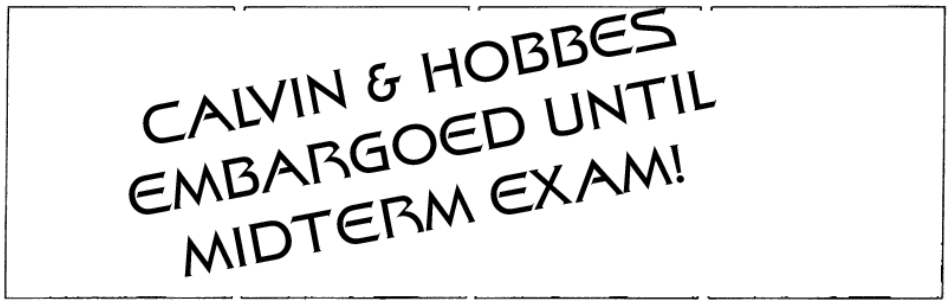
PHYS 2020: College Physics II
Midterm Number 3, Spring Semester 2008



You may find some of the following formulae useful:

Light

$$c = \lambda \cdot f \qquad v = \frac{c}{n}$$

$$\theta_i = \theta_r \quad \text{(Law of Reflection)} \qquad n_1 \sin\theta_1 = n_2 \sin\theta_2 \quad \text{(Law of Snell)}$$

$$\sin\theta_c = \frac{n_2}{n_1} \quad \text{(Total Internal Reflection)}$$

Geometric Optics: Mirrors

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \qquad m = -\frac{d_i}{d_o} \qquad R = \pm 2f$$

Geometric Optics: Lenses

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \qquad m = -\frac{d_i}{d_o}$$

Ray Tracing

Three rays for a complete ray tracing diagram in geometric optics:

- ▷ Ray through center of curvature (*mirrors*), or ray through center of optic (*lenses*)
- ▷ Ray parallel to axis, through focus
- ▷ Ray thruough focus, parallel to axis

For diverging ray traces, extend rays to intersection, even if on opposite side of optical element.

Physical Optics

$$d \cdot \sin\theta = m \cdot \lambda \qquad m = 0, \pm 1, \pm 2, \ldots \qquad (\text{two} - \text{slit, bright fringes})$$

$$d \cdot \sin\theta = (m - \frac{1}{2}) \cdot \lambda \qquad m = 0, \pm 1, \pm 2, \ldots \qquad (\text{two} - \text{slit, dark fringes})$$

$$m \cdot \lambda = W \cdot \sin\theta \qquad m = \pm 1, \pm 2, \pm 3, \ldots \qquad (\text{single} - \text{slit, dark fringes})$$

Relativity

$$\gamma = \frac{1}{\sqrt{1 - (v/c)^2}} \qquad \gamma \simeq 1 + \frac{1}{2}\left(\frac{v}{c}\right)^2 \qquad (\text{slow speeds})$$

$$\Delta t = \gamma \Delta\tau \qquad \Delta L = \frac{\Delta\lambda}{\gamma}$$

$$p = \gamma\, m\, v \qquad E_{tot} = \gamma\, m\, c^2 \qquad K_E = (\gamma - 1) m\, c^2$$

A list of some things you should be able to do — there are many other things, but these are some important ones:

- ▷ Make ray traces to find location, size and orientation of images
- ▷ Determine if images are *real* or *virtual*
- ▷ Use lens/mirror equations to determine the properties of optical experiments (object/image locations, focal lengths, magnifications, etc).
- ▷ Describe how jamming radio signals (e.g. between Imperial TIE fighters) can be accomplished with interference
- ▷ Determine the appearance of interference patterns
- ▷ Compute wavelengths from interference phenomena
- ▷ Solve relativistic collision problems using momentum and energy conservation
- ▷ Make length contraction and time dilation compuations between different frames of reference.
- ▷ Tell me important things about "relativistic mass" in **really big fonts**.