

# Spectroscopy - Question Bank - Set 2 (For JAM NET GATE/TIFR)

\*  $\rightarrow$  Very very important in NET

- \* ① Show that the transition  $A_1 \rightarrow A_2$  is forbidden for electric dipole transition in  $NH_3$  molecule.
- ② Show that the function  $xy$  has  $B_2$  Symmetry properties in group  $C_{4v}$ .
- ③ Does the integral  $\int (3d_{z^2}) \times (3d_{xy}) d\tau$  vanish in a  $T_d$  symmetry molecule?
- \* ④ Is  $p_y \rightarrow p_x$  an allowed transition in a  $T_d$  molecule.
- ⑤ What are the allowed transitions and their polarization of a  $B_1$  electron in a  $C_{4v}$  system?
- \* ⑥ Investigate whether an  $A_1$  electron in  $H_2O$  can make an electric dipole transition to a  $B_1$  orbital.
- \* ⑦ The  $ClO_2$  molecule was trapped in a solid. Its ground state is known to be  $B_1$ . Light polarized parallel to the  $y$ -axis excited the molecule to an upper state. What is the symmetry of the state?
- \* ⑧ The ground state of  $NO_2$  is  $A_1$ . To what excited state may it be excited by electric dipole transition and what polarization of light is necessary to use?
- \* ⑨ Check the  $\delta \rightarrow \delta^*$  transition is allowed or not. In the following molecule:  
$$\left. \begin{array}{l} [Re_2Cl_8]^{2-} \\ [Mo_2Cl_8]^{4-} \end{array} \right\}$$
- ⑩ What is the selection rules for electric dipole transition and magnetic dipole transition. Explain with proper examples.



\* (11) One photon transition and two photon transition - Explain the selection rules by proper diagram.

\* (12) What is double resonance? How to calculate the irradiation frequency for a chosen nuclear system?

\* (13) What do you mean by "x polarized / y polarized or (x, y) polarized"?

\* (14) What is totally symmetric modes? Explain its significance in spectroscopic transition.

(15) What is  $\Sigma$ ,  $\Delta$ ,  $\Pi$ ?

\* (16)  $^1\Sigma \rightarrow ^1\Sigma$  transition produce PR type contour. Explain.

(17) Please check the correct transition (allowed). Explain with proper reason.

