Phys 375 Exam Review

Mean: $\bar{x} = \frac{\sum_i x_i}{N}$

Standard Deviation: $\sigma = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{N-1}}$

uncertainty on one measurement

Standard Deviation of the mean:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{N}}$$

uncertainty on the mean value of N measurements.

Propagation: if $F = F(x, y, \ldots)$ then

$$\Delta F = \sqrt{\left(\frac{\partial F}{\partial x}\Delta x\right)^2 + \left(\frac{\partial F}{\partial y}\Delta y\right)^2 + \ldots}$$

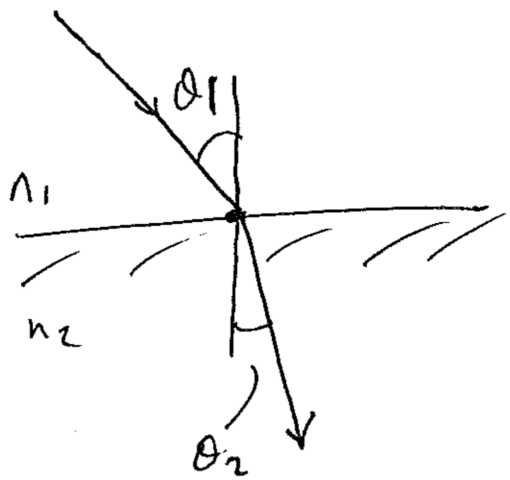
Special Case: $F = xy$. Then

$$\left(\frac{\Delta F}{F}\right) = \sqrt{\left(\frac{\Delta x}{x}\right)^2 + \left(\frac{\Delta y}{y}\right)^2}$$

Special Case: $F = X + Y$. Then

$$\Delta F = \sqrt{(\Delta X)^2 + (\Delta Y)^2}$$

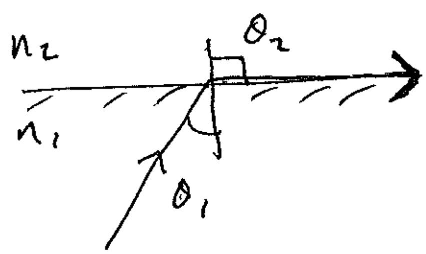
Snell's Law:



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

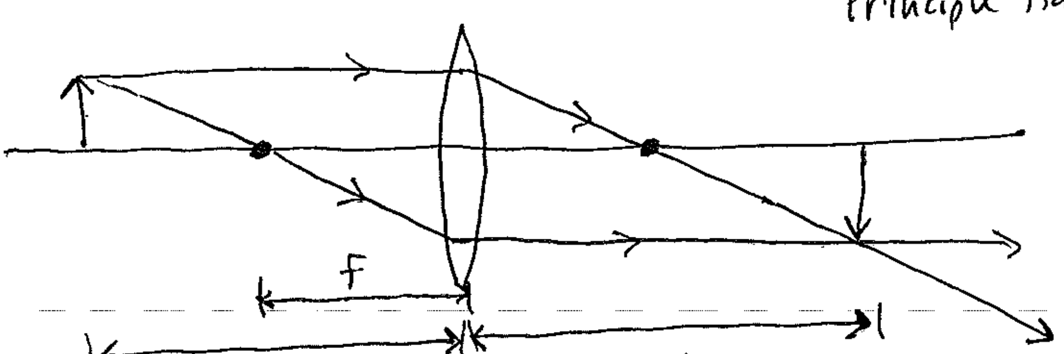
Total internal Reflection: (possible when $n_1 > n_2$)

$$\sin\theta_c = \frac{n_2}{n_1}$$



Thin Lens: $\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$

Principle Ray Diagram.



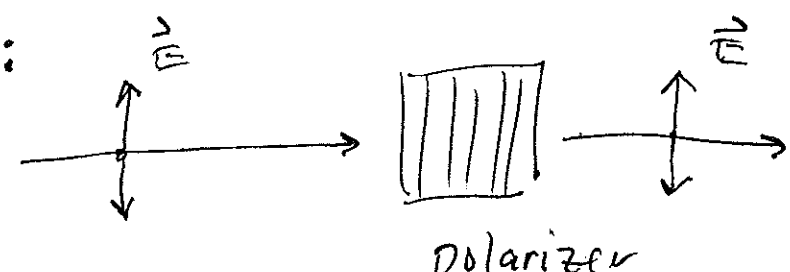
Converging Lens: $f > 0$

Diverging Lens: $f < 0$.

Virtual Image: $s' < 0$, image is located on the input side of the lens.

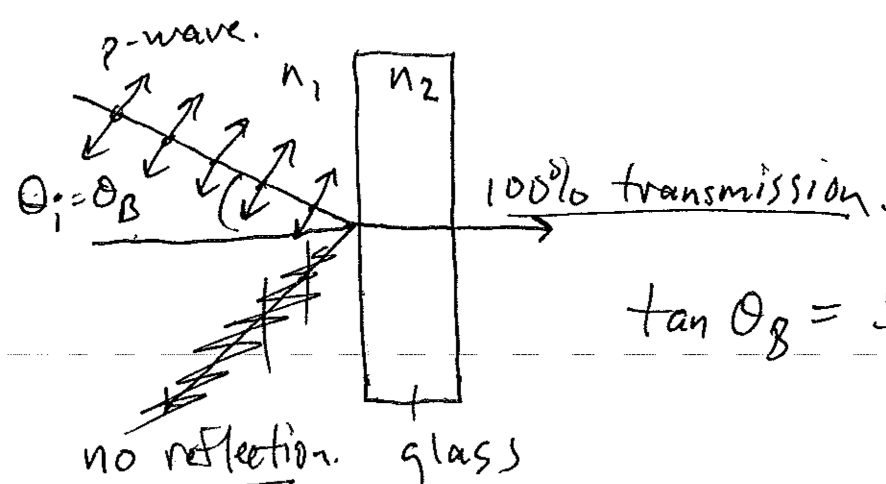
Real Image: $s' > 0$, image is located on the output side of the lens.

Malus' Law:



$I = I_0 \cos^2(\theta)$, θ = angle btw $\vec{E}$ and the polarizer direction.

Brewster's Angle: The angle of incidence at which p-wave polarized light does not reflect:



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

Michelson Interferometer.

$$\Delta m = \frac{2(x_2 - x_1)}{\lambda}$$

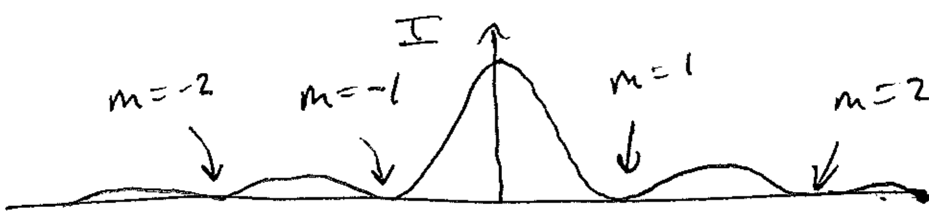
For the sodium lamp, $\Delta\lambda = \frac{\bar{\lambda}^2}{2\Delta d}$,

Δd = distance between maximum fringe visibility.

Any 2-beam interference:

$$I = I_0 \cos^2\left(\frac{\Delta\phi}{2}\right), \quad \Delta\phi = \text{phase difference}$$

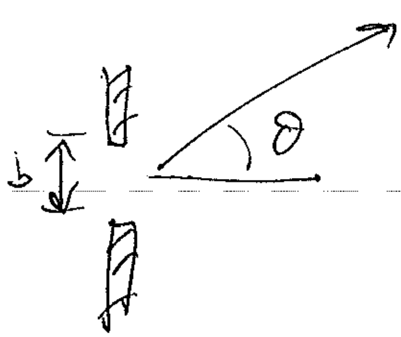
Single Slit Diffraction:



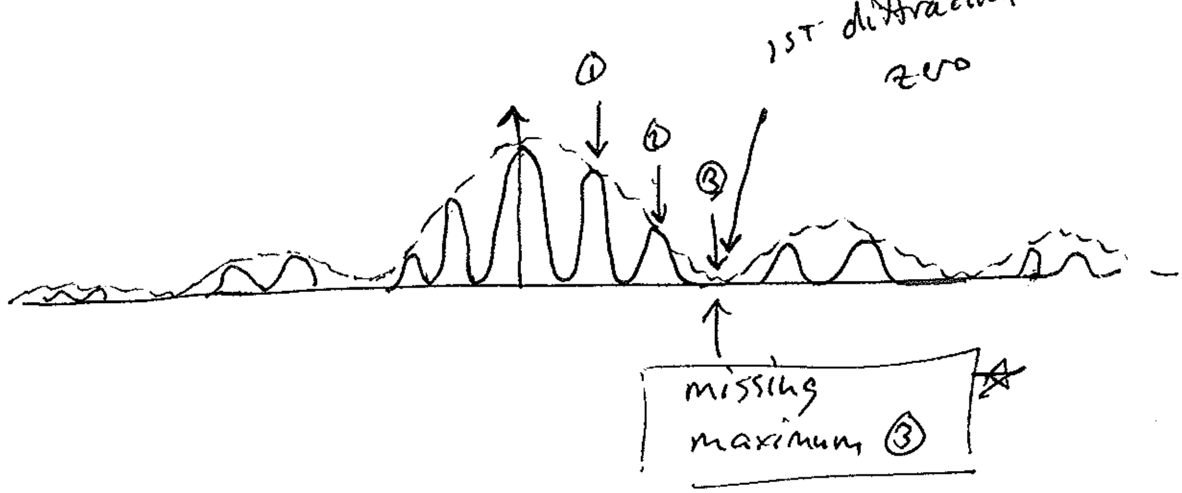
zeros occur where $b \sin\theta = m\lambda$,

b = slit width

θ = angle from normal.



Double Slit Diffraction:



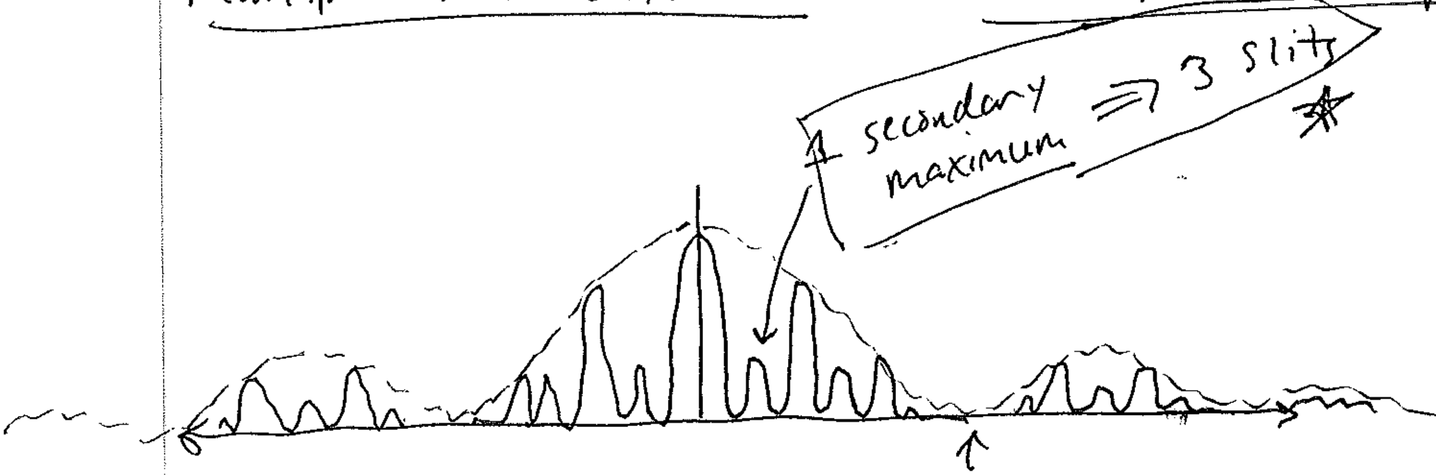
Ratio of slit spacing to slit width = **3** in this case.

Slit width is still $b \sin\theta = m\lambda$

or ~~sin θ~~

$b = \frac{\lambda}{\sin\theta}$ for $m = 1$.

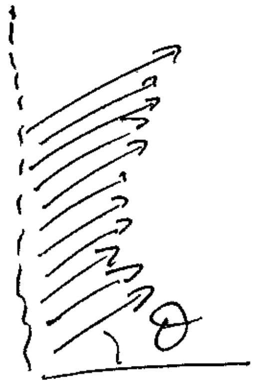
Multiple Slit Diffraction: Secondary Maxima Appear



still missing maximum ③,

so slit spacing = 3x slit width.

Diffraction Grating



Grating Equation:

$$a \sin\theta = n\lambda,$$

a = grating spacing.

This tells us where observable maxima will occur.

Hydrogen Atom.

$$\Delta E = (-13.6\text{ eV})\left(\frac{1}{n^2} - \frac{1}{n'^2}\right)$$

$$\frac{1}{\lambda} = R\left(\frac{1}{n^2} - \frac{1}{n'^2}\right)$$

, R = Rydberg Constant.