November 13th/14th

Images

Chapter 35

Review: EM waves

- Intensity of unpolarized light after hitting a polarizing sheet

$$I = \tfrac{1}{2} I_0$$

- Intensity of polarized light after hitting a polarizing sheet

$$I = I_0 \cos^2 \theta$$

- Peak intensity is twice the average intensity

$$I_{peak} = 2 I_{avg}$$

$$I_{peak} = \frac{1}{c\mu_0} E_m{}^2 = \frac{1}{c\mu_0} \left(\sqrt{2} E_{rms}\right)^2 = 2 \frac{1}{c\mu_0} E_{rms}^2 = 2 I_{avg}$$

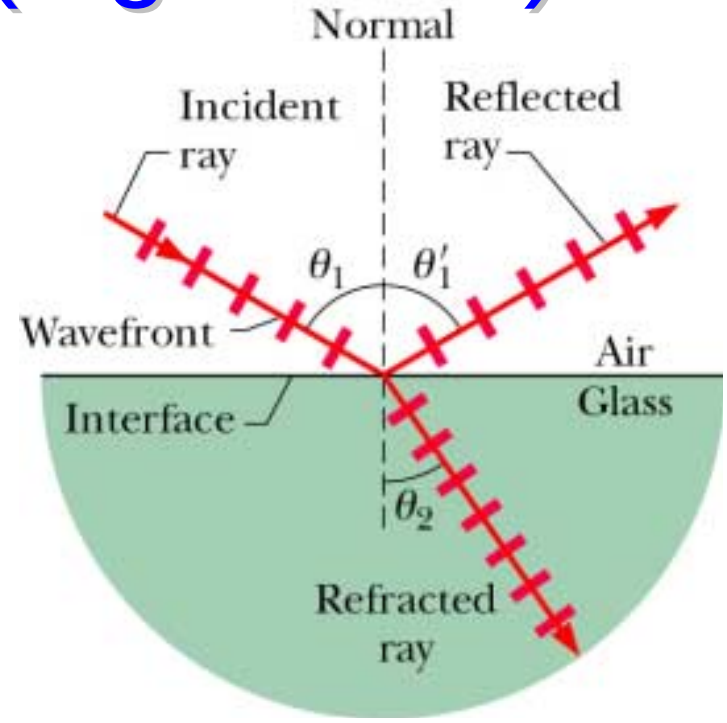
Review: EM waves (Fig. 34-17)

- Law of reflection: $\theta_1' = \theta_1$
- Law of refraction: Snell's law

$$n_2 \sin\theta_2 = n_1 \sin\theta_1$$

- Index of refraction
  - Nothing has $n < 1$, v is always < c

$$n = \frac{c}{v}$$



- If $n_2 = n_1$ then $\theta_2 = \theta_1$

  $n_2 > n_1$ $\quad\theta_2 < \theta_1$

  $n_2 < n_1$ $\quad\theta_2 > \theta_1$

- Frequency of wave does not change but

$$\frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2} = \frac{n_2}{n_1}$$

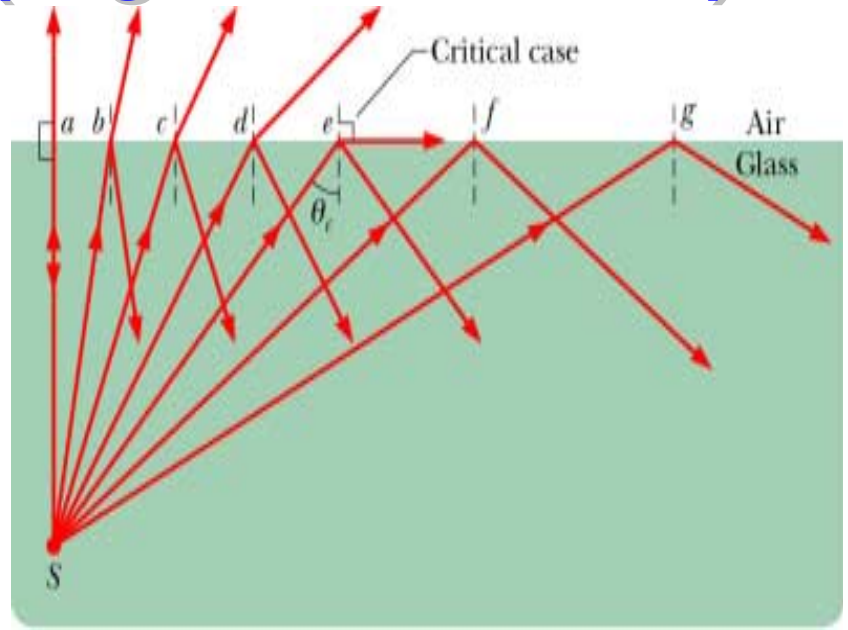
Review: EM waves (Fig. 34-24, 27)

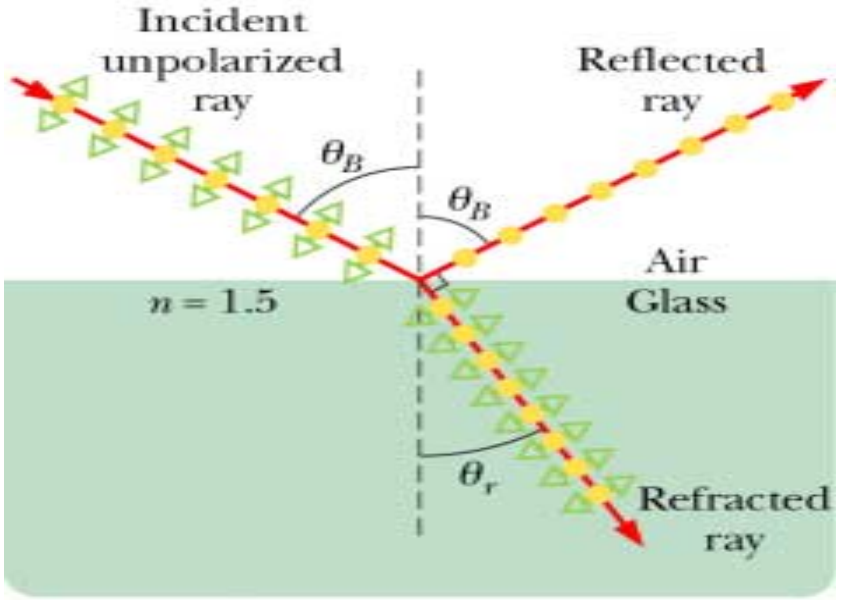
- Critical angle, θ_c – refracted ray along surface

$$\theta_C = \sin^{-1}\frac{n_2}{n_1}$$

- Total internal reflection – no refracted ray
  - Only occurs if $n_2 < n_1$
- Brewster angle - reflected light is fully polarized

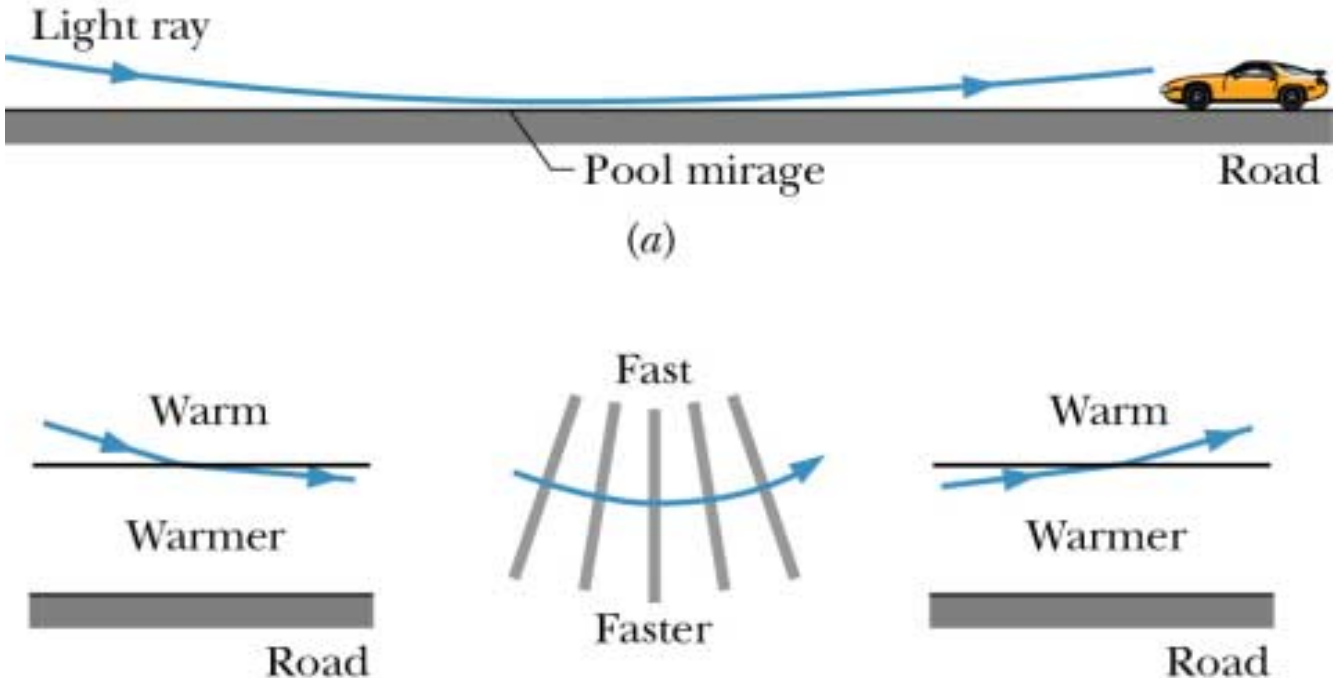
$$\theta_B = \tan^{-1}\frac{n_2}{n_1}$$





Real & Virtual images (Fig. 35-1)

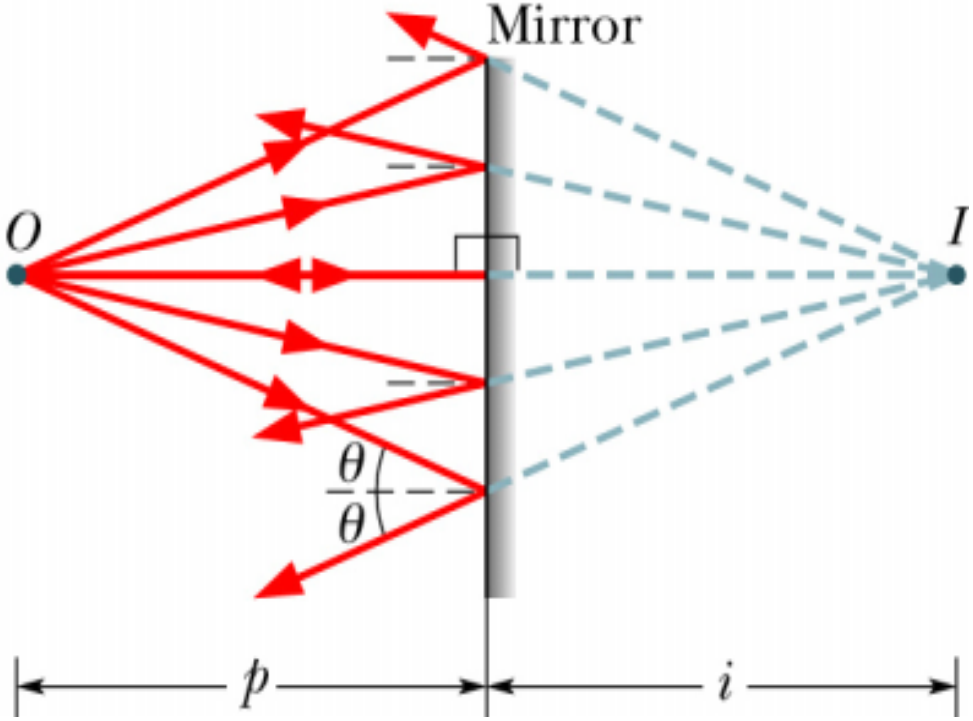
- Real images – light intersects the image point
- Virtual images – light doesn't really intersect but images appears to come from that point
  - Sunny day the mirage pool of water on the road is really reflection of low section of the sky in front of you



Plane mirrors (Fig. 35-2)

- Mirror – surface which reflects light in one direction instead of scattering it in many directions or absorbing it
- Plane mirror – flat reflecting surface

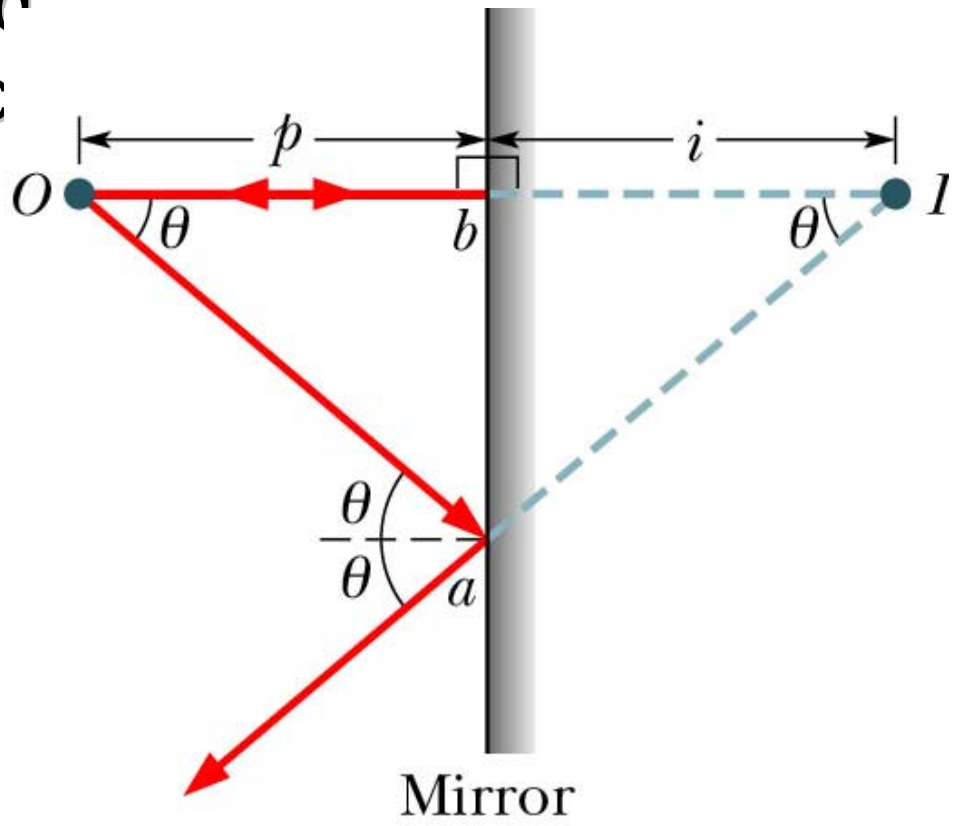
- Extend reflected rays from O behind mirror
- Intersect at point of virtual image I



Plane mirrors (Fig. 35-3)

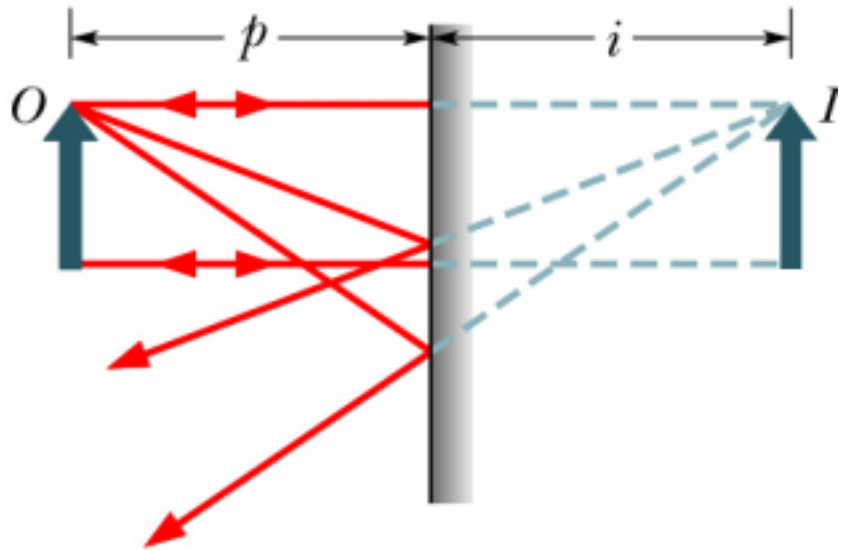
- Plane mirror – virtual image I is as far behind the mirror as the objec O is in front of it
- By convention, object distances *p* are positive, image distances *i* for virtual images are negative

$$i = -p$$



Plane mirrors (Figs. 35-4, 35-5)

- Plane mirror – virtual image I has same orientation and height as object O



- Only portion of mirror smaller than pupil of eye is used to form images