Lenses, optical instuments, and interference

Equations:

Thin-lens equation:

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

Magnification

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

Refractive power of a lens:

$$\text{Refractive power(in diopters)} = \frac{1}{f} \quad \text{where } f \text{ is in meters}$$

Bright fringes of a double slit:

$$\sin\theta_m = m\frac{\lambda}{d}$$

where λ is the wavelength, d is the slit separation, and θ_m is the angle pointing to the m^{th} maximum.

Position on the screen of such a peak:

$$y_m = L\tan\theta_m$$

where y_m is the position of the m^{th} order peak from the central maximum, L is the distance to the screen.

Thin-film interference (maximum reflection, one phase change):

$$2t = (m + 1/2)\lambda_{\text{film}}$$

where t is the thickness of the film. The $m + 1/2$ becomes m if there are zero or two phase changes. Remember that λ_{film} is the wavelength of the light in the film, and that the wavelength scales proportional to $1/n$.

Thin-film interference (minimum reflection, one phase change):

$$2t = m\lambda_{\text{film}}$$

The m becomes $m + 1/2$ if there are zero or two phase changes.

Assorted Facts:

1. Positive image distance infers image is on opposite side as object (real).
2. Negative image distance infers image is on same side as object (virtual).
3. If the magnification m is negative, the image is inverted.
4. Normal near point is defined as 25 cm, normal far point is ∞.
5. Optical prescriptions should be designed such that for an object at the normal near/far point, the image is at the person's own near/far point.
6. $\sin\theta \approx \tan\theta \approx \theta$(radians) for small θ.
7. In light reflecting from a film there is a phase change at the first surface if the index of refraction of the film is higher than that of the initial medium. There is a phase change from the second surface if the index of refraction of the substrate (the medium below the film) is higher than the index of refraction of the film.