**D. Valence Bond Theory (VB) of Complexes**  
Walence Bond Theory is the first theory to explain the electronic  
problems:  
Cr(NB3)6<sup>3+</sup> (in [Cr(NB3)6]Cl3)  
Lewis electron dot structure  
H<sub>3</sub>N 
$$= \int_{c}^{c} \int_{c}^{c} \int_{u_{13}}^{u_{13}}$$
  
NH3  
Number of ligands around the central atom 6  
Geometry Octavadaal  
Naguetic Properities 7  
Blectron box diagram  
Cr<sup>3+</sup>  $= \int_{3}^{c} \int_{c}^{u_{13}} \frac{u_{13}}{u_{13}}$   
Cr(H20)6<sup>2+</sup> (in [Fe(B20)6]Br2)  
Lewis electron dot structure  
H<sub>3</sub>O  $= \int_{c}^{c} \int_{c}^{c} \int_{u_{13}}^{u_{13}} \frac{u_{13}}{u_{23}}$   
Dondard Stada  
Fe(H20)6<sup>2+</sup> (in [Fe(B20)6]Br2)  
Lewis electron dot structure  
H<sub>3</sub>O  $= \int_{c}^{c} \int_{c}^{c} \int_{u_{13}}^{u_{13}} \frac{u_{13}}{u_{23}}$   
Number of ligands around the central atom 6  
Geometry Octavadaal  
Fe(H20)6<sup>2+</sup> (in [Fe(B20)6]Br2)  
Lewis electron dot structure  
H<sub>3</sub>O  $= \int_{c}^{c} \int_{c}^{c} \int_{u_{13}}^{u_{13}} \frac{u_{13}}{u_{23}}$   
Number of ligands around the central atom 6  
Geometry Octavadaal  
H<sub>3</sub>O  $= \int_{u_{13}}^{c} \int_{u_{13}}^{u_{13}} \frac{u_{13}}{u_{13}}$   
Mumber of ligands around the central atom 6  
Geometry Octavadaal  
H<sub>4</sub>O  $= \int_{c}^{c} \int_{c}^{c} \int_{u_{13}}^{u_{13}} \frac{u_{13}}{u_{13}}$   
Regretic Properities Paramagnetic w/4 unpairede  
Biestron box diagram  
Fe<sup>2+</sup> 1k = 1 = 1 = 1 = 1 = 1 = 1 = 0  
 $= \int_{u_{13}}^{u_{13}} \frac{u_{13}}{u_{13}} \frac{u_{$ 

Octahedral Complexes, cont'd

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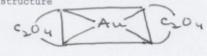
You all have by the end of today  $Co(CN)6^{4-}$  (in [Co(CN)6]Br4) Lewis electron dot structure CN CN >CO CN ۱ CN Number of ligands around the central atom bOctanedral Geometry Magnetic Properities Electron box diagram  $\begin{array}{c} Co^{2+} 1 \downarrow 1 \downarrow 1 1 1 1 1 \\ 3d \\ 3d \\ Co^{2+} 1 \downarrow 1 \downarrow 1 \downarrow 1 \\ Co^{2+} 1 \\ Co^{2+} 1 \downarrow 1 \\ Co^{2+} 1$ Cr(H2O)63+ (in [Cr(H2O)6]C13) Lewis electron dot structure  $H_{20} = H_{20} - OH_{1}$   $H_{20} = Cr - OH_{2}$   $H_{20} = I - OH_{2}$ HLO Number of ligands around the central atom\_\_\_\_\_\_ <p . st7 Octanedral Geometry Magnetic Properities para magnetre w/ 3unpaired e-Electron box diagram Cr<sup>3+</sup> <u>111</u> Gr<sup>3+</sup> <u>111</u> Cr<sup>3+</sup> <u>111</u> Cr

[Co(en)3]3+ Number of ligands around the central atom 3 = 6 bonds since Geometry Octanedral since en= bidentate Magnetic Properties en = SFL = Low Spin complex Energy diagram w1 6 e-Co3+ 1v 1 1 1 1 - Ground State 45 40 3d + Pairing Energy Excited State Co3+ 12 72 72 40 4 . 30 J en bonds Co3+ 11 14 74 4. Bonded . . state 30



 Square Planar Complexes - d<sup>8</sup> metals/Coordination number = 4 Problems: Ni(CN)42~ Lewis electron dot structure CN >NI CN Number of ligands around the central atom Ground State Excited stade Ni<sup>2+</sup> <u>1L1L 7L1L</u> Hybridization 3d dspz state Aucla-Lewis electron dot structure  $C_1 \qquad A_{11} \qquad C_1$ Number of ligands around the central atom \_\_\_\_\_4 <post> Square Planar Geometry Magnetic Properities Dia magnetic Electron box diagram 

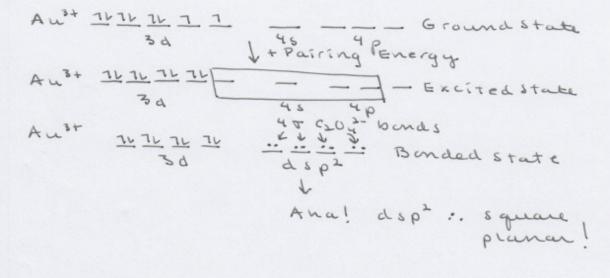
Au(C2O4)2 Lewis electron dot structure



Number of ligands around the central atom  $\lambda = 4$  bonds due to Geometry  $c_2 O_4^{-2} = b_1^2 dentate$ 

Magnetic Properties: Consider  $C_2 O_4{}^{2-}\ \text{as}\ \text{a}\ \text{strong}\ \text{field}\ \text{ligand}$ 

Energy diagram



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3. Tetrahedral Complexes - Coordination number = 4 Problems: Ni(NH3)42+ NH3 Lewis electron dot structure H3N NH3 Number of ligands around the central atom 4 Geometry Tetrahedral Magnetic Properities Paramagnetic w/ 2 unpaired e-Blectron box diagram Nita 16 16 16 1 1 16 16 17 15 MT croital 3 d 45 4p Electron box diagram Ground hybridization Ni2+ 16 16 16 1 7 Bonded 39 5p3 state  $Cd(CN)4^{-2}$ CAI Lewis electron dot structure (post) Number of ligands around the central atom 4 Geometry Tetra hedral Magnetic Properities Diamagnetic Electron box diagram 45 4p Ground J hypridization CNJ bondo 16 76 July 16 76 July Sp<sup>3</sup> Bonded State 2 22+ 11 11 11 11 11 30 02+ 11-11-11-11-11-3d

Octahedral, Square Planar, and Tetrahedral Complexes Problems: Co[(NH3)5H2O]<sup>3+</sup> Number of ligands around the central atom 6 Hagnetic Properities Paramagnetic w/ 4 un pained e-Blectron box diagram Co<sup>3+</sup> 121117 3d 45 4p 4d State Lewis electron dot structure Geometry Octanedral FeC14<sup>-</sup> Number of ligands around the central atom 🛛 🐴 Ragnetic Properities Paramagnetic W/ 5 unpained e-Electron box diagram  $Fe^{3t} \underbrace{1}_{3d} \underbrace{1}_{3d} \underbrace{4s}_{4s} \underbrace{4p}_{4d} \underbrace{4d}_{4d} \operatorname{state}_{4d}$   $Fe^{3t} \underbrace{1}_{3d} \underbrace{1}_{3d} \underbrace{4s}_{sp^3} \underbrace{4p}_{t} \underbrace{4d}_{t} \operatorname{state}_{t}$ Ground Lewis electron dot structure ci -Fe'''. ci Geometry Terra hedral

Octahedral, Square Planar, and tetrahedral Complexes, cont'd PdC14-2 Number of ligands around the central atom Magnetic Properities Diamagnetic Electron box diagram Pd2+ 71 11 11 1 7 Ground State + Eningy charting) 55 5p Excited State I mybridization Pd<sup>2+</sup> <u>IL IL IL IL</u> <u>4d</u> Lewis electron dot structure Bonded State dspz ci pa ci Square Planar Geometry Lpost>  $\underline{\text{ZnCl}_{4}}^{2^{-}}$ Number of ligands around the central atom\_\_\_\_\_ 4 Magnetic Properities Diamagnetic Electron box diagram Zn2+ 12121212 12 12 3d Ground State 45 4p 2n2+ 72 72 72 72 72 72 Lewis electron dot structure ¢⊂ι Geometry