Physics 123 - Study guide for exam 3
Dr Colton, Winter 2026 (last updated 7 Apr 2026)

- Optics!!
  - Properties of light – wavelengths, speed, index of refraction, wavefronts, dispersion
  - Law of reflection, law of refraction (Snell's law)
    - Fermat's principle of least time
    - Huygens' principle, how wavefronts are constructed leading to refraction
  - Fresnel equation plots for r and t of a typical air/glass interface
    - Normal vs grazing incidence
    - Definition of s- and p-polarizations
    - Phases shifts for r and t, for both polarizations
    - Brewster's angle (only for p-polarization)
  - Total internal reflection, critical angle
  - Polarizers – how to determine amount of light that gets through
  - Lenses and mirrors
    - Converging vs diverging lens or mirror
      - Focal length of mirror
      - Focal length of lens (lensmaker's equation)
    - Ray diagrams, image formation
    - Thin lens equation
    - Real vs virtual images
    - Upright vs inverted images
    - Real vs virtual objects
    - Magnification
    - Compound lens problems (image of previous lens becomes object of next lens)
  - Aberrations – descriptions, causes, solutions of these types:
    - Spherical
    - Chromatic
    - Coma
  - Specific optical instruments
    - Camera – how lens forms image on detector (real!)
    - Eye – how lens forms image on retina (real!)
      - Near-sighted: glasses take object at ∞ and produce virtual image at $-d_{far\ point}$
      - Far-sighted: glasses take object at ~25 cm and produce virtual image at $-d_{near\ point}$
    - Magnifier – how lens creates magnified image (virtual!)
      - Definition of angular magnification
    - Telescope
      - First lens (objective) creates image close to focus of second lens (real!)
      - Second lens (eyepiece) creates magnified image using the preliminary image as its object (virtual!)
      - Definition of angular magnification
  - Interference
    - Path length differences produce maxima and minima
    - Diffraction from narrow slits
      - How interference pattern is formed
      - Phases shifts: importance/effect of, how to calculate
        - Simple double slit maxima/minima formula
      - How to calculate full pattern for arbitrary configuration of slits
        - With and without approximation of very small slit separations

        - With and without approximation of small angles to pattern on screen
- Thin film interference (careful with phase shifts)
- Michelson interferometer (stuff from lab)