Electron configuration
- order of electron addition (Hund's rule, Aufbau, Pauli)
- order of electron removal (shielding + penetration)

Physical properties of transition metals
- change in radius across period
- lanthanide contraction

Complexes
- determining # of d e⁻ on a complex

$K[Pt(NH_3)Cl_5] \rightarrow -1$ platinum must be +4 to make the complex −1

potassium amminepentachloroplatinate(IV)

1) complexes are named cation first then anion
2) ligands are named in alphabetical order
3) numerical prefixes are used with ligands, but the prefixes are not considered for alphabetization
4) If the complex is anionic, the ending "-ate" is used with the transition metal
5) The oxidation state of the TM is always written

Pt^{+4}: $[Xe]5d^6$ Pt: $[Xe]6s^25d^8$

*Exceptions to standard filling order: Cu, Cr

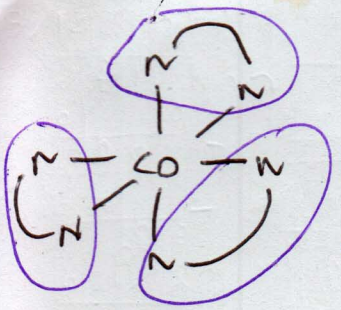
Cu: $[Ar]4s^23d^9$ → Cu: $[Ar]4s^13d^{10}$
(according to rules) subshell stabilization (exactly filled)

Cr: $[Ar]4s^23d^4$ → Cr: $[Ar]4s^13d^5$
half-subshell stabilization (exactly one e⁻ per orbital)

Coordination number — the # of attachment points to a TM

CN 6 → 6 monodentate ligands
3 bidentate (en)
2 tridentate
1 hexadentate (EDTA)

TM = transition metal



3 bidentate ligands → coordination # 6

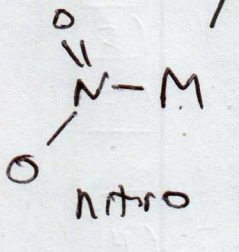
Geometries – octahedral, tetrahedral, square planar

square planar – Ni, Pt

Isomers

Isomers – same molecular formula, different structures

- Structural isomers – different connectivity
  - linkage isomer
  - coordination isomer
- Stereoisomers – different 3D arrangement
  - geometric cis/trans
  - optical left/right



different ligands

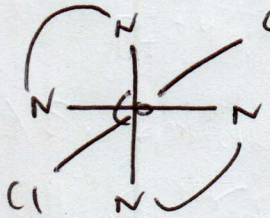
Counter ions

$[Pt(NH_3)_4Cl_2](NO_2)_2$

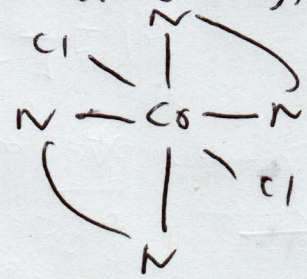
$[Pt(NH_3)(NO_2)_2]Cl_2$

ligands – mono-, bi-, poly dentate

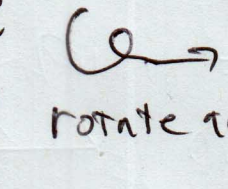
must know name + structure of (en) & (EDTA)

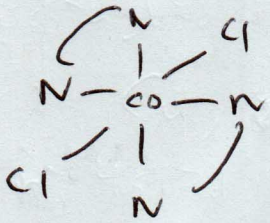


Trans

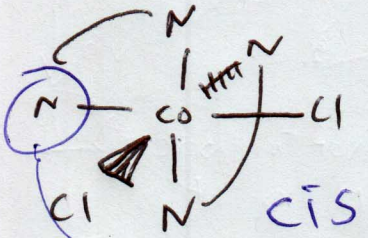


mirror

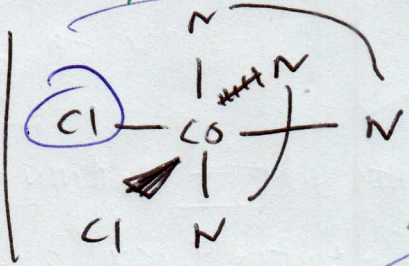




Since the mirror image is identical to the original molecule, it does not have optical isomers



cis



mirror

will not overlap

Since the mirror images are not identical, they are optical isomers,

hybridization not on exam

octahedral splitting

Co^{+3} $Co(H_2O)_6^{+3}$ $d_{z^2}, d_{x^2-y^2}$

$\Delta = h\nu$

d_{xz}, d_{yz}, d_{xy}

octahedral

Tetrahedral + Square planar complexes experience different splitting because the geometries are different

strong vs weak field ligands

Strong field
large ΔE
high frequency light

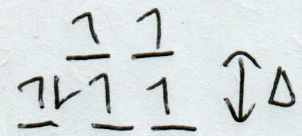
Weak field
lower ΔE
low frequency light

Bonus

$Co(H_2O)_6^{+3}$

weak field

pairing costs more energy than jumping up a level



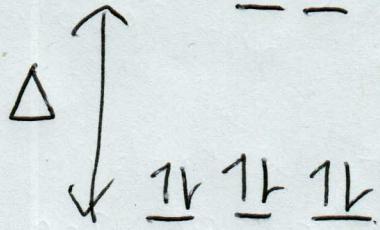
$Co: [Ar]\,4s^2\,3d^7$

$Co^{+3}: [Ar]\,3d^6$

Paramagnetic – when some electrons are unpaired, the atom will respond to magnetic fields.

$Co(CN)_6^{-3}$

strong field



pairing costs less energy than jumping up a level

diagmagnetic – when all electrons are paired within orbitals, the atom does not interact with magnetic fields.