P410 First Exam Topic List

Numerical values
Boltzmann constant
Mass of a proton, neutron, and electron
Basic properties of periodic table (H, He, C, N, O)
Avagadro’s number, Planck’s constant, Charge of a proton e
STP, atmospheric pressure

Classical Thermodynamics
Temperature scales
1\textsuperscript{st} and 2\textsuperscript{nd} Laws of thermodynamics
The Carnot cycle and engine
State variables
Mechanical work
Reversible and irreversible processes
Entropy
Heat capacity, \(C_V\) and \(C_p\), and \(\gamma \equiv C_p/C_v\)
Latent heat of fusion and vaporization
The Ideal gas law
Classical equipartition theorem

the Microcanonical Ensemble
Postulates of Statistical Mechanics
number of accessible states, \(\Omega\)
entropy, \(S = k_B \log(\Omega)\)
temperature parameter and absolute temperature, \(\beta = \frac{\partial \log \Omega}{\partial U} = \frac{1}{kT}\)
Equilibrium implies entropy is maximized
External parameter and work
Pressure and chemical potential,

the Canonical Ensemble
Boltzmann factor, \(e^{-\beta E}\)
Partition function, \(Z \equiv \sum_{a} e^{-\beta E_a}\)
Mean energy, \(\overline{U} = -\frac{\partial \log Z(\beta,V,N)}{\partial \beta}\)
Pressure and chemical potential, \(\beta p = \frac{\partial \log Z(\beta,V,N)}{\partial V}\), \(\beta \mu = -\frac{\partial \log Z(\beta,V,N)}{\partial N}\)
Paramagnetic, 2-level system
Energy dispersion (i.e., variance),
Density of states

Maxwell-Boltzmann speed and velocity distributions
Mean speed, rms-speed, peak speed