2023학년도 2학기 무기화학 2 중간고사

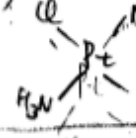
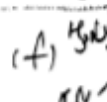
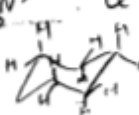
1 48 (2×24)

원자번호	원소기호	이름	족	주기
27	Co	cobalt	9, 8B	4
62	Sm	samarium	란탄족	6
70	Yb	ytterbium	란탄족	6
72	Hf	hafnium	4 (4B)	6
84	Po	Polonium	16 (6A)	6
94	Pu	plutonium	악탄족	7

2 25 (5×5)

(a) C_3 (b) σ_v (c) S_4 (d) i (e) σ_h

3 59

주어진 것	point group	symmetry elements	chirality
(a)	D_{2d} 3	E, $2S_4$, C_2, $2C_2'$, $2\sigma_d$ 2	no 2
(b)	D_2 3	E, $C_2(z)$, $C_2(y)$, $C_2(x)$ 2	yes 2
(c) 2	C_{2v} 3	E, C_2, $\sigma_v(xz)$, $\sigma_v'(yz)$ 2	no 2
(d) 2	D_{3h} 3	E, $2C_3$, $3C_2$, σ_h, $2S_3$, $3\sigma_v$ 2	no 2
(e)  2	D_{2h} 3	E, $C_2(z)$, $C_2(y)$, $C_2(x)$, i, $\sigma(xy)$, $\sigma(xz)$, $\sigma(yz)$ 2	no 2
(f)  2	C_{2v} 3	E, C_2, $\sigma_v(xz)$, $\sigma_v'(yz)$ 2	no 2
(g)  2	D_{3d} 3	E, $2C_3$, $3C_2$, i, $2S_6$, $3\sigma_d$ 2	no 2

4. 30 (3×10)

	nomenclature	formula	structure
(a)	trans - ~~hexaaqua copper (II)~~ diaqua bis ethylenediamine	trans-$[Cu(H_2O)_2(en)_2]^{2+}$	3
(b)	cis-diammine dichloroplatinum(II)	cis-$[Pt(Cl)_2(NH_3)_2]$ 3	3
(c)	fac-trichlorotris(trimethylphosphine) iridium (III) 3	fac-$[Ir(Cl)_3(PMe_3)_3]$	3
(d)	trans-diaquatetracyanonickelate (II) 3	trans-$[Ni(CN)_4(H_2O)_2]^{2-}$	3
	μ-oxo-bis(pentaammine)chromium(III)	~~μ-O-~~ $[Cr(NH_3)_5]^{4+}$ ~~fac~~ 3	3

(a) trans-diaqua bis(ethylenediamine) copper(II)

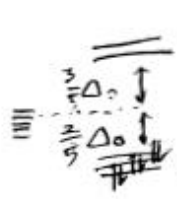
15 (59)

(a) 10 O_h , d^6 low-spin

$LFSE = -\frac{2}{5}\Delta_o \times 6$

$= -2.4\Delta_o$

5



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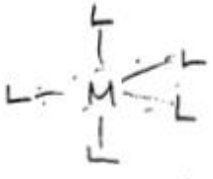
(b) 10 $[ML_5]^*$

5

square pyramidal

C_{4V}



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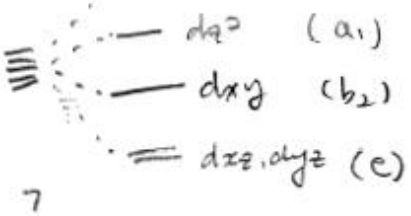
trigonal bipyramidal

D_{3h}

(c) 14

C_{4V}



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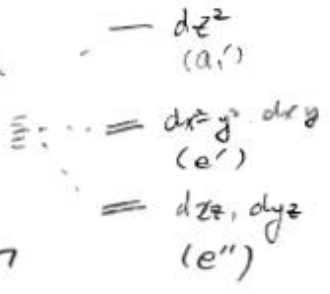
D_{3h}



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(d) C_{4V} 15

D_{3h}

O_h

$[ML_5]^*$의 두 구조에서 LFSE는 O_h (ML_6)의 LFSE보다 작으므로 (절대값이) 에너지 상태가 더 높을 것이다.

(e) C_{4V} D_{3h}

10 $S=0$ $S=1$

$\therefore \mu = 0$ $\therefore \mu = 2\sqrt{2}\,\mu_B$

5 5

6 (30)

(a) $3N-6 = 3\times6-6 = \underline{12개}$ 5

(b) 25

C_{4v}

C_{4v}	E	$2C_4$	C_2	$2\sigma_v$	$2\sigma_d$	(h=8)
Γ_{vib}	5	1	1	3	1	

$\Gamma_{vib} = 2A_1 + B_1 + E$

$2A_1$: IR-active, E: IR-active

∴ 4개의 ~~symmetric~~ streching modes (IR-detective)

D_{3h}

D_{3h}	E	$2C_3$	$3C_2$	σ_h	$2S_3$	$3\sigma_v$	(h=12)
Γ_{vib}	5	2	1	3	0	3	

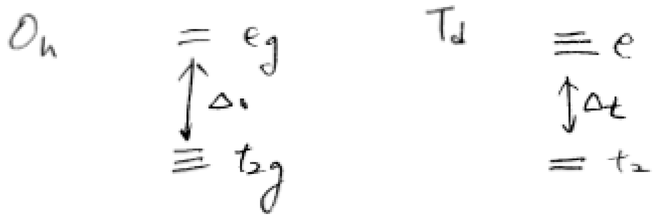
$\Gamma_{vib} = A_1' + E' + A_2''$

E', A_2'': IR-active

∴ 3개의 ~~symmetric~~ streching modes (IR-detective).

∴ $[ML_5]^*$의 구조는 C_{4v}, (square planar)

7 25



$\Delta_t < \Delta_o$

Spectrochemical series

$Cl^- < H_2O < NH_3$

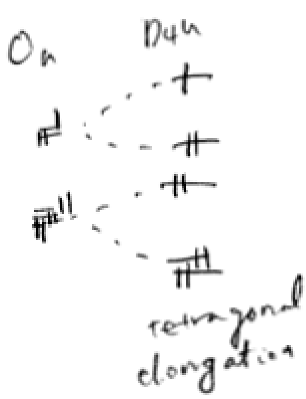
∴ ligand splitting parameter Δ

$[Co(Cl)_4]^{2-} < [Co(H_2O)_6]^{2+} < [Co(NH_3)]^{2+}$

∴ ⟵ 장파장 흡수

∴ 색깔 blue pink yellow

8 25



$[Cu(H_2O)_6]^{2+}$

Cu^{2+}, d^9

∴ 그러나 이론적으로는 On에서 tetragonal elongation이 일어나면 LFSE가 유리해진다. 따라서 $[Cu(H_2O)_6]^{2+}$는 D4h의 point group에 속하는 구조를 갖는다. (Jahn-Teller effect)

19 58 (a)

3d [$d_{x^2-y^2}$, d_{z^2} : E_g
   [d_{xy}, d_{yz}, d_{xz} : T_{2g}

4s : A_{1g}

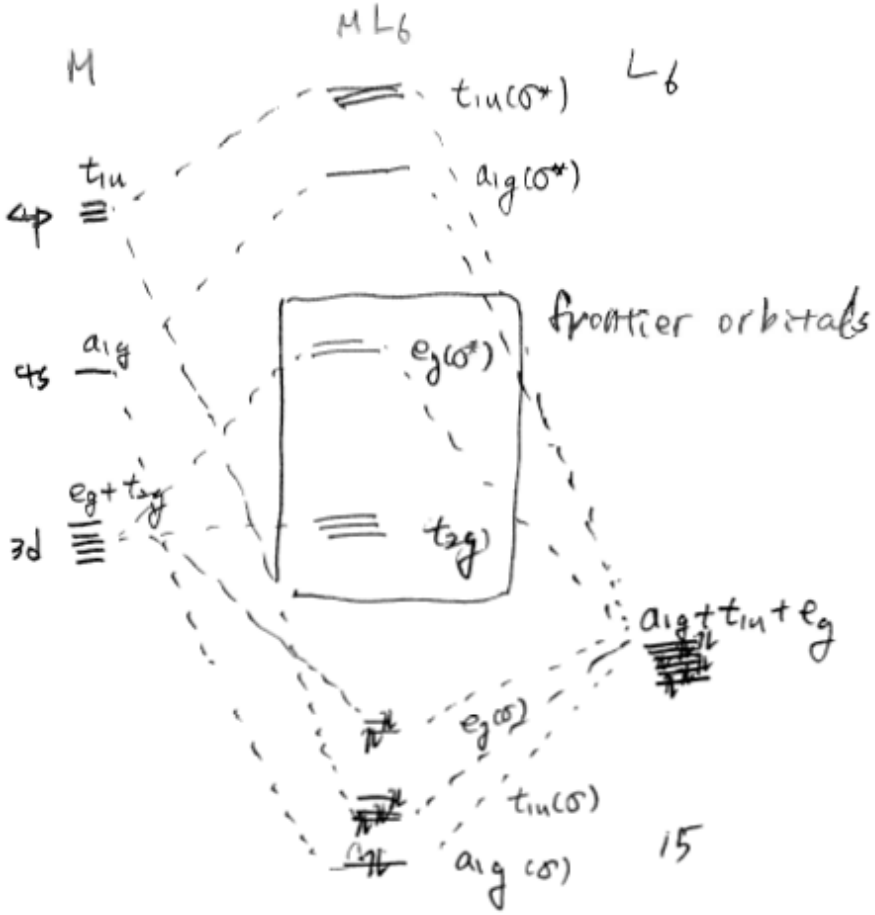
4p – p_x, p_y, p_z : T_{1u} 10

(b)

O_h	E	$8C_3$	$6C_2$	$6C_4$	$3C_2$ ($=C_4^2$)	i	$6S_4$	$8S_6$	$3\sigma_h$	$6\sigma_d$
Γ_σ	6	0	0	2	2	0	0	0	4	2

$\Gamma_\sigma = A_{1g} + T_{1u} + E_g$ 15

(c)



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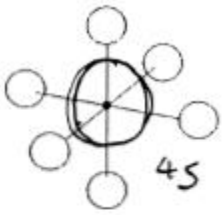
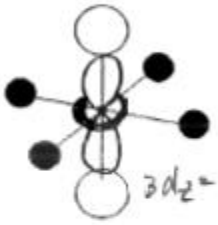
9. (d) (8 이름 학번

O_h

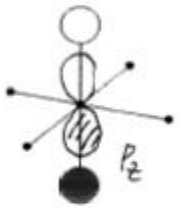
A_{1g}

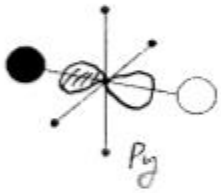


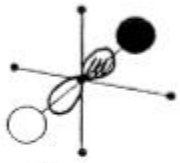
E_g



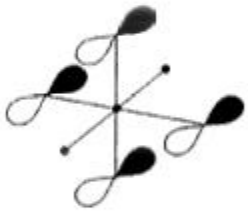
T_{1u}

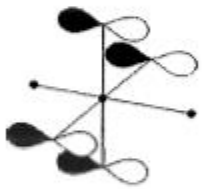


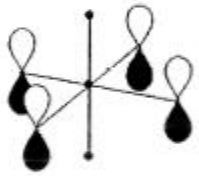




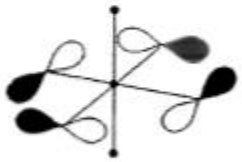
T_{1u}



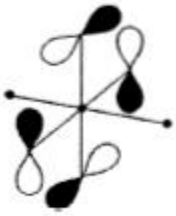


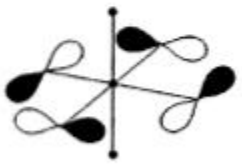


T_{2g}



T_{1g}





T_{2u}