

1. Geometric Optics

Law of Reflection:

$$\theta_i = \theta_r$$

Snell's Law of Refraction:

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

where refractive index $n = \frac{c}{v}$.

Total Internal Reflection (TIR): Critical angle θ_c when $\theta_2 = 90^\circ$:

$$\sin \theta_c = \frac{n_2}{n_1} \quad (n_1 > n_2)$$

Spherical Mirrors Lenses: Mirror/Lens formula:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

Magnification:

$$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

Lensmaker's Equation:

$$\frac{1}{f} = (n - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

2. Wave Optics

Phase Difference Path Difference:

$$\Delta \phi = \frac{2\pi}{\lambda} \Delta x$$

Young's Double Slit Experiment (YDSE):

* **Constructive Interference (Bright fringes):**

$$d \sin \theta = m\lambda, \quad m = 0, \pm 1, \pm 2, \dots$$

* **Destructive Interference (Dark fringes):**

$$d \sin \theta = \left(m + \frac{1}{2} \right) \lambda$$

* **Fringe Width (β):**

$$\beta = \frac{\lambda D}{d}$$

3. Diffraction

Single Slit Diffraction (Minima):

$$a \sin \theta = m\lambda, \quad m = \pm 1, \pm 2, \dots$$

Rayleigh Criterion for Resolution:

$$\theta_R \approx 1.22 \frac{\lambda}{D}$$

4. Polarization

Malus's Law:

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

Brewster's Law: When light is incident at polarizing angle θ_p , reflected and refracted rays are perpendicular.

$$\tan \theta_p = \frac{n_2}{n_1}$$

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