

List of Concepts / Terms to understand Quiz 1+2

The topics on page one are were mainly covered in quiz1 but are important and the basis for understanding the topics on page two that are the main focus of quiz 2.

- 1) Stephan-Boltzmann Law
- 2) Black Body Radiation Problem  
(physical set-up)
- 3) Rayleigh-Jeans Law
- 4) Ultraviolet Catastrophe
- 5) Max Planck  
Energy quantization
- 6) Planck Radiation Law
- 7) Optical pyrometer
- 8) Heat Capacity of Solids Problem  
Physical Set-up
- 9) Einstein's Description of Heat Capacity
- 10) Photoelectric effect  
Physical set-up  
Quantum mechanical lesson learned
- 11) Two Slit experiments
- 12) Wave / particle Duality
- 13) Wave Equations for classical phenomena
- 14) What is a quantum mechanical wave equation in general, what is the meaning of the square of the wave equation.
- 15) Schrödinger's Equation  
Derivation
- 16) Hamiltonian Operator  
What are the terms in general, how do you construct one for a given situation
- 18) Eigen value equations
- 19) Conditions on acceptable wavefunctions

- 20) Properties of Linear Hermetian operators
- 21) Particle in a box problem  
What is the physical set up?  
In general how is the problem solved?  
What are the boundary conditions?  
What do the wave functions tell you about the behavior of the particle  
How are the energy levels related to the properties of the particle and the box  
Solution of the problem
- 22) Correspondence Principle
- 23) Average value of an Operator  

$$M_x = \frac{\int \psi^* \hat{M} \psi d\tau}{\int \psi^* \psi d\tau}$$

$$d\tau = \text{all coordinates} \quad \int \psi^* \psi d\tau = 1$$
- 23) Particle in a square well  
What is the physical set up?  
In general how is the problem solved?  
What are the boundary conditions?  
What do the wave functions tell you about the behavior of the particle  
How are the energy levels related to the properties of the particle and the box
- 24) Particle in a double well
- 25) Correlation Diagram
- 26) Barrier penetration / tunneling
- 27) Particle in a plane or 3D box  
Separation of variables  
Form of wavefunctions, form of energies
- 28) Degenerate Energy Levels

Quiz 2 topics

- 29) Particle in a ring
  - $\omega$  = angular momentum
  - I = moment of inertia
- 30) Harmonic oscillator
  - Classical harmonic oscillator
  - General approach to solutions
    - Infinite series
    - Recursion relation
    - Truncating polynomials
  - Energy Functions
- 31) Bohr model of the hydrogen atom
  - Predictions
  - Energy equation
  - Derivation (assumptions)
- 32) Schrödinger's solution to the hydrogen atom
  - Separation of variables,
  - $R, \Theta, \Phi$  solutions
  - Quantum numbers  $n, l, m_l, m_s$
  - Angular momentum of states
  - Shapes of solutions, recognizing wavefunctions
  - Atomic Units
- 33) Three dimensional integration in polar coordinate systems
  - $r^2 \sin\theta$  volume element
- 34) Circular Harmonics
- 35) Angular Momentum and how it relates to the circular harmonics and the various solutions to the hydrogen atom
- 36)  $L_z$
- 37)  $L^2$
- 38) Stern Gerlach experiment and magnetic moment of an orbit
- 39) Rigid Rotor and diatomic molecules
- 40) Electron spin
- 41) Restrictions to wavefunctions based on spin
- 42) Slater Determinants
- 42) Independent Electron Approximation
- 43) Solution to the He atom
- 44) Pauli exclusion principle in terms of electron spin and wavefunctions
- 45) Variation Principle / Method
- 46) Hydrogen molecule solution
- 47) Born Oppenheimer Approximation
- 48) How light and matter interact
- 49) Complete wavefunction
- 50) Mixing states
- 51) Spectroscopic selection rules
- 52) Term Symbols
- 53) Calculating the transitions state dipole moment
- 54) Calculating molecular properties from vibrational spectral data
- 55) Calculating molecular properties from rotational spectra
- 56) Pure rotational Spectra
- 57) Raman vs "regular" spectroscopy
- 58)