

**List of Concepts / Terms to understand for
Statistical Mechanics**

**Concepts 1-22 were covered in quiz three but
are important for using/understanding**

Concepts 23-50 covered in quiz 4

Concepts 23-27 covered in quiz 3 and quiz 4

- 1) Equipartition Principle
 - Derivation from physical description of ideal gas
- 2) Probabilities
 - Adding
 - Independent events
 - Normalizing
 - Average value from Continuous Distributions
- 3) Permutations Combination and Configurational Weight
- 4) Binomial Distribution
 - Probabilities relating to
- 5) Normal Distribution
- 6) The Boltzman Distribution
- 7) Derivation of the Boltzman Distribution
 - In words, what are the steps, what are the assumptions
- 8) Definition of Statistical Mechanics
- 9) Sterling's Approximation
- 10) General Definition of Partition Function
- 11) Meaning of partition function
- 12) Partial derivatives of thermodynamic functions
- 13) First Law of Thermodynamics
- 14) Thermodynamic definitions/relations
 - Internal Energy
 - Enthalpy
 - Heat Capacity
 - Pressure
 - Free energy
 - Enthalpy
- 15) Vibrational Partition function
 - Derivation from harmonic oscillator energy levels
 - Characteristic vibrational temperature
 - Calculating q_{vib} for molecules with multiple modes
- 16) Number of vibrational modes in a given molecule.
- 17) General relations between energies and partition functions (additive energies \rightarrow multiplicative partition functions)
- 18) Translational Partition Function
- 19) Thermal Wavelength
- 20) Rotational Partition Function
 - Rigid Rotor model
 - Energy of rotational Linear Molecules
 - Spherical Molecules
 - Symmetric Molecules
 - Asymmetric Molecules
- 21) Symmetry number σ
- 22) Rotational Constants and Moments of Inertia
- 23) Total molecular partition function q_{total}
- 24) Ensemble or System partition function Q
- 25) Distinguishable vs Indistinguishable particles
 - How not to over count with indistinguishable particles
- 26) Calculating internal energy from partition functions
- 27) Entropy and Boltzmann's formula $S=k \ln W$

PRIMARY TOPICS FOR QUIZ 4:

- 28) Calculating internal energy, entropy, heat capacity or other thermodynamic functions from partition functions.
- 29) Calculation of average thermodynamic properties
- 30) Average thermodynamic properties and equipartition of energy
- 31) Statistical mechanical picture of temperature
- 32) Relating temperature to energy level populations
- 33) Negative Temperatures (changes in internal energy with entropy)
- 34) Heat Capacity and energy Fluctuations
- 35) Ensemble or System partition function Q
Statistical mechanics from the perspective of molecules or from the perspective of systems
- 36) Calculating equilibrium constants from statistical mechanics
Theory
Practice
- 37) Equations of state
Ideal gas law
Van der Waals equation (and other empirical equations)
- 38) Derivation of ideal gas law from statistical thermodynamics
- 39) Configurational Integral
- 40) Radial distribution function
- 41) Intermolecular interactions
Theory
Forms used in calculations
- 42) Theory of Fluids
What does $g(r)$ tell us about fluids
- 43) Hard sphere fluid
- 44) molecular dynamics
- 45) Maxwell-Boltzmann distribution of speeds
 - Derivation
 - RMS velocity
 - Most probable velocity
 - Average velocity
- 46) Collisions between particles
Relative velocity
Collision cross section
Collision volume
collisions
Collision frequency
Mean free path
- 47) Collision Flux
- 48) Molecular description of viscosity
- 49) Molecular description of thermal conductivity
- 50) Rates of Effusion, calculating vapor pressure