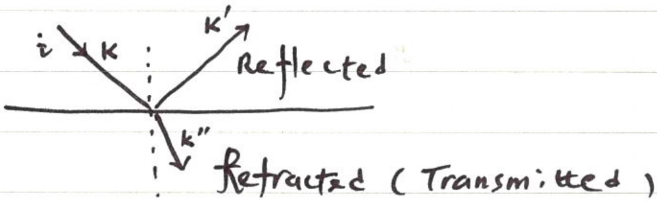
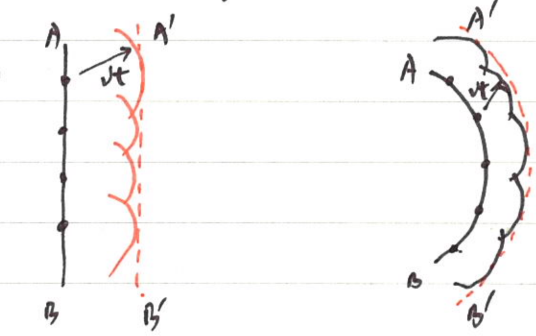
2.6 Reflection & Refraction at a plane boundary



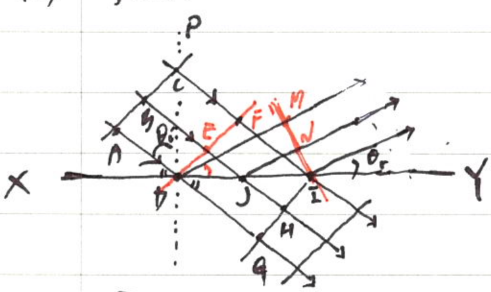
· Huygens' principle

· Each point on the leading surface of a wave front is the secondary source of wavelets, which propagate at a speed of light and form a new wavefront at a later time.

ex)



(i) Reflection



· Wave front : $\overline{AC}$

· plane surface : $\overline{XY}$

· incidence angle : θ_i

· Reflection angle : θ_r

A. If there is no $\overline{XY}$,

$\overline{AC} \longrightarrow \overline{IG}$:

$\left(\begin{array}{l} \overline{CF} = \overline{BE} = \overline{AD} \\ \overline{FI} = \overline{EH} = \overline{DG} \rightarrow \overline{IG} \text{ wavefront} \end{array} \right.$

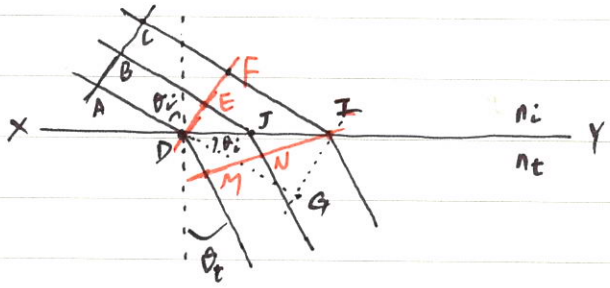
B. $\overline{EH} = \overline{EJ} + \overline{JH}$
$\qquad\qquad\qquad\quad$ " $\overline{JN}$

Similarly, $\overline{DG} = \overline{DM}$; $\overline{JH} = \overline{JN}$

$\therefore \overline{GI} = \overline{MI} \rightarrow \triangle DMI = \triangle DGI$

$\rightarrow \angle MDI = \angle IDG = \angle ADX$ $\quad\therefore$ incidence angle = reflection angle

(ii) Refraction



- Different speed at refraction region

$$v_i = \frac{c}{n_i}$$

$$\therefore \overline{DM} = v_t t = v_t \left(\frac{\overline{DG}}{v_i}\right) = \left(\frac{v_t}{v_i}\right)\overline{DG} = \left(\frac{n_i}{n_t}\right)\overline{DG}$$

$$\therefore n_t \overline{DM} = n_i \overline{DG}$$

$$\left(\begin{array}{l} \overline{DG} = \overline{FI} = \overline{DI}/\sin\theta_i \\ \overline{DM} = \overline{DI}/\sin\theta_t \end{array}\right.$$

$$\therefore n_i \sin\theta_i = n_t \sin\theta_t \quad : \text{Snell's law}$$

$$k = \frac{2\pi}{\lambda} = \left(\frac{2\pi}{\lambda_0}\right) n \quad \rightarrow \quad k \propto n$$

In Fig. 2.9,

$$\therefore k \sin\theta = k'' \sin\phi, \qquad (2.45)$$

$$(\phi = \theta_t \;;\; \theta = \theta_i)$$