Geometric Optics:

Reflection

$$\theta = \theta'$$

Refraction

$$\begin{aligned} \frac{\sin\theta_1}{\sin\theta_2} &= \frac{v_1}{v_2} \\ n &= \frac{c}{v} \\ n_1\lambda_1 &= n_2\lambda_2 \\ n_1\sin\theta_1 &= n_2\sin\theta_2 \end{aligned}$$

Magnification

$$M = \frac{h'}{h} = -\frac{q}{p}$$

Mirror and lens equation

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

Image formed by refraction

$$\begin{aligned} \frac{n_1}{p} + \frac{n_2}{q} &= \frac{n_2 - n_1}{R} \\ \frac{n_1}{p} &= -\frac{n_2}{q} \end{aligned}$$

Lenses

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

Interference:

$$\begin{aligned} \frac{\delta}{\lambda} &= \frac{\phi}{2\pi} \\ \delta &= m\lambda \qquad m = 0, 1, 2, \ldots \qquad \text{Constructive} \\ \delta &= \left(m + \frac{1}{2}\right)\lambda \qquad m = 0, 1, 2, \ldots \qquad \text{Destructive} \end{aligned}$$

Double Slit Experiment

$$\begin{aligned} \delta &= d\sin\theta_{bright} = m\lambda \qquad m = 0, 1, 2, \ldots \\ \delta &= d\sin\theta_{dark} = \left(m + \frac{1}{2}\right)\lambda \qquad m = 0, 1, 2, \ldots \\ y_{bright} &= L\tan\theta_{bright} \\ y_{dark} &= L\tan\theta_{dark} \\ I_{max} &= \cos^2\left[\frac{\pi d\cos\theta}{\lambda}\right] \end{aligned}$$

Single Slit Diffraction

$$\sin\theta_{dark} = m\frac{\lambda}{a} \qquad m = 0, 1, 2, \ldots$$

Diffraction Grating

$$d\sin\theta_{bright} = m\lambda \qquad m = 0, 1, 2, \ldots$$

Quantum Physics:

Blackbody

$$\begin{aligned} P &= \sigma A T^4 \\ \lambda_{max} T &= 2.898 \times 10^{-3} m \cdot K \end{aligned}$$

Photoelectric Effect

$$\begin{aligned} E &= hf \\ K_{max} &= hf - \phi = e\Delta V_s \\ \lambda_c &= \frac{c}{f_c} = \frac{hc}{\phi} \end{aligned}$$

Compton Effect

$$\lambda' - \lambda_0 = \frac{h}{m_e c}(1 - \cos\theta)$$

de Broglie Wavelength

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Uncertainty Principle

$$\Delta x \cdot \Delta p \geq \frac{\hbar}{2}$$

Trigonometry:

$$\theta \ll 1rad. \rightarrow \tan\theta \approx \sin\theta \approx \theta$$

Sine Values

$$\begin{aligned}
\sin 5^\circ &= 0.087 \\
\sin 10^\circ &= 0.174 \\
\sin 15^\circ &= 0.259 \\
\sin 20^\circ &= 0.342 \\
\sin 25^\circ &= 0.423 \\
\sin 30^\circ &= 0.500 \\
\sin 35^\circ &= 0.574 \\
\sin 40^\circ &= 0.643 \\
\sin 45^\circ &= 0.707 \\
\sin 50^\circ &= 0.766 \\
\sin 55^\circ &= 0.819 \\
\sin 60^\circ &= 0.866 \\
\sin 65^\circ &= 0.906 \\
\sin 70^\circ &= 0.940 \\
\sin 75^\circ &= 0.966 \\
\sin 80^\circ &= 0.984 \\
\sin 85^\circ &= 0.996
\end{aligned}$$

Cosine Values

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