Coyetal field stabilization energy in octahedral complexes: -By an octahedral complex, the d-orbitals of the central metal In an octamedral complex, the d-orbitals of the central interval interval are split into two sets of orbitals having different energies The separation blue these two steps is so or 10 Dq. The trg set has an energy of -0.450 and the eq set has any energy of to 650 relative to Bary antre - & t signs indicate decrease & increase in energy related to Bary untre Crystal - field stabilization chergy is given by: In an octahedral complex with e.e trace eq 3.0 The C.F.S.E is given by C.F.S.E = [co.4 xxe) t (0.6 xy)]Ab X= no. of E's in try & y = no. of E's in try % y = no. of E's in try % y = no. of E's in try

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Metal ions CESE = C-0:4×1300	C
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comment lighting have been arranged in the order of	
their power to cause of level splitting. This arrangement	
d6 CFSE = E-0.4×6] so+2P - or CFSE = E-0.4×4 t0.6×2]	a
= -2.4 So + 2P = - 10.4 So + 2P = - 0.4 So	
CORCH 2 NO. 2 CH > MH3 > H, O > C, O, - > OH - F - 7 (1 > 3+7 I	
d7 CFSE = [-0.4×6 +1×0.6] so+P. CFSE = [-0.4×5+6.	6x2]30
0-8-00= [-2:4 + 0:6] sot P with the black to 8-00	
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In an octabedral complex, the d-orbitale, of the certical metal	
18 CFSE = EO:4×6 +2×0.6] Do 202 (FSE = E-0:4×6+0.6×2]	50
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Coystal Field Stabilization Energy in Tetrohedral Complexes:-By a tetrahedral complexe, the d- orbitals of the metal calion are split into two sets of different chargins, e of Lower eyergy and to of higher eyergy. The separation blue these two sets is equal to by the egset has an energy of - 0.6 St and the togset has an energy + 0.4 St relative to the barycentre. For a dn tetrahedral complexe with eg tig high spin nempton , and CFSE = E-0.6p + 0.4g Jot (: St= 4 Do) = C-0.6p + 0.49] × 4 50 tastors allering in march 10:18 grid to Filt spilling de paros Since tetrahedral complexes are high spin and no pairing of d- cleatroys occurs (st 2 P). Therefore, yo pairing energy is include in the above cquation. The CESE values of tetrahedral complexes of dito d'o metal ions. splitting produced by the control restal ion with 13 0-5 is 101 101CFSE = 15-0.6×17 2+12 -0.62+.00 2011 7-1 110000 3.0° S.+ CFSE = [-0.6×2] St = -1.2 St d2 Notore of the Updayde: Ligande which causes apply smjold al 31 des " SEESE = E-0:6x2 + (0.4)x1] OL = 0 0 0000 prilling? causes a large splitting are called strong field ligands It. 150 10004 01 CESE = (C-0.6x2 + (0.4)x2) 0+11 = = 0.40+ of slower 2: of 5 observed with a given white ing this sequence for d5 , , , CFSE = [-0.6x2 + (0.4)x3] st = 0 st propil nomino? wollof 1 d6 ON CFSE = E-0.6x3 + (0.4) x3) St = [-118 + 1.2] St = 0.6 St.T CFSE = [-0.6×4 +10.4)×3] 6t = [-2.4+1.2] St = -1.251 d7 Chemical series. CFSE = [-0.6×4 + (0.4)×4] S+ = [-2.4 + 1.6] S+ = -0.851 d8 received of the complexes the magnitude of A varies with d9 CFSE = [-0:6×4 + (0.4)×5]st = [-2.4 + 2.0]st = -0.40 dio CFSE = [-0.6×4 + (0.4) ×6] 0+ = 0

Since, the magnitude of constal field splitting Some page NO. Small and always lesser then the pairing ching y, <u>Ditherectorical</u>
TAR TILL COULDER TO COULDER TO THE TOTAL
Pairing Eyengy: - Eyengy required to cause pairing of electroys in the same orbital is called the pairing Eyengy
the same orbital is called the pairing theray
(F) of is expressed in chill the value of this
may be obtained from the analysis of clochronic spectra
if so is greater they P, it - Pavours low spin complexes
If So < P, it favours high spin complexe.
If Do= P, high spin & low spin complexes equally wish

Date : / / Examples: Pairing energy for Fe(cN) Where CN is a strong field ligand Lo pairing of Es Take place. Here Fe³⁺ = d5 Heg (Low spin complex) Tutint trg रामागा स्त्रू CFSE = (5x-0.400) + 2P z - 2.000 + 2P -> where 2p is pairing energy for two e pairs But when we take [Fe(H,0)6]3+ It is a high spin complex, as H, O > weak field ligand No pairing of es occur C. + E. OBL. Fest - ds 111 tags ege CFSE -0.4×3+0.6×2 = -1.2 + 1.2 = 0 + 0P

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Page No. : Date : 1 CO(CN) = > Lou compley Steong field ligand $Co(\Pi) = d6$ 12/14/14 CFSE = -0.4926+2P Paul = -2.4 Do +(2P) High spin con Ct is a wea Co(cl)6 when High eld ligan wea CO(TTL) = d CFSE = - 0.4 Do X4 + 0.6 Do X2 = -1.6 Do + 1.2 Do = -0.4 Do

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Factors affecting ceystal field splilling Parameter :-There are several factors that affect-the magnitude of splitting of d-orbitals by surrounding ligands. (is Oxidation state of metal cation :> The higher the opidation state of metal calion, the greater will be magnitude of D. The higher oxidation state of metal causes the ligands to approach more closely to it and therefore the ligand cause more splitting of metal d-orbitals. e.g. So for $[CO(H_2O)_6]^{2+} = 9200 \text{ cm}^{-1}$ Δ_0 for $[C_0(H_20)_6]^{3+} = 20760 \text{ cm}^{-1}$

(ii) Same Oxidation state of metal cation but no. of d-electrons is different :- In general par a genen series of transition elements in complexes having metal cation with Oxidation states but with different no. of electrons in d-orbitals, the magnitude of Do decreases with increase in no. of delections. It is due to the fact that the higher the no. of d-electrons prevent the legand to come closer the metal cation . e.g. Do for [(0(H20)6]²⁺ = 9200 cm⁻¹ (3d⁷) So for $[Ni(H_20)_6]^{2+} = 8500 \text{ cm}^{-1} (3d^8)$ (iii) Nature of the ligards :- ligands which carries only small splitting are called weak field ligands and trove which causes à large spletting are called strong field ligands. It 10 possible - 10 arrange the ligands according to the magnitude of D observed with a given metal ion. The server of arrangement of ligends is called spectrochemical series $I < Br < S^{2} < SCN < Cl < N_{3} < F < NCO < OH < C_{2}O_{4}^{2-} < O^{2-} < H_{2}O_{4}^{2-}$ < acat < NCS < CH3CN < gly < pyridine < NH3<en < bipy < phen < NOZ < PPh3< CN < CO.

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IV) Geometry of the complex :- The magnitude of & varies with the geometry of the complex. e.g. A values for detrahedral complex is about 40-50.1. Less than that of Octahedral complexes.

V) Type of d-orbitals: - The magnitude of D varies little through first transition series (3d) for a facticular Oxidation state of central metal cation but becomes considerably large i.e. 30-50.1. in second (4d) and third (5d) transition series for a particular ligand. This may be explained on the bais that 4d or 5d orsital are bigger in size as compared to 3d orbital and thus can extend further out from the central metal ion and interact more shongly with the ligend.

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