Consider an ordinary (unpolarized) light incident upon a transparent medium of refractive index μ at the polarizing angle such that the reflected ray is completely plane polarized while the refracted (transmitted) ray is partially polarized, as shown in figure.

For polarizing angle, the reflected and refracted rays are perpendicular to each other.

i.e., $\angle RST = 90^o$

$$\therefore \quad \theta_p + r = 90^o$$

$$or, \quad r = 90^o - \theta_p \ldots \ldots \ldots (1)$$

Now, from Snell's law: $\mu = \frac{\sin i}{\sin r} = \frac{\sin \theta_p}{\sin (90-\theta_p)} = \frac{\sin \theta_p}{\cos \theta_p} = \tan \theta_p$

$$\therefore \ \tan \theta_p = \mu$$

This is Brewster's law.

Applications of Brewster's law:

1. It is used in polarizing filter of the camera lens to reduce the reflection from reflective surface (that helps to take pictures of object below water surface).
2. It is used in polarized sunglasses to reduce glare that is reflected directly from the sun and also from horizontal surfaces like roads and water.

Brewster's law: $\mu = \tan \theta_p$ $\quad \theta_p + r = 90^o$

- ✓ For air -glass boundary: ${}_a\mu_g = \mu_g = tan\theta_p$
- ✓ For water-glass boundary: ${}_w\mu_g = \mu_g = tan\theta_p$ Where, ${}_w\mu_g = \frac{\mu_g}{\mu_w}$
- ✓ For any medium, refractive index: $\mu = \frac{c}{v}$ Where, $c = speed\ of\ light\ in\ air = 3 \times 10^8 m/s$
  $v = speed\ of\ light\ in\ the\ medium$

If C be the critical angle of medium, $\mu = \frac{1}{Sin\ C}$ $\therefore \frac{1}{Sin\ C} = tan\theta_p$

- ➢ The value of polarizing angle depends upon: (i) nature of medium (refractive index of medium).
  (ii) wavelength of light used.
  [**Cauchy formula**: $\mu = A + \frac{B}{\lambda^2} + \frac{C}{\lambda^4} + \cdots$]
- ➢ Polarizing angle is greater for denser medium ($\mu\ higher$) and smaller for rarer medium (μ smaller).

1. For a given medium, the polarizing angle is 60°. What will be the critical angle and refractive index of the medium. Also, find the speed of light in the medium. [$\boldsymbol{Ans}$: $\mathbf{1.73, 35.23^o, 1.73 \times 10^8 m/s}$]
2. The critical angle for light in a certain substance is 45°. The polarizing angle is:
   a. 45° b. 55° c. 65° d. 75°
3. When a ray of light is incident on a surface at glancing angle 30°, the reflected ray is found to be completely polarized. The angle of refraction will be:
   a. 20° b. 30° c. 40° d. 50°
4. The polarizing angle for the light travelling from water of refractive index 1.33 to a glass of refractive index 1.53 is:
   a. 30° b. 39° c. 40° d. 49°