

ASSIGNMENT FOR CHEM 4051 25 %

1. Briefly discuss between Classical and Quantum mechanics.
2. Write all the theorems of Quantum mechanics and Prove them.
3. Calculate the wavenumber of the wavelength of the light emitted from the $n=8$ to $n=6$ transition. Given $R_H = 109,737\text{cm}^{-1}$.
4. What conditions must be satisfied for the Schrodinger's equation for ψ to be an acceptable wave function. What are some examples of unacceptable wave functions?
5. How many subshells and orbitals are contained within the principal shell with $n = 4$?
6. Write the Schrodinger equation for He atom and H_2 .
7. What is the ΔE between the $n=4$ and $n=5$ states for an F_2 molecule trapped within in a one-dimension well of length 3.0 cm? At what value of n does the energy of the molecule reach $\frac{1}{4}k_B T^{1/4}$ at 450 K, and what is the separation between this energy level and the one immediately above it?

8.
$$\psi_m(\phi) = \frac{1}{\sqrt{2\pi}} e^{im\phi}$$
 Show that the function is orthonormal ($0 \leq \phi \leq 2\pi$) calculate it's the first five energies with their degeneracy.
9. Write all the approximation methods with brief explanations.
10. **The normalized state of the free particle is represented by a wave function.**

$$\psi(x) = N e^{-(x^2/2a^2)} e^{ikx}$$

I. Calculate normalization constant.

II. In what region of space, the probability of finding the particle is maximum?