

Chem 2430: HW set #4

1. Using ladder operators evaluate $\langle 0 | x^4 | 0 \rangle$ and $\frac{|\langle 0 | x^3 | 1 \rangle|^2}{\hbar\omega}$ and $\frac{|\langle 0 | x^3 | 3 \rangle|^2}{3\hbar\omega}$

2. If we measure L_z of a particle whose state function is an eigenfunction of \hat{L}^2 with eigenvalue 6, what are the possible outcomes? Would this be different if we measured L_y

3. For a rigid rotor diatomic molecule the rotational energy level go as

$$E = \frac{J(J+1)\hbar^2}{2I}, J = 0, 1, 2, 3, \dots \text{ .The rotational constant is } B = \hbar^2 / 2I$$

Consider $^1\text{H}^{35}\text{Cl}$. For this molecule the first rotational transition is at 21.2 cm^{-1} . What is the value of B? Calculate the bond length of the molecule.