Atomic Energy Central School, Indore

Class XII Chemistry CO-ORDINATION COMPOUNDS Worksheet 4/6

Questions

1. Why is $[NiCl_4]^{2-}$ paramagnetic but $[Ni(CN)_4]^{2-}$ is diamagnetic? (At. Nos.: Cr =24, Co = 27, Ni =28)

2. For the complex $[Fe(CN)_6]^{4-}$, write the hybridization, magnetic character and spin type of complex.
(At. Number: Fe=26)

3. Fill in the table for various complexes given: (some are done for you)

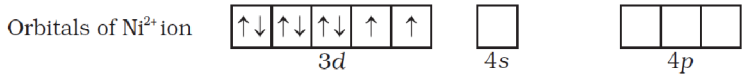
Complex	ON of central metal atom	Hybridisation	shape	Magnetic prop.	Type of complex
$[NiCl_4]^{2-}$	+2	Sp^3	tetrahedral	paramagnetic	high spin
$[Ni(CN)_4]^{2-}$	+2	dsp^2	Square planar	diamagnetic	low spin
$[Pt(CN)_4]^{2-}$					
$[Ni(CO)_4]$					
$[Fe(CN)_6]^{3-}$					
$[Co(ox)_3]^{3-}$					
$[CoF_6]^{3-}$					
$[Cr(NH_3)_6]^{3+}$					

4. A solution of $[Ni(H_2O)_6]^{2+}$ is green but a solution of $[Ni(CN)_4]^{2-}$ is colourless. Explain.

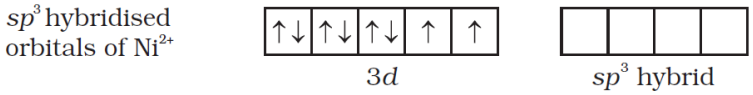
5. Amongst the following ions which one has the highest magnetic moment value?
(i) $[Cr(H_2O)_6]^{3+}$ (ii) $[Fe(H_2O)_6]^{2+}$ (iii) $[Zn(H_2O)_6]^{2+}$

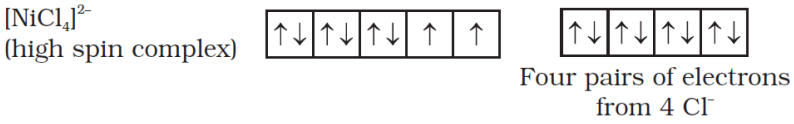
Answers

1. $[NiCl_4]^{2-}$ $_{28}Ni$ – outer e confg = $3d^8\ 4s^2$



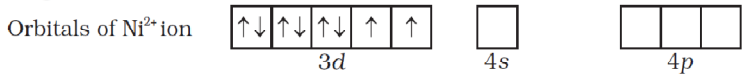
F^- being a weak ligand, pairing up the electrons doesn't take place.



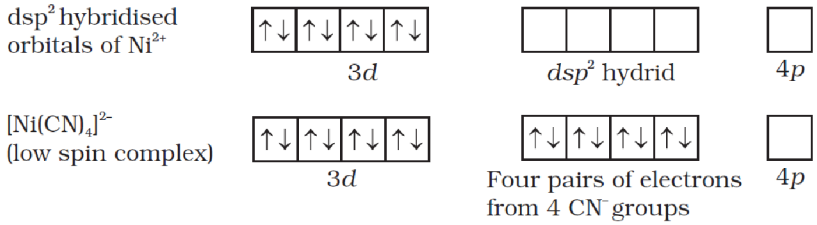


$[NiCl_4]^{2-}$
As the e- are not paired, it is **paramagnetic** in nature.

$[Ni(CN)_4]^{2-}$ $_{28}Ni$ – outer e confg = $3d^8\ 4s^2$

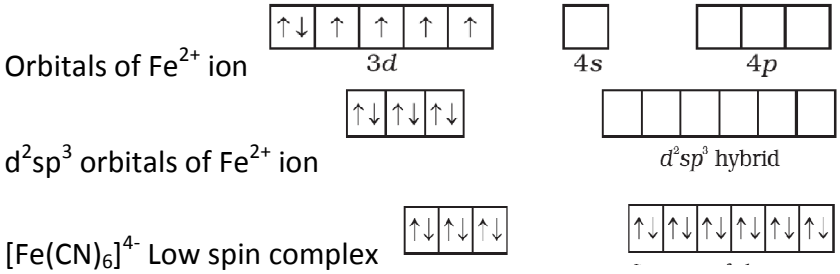


CN^{2-} being a strong ligand, pairing up the electrons takes place



$[Ni(CN)_4]^{2-}$
As the e- are paired, it is **diamagnetic** in nature.

2. $[Fe(CN)_6]^{4-}$ $_{26}Fe$ – outer e confg = $3d^6\ 4s^2$



$[Fe(CN)_6]^{4-}$
1. As inner d orbitals are used in d^2sp^3, it is an **inner orbital complex**
2. As the e- are paired, it is called a **low spin** or **spin paired complex**
3. As the e- are paired, it is **diamagnetic** in nature.

3.

Complex	ON of central metal atom	Hybridisation	shape	Magnetic prop.	Type of complex
$[NiCl_4]^{2-}$	+2	Sp^3	tetrahedral	paramagnetic	high spin
$[Ni(CN)_4]^{2-}$	+2	dsp^2	Square planar	diamagnetic	low spin
$[Pt(CN)_4]^{2-}$	+2	dsp2	Square planar	diamagnetic	low spin
$[Ni(CO)_4]$	0	sp^3	tetrahedral	diamagnetic	low spin
$[Fe(CN)_6]^{3-}$	+3	d^2sp^3	octahedral	Weakly paramagnetic	low spin
$[Co(ox)_3]^{3-}$	+3	d^2sp^3	octahedral	diamagnetic	low spin
$[CoF_6]^{3-}$	+3	Sp^3d^2	octahedral	paramagnetic	high spin
$[Cr(NH_3)_6]^{3+}$	+3	d^2sp^3	octahedral	paramagnetic	high spin

4. $[Ni(H_2O)_6]^{2+}$ is a high spin complex having unpaired electrons which can excite and on returning back, can emit radiations in the visible region, whereas $[Ni(CN)_4]^{2-}$ is a low spin complex. It has no electrons to excite and hence is colourless.

5. (ii) $[Fe(H_2O)_6]^{2+}$ as Fe^{2+} has 4 unpaired electrons in this complex.

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