Physics 123 - Study guide for exam 1
Dr Colton, Winter 2026

- Math stuff
  - Logarithms – Be sure you have fully internalized the laws of logs
  - Calculus – should be able to set up and do integrals of the sorts that have been on the homework problems
- Fluids
  - Pressure as force/area, integrate if the force is changing
  - Pressure in a static fluid, how it varies with depth
  - Archimedes' principle – weight of displaced fluid; unequal forces due to pressure gradient
  - Pressure in a moving fluid, Bernoulli's law relating heights, speeds, and pressures
  - Eq of continuity (conservation of mass) to determine flow speeds
- Thermal Effects
  - Thermal expansion (especially linear for solids, and volume for liquids)
  - Ideal gas law for relationship between P, V, and T in gases (also can be nRT or Nk_BT)
    - Kinetic theory—relationship between microscopic motion and macroscopic pressure and temperature… result was ideal gas law with. $\frac{1}{2}mv_{ave}^2 = \frac{3}{2}k_BT$
    - Maxwell-Boltzmann velocity distribution
  - Specific and latent heats, calorimetry
  - Heat transfer, joules per second
    - Thermal conductivity equation
    - Radiation equation, heat per time
- Thermodynamics
  - Constant volume and constant pressure changes—C_v, C_p, and γ
    - How C_p and C_v relate to each other
  - Where degrees of freedom come from, what they are for monatomic & diatomic
  - First Law of Thermodynamics—how to use; when the quantities are positive or negative
    - $W_{by\ or\ on} = \pm \int PdV$
    - $\Delta E_{int} = nC_v\Delta T$
    - $Q_{added} = nC\Delta T$ in two cases, or $\Delta E_{int} + W_{by}$ in general
  - P-V diagrams and special changes
    - Constant volume: $W = 0$, $Q = nC_v\Delta T$
    - Constant pressure: $W = P\Delta V$, $Q = nC_p\Delta T$
    - Constant temperature: $W = (have\ to\ do\ integral)$, $\Delta E_{int} = 0$; $PV = constant$
    - Adiabatic (reversible): $Q = 0$, $\Delta S = 0$, $PV^\gamma = constant$, $TV^{\gamma-1} = constant$
  - Engines
    - How to calculate Q_{in} and Q_{out} for each leg of cycle
    - How to calculate efficiency
    - How to use efficiency to relate power, fuel consumed, etc
    - Special cycles: Otto, Diesel, Carnot (including Carnot theorem)
    - Refrigerators and heat pumps, what is COP (use instead of efficiency)
  - Entropy
    - What it means to be a "state variable"
    - Definition of ΔS, how to calculate
    - Various ways of looking at the Second Law of Thermodynamics
    - Why/when entropy must increase
    - Connection between microscopic entropy (def of S) and macroscopic entropy
    - Example of adiabatic free expansion ("irreversible")