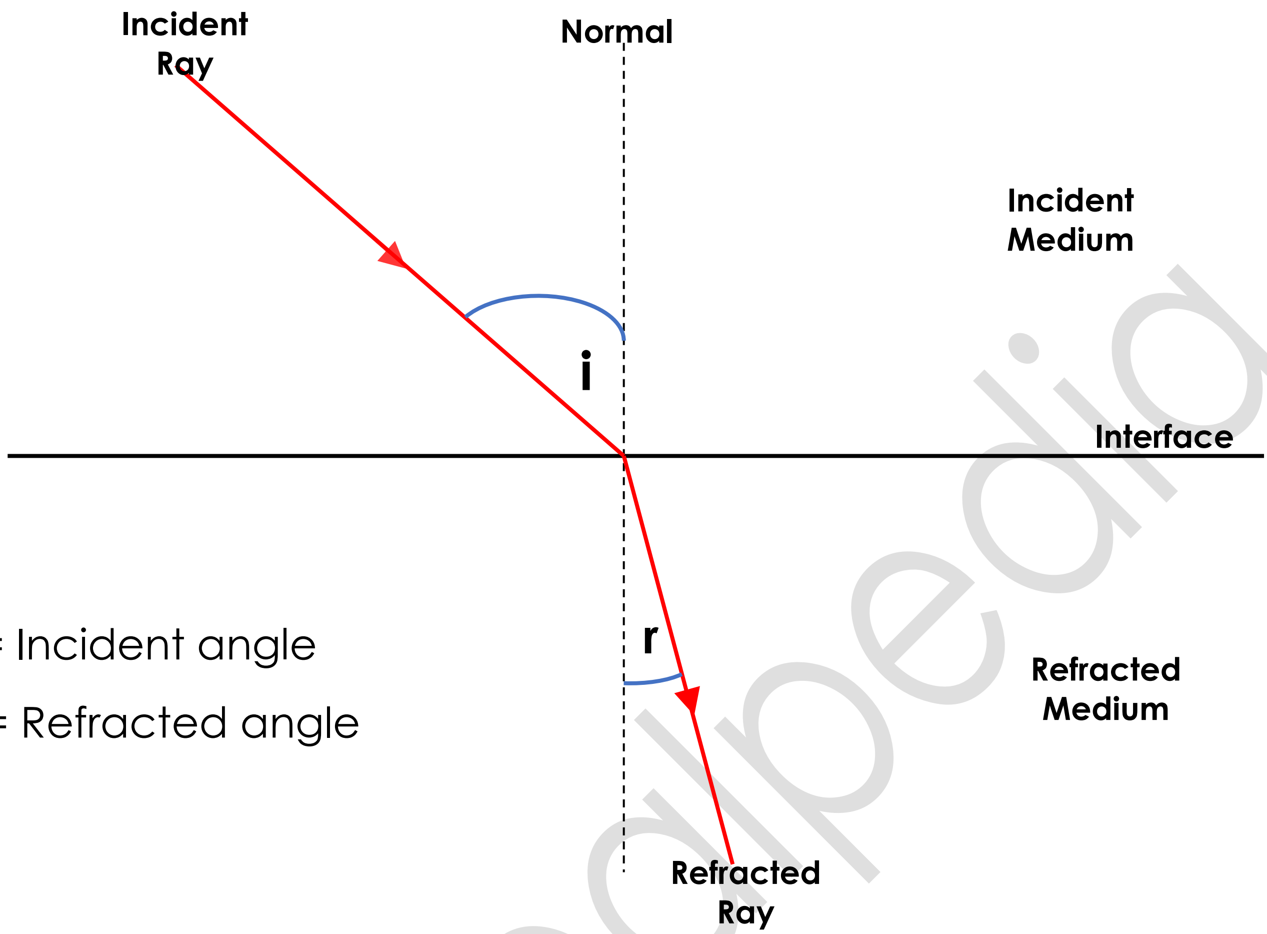
Optical Refraction



i = Incident angle

r = Refracted angle

- **Laws of Refraction**

  - Incident ray, Refracted ray and Normal will be in the same planar.

  - Ratio of the Sin values of Incident angle and Refracted angle is a constant.

$$\frac{\text{Sin i}}{\text{Sin r}} = k$$

- **Absolute refractive index (n)**

$$n = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$$

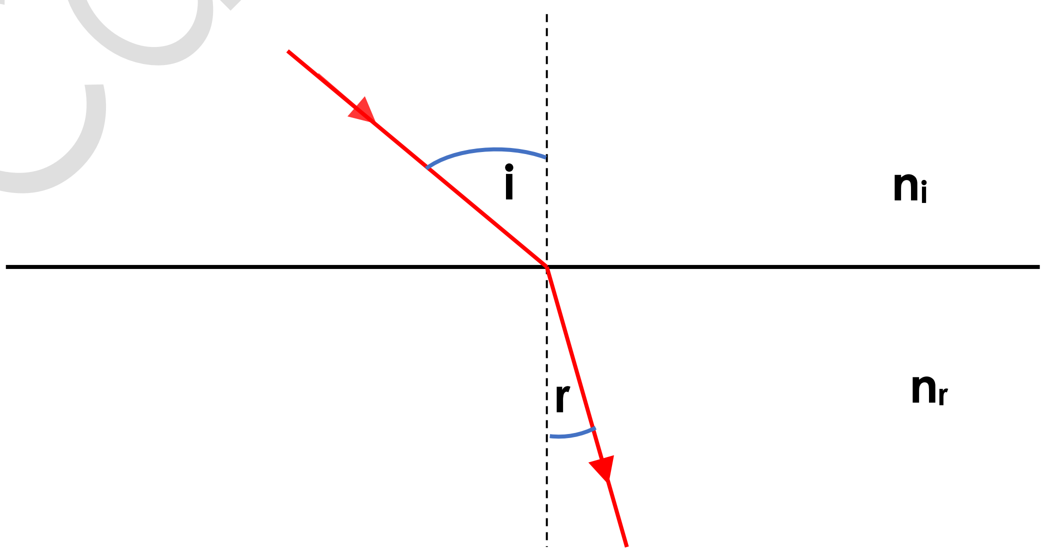
- **Relative refractive index ($^x n_y$ – refractive index of medium x relative to the refractive index of medium y.)**

$$^x n_y = \frac{\text{Speed of light in medium x}}{\text{Speed of light in medium y}}$$

From that formula, we get the below formula too. See how it came yourself.

$$^x n_y = \frac{\text{Absolute refractive index of medium x}}{\text{Absolute refractive index of medium y}}$$

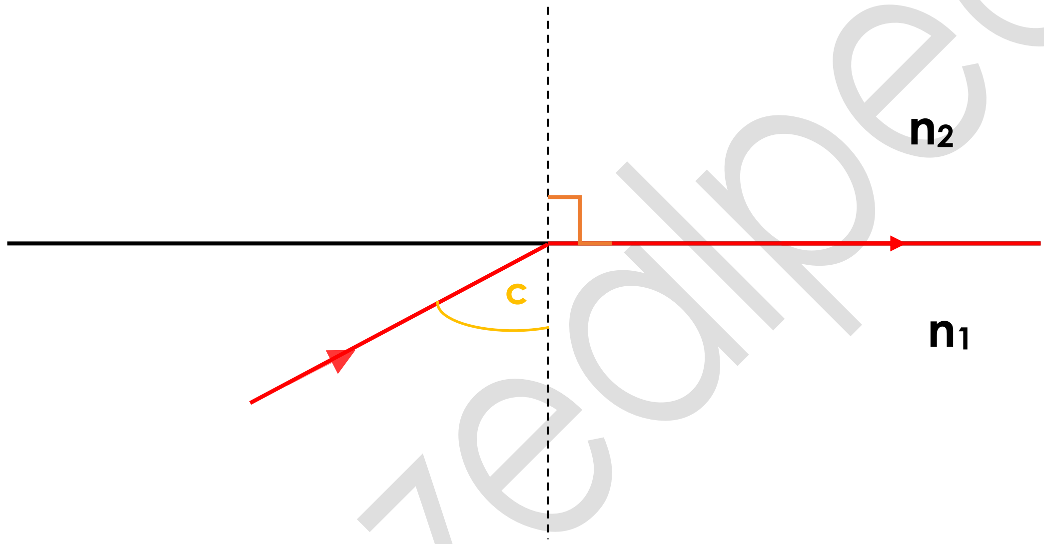
- **Snell's law**



$$n_i \sin i = n_r \sin r$$

- **<u>Critical Angle</u>**

- Critical angle is the incidence angle when refraction angle is 90°. In order to happen this the ray must travel from dense medium to rarer medium.



From Snell's law,

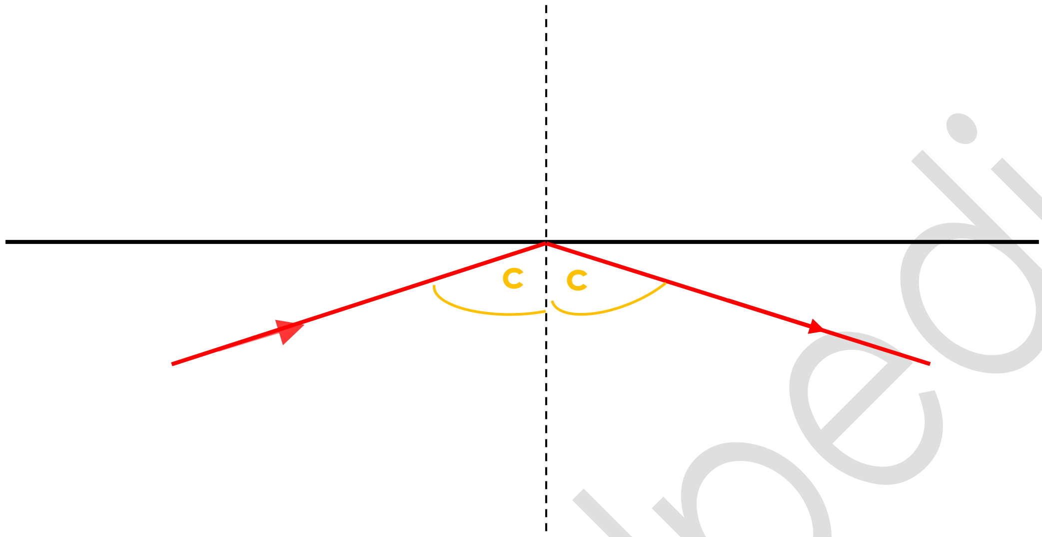
$$n_1 \sin c = n_2 \sin r$$

$$n_1 \sin c = n_2 \sin 90^\circ$$

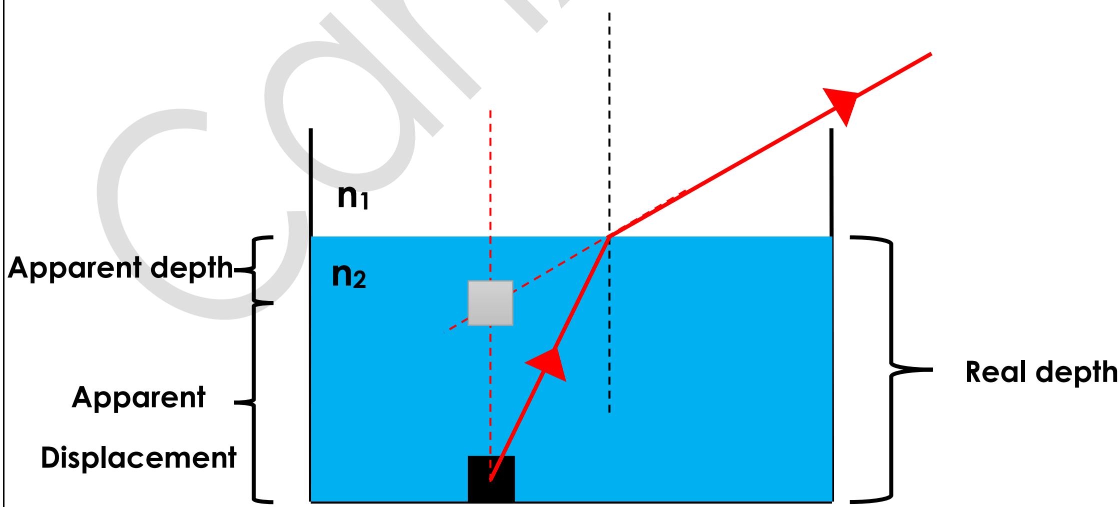
$$n_1 \sin c = n_2$$

- **Total internal reflection**

➢ This happens when incidence angle is larger than critical angle.



- **Real depth and apparent depth**



$$\frac{n_2}{n_1} = \frac{\text{Apparent depth}}{\text{Real depth}}$$

Note: Normally **$n_1 = 1$** as it's air.
Absolute refractive index of air ≈ 1
If it wasn't air, you have to add the right refractive index.

- **Apparent Displacement (d)**

$$d = t\left(1 - \frac{n_1}{n_2}\right)$$

➢ Most of the times…$n_1 = 1$.