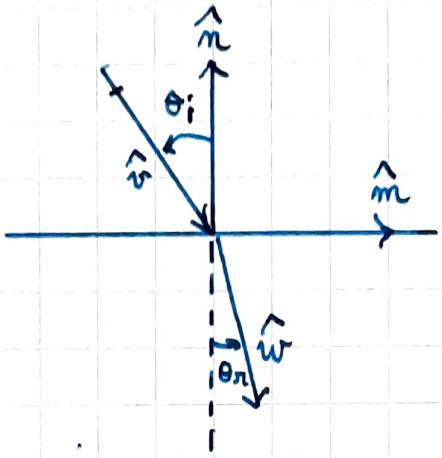
Snell-Descartes



$$\hat{n} = n_x \hat{e}_x + n_y \hat{e}_y$$

$$\hat{m} = \begin{pmatrix} n_y \\ -n_x \end{pmatrix}$$

$$\hat{v} = -\cos(\theta_i)\hat{n} + \sin(\theta_i)\hat{m}$$

$$\hat{w} = -\cos(\theta_r)\hat{n} + \sin(\theta_r)\hat{m}$$

$$= -|\cos(\theta_r)|\hat{n} + \sin(\theta_r)\hat{m}$$

$$= -\sqrt{1-\sin^2(\theta_r)}\,\hat{n} + \sin(\theta_r)\hat{m}$$

$$= -\sqrt{1-\left(\frac{n_i}{n_r}\sin(\theta_i)\right)^2}\,\hat{n} + \frac{n_i}{n_r}\sin(\theta_i)\hat{m}$$

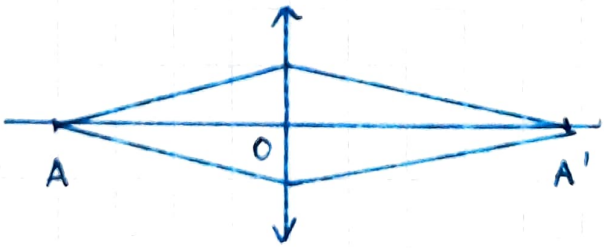
$$\hat{w} = -\sqrt{1-\left(\frac{n_i}{n_r}\hat{v}\cdot\hat{m}\right)^2}\,\hat{n} + \frac{n_i}{n_r}(\hat{v}\cdot\hat{m})\hat{m}$$

or $n_i \sin\theta_i = n_r \sin\theta_r$

$\cos^2\theta_r + \sin^2\theta_r = 1$

$|\cos\theta_r| = \sqrt{1-\sin^2\theta_r}$

Descartes formula



$$\frac{1}{\overline{OA'}} - \frac{1}{\overline{OA}} = \frac{1}{f} = V$$

vergence of the lens

- $V > 0$ if ↕
- $V < 0$ if I