

The crystal field stabilisation energy (CFSE) of  $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_2$  and  $\text{K}_2[\text{NiCl}_4]$ , respectively, are  
(2019 Main, 10 April II)

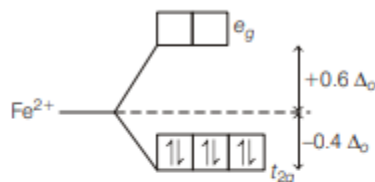
- (a)  $-0.4 \Delta_o$  and  $-1.2 \Delta_t$       (b)  $-0.4 \Delta_o$  and  $-0.8 \Delta_t$   
(c)  $-2.4 \Delta_o$  and  $-1.2 \Delta_t$       (d)  $-0.6 \Delta_o$  and  $-0.8 \Delta_t$

**Key Idea** Crystal field splitting occurs due to the presence of ligands in a definite geometry. In octahedral complexes the energy of two,  $e_g$  orbitals will increase by  $(0.6) \Delta_o$  and that of three  $t_{2g}$  will decrease by  $(0.4) \Delta_o$ .

The complex ion that will lose its crystal field stabilisation energy upon oxidation of its metal to +3 state is  $[\text{Fe}(\text{phen})_3]^{2+}$ .

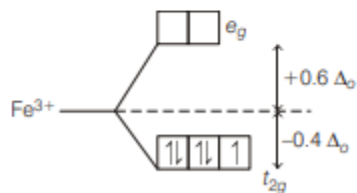


In  $[\text{Fe}(\text{phen})_3]^{2+}$ , electronic configuration of  $\text{Fe}^{2+}$  is  $3d^6 4s^0$ . Phenanthrene is a strong field symmetrical bidentate ligand. The splitting of orbital in  $\text{Fe}^{2+}$  is as follows:



$$\text{CFSE} = 6 \times -0.4 \Delta_o = -2.4 \Delta_o.$$

The splitting of orbital and arrangement of electrons in  $\text{Fe}^{3+}$  is as follows :



$$\text{CFSE} = 5 \times -0.4 \Delta_o = -2.0 \Delta_o$$

$\text{Fe}^{2+}$  upon oxidation of its metal to +3 state lose its CFSE from  $-2.4 \Delta_o$  to  $-2.0 \Delta_o$ .