Assignment NPTEL
06-02-2022

Co-Ordination Chemistry (Chemistry Of Transition Elements)/ Week 2

The complex $[Ag(NH_3)_2]^+$ has the coordination number :

a) 3

b) 2

c) 1

d) 6

- a
- b
- c
- d

Ans. (b)

What will be geometry when four cyanides are attached to the nickel (Ni) centre?

a) Tetrahedral

b) Square planar

c) Trigonal bipyramidal

d) Square pyramidal

- ○ a
- ○ b
- ○ c
- ○ d

Ans. (b)

What is coordination number and the oxidation state of Pd in the $Pd(PPh_3)_4$ complex?

a) 4, 0

b) 4, +2

c) 2, 0

d) 2, +2

- a
- b
- c
- d

Ans. (a)

Which one of the given compounds is known as Wilkinson's catalyst?

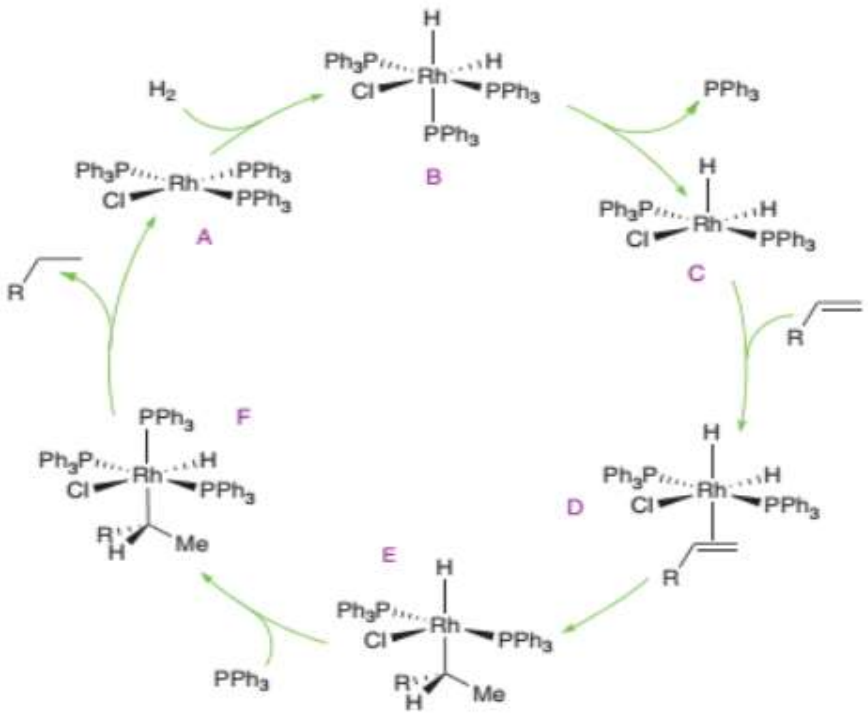
a) $[RhCl(PPh_3)_3]$

b) $[RhCO(PP_3)_3]$

c) $[IrCl(PPh_3)_2]$

d) $[IrCl(CO)_2]$

- ○ a
- ○ b
- ○ c
- ○ d



Ans. (a)

The INCORRECT statement of Vaska's complex is:

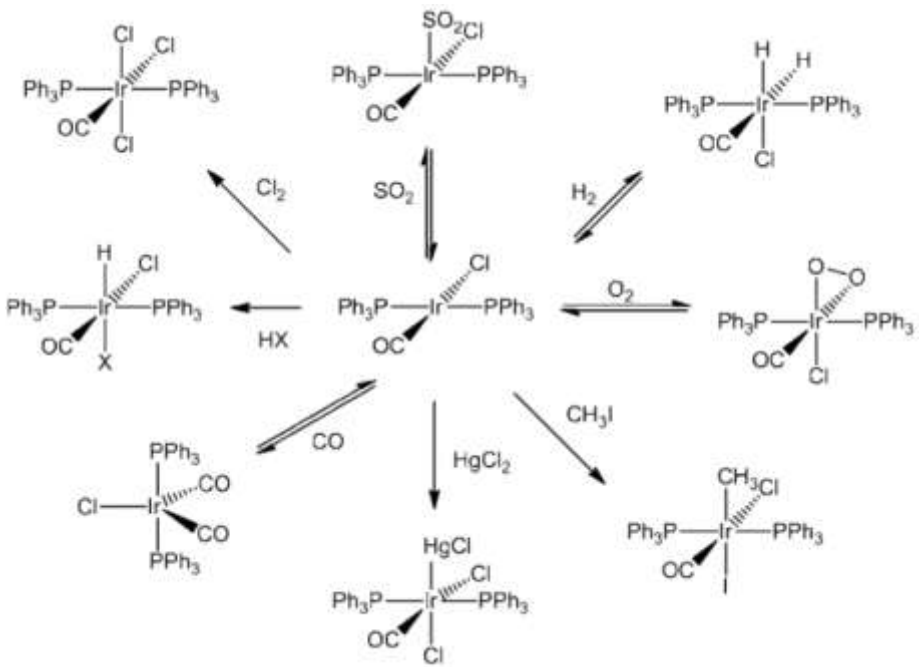
a) It has trans geometry

b) Its coordination number is 4

c) It has affinity to react with the molecular oxygen

d) It is a rhodium-based complex

- ○ a
- ○ b
- ○ c
- ○ d



Ans. (d)

In which reactions $VO(acac)_2$ is used as a reagent?

a) epoxidation of allylic alcohols by tert-butyl hydroperoxide (TBHP)

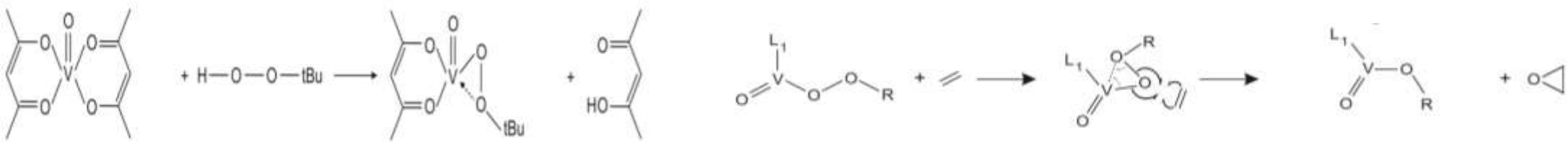
b) chlorination reactions

c) alkylation reactions

d) sulphonation reactions by tert-butyl hydroperoxide (TBHP)

- ○ a
- ○ b
- ○ c
- ○ d

Ans. (a)



Fill in the blanks with suitable option given below.

Berry pseudorotation present in _____ geometry.

a) Tetrahedral

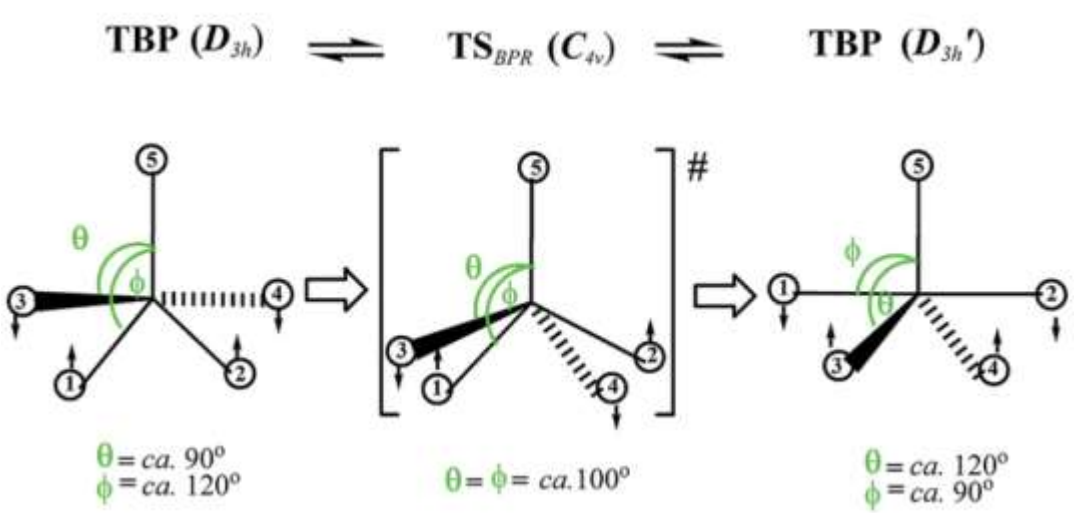
b) Octahedral

c) Trigonal bipyramidal

d) Trigonal planar

- ○ a
- ○ b
- ○ c
- ○ d

Ans. (c)



What is the condition for isotropic nature in octahedral geometry?

a) $x = y = z$

b) $x = y \neq z$

c) $x \neq y = z$

d) $x \neq y \neq z$

- a
- b
- c
- d

Ans. (a)

Table 1: Crystal Field Stabilization Energies (CFSE) for high and low spin octahedral complexes

Total d-electrons	Isotropic Field	Octahedral Complex				Crystal Field Stabilization Energy	
		High Spin		Low Spin			
	$E_{\text{isotropic field}}$	Configuration	$E_{\text{ligand field}}$	Configuration	$E_{\text{ligand field}}$	High Spin	Low Spin
d^0	0	$t_{2g}0e_g0$	0	$t_{2g}^0e_g^0$	0	0	0
d^1	0	$t_{2g}1e_g0$	-2/5 Δ_o	$t_{2g}^1e_g^0$	-2/5 Δ_o	-2/5 Δ_o	-2/5 Δ_o
d^2	0	$t_{2g}2e_g0$	-4/5 Δ_o	$t_{2g}^2e_g^0$	-4/5 Δ_o	-4/5 Δ_o	-4/5 Δ_o
d^3	0	$t_{2g}3e_g0$	-6/5 Δ_o	$t_{2g}^3e_g^0$	-6/5 Δ_o	-6/5 Δ_o	-6/5 Δ_o
d^4	0	$t_{2g}3e_g1$	-3/5 Δ_o	$t_{2g}^4e_g^0$	-8/5 Δ_o + P	-3/5 Δ_o	-8/5 Δ_o + P
d^5	0	$t_{2g}3e_g2$	0 Δ_o	$t_{2g}^5e_g^0$	-10/5 Δ_o + 2P	0 Δ_o	-10/5 Δ_o + 2P
d^6	P	$t_{2g}4e_g2$	-2/5 Δ_o + P	$t_{2g}^6e_g^0$	-12/5 Δ_o + 3P	-2/5 Δ_o	-12/5 Δ_o + P
d^7	2P	$t_{2g}5e_g2$	-4/5 Δ_o + 2P	$t_{2g}^6e_g^1$	-9/5 Δ_o + 3P	-4/5 Δ_o	-9/5 Δ_o + P
d^8	3P	$t_{2g}6e_g2$	-6/5 Δ_o + 3P	$t_{2g}^6e_g^2$	-6/5 Δ_o + 3P	-6/5 Δ_o	-6/5 Δ_o
d^9	4P	$t_{2g}6e_g3$	-3/5 Δ_o + 4P	$t_{2g}^6e_g^3$	-3/5 Δ_o + 4P	-3/5 Δ_o	-3/5 Δ_o
d^{10}	5P	$t_{2g}6e_g4$	0 Δ_o + 5P	$t_{2g}^6e_g^4$	0 Δ_o + 5P	0	0

$$CFSE = \Delta E = E_{\text{ligand field}} - E_{\text{isotropic field}}$$

The geometry of the $[W(CO)_4(Br)_3]^-$ compound is:

a) Capped trigonal prism

b) Pentagonal bipyramidal

c) Capped octahedron

d) Square planar

- ○ a
- ○ b
- ○ c
- ○ d

Ans. (c)

Seven-Coordination. A Molecular Orbital Exploration of Structure, Stereochemistry, and Reaction Dynamics

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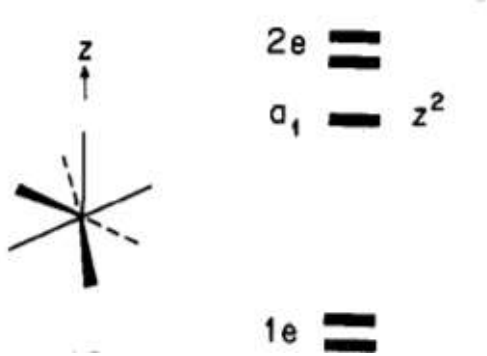

Table II. Structures of the $ML_xL'_yL''_z$ Type, with Seven Mixed Monodentate Ligands

Complex[a]	x in d^x	Structure[b]	Ref	Geometrical details[c]
$UO_2F_5^{3-}$	0^d	PB	31	O:FFFFF:F
$NbOF_6^-$	0	PB	32	F:FFOFF:F
$UO_2(urea)_4(H_2O)$	0^d	PB	33	O:OOOOO:O
$UO_2(NCS)_5^{3-}$	0^d	PB	34	O:NNNNN:O
$UCl(tmpo)_6^{3+}$	0^e	CO	35	Cl:OOO:OOO
$MoCl_4P_3$	2	CO	36	Cl:PPP:ClClCl; $\theta_2 = 74.6°, \theta_3 = 127.2°$
$MoBr_4P_3$	2	CO	37	Br:PPP:BrBrBr; $\theta_2 = 74.5°, \theta_3 = 127.4°$
$W(CO)_4Br_2^-$	4	CO	38	C:CCC:BrBrBr; $\theta_2 = 74.1°, \theta_3 = 125.5°$
$Mo(CNR)_4I^+$	4	CTP	39	I:CCCC:CC
$W(CO)_3P_3I^+$	4	CO/CTP	40	as CO P:CCC:PPI as CTP I:CCPP:CP
$MoCl_2(CO)_3P_2$	4	CO/CTP	41	as CO C:CPP:PClCl as CTP Cl:CPPCl:PC
$MoCl_3(CO)_3P_3$	4	CO	42	C:CCP:PClCl
$MoBr_3(CO)_3P_3$	4	CO	42	C:PPP:CBrBr
$WBr_2(CO)_3As_2$	4	CO	43	C:CCAs:AsBrBr

[a] P = phosphine, As = arsine, R = alkyl. [b] Where two structures are indicated, the geometry is intermediate. [c] Partitioning of ligands is indicated in an obvious way: 1:5:1 for PB, 1:3:3 for CO, 1:4:2 for C_{2v} CTP. [d] U(VI). [e] U(IV).

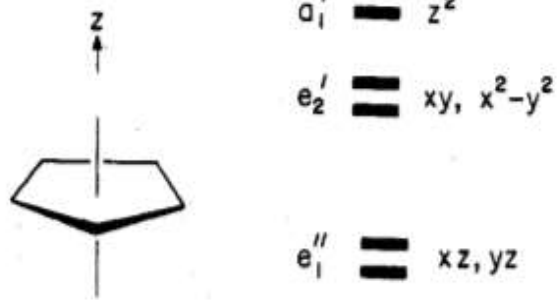

Table I. ML_7 Structures

Species	Confign	Structure	Ref
IF_7	d^0 [a]	D_{5h}	23
ZrF_7^{3-}	d^0	D_{5h}	24
NbF_7^{2-}	d^0	C_{2v}	25
ReF_7	d^0	D_{5h}	26
$V(CN)_7^{4-}$	d^2	D_{5h}	27
$Mo(CN\text{-}t\text{-}Bu)_7^{2+}$	d^4	C_{2v}	28
$Mo(CN)_7^{5-}$	d^4	D_{5h}	29

[a] Or d^{10}.

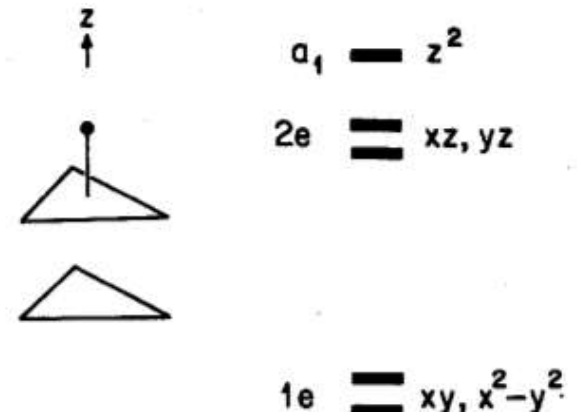

Table III. C_{2v} Capped Trigonal Prism Parameters[a]

Structure		θ_2, deg	φ_2, deg	θ_6, deg
Points on a sphere[b]	$n = 1$	80.8	49.0	144.2
	$n = 6$	79.4	48.7	143.3
	$n = 12$	78.3	48.7	142.6
Calcd L_7^{7-}		79	48	142
ML_7 d^0		68	52	118
ML_7 d^2		80	54	122
ML_7 d^4		82	46	148
MCl_7 d^0–d^4		80	48	145
$M(CO)_7$ d^4		85	48	150
NbF_7^{2-} [c] d^0		78.6	48	143.0
$Mo(CN\text{-}t\text{-}Bu)_7^{2+}$ [d] d^4		82.0	50	144.0

[a] The last two entries are experimental structure determinations. [b] Reference 10. [c] Reference 25. [d] Reference 28.