SUBJECT - CHEMISTRY

CLASS - B.Sc(Hons) PART-III

PAPER - V

TOPIC - Fluorescence and phosphorescence

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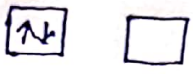
Q Explain fluorescence and phosphorescence Describe clearly The difference between these two terms.

Ans Fluorescence and phosphorescence: The molecule is raised to excited state by absorption of radiation. The absorbed radiation may be emitted instantaneously. This process is called fluorescence. The moment incident radiation is removed. fluorescence stops. The name fluorescence was adopted from fluorite (CaF_2) because it is well exhibited by CaF_2 U, Hg, I_2, Na - Vapours etc. also show fluorescence.

Many substances after being excited by absorption of radiation Continue to emit radiation slowly even long after the exciting radiation has been removed. This process is called phosphorescence. ZnS and Sulphide of alkaline earths are excellent example of such substances.

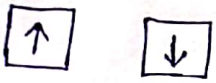
only such molecules which can absorb UV-VIS radiation, Can exhibit fluorescence and phosphorescence. Substances Showing fluorescence remit excess radiation within 10^{-6} to 10^{-4} seconds of absorption while substances exhibiting phosphorescence re-emit excess radiation within 10^{-4} to 20 second or longer. Hence life-time of phosphorescence is much longer than that of fluorescence.

Mechanism of fluorescence and phosphorescence: In ground State, generally molecules do not have unpaired electrons i.e They are in Singlet State (S_0). When such a molecule absorbs radiation one or more of the paired electrons go to excited Singlet state (S_1). In S_0 state, two electrons are present in an orbital with opposite spins



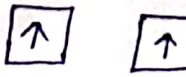
$\therefore$ $n+1 = 0+1 = 1$ i.e Singlet state.

In S_1 State, two electrons are present in two different orbitals with opposite spins



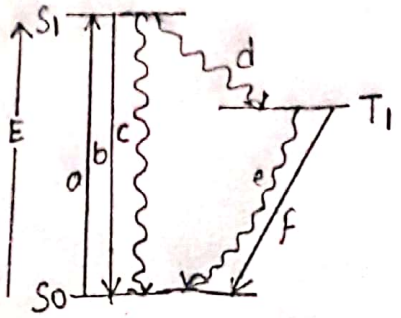
$\therefore$ $n+1 = 0+1 = 1$ i.e Singlet State

The spin of electron does not change during excitation from S_0 to S_1 State and hence the net spin remains zero. Now if it emits the radiation without any loss of time and returns to the S_0 State, then the process is called fluorescence. But if there is some time-lag between the absorption and its remission, it may suffer change in electronic spins i.e one of the electron undergoes spin conversion leading to the excited triplet state (T_1) in which there are two unpaired electrons present in two different orbitals with similar spins



$\therefore$ $n+1 = 2+1 = 3$ i.e Triplet State

The Singlet and triplet states arise from spin multiplicity $= 2S+1$ or $n+1$, where n is the number of unpaired electrons. If $n=0$, we get Singlet state and if $n=2$ we get triplet state Any radiation emitted in passing from excited triplet state



(T_1) to the ground Singlet state (S_0) results in phosphore - scence. The energy state having only spin paired electrons is called Singlet state and that having only parallel spin electrons as triplet state. Excited triplet state has longer life-time than excited Singlet state S_1 and thus may Survive after the exciting radiation has been removed. There is very little chance of direct S_1 to T_1 state transition. when triplet state goes to S_0 state, it must involve spin Conversion which is formally forbidden. Hence such Conversion is delayed.

Therefore phosphorescence is a delayed fluorescence.