CHAPTER - IV

SCHIFF BASE COMPLEXES OF AROMATIC AND HETEROCYCLIC MONOAMINES

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Schiff base Complexes of Cu(II), Ni(II) and Zn(II) Ions derived from Aromatic Amines :

Extensive studies on coordination complexes of salicylidenoamide ligands have revealed a diversity of stereochemical arrangement[1] arising from steric[2] and electronic[3] effects within molecules. Sacconi and coworkers[4] have reported complexes of N-aryl salicylideneimine. Yomada and Kuge[5] have reported the oxovanadium (IV) complexes of Schiff bases obtained from salicylaldehyde derivatives and Arylamines and showed that the tendency towards the distortion in the solid state is lower with R = aryl than with R = -branched alkyl groups. Singh and Tandon[6] discussed the antimony (III) complexes of Schiff bases derived from salicylaldehyde and aniline. Joshi and et al[7] prepared O-hydroxy ketoanils and their metal chelates. Gornovskil and co-workers[8] prepared the metal chelates of aromatic aldehyde-O-hydroxy ketoanils with metals like Cu(II), Co(II), Ni(II) and discussed the chelate structure on the basis of IR magnetic measurements and dipole moments. Ahuja[9] discussed the preparation and structure of Aniline complexes of Cd(II). Physicochemical properties and structure of vanadyl chelates with salicylidene arylamine have been discussed by Kogan, Lompart and co-workers[10]. Transition metal ion complexes with the ligands p-Nitroso Aniline and N-methyl-p-Nitroso Aniline have been prepared and studied by Popp and co-workers[11]. Fe(III) complexes of salicylideneaniline and salicyldeno O-, m- and p-toluidine have been reported by Shori and Gurg[12]. Tokili and Muto[13] prepared and characterized binuclear Cu(II) propionato complexes with N-aryl salicyldene amines and showed that the propionato posseses a carboxylate bridged binuclear structure. The magnetic moment of N-substituted bis-salicylaldimine nickel complexes in benzene and chloroform have been shown to vary from 0 to 2.6 B.M., as the bulk of substitutent is increased in the alkyl series and depends critically on the nature of the substituent when it is aromatic[14]. practical paramagnetism has been attributed to varying degree of polymerization leading to distorted structure and square plannar tetrahedral equilibrium[15,16] Nickel(II) complexes with Schiff bases derived from O-amino benzaldehyde are reported by Brezina[17]. The synthesis, physicochemical and biological studies of ruthenium (III) complexes with Schiff bases derived from anthranilic acid as amine and hydroxy ketone is reported by Sharma[18]. Copper (II) and Nickel (II) complexes of unsymmetrical tetradentate Schiff base ligands were prepared by Atkins[19]. 3-Aminopyridine was condensed with RCHO or Ar.CHO to give Schiff base[20]. Bis (Schiff base) have been prepared from terephthalaldehyde and anthranilic acid and its complexes with bivalent metals have been synthesised by Singh et al[21]. Singh and Misra[22] studied polymeric 2:1 metal ligand complexes formed by thiophen 2-aldehydeoxyalydihydrazone with bipositive cations. Singh[23] et al have investigated in detail the synthesis of coordination polymers of terephthaldehyde bis (isonicotinic acid hydrazone). Manganese (II), Cobalt (II), Nickel(II) and Copper(II) complexes with p-Toly-2-furylglyoxalimine are reported by Saxena et al[24].

Mixed Schiff base complexes of the types [ML_1 L_2 $2H_2O$] and [M_2 L'_1 L'_2] were M = Cu(II), Ni(II) and Zn(II) and L_1 = organic Schiff base ligands derived from 7 formyl 8 hydroxy quinoline and Aniline or 0 or p-toluidine or 3-amino pyridine or 2-aminothiophen as primary amine L_2 = organic Schiff base ligands derived from salicylaldehyde or 2 hydroxy Naphthaldehyde or 2 amino 5 chloro Benzophenone or 0-hydroxy acetonaphthone or 2-hydroxy 4-methoxy acetophenone or 2,4-dihydroxy acetophenone or 0-hydroxy acetophenone and aniline or 0 or p-toluidine or 3-amino pyridine or 2-aminothiophen L'_1 = Organic Schiff base ligands derived from 7-formyl

8-hydroxy quinoline and anthranilic acid and L'_2 = Organic Schiff base ligands derived from Salicylaldehyde Acetophenone or 2-hydroxy naphthaldehyde or O-hydroxy acetonaphthone or 2,4-dihydroxyacetophenone or 2-hydroxy 4-methoxy 4-methoxyacetophenone or 2 amino 5-chloro benzophenone or O-hydroxy acetonaphthone and anthranilic acid as primary amine have not been reported earlier. Such complexes have been isolated and characterized in the present investigation.

These complexes were prepared by two methods. First is the reaction of aromatic amine and heterocyclic or aromatic amine namely aniline, O- and p-toluidine, 3-aminopyridine, 2-amino thiophen and anthranilic acid with mixed imine Cu(II), Ni(II) and Zn(II) complexes. The reaction was carried out as be the amine exchange brought by primary amines detailed in Section-2.

Second Method :

The above complexes were also prepared by treating the metal salt with preformed Schiff base of aniline, or O-, p- toluidine or 2-amino thiophen or 3-aminopyridine or anthranilic acid with 7-formyl 8-hydroxy quinoline or salicylaldehyde or

2-hydroxy-1-naphthaldehyde and O-hydroxyacetophenone or 2-hydroxy 4-methoxyacetophenone or 2-4-dihydroxyacetophenone or O-hydroxy acetonaphthone or 2-amino 5-chlorobenzophenone.

Experimental

Aniline, Ortho and para toluidine, 3-amino pyridine, 2-amino thiophen, anthranilic acid (BDH) were used. Acetone Ether, Ethanol, Chloroform and DMF were of Analar grade.

Preparation of Schiff bases using hydroxy aldehydes : [Fig. 4.1 to 4.3]

Preperation of 7-formyl 8-hydroxy quinoline is shown in chapter 2. Schiff bases of 7-formyl 8-hydroxyquinoline and 2-hydroxy naphthaldehyde or salicylaldehyde with aniline or with O- and p- toluidine or 3-amino pyridine or 2-amino thiophen or anthranilic acid were prepared by taking 100 ml (50 % alcohol and 50 % chloroform) solution of the (0.12 mole) aldehyde and refluxing (3 hrs) it with alcoholic solution of (0.1 mole) aromatic amine. The reaction mixture was then cooled by adding ice when reddish-violet solid separated out. This was recrystallized three times from chloroform and DMF and analysed for the nitrogen content. Nitrogen analyses is found to be in excellent agreement with the expected composition (Table 4.1) & for IR study (Table 4.2).

Preparation of Schiff base using Hydroxy ketones :
[Fig. 4.2 to 4.4]

0.1 mole 50 ml ethanolic solution of 0-hydroxy acetophenone or 2,4-dihydroxy acetophenone or 2-hydroxy 4-methoxy acetophenone or 2-hydroxy acetonaphthone or 2-amino 5-chloro benzophenone was mixed with 0.16 mole of aniline or 0 or p-toluidine or 3-aminopyridine or 2-aminothiophen or anthranilic acid and was refluxed in presence of 2 gms of p-toluidine sulfonic acid (PTS) as catalyst for 0-hydroxy acetophenone or 2,4-dihydroxy acetophenone or 2-hydroxy 4-methoxy acetophenone or 2-hydroxy acetonaphthone reactions and 2.5 ml , 40 % aqueous hydrobromic acid as catalyst for 2-amino 5-chloro benzophenone reaction . It was then cooled by adding ice, colored solid seperated, it was recrystallized from DMF TLC test was done, and melting point recorded (see Table 4.1) for purity check. & for IR study (Table 4.2).

Schiff base ligands:

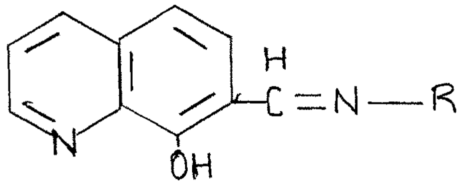
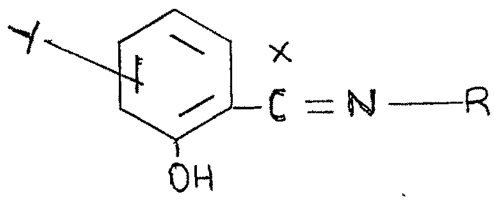


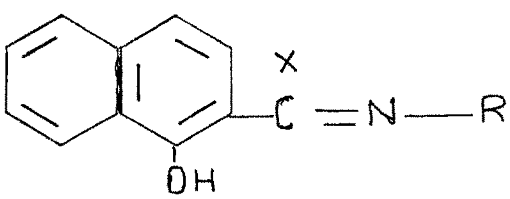
Fig.4.1



X = H, CH_3

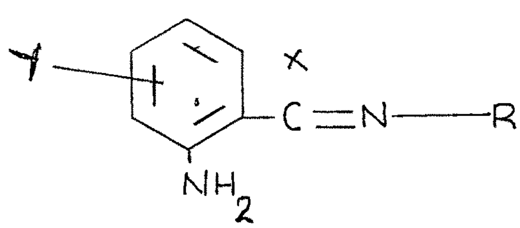
Y = H,4-OH, 4-OCH_3

Fig.4.2



X = H, CH_3

Fig.4.3



X = C_6H_5

Y = 5-Cl

Fig.4.4

R = C_6H_5, $C_6H_4$2CH_3, $C_6H_4$4CH_3, C_6H_4COOH, C_5H_4N, C_4H_3S

Name of Schiff bases derived by using Aromatic amines.

SB-1. (N- Phenyl - 7 Aldimine 8 Hydroxy Quinoline).

SB-2. (2- methyl N- phenyl 7 Aldimine 8 Hydroxy Quinoline).

SB-3. (4- methyl - N- phenyl - 7 Aldimine 8 Hydroxy Quinoline).

SB-4. (3,N-pyridine - 7 Aldimine 8 Hydroxy Quinoline).

SB-5. (2,N- thiophen - 7 Aldimine 8 Hydroxy Quinoline).

SB-6. (2- Carboxyl N- phenyl - 7 Aldimine 8 Hydroxy Quinoline).

SB-7 (N-phenyl Salicylaldimine).

SB-8 (2- methyl - N - phenyl Salicylaldimine).

SB-9. (4- methyl N- phenyl Salicylaldimine).

SB-10. (3,N- pyridine Salicylaldimine).

SB-11. (2,N - thiophen Salicylaldimine).

SB-12. (2- Carboxyl N- phenyl Salicylaldimine).

SB-13. (N- phenyl O-hydroxy Acetophenomine).

SB-14. (2- methyl N- phenyl O- hydroxy Acetophenomine).

SB-15. (4- methyl N- phenyl O- hydroxy Acetophenomine).

SB-16. (3, N- pyridine O- hydroxy Acetolphenomine).

SB-17. (2, N- thiophen- O- hydroxy Acetophenomine).

SB-18. (2- Carboxyl N- phenyl O- hydroxy Acetophenomine).

SB-19. (N- phenyl 2,4 dihydroxy Acetophenomine).

SB-20. (2- methyl N- phenyl 2,4 dihydroxy Acetophenomine).

SB-21. (4- methyl N- phenyl 2,4 dihydroxy Acetophenomine).

SB-22. (3, N- pyridine 2,4- dihydroxy Acetophenomine).

SB-23. (2,N -thiophen 2,4 dihydroxy Acetophenomine).

SB-24. (2- Carboxyl N- phenyl 2,4 dihydroxy

Acetophenomine).

SB-25. (N- phenyl 0- hydroxy 4 methoxy Acetophenomine).

SB-26. (2- methyl N- phenyl 0- hydroxy 4 methoxy Acetophenomine).

SB-27. (4- methyl N- phenyl 0- hydroxy 4 methoxy Acetophenomine).

SB-28. (3, N- pyridine 0- hydroxy 4 methoxy Acetophenomine).

SB-29. (2, N- thiophen 0- hydroxy 4 methoxy Acetophenomine).

SB-30. (2- Carnoxyl N- phenyl 0- hydroxy 4 methoxy Acetophenomine).

SB-31. (N- phenyl 0- hydroxy Naphthaldimine).

SB-32. (2- methyl N- phenyl 0- hydroxy Naphthaldimine).

SB-33. (4- methyl N- phenyl 0- hydroxy Naphthaldimine).

SB-34. (3, N- pyridine 0- hydroxy Naphthaldimine).

SB-35. 2, N- thiophen O- hydroxy Naphthaldimine).

SB-36. (2- Carboxyl O- hydroxy Naphthaldimine).

SB-37. (N- phenyl O- hydroxy Acetonaphthomine).

SB-38. (2-methyl N-phenyl O-hydroxy Acetonaphthomine).

SB-39. (4-methyl N-phenyl O-hydroxy Acetonaphthomine).

SB-40. (3, N-phridine O-hydroxy Acetonaphthomine).

SB-41. (2, N-thiophene O-hydroxy Acetonaphthomine).

SB-42. (2-Carboxyl N-phenyl O-hydroxy Acetonaphthomine).

SB-43. (N-phenyl 2-Amino 5-chloro Benzophenomine).

SB-44. (2-methyl N-phenyl 2-Amino 5-chloro Benzophenomine).

SB-45. (4-methyl N-phenyl 2-Amino 5-chloro Benzophenomine).

SB-46. (3, N-pyridine 2-Amino 5-chloro Benzophenomine).

SB-47. (2, N-thiophen 2-Amino 5-chloro Benzophenomine).

SB-48. (2-Carboxyl N-phenyl 2-Amino 5-chloro Benzophenomine).

* Names are given as per reported work :

(1) J.F.W. McOmie, "Protective groups in organic Chemistry", 1976,66.

(2) E.Sinn and C. M. Harris, Coord. Chem. Rev., 1969,4,391.

Preparation of Mixed Schiff base Complexes of Cu(II), Ni(II) and Zn(II) : [Fig. 4.5 to 4.10]

About 0.2 gm of preformed mixed imine complexes i.e.

1. (7 Aldiminato 8-hydroxy Quinoline salicylaldiminato) M (II),

2. (7 Aldiminato 8-hydroxy Quinoline 0-hydroxy Acetophenom -inato) M (II),

3. (7 Aldiminato 8-hydroxy Quinoline 2,4-dihydroxy Acetophenominato) M (II),

4. (7 Aldiminato 8-hydroxy quinoline 2-hydroxy 4-methoxy Acetophenominato) M (II),

5. (7 Aldiminato 8-hydroxy quinoline 2-hydroxy naphthaldiminato) M (II),

6. (7 Aldiminato 8-hydroxy quinoline 0-hydroxy Acetonaphthominato) M (II),

7. (7 Aldiminato 8-hydroxy quinoline 2-amino 5-chloro Benzophenominato) M (II) where M = Cu(II) or Ni(II) or Zn(II), was dissolved in 50 ml DMF and heated,

to this an excess of DMF solution of aniline, O- or p-toluidine, 3-amino pyridine, 2-amino thiophen or anthranilic acid was added. The reaction mixture was refluxed for about 4 hrs. It was then filtered washed with ether and vacuum dried and analysed.

Preparation of Bis Schiff base Complexes :

Metal salt (0.50 mole) 50 ml solution was taken in a 250 ml round bottom flask and to this added 50ml (50 % chloroform and 50 % ethanol) solution of (1.0 mole) organic ligand L_1 and refluxed for about 3 - 4 hrs. The complexes obtained were cooled, filtered and washed with ether dried and recrystallized from chloroform and analysed for M, C, H, and N (Table).

Preparation of Mixed Schiff base Complexes : [Fig. 4.5 to 4.10]

(0.5 mole) 50 ml DMF solution of above bis Schiff base complexes was taken in 250 ml round bottom flask and (0.5 mole) 50 ml DMF solution of organic ligand L_2 was added and refluxed for 6 hrs. red complex was obtained. It was cooled, filtered and washed with ether, dried and recrystallized from chloroform or DMF and analysed for Metal, Carbon, Hydrogen and Nitrogen (Table).

Physical Measurements :

The isolated mixed Schiff base complexes were analysed for metal contents using complexometric titration with EDTA. Elemental analysis for C, H and N was done by microanalysis (Table 4.3).

The purity of complexes was checked by TLC technique using silica gel with chloroform acetone (5:3) mixture as adsorbent and U.V. light as visualisation agent.

The molar conductance of the complexes was measured in DMF with Toshniwal conductivity bridge. The magnetic susceptibility was measured at room temperature. TGS analysis was carried out to ensure the presence of water mlecules in the complexes. Using Gouy's balance (at room temperature). The IR spectral data were recorded in KBr on perkin-Elmer 427 grating spectrophotometer and Electronic spectra in DMF on Beckman spectrophotometer. IR bands are showen in (Table, 4.4)

Results and Discussions :

The analytical data (Table-4.3) show that the composition of the mixed Schiff base complexes is $[ML_1L_22H_2O]$.

The chloroform solutions of the complexes showed very poor molar conductivity (5.6 to 7.2 ohm^{-1} cm^2) indicating the complexes to be neutral. The electronic spectra of the ligands exhibited two bands at 36630 cm^{-1} and 29671 cm^{-1} assignable to $\pi \longrightarrow \pi^*$ and $n \longrightarrow \pi^*$ transitions respectively.

The electronic spectra of Cu(II) complexes showed a broad absorption maximum at 17200 cm^{-1} corresponds to $2B_{1g} \longrightarrow 2A_{2g}$ transition characteristic of distorted octahedral geometry[25] . (E. Curve 4.1)

The electronic spectra of Ni(II) complexes exhibited three spin allowed transitions at 9220 cm^{-1} , 14530 cm^{-1} and 25340 cm^{-1} assignable to (E. Curve 4.2)

$$3A_{2g} \longrightarrow 3T_{2g} \quad (\nu_1)$$

$$3A_{2g} \longrightarrow 3T_{1g}(F) \quad (\nu_2)$$

$$3A_{2g} \longrightarrow 3T_{1g}(F) \quad (\nu_3)$$ respectively.

The spectral parameter β has been calculated[26] by utilising the equation $\beta = (\nu_2 + \nu_3 - 3\nu_1)/15$. The lower value of β (814 cm^{-1}) indicates considerable covalent nature of the metal ligand bond[27]. The lowering of ν_2/ν_1 ratio (1.57) from 1.8 shows high spin octahedral configuration for the complexes.

The magnetic moment values at 300°K for Cu(II) and Ni(II) complexes were found to be in the range of 1.80 to 1.90 and 2.90 to 3.10 B.M. respectively. This may correspond to octahedral geometry of the complex molecules[28].

The I.R. spectra of the free Schiff base ligands exhibited two bands at ~1600 cm^{-1} and ~1690 cm^{-1} due to $>C = N$ and $>C = C<$ frequencies respectively. Band at 3800 cm^{-1} corresponds to phenolic -OH group present. These bands show shifts to lower wave numbers in the IR spectra of the metal complexes indicating the involvement of nitrogen of azomethine group and oxygen of phenolic group in the metal complex formation[29,30]. This is shown by the non ligand bands at 450 cm^{-1} and 380 cm^{-1} as ν_{M-N} and ν_{M-O} respectively. The coordinated nature of water molecule is confirmed by a broad band in the region 3200 cm^{-1} - 3500 cm^{-1} due to stretching mode and a band at 800 cm^{-1} is due to rocking mode. It is supported by TGA data. (T. Curve 4.3 to 4.4)

In case of anthranilic acid complexes the elemental analysis of bis Schiff base complexes corresponds to the $M_2 L_2$ type. This type of tridentate symmetrical binuclear complexes are reported earlier[31]. The structure is also supported by magnetic suceptibility values, which are slightly higher than expected values due to M - M interations. This also may be due to possible dimeric structure, due to bridging oxygen atom of carboxylate ion, which is also supported by I.R. studies.

The ligands synthesised for bis and mixed Schiff base complexes show band of medium intensity at 1580 cm^{-1} corresponds to asymmetric - COOH group. This is found absent in the spectra of the metal complexes and is replaced by a very strong band at 1600 cm^{-1} which is due to coordination of carboxylate ions. This overlaps the ν C = N in ligand. There is, however, no sign of a band at 1610 cm^{-1} in both type of complexes and hence it can be assumed that because of coordination the νC = N has been displaced to lower wavenumber and is observed by the more intense carboxylate band[31]. The strong band found around 1540 cm^{-1} in the ligand is assigned to phenolic C - O stretching vibrations[32].

In bis and mixed Schiff base complexes the asymmetric and symmetric stretching vibrations of the carboxylic group occur at $\sim 1590^{-1}$ and $\sim 1560^{-1}$. For monodentate carboxylic group – COOH is in the range of 150 to 160 cm^{-1}. While in the bidentate or bridging carboxylate group has much less difference[33] (1590 - 1560 = 30), hence the bridging nature of anthranilic acid is indicated in both types of complexes.

The molecular formula based on elemental analysis proves that the structure of the bis complexes must be $[M_2L_2]$ and that of mixed Schiff base complexes as $[M_2LL']$, Fig.4.5 to 4.10

The electron donation from carboxylate oxygen to the metal ion decreases when oxygen coordinates two metal ions. This may increase the I.R. frequency of carboxylate oxygen[34]. It can thus be concluded that binuclear complexes have a tetrahedral or pseudotetrahedral environment with metal - metal interaction paramagnetic character[34].

The new bands observed in the far I.R.spectra of both types of complexes at 480 cm^{-1} and 380 cm^{-1} are due to ν M - O and ν M - N respectively.

The TGA data of the mixed Schiff base complexes shows weight loss between 150° and 230°C, the weight loss corresponds to the presence of two coordinated water molecules. The decomposition temperatures show that the order of thermal stability of the complexes is Zn > Ni > Cu as reported[35]. In case of anthranilic acid Binuclear Schiff base complexes show decompostion at 280°C, it indicates that there is no water in complexes TGA-Curve - 4.3 to 4.4

T. 4.1

	Type of compounds	Colour	Mp. °C	% Cal (Found) C	H	N
SB_1	$C_{16}H_{12}ON_2$	Reddish brown	168	77.41 (77.50)	4.83 (5.11)	11.29 (11.50)
SB_2	$C_{17}H_{14}ON_2$	"	172	77.68 (77.82)	5.34 (5.50)	10.68 (11.12)
SB_3	$C_{17}H_{14}ON_2$	"	178	77.86 (77.52)	5.34 (5.50)	10.68 (11.12)
SB_4	$C_{15}H_{11}ON_3$	Yellowish	135	72.28 (72.50)	4.41 (4.50)	16.86 (17.12)
SB_5	$C_{14}H_{10}ON_2S$	Brick red	126	66.14 (66.52)	3.93 (4.11)	11.02 (11.21)
SB_6	$C_{17}H_{12}O_3N_2$	"	132	69.86 (70.10)	4.10 (4.20)	9.88 (9.72)
SB_7	$C_{13}H_{11}NO$	White crystal	50	79.18 (79.20)	5.58 (6.12)	7.10 (7.16)
SB_8	$C_{14}H_{13}NO$	"	48	79.62 (79.50)	6.16 (6.20)	6.63 (6.86)
SB_9	$C_{14}H_{13}NO$	"	160	79.62 (79.46)	6.16 (6.52)	6.63 (6.56)
SB_{10}	$C_{12}H_{10}N_2O$	Yellowish	46	72.72 (72.50)	5.05 (5.12)	14.14 (14.26)
SB_{11}	$C_{11}H_9NOS$	"	38	65.02 (65.12)	4.43 (4.52)	6.89 (6.94)
SB_{12}	$C_{14}H_{11}O_3N$	"	68	69.70 (70.11)	4.56 (4.60)	5.80 (6.11)
SB_{13}	$C_{14}H_{13}NO$	pinkish	48	79.62 (80.11)	6.16 (6.20)	6.63 (6.50)
SB_{14}	$C_{15}H_{15}NO$	"	56	80.00 (80.12)	6.66 (6.70)	6.22 (6.30)

cont...

Table cont...

SB_{15}	$C_{15}H_{15}NO$	pinkish	58	80.00 (80.32)	6.66 (6.52)	6.22 (6.36)
SB_{16}	$C_{13}H_{12}N_2O$	Yellowish	52	73.58 (73.62)	5.66 (5.70)	13.20 (13.50)
SB_{17}	$C_{12}H_{11}NOS$	"	45	66.35 (66.50)	5.06 (5.12)	6.45 (6.50)
SB_{18}	$C_{15}H_{13}O_3N$	White crystal	54	70.58 (70.72)	5.09 (5.12)	5.49 (5.62)
SB_{19}	$C_{14}H_{13}NO_2$	"	61	74.00 (74.12)	5.72 (5.86)	6.16 (6.20)
SB_{20}	$C_{15}H_{15}NO_2$	"	54	74.68 (74.70)	6.22 (6.30)	5.80 (6.11)
SB_{21}	$C_{15}H_{15}NO_2$	"	58	74.68 (74.52)	6.22 (6.42)	5.80 (5.92)
SB_{22}	$C_{13}H_{12}N_2O_2$	Yellowish&	46	68.42 (68.50)	5.26 (5.32)	12.28 (12.34)
SB_{23}	$C_{12}H_{11}NO_2S$	"	49	61.80 (62.12)	4.73 (4.84)	6.00 (6.12)
SB_{24}	$C_{15}H_{13}O_4N$	white crystal	51	66.42 (66.56)	4.79 (5.12)	5.16 (5.46)
SB_{25}	$C_{15}H_{15}NO_2$	"	57	74.68 (74.56)	6.22 (6.30)	5.80 (5.62)
SB_{26}	$C_{16}H_{17}NO_2$	"	54	75.29 (75.30)	6.66 (6.72)	5.49 (5.52)
SB_{27}	$C_{16}H_{17}NO_2$	"	61	75.29 (75.36)	6.66 (6.56)	5.49 (5.68)
SB_{28}	$C_{14}H_{14}N_2O_2$	yellowish crystal	38	69.42 (69.56)	5.78 (6.12)	11.57 (11.69)
SB_{29}	$C_{13}H_{13}NO_2S$	"	43	63.15 (63.50)	5.26 (5.32)	5.66 (5.72)
SB_{30}	$C_{16}H_{15}O_4N$	white amorphous	48	66.43 (66.52)	5.19 (5.24)	4.84 (5.12)
SB_{31}	$C_{17}H_{13}NO$	"	58	82.59 (82.62)	5.26 (5.32)	5.66 (5.70)

cont...

Table cont...

SB_{32}	$C_{18}H_{15}NO$	White Amorphous	64	82.75 (82.82)	5.74 (5.86)	5.36 (5.52)
SB_{33}	$C_{18}H_{15}NO$	"	72	82.75 (82.70)	5.74 (5.52)	5.36 (5.32)
SB_{34}	$C_{16}H_{12}N_2O$	Yellow	61	77.41 (77.56)	4.83 (4.86)	11.29 (11.56)
SB_{35}	$C_{15}H_{11}NOS$	"	54	71.14 (71.26)	4.34 (5.52)	5.53 (5.62)
SB_{36}	$C_{18}H_{13}NO_3$	"	58	79.70 (80.12)	4.79 (4.52)	5.16 (5.20)
SB_{37}	$C_{18}H_{15}NO$	"	39	82.75 (82.74)	5.74 (5.86)	5.36 (5.52)
SB_{38}	$C_{19}H_{17}NO$	"	46	82.90 (83.11)	6.18 (6.26)	5.09 (5.11)
SB_{39}	$C_{19}H_{17}NO$	"	52	82.90 (83.18)	6.18 (6.20)	5.09 (5.26)
SB_{40}	$C_{17}H_{14}N_2O$	White crystal	50	77.86 (77.92)	5.34 (5.52)	10.68 (11.12)
SB_{41}	$C_{16}H_{13}NOS$	"	58	69.31 (69.56)	4.69 (4.86)	5.05 (5.12)
SB_{42}	$C_{19}H_{15}NO_3$	"	62	77.28 (77.36)	5.08 (5.11)	4.74 (5.12)
SB_{43}	$C_{19}H_{15}N_2Cl$	Yellowish red	48	74.38 (74.52)	4.89 (4.96)	9.13 (9.26)
SB_{44}	$C_{20}H_{17}N_2Cl$	"	62	74.88 (74.52)	5.30 (5.56)	8.73 (8.92)
SB_{45}	$C_{20}H_{17}N_2Cl$	"	68	74.88 (74.68)	5.30 (5.60)	8.73 (8.62)
SB_{46}	$C_{18}H_{14}N_3Cl$	Pinkish red	72	70.24 (70.36)	4.55 (4.72)	13.65 (13.60)
SB_{47}	$C_{17}H_{13}N_2ClS$	Reddish	48	65.28 (65.48)	4.16 (4.42)	8.96 (9.12)
SB_{48}	$C_{20}H_{15}O_2N_2Cl$	"	58	68.47 (68.56)	4.27 (4.32)	7.98 (8.16)

T. 4.2

IR Characteristic frequencies cm^{-1}

SB_1 $C_{16}H_{12}ON_2$

2900(s), 1620(s), 1570(vs), 1510(m), 1315(vs),
1160(s), 1145(m)

SB_2 $C_{17}H_{14}ON_2$

2880(s), 1630(s), 1570(m), 1515(m), 1310(vs)
1150(s), 1135(m)

SB_3 $C_{17}H_{14}ON_2$

2890(s), 1625(s), 1570(vs), 1505(m), 1310(vs),
1160(s), 1140(m).

SB_4 $C_{15}H_{11}ON_3$

2910(s), 1620(s), 1570(vs), 1580(m), 1315(vs),
1510(m), 1165(s), 1130(s).

SB_5 $C_{14}H_{10}ON_2S$

2920(s), 1625(s), 1570(s), 1515(m), 1310(vs),
1170(s), 1140(m), 1070(s), 695(s).

SB_6 $C_{17}H_{12}O_3N_2$

2910(s), 1620(s), 1570(vs), 1510(m), 1320(vs),
1165(s), 1145(s).

Table cont...

SB_7 $C_{13}H_{11}NO$

2900(s), 1620(s), 1510(m), 1325(vs), 1160(s), 1140(m).

SB_8 $C_{14}H_{13}NO$

2920(s), 1630(s), 1520(m), 1340(s), 1135(m),

SB_9 $C_{14}H_{13}NO$

2910(s), 1620(m), 1510(m), 1310(s), 1170(s), 1130(s).

SB_{10} $C_{12}H_{10}N_2O$

2910(s), 1620(m), 1570(vs), 1515(m), 1340(s), 1175(s), 1125(m).

SB_{11} $C_{11}H_9NOS$

2910(s), 1625(s), 1510(m), 1310(s), 1160(s), 1125(m), 1070(s), 690(s).

SB_{12} $C_{14}H_{11}O_3N$

2900(s), 1620(s), 1520(m), 1170(s), 1315(s), 1140(m).

SB_{13} $C_{14}H_{13}NO$

2900(s), 1630(s), 1510(s), 1175(m), 1310(vs), 1135(s).

Table cont..

SB_{14} $C_{15}H_{15}NO$

2920(vs), 1620(s), 1525(s), 1315(m), 1180(s), 1140(m).

SB_{15} $C_{15}H_{15}NO$

2910(s), 1635(vs), 1510(s), 1310(vs), 1170(m), 1140(vs)

SB_{16} $C_{13}H_{12}N_2O$

2920(s), 1630(s), 1510(m), 1310(vs), 1170(s), 1120(m), 1070(s), 680(s)

SB_{17} $C_{12}H_{11}NOS$

2920(s), 1630(s), 1510(m), 1310(vs), 1170(s), 1120(m), 1070(s), 680(s).

SB_{18} $C_{15}H_{13}O_3N$

2900(s), 1620(s), 1530(m), 1315(vs), 1175(s), 1135(m).

SB_{19} $C_{14}H_{19}NO_2$

3200(s), 2910(s), 1630(m), 1520(s), 1325(m), 1165(m), 1125(s).

SB_{20} $C_{15}H_{15}NO_2$

3150(s), 2900(vs), 1630(s), 1520(s), 1310(m), 1170(s), 1130(m).

Table cont..

SB_{21} $C_{15}H_{15}NO_2$

3190(vs), 2880(s), 1620(s), 1510(m), 1325(s),
1165(m), 1130(s)

SB_{22} $C_{13}H_{12}N_2O_2$

3200(s), 2910(vs), 1620(s), 1570(vs), 1520(m),
1310(s), 1170(m), 1135(s)

SB_{23} $C_{12}H_{11}NO_2S$

3215(vs), 2920(s), 1625(m), 1510(s), 1320(s),
1170(m), 1130(m), 1070(s), 685(s)

SB_{24} $C_{15}H_{13}O_4N$

3210(s), 2930(vs), 1630(s), 1510(m), 1310(m),
1165(m), 1125(s).

SB_{25} $C_{15}H_{15}NO_2$

2920(s), 1620(vs), 1520(m), 1315(m), 1240(s),
1170(m), 1120(s), 1040(m).

SB_{26} $C_{16}H_{17}NO_2$

2900(s), 1630(vs), 1525(m), 1310(s), 1245(m),
1165(s), 1125(s), 1040(vs).

SB_{27} $C_{16}H_{17}NO_2$

2910(s), 1625(vs), 1520(s), 1320(vs), 1235(m),
1170(m), 1130(s), 1045(m).

SB_{28} $C_{14}H_{14}N_2O_2$

2900(s), 1620(m), 1570(vs), 1510(s), 1315(vs),
1230(m), 1170(s), 1135(m), 1040(s).

SB_{29} $C_{13}H_{13}NO_2S$

2930(vs), 1620(m), 1510(s), 1320(s), 1240(s),
1170(m), 1125(m), 1070(s), 1040(s). 680(s)

SB_{30} $C_{16}H_{15}O_4N$

2900(s), 1620(s), 1520(m), 1335(vs), 1210(m),
1175(s), 1135(s), 1040(s).

SB_{31} $C_{17}H_{13}NO$

2910(s), 1620(s), 1510(m), 1320(vs), 1170(m),
1140(s).

SB_{32} $C_{18}H_{15}NO$

2910(s), 1625(vs), 1510(m), 1310(s), 1160(m),
1125(m).

SB_{33} $C_{18}H_{15}NO$

2920(s), 1620(s), 1520(m), 1320(s), 1170(s),
1130(m).

SB_{34} $C_{16}H_{12}N_2O$

2910(s), 1620(m), 1570(vs), 1510(m), 1310(s),
1170(s), 1135(m).

SB_{35} $C_{15}H_{11}NOS$

2940(s), 1620(s), 1520(m), 1320(m), 1170(s),
1135(s), 1135(s), 1070(s), 685(s).

SB_{36} $C_{18}H_{13}NO_3$

2900(s), 1620(s), 1520(m), 1175(s), 1320(m), 1140(s).

SB_{37} $C_{18}H_{15}NO$

2900(s), 1635(s), 1515(s), 1170(s), 1325(vs), 1135(s).

SB_{38} $C_{19}H_{17}NO$

2930(vs), 1620(s), 1520(s), 1310(m), 1175(s), 1135(m).

SB_{39} $C_{19}H_{17}NO$

2930(vs), 1620(s), 1530(m), 1320(s), 1170(s), 1125(m).

SB_{40} $C_{17}H_{14}N_2O$

2900(s), 1625(m), 1570(vs), 1520(s), 1315(vs), 1165(m), 1125(s).

SB_{41} $C_{16}H_{13}NOS$

2910(s), 1630(s), 1510(m), 1325(vs), 1170(s), 1120(s), 1120(m), 1065(s), 680(s).

SB_{42} $C_{19}H_{15}NO_3$

2900(s), 1620(s), 1520(v), 1320(m), 1170(s), 1125(m).

SB_{43} $C_{19}H_{15}N_2Cl$

3510(s), 1620(s), 1510(s), 1320(m), 1170(s), 1130(s), 720(s).

SB_{44} $C_{20}H_{17}N_2Cl$

3490(s), 1620(vs), 1520(s), 1310(m), 1165(m),
1120(s), 715(s)

SB_{45} $C_{20}H_{17}N_2Cl$

3485(s), 1620(m), 1510(s), 1320(s), 1170(vs),
1130(s), 715(s).

SB_{46} $C_{18}H_{14}N_3Cl$

3490(vs), 1620(m), 1570(vs), 1520(s), 1310(m),
1170(vs), 1130(s), 710(s)

SB_{47} $C_{17}H_{13}N_2ClS$

3510(v), 1620(s), 1510(s), 1320(m), 1175(m),
1125(m), 1070(s), 710(m), 680(s)

SB_{48} $C_{20}H_{15}O_2N_2Cl$

3505(vs), 1620(s), 1520(m), 1310(s), 1175(s),
1130(m), 715(s).

Mononuclear Complexes :

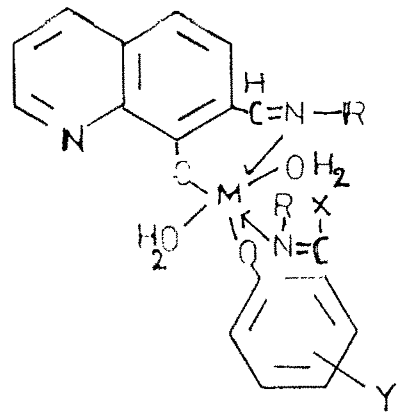


Fig. 4.5

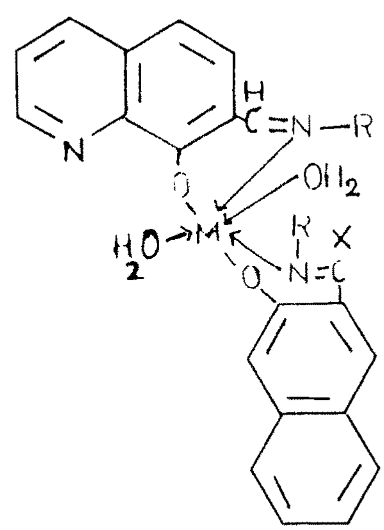


Fig. 4.6

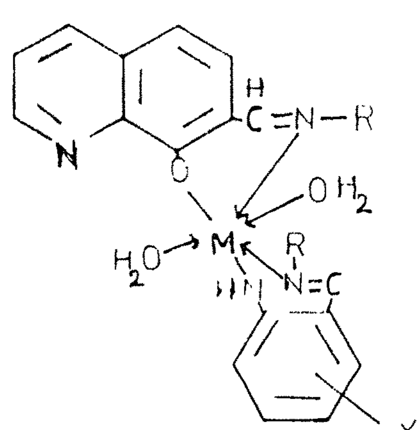


Fig. 4.7

X=H, CH_3, C_6H_5, Y - H, 4-OH, 4-OCH_3, 5-Cl,
R-C_6H_5, $C_6H_4$2CH_3, $C_6H_4$4CH_3, C_6H_4COOH, C_5H_4N, C_4H_3S
M= Cu(II), Ni(II), Zn(II)

Binuclear Complexes :

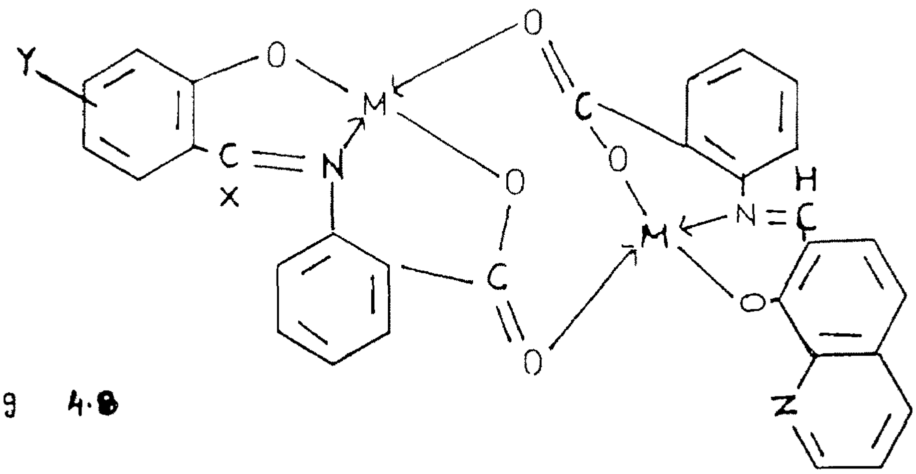


Fig 4.8

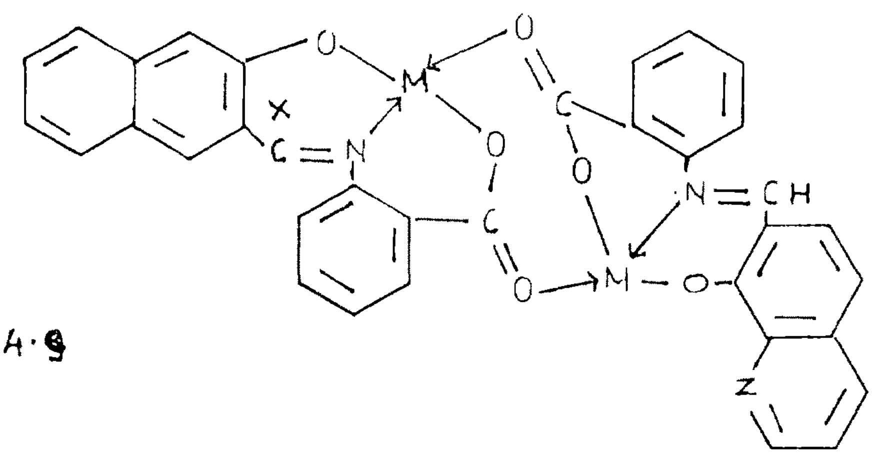


Fig. 4.9

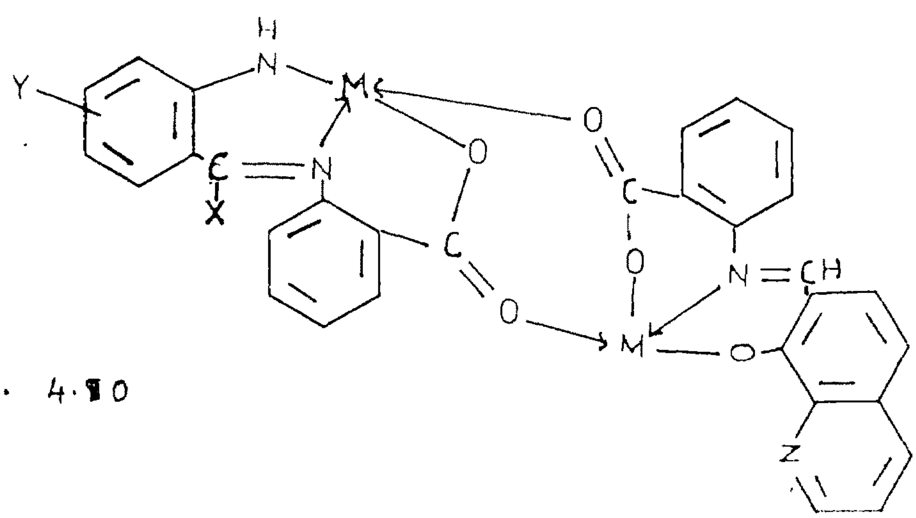


Fig. 4.10

Table 4.3

Elemental Analysis

Type of Compounds MSB = Mixed Schiff base	Calculated (Found) C%	N%	H%	M%	μ eff B.M.
Fig. 4.5 X = H, Y=H, R=C_6H_5					
MSB 1.					
a $[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Ni$	64.80 (65.12)	7.82 (7.90)	4.65 (4.82)	10.80 (11.12)	3.02
b $[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Cu$	64.14 (64.50)	7.74 (7.82)	4.60 (4.88)	11.70 (12.12)	2.06
c $[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Zn$	63.97 (64.12)	7.72 (7.92)	4.59 (4.69)	11.94 (12.60)	-
X=H, Y=H, R=C_6H_4 2-CH_3					
MSB 2.					
a $[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Ni$	65.84 (66.12)	7.43 (7.52)	5.13 (5.25)	10.26 (10.50)	2.98
b $[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Cu$	65.20 (65.82)	7.36 (7.46)	5.08 (5.12)	11.13 (11.52)	1.99
c $[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Zn$	65.03 (65.44)	7.34 (7.42)	5.06 (5.14)	11.36 (11.62)	-

cont...

Table cont....

	X=H, Y=H, R=C_6H_4-4-CH_3					
MSB 3. a	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Ni$	65.84 (66.12)	7.43 (8.12)	5.13 (5.68)	10.26 (11.04)	3.06
b	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Cu$	65.20 (66.18)	7.36 (7.56)	5.08 (5.24)	11.13 (11.52)	1.99
c	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Zn$	65.03 (65.50)	7.34 (7.68)	5.06 (5.14)	11.36 (11.62)	--
	X=H, Y=H, R=C_5H_4N					
MSB 4. a	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Ni$	60.11 (60.14)	12.98 (13.12)	4.26 (4.48)	10.76 (11.12)	3.02
b	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Cu$	59.50 (60.42)	12.85 (13.41)	4.22 (4.32)	11.66 (12.14)	2.12
c	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Zn$	59.34 (60.12)	12.82 (13.16)	4.21 (4.46)	11.90 (12.18)	--
	X=H, Y=H, R=C_4H_3S					
MSB 5. a	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Ni$	54.64 (55.12)	7.65 (7.82)	3.82 (4.12)	10.56 (10.52)	3.04
b	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Cu$	54.10 (54.12)	7.57 (7.68)	3.78 (3.82)	11.45 (11.50)	2.04

cont....

Table cont....

	c.	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Zn$	53.95 (54.16)	7.53 (7.68)	3.77 (3.96)	11.69 (12.12)	—
		Fig. 4.8 X=H, Y=H, R=C_6H_4COOH					
MSB 6.	a.	$[C_{31}H_{19}N_3O_6Ni_2]$	57.67 (68.11)	6.51 (6.82)	2.94 (3.11)	17.98 (18.11)	3.02
	b.	$[C_{31}H_{19}N_3O_6Cu_2]$	56.90 (57.11)	6.40 (7.11)	2.89 (3.12)	19.35 (19.88)	1.94
	c.	$[C_{31}H_{19}N_3O_6Zn_2]$	56.44 (56.50)	6.37 (6.38)	2.88 (3.16)	19.72 (20.02)	—
		Fig. 4.5 X=CH_3, Y=H, R=C_6H_5					
MSB 7.	a.	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Ni$	65.33 (65.50)	7.62 (7.80)	4.90 (5.12)	10.52 (11.04)	3.12
	b.	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Cu$	64.66 (65.12)	7.54 (7.62)	4.85 (5.06)	11.41 (11.52)	2.04
	c.	$[C_{30}H_{23}N_3O_2 \cdot 2H_2O]Zn$	64.51 (64.82)	7.52 (7.64)	4.83 (5.12)	11.64 (11.82)	--

cont...

Table cont....

	X=CH_3, Y=H, R=C_6H_4-2CH_3					
MSB 8. a.	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Ni$	66.32 (66.52)	7.25 (7.32)	5.35 (5.46)	10.01 (10.52)	3.02
b.	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Cu$	65.69 (66.12)	7.18 (7.24)	5.30 (5.48)	10.89 (11.12)	2.12
c.	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Zn$	65.52 (65.82)	7.16 (7.20)	5.29 (5.32)	11.09 (11.56)	--
	X=CH_3, Y=H, R=$C_6H_4$4CH_3					
MSB 9. a.	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Ni$	66.32 (66.50)	7.25 (7.32)	5.35 (5.42)	10.01 (10.50)	3.06
b.	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Cu$	65.69 (66.12)	7.18 (7.24)	5.30 (5.50)	10.86 (11.12)	2.04
c.	$[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Zn$	65.52 (65.82)	7.16 (7.26)	5.29 (5.30)	11.09 (11.52)	--
	X=CH_3, Y=H, R=C_5H_4N					
MSB 10. a.	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Ni$	60.75 (61.12)	12.65 (12.89)	4.52 (4.62)	10.48 (11.12)	3.16

cont...

Table cont...

	b.	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Cu$	60.16 (60.52)	12.53 (12.82)	4.47 (4.52)	11.36 (11.52)	2.02
	c.	$[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Zn$	60.00 (60.12)	12.50 (12.62)	4.46 (4.56)	11.60 (11.82)	--
	d.	$X=CH_3$, $Y=H$, $R=C_4H_3S$					
MSB 11.	a.	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Ni$	55.41 (55.52)	7.46 (7.52)	4.09 (4.12)	10.30 (10.52)	3.08
	b.	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Cu$	54.88 (55.12)	7.38 (7.42)	4.04 (4.16)	11.16 (11.52)	2.04
	c.	$[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Zn$	54.73 (55.16)	7.36 (7.52)	4.03 (4.12)	11.40 (11.62)	--
		Fig. 4.8 $X=CH_3$, $Y=H$, $R=C_6H_4COOH$					
MSB 12.	a.	$[C_{32}H_{21}N_3O_6Ni_2]$	58.27 (58.32)	6.37 (6.52)	3.18 (3.36)	17.60 (17.82)	3.06
	b.	$[C_{32}H_{21}N_3O_6Cu_2]$	57.37 (57.52)	6.26 (6.62)	3.13 (3.42)	18.95 (19.12)	1.92
	c.	$[C_{32}H_{21}N_3O_6Zn_2]$	57.05 (57.22)	6.24 (6.46)	3.12 (3.52)	19.31 (19.51)	--

Table cont...
Fig. 4.5

$X=CH_3$, $Y=4-OH$, $R=C_6H_5$

MSB 13.						
a.	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Ni$	63.49 (64.12)	7.40 (7.52)	4.76 (5.12)	10.22 (10.14)	3.12
b.	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Cu$	62.88 (63.16)	7.33 (7.46)	4.71 (4.89)	11.09 (11.12)	2.06
c.	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Zn$	62.71 (63.12)	7.31 (7.42)	4.70 (4.82)	11.32 (11.50)	--

$X=CH_3$, $Y=4-OH$, $R=C_6H_4$ 2-CH_3

MSB 14.						
a.	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Ni$	64.53 (64.62)	7.05 (7.15)	5.21 (5.25)	9.74 (10.12)	3.02
b.	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Cu$	63.94 (64.12)	6.99 (7.16)	5.16 (5.46)	10.57 (10.68)	2.04
c.	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Zn$	63.78 (64.26)	6.97 (7.12)	5.14 (5.52)	10.79 (11.12)	--

$X=CH_3$, $Y=4-OH$, $R=C_6H_4$ 4-CH_3

MSB 15.						
a.	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Ni$	64.53 (64.68)	7.05 (7.10)	5.21 (5.62)	9.74 (10.16)	3.04

cont...

Table cont....

	b	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Cu$	63.94 (64.16)	6.99 (7.16)	5.16 (5.42)	10.57 (10.82)	2.06
	c	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Zn$	63.78 (64.16)	6.97 (7.14)	5.14 (5.52)	10.79 (11.16)	—
	$X=CH_3$, $Y=4$-OH, $R=C_5H_4N$						
MSB 16.	a	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Ni$	59.05 (59.16)	12.30 (12.50)	4.39 (4.52)	10.19 (10.16)	3.04
	b	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Cu$	58.58 (58.62)	12.18 (12.34)	4.35 (4.68)	11.05 (11.12)	2.12
	c	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Zn$	58.33 (58.50)	12.15 (12.50)	4.34 (4.62)	11.28 (11.50)	—
	$X=CH_3$, $Y=4$-OH, $R=C_4H_3S$						
MSB 17.	a	$[C_{26}H_{19}N_3O_3 \cdot 2H_2O]Ni$	53.88 (54.12)	7.25 (7.34)	3.97 (4.11)	10.01 (10.50)	3.12
	b	$[C_{26}H_{19}N_3O_3 \cdot 2H_2O]Cu$	53.37 (53.50)	7.18 (7.40)	3.93 (4.16)	10.86 (11.12)	2.02

cont....

Table cont...

	c	$[C_{26}H_{19}N_3O_3S_2 \cdot 2H_2O]Zn$ Fig. 4.8	53.24 (53.40)	7.16 (7.60)	3.92 (4.20)	11.09 (11.42)	---
		$X=CH_3$, $Y=4-OH$, $R=C_6H_4COOH$					
MSB 18.	a	$[C_{32}H_{21}N_3O_7Ni_2]$	56.88 (57.12)	6.22 (6.52)	3.11 (3.52)	17.18 (17.52)	3.02
	b	$[C_{32}H_{21}N_3O_7Cu_2]$	55.97 (56.16)	6.12 (7.12)	3.06 (3.16)	18.51 (18.62)	1.92
	c	$[C_{32}H_{21}N_3O_7Zn_2]$ Fig 4.5	55.73 (55.82)	6.09 (6.16)	3.04 (3.32)	18.86 (19.12)	--
		$X=CH_3$, $Y=4-OCH_3$, $R=C_6H_5$					
MSB 19.	a	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Ni$	64.02 (64.50)	7.22 (7.26)	4.94 (5.11)	9.98 (10.12)	3.02
	b	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Cu$	63.42 (63.52)	7.16 (7.14)	4.94 (5.16)	10.82 (11.16)	2.01
	c	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Zn$	63.26 (63.42)	7.14 (7.20)	4.93 (5.12)	11.05 (11.16)	--

cont...

Table cont....

	$X{=}CH_3$, $Y{=}4{-}O{-}CH_3$, $R{=}C_6H_4 2CH_3$						
MSB 20.	a	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Ni$	65.02 (65.12)	6.89 (7.16)	5.41 (5.52)	9.52 (9.68)	3.12
	b	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Cu$	64.44 (64.56)	6.83 (7.12)	5.37 (5.46)	10.33 (10.42)	2.06
	c	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Zn$	64.28 (64.36)	6.81 (6.92)	5.35 (5.46)	10.55 (10.62)	--
	$X{=}CH_3$, $Y{=}4{-}OCH_3$, $R{=}C_6H_4{-}4{-}CH_3$						
MSB 21.	a	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Ni$	65.02 (65.12)	6.89 (7.12)	5.41 (5.52)	9.52 (10.12)	3.02
	b	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Cu$	64.44 (64.50)	6.83 (6.96)	5.37 (5.42)	10.33 (10.52)	2.02
	c	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Zn$	64.28 (64.62)	6.81 (6.92)	5.35 (5.46)	10.55 (11.12)	--
	$X{=}CH_3$, $Y{=}4{-}OCH_3$, $R{=}C_5H_4N$						
MSB 22.	a	$[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Ni$	59.69 (60.12)	12.00 (12.16)	4.63 (4.72)	9.94 (10.12)	3.02

cont...

Table cont....

	b	$[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Cu$	59.13 (59.50)	11.89 (12.12)	4.58 (4.62)	10.79 (11.16)	2.01
	c	$[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Zn$	58.98 (59.12)	11.86 (11.52)	4.57 (4.78)	11.01 (11.12)	--
		$X=CH_3$, $Y=4-OCH_3$, $R=C_4H_3S$					
MSB 23.	a	$[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Ni$	54.63 (54.72)	7.08 (7.12)	4.21 (4.25)	9.78 (10.16)	3.16
	b	$[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Cu$	54.13 (54.50)	7.01 (7.26)	4.17 (4.20)	10.60 (11.12)	2.06
	c	$[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Zn$	54.00 (54.12)	7.00 (7.14)	4.16 (4.26)	10.83 (11.14)	--
		$X=CH_3$, $Y=4-OCH_3$ Fig. 4.8 $R=C_6H_4COOH$					
MSB 24.	a	$[C_{33}H_{23}N_3O_7Ni_2]$	57.47 (57.52)	6.09 (6.12)	3.33 (3.52)	16.83 (17.11)	3.01
	b	$[C_{33}H_{23}N_3O_7Cu_2]$	56.57 (57.11)	6.00 (6.52)	3.28 (3.68)	18.14 (18.50)	1.94
	c	$[C_{33}H_{23}N_3O_7Zn_2]$	56.33 (56.50)	5.07 (6.12)	3.27 (3.42)	18.49 (18.92)	--

cont....

Table cont...

Fig. 4.6

		X=H, R=C_6H_5					
MSB 25.	a	$[C_{33}H_{25}N_3O_2 \cdot 2H_2O]Ni$	67.23 (67.42)	7.13 (7.20)	4.92 (5.11)	9.64 (10.12)	3.04
	b	$[C_{33}H_{25}N_3 \cdot 2H_2 2H_2O]Cu$	66.61 (66.72)	7.06 (7.16)	4.87 (4.92)	10.68 (11.16)	2.00
	c	$[C_{33}H_{25}N_3O_2 \cdot 2H_2O]Zn$	66.44 (66.52)	7.04 (8.12)	4.86 (4.96)	10.90 (11.12)	--
		X=H, R=C_6H_4 2-CH_3					
MSB 26.	a	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Ni$	68.81 (68.92)	6.80 (7.11)	5.34 (5.42)	9.40 (9.50)	3.06
	b	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Cu$	67.46 (68.12)	6.74 (6.82)	5.30 (5.36)	10.20 (10.50)	2.12
	c	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Zn$	67.30 (67.50)	6.73 (6.92)	5.28 (5.32)	10.41 (10.62)	--
		X=H, R=C_6H_4 4-CH_3					
MSB 27.	a	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Ni$	68.81 (69.12)	6.80 (7.12)	5.34 (5.36)	9.40 (10.12)	3.02

contd...

Table cont...

	b	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Cu$	67.46 (67.52)	6.74 (6.82)	5.30 (5.42)	10.20 (10.50)	2.06
	c	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Zn$	67.30 (67.42)	6.73 (6.92)	5.28 (5.34)	10.41 (10.62)	--
		X=H, R=C_5H_4N					
MSB 28.	a	$[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Ni$	62.94 (63.12)	11.84 (12.12)	4.56 (4.52)	9.81 (10.12)	3.01
	b	$[C_{31}H_{23}N_4O_2 \cdot 2H_2O]Cu$	62.36 (62.42)	11.73 (12.16)	4.52 (4.56)	10.64 (10.52)	2.08
	c	$[C_{31}H_{23}N_4O_2 \cdot 2H_2O]Zn$	62.20 (62.62)	11.70 (12.12)	4.51 (4.58)	10.86 (11.12)	--
		X=H, R=C_4H_3S					
MSB 29.	a	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Ni$	57.90 (58.11)	6.98 (7.14)	4.15 (4.52)	9.65 (9.72)	3.04
	b	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Cu$	57.37 (57.52)	6.92 (7.16)	4.12 (4.52)	10.46 (10.62)	2.01
	c	$[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Zn$	57.23 (57.34)	6.90 (7.11)	4.11 (4.42)	10.69 (11.12)	--

cont....

Table cont... Fig. 4·9

	$X=H,\ R=C_6H_4COOH$					
MSB 30. a	$[C_{35}H_{23}N_3O_6Ni_2]$	60.25 (60.50)	6.02 (6.12)	3.29 (3.78)	16.64 (16.59)	3.02
b	$[C_{35}H_{23}N_3O_6Cu_2]$	59.32 (60.11)	5.93 (6.06)	3.24 (3.63)	17.93 (18.11)	1.94
c	$[C_{35}H_{23}N_3O_6Zn_2]$	59.07 (59.50)	5.90 (6.12)	3.23 (3.52)	18.28 (18.42)	--
	$X=CH_3,\ R=C_6H_5$ Fig 4·6					
MSB 31. a	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Ni$	67.66 (68.11)	6.96 (7.12)	5.14 (5.30)	9.61 (10.12)	3.12
b	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Cu$	67.05 (67.12)	6.90 (7.16)	5.09 (5.20)	10.43 (10.52)	2.06
c	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Zn$	66.88 (67.14)	6.88 (7.14)	5.08 (5.12)	10.65 (10.72)	--
	$X=CH_3,\ R=C_6H_4\,2\text{-}CH_3$					
MSB 32. a	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Ni$	68.46 (68.52)	6.65 (6.76)	5.54 (5.62)	9.19 (9.12)	3.06
b	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Cu$	67.87 (68.12)	6.59 (6.62)	5.49 (5.56)	9.97 (10.12)	2.03

cont...

Table cont....

	c	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Zn$	67.71 (68.24)	6.58 (6.82)	5.48 (5.40)	10.18 (10.20)	--
		$X=CH_3$, $R=C_6H_4-4CH_3$					
MSB 33.	a	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Ni$	68.46 (68.52)	6.65 (6.72)	5.54 (5.72)	9.19 (9.50)	3.02
	b	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Cu$	67.82 (68.12)	6.59 (6.62)	5.49 (5.62)	9.97 (10.12)	2.00
	c	$[C_{36}H_{31}N_3O_2 \cdot 2H_2O]Zn$	67.71 (67.82)	6.58 (6.62)	5.48 (5.52)	10.18 (10.52)	--
		$X=CH_3$, $R=C_5H_4N$					
MSB 34.	a	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Ni$	63.47 (64.11)	11.57 (11.68)	4.79 (5.11)	9.58 (10.11)	3.01
	b	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Cu$	62.89 (63.12)	11.46 (11.62)	4.75 (4.82)	10.40 (10.52)	2.06
	c	$[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Zn$	62.74 (63.14)	11.43 (11.52)	4.73 (4.85)	10.62 (10.82)	--
		$X=CH_3$, $R=C_4H_3S$					
MSB 35.	a	$[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Ni$	58.53 (58.62)	6.82 (7.12)	4.39 (4.52)	9.43 (10.02)	3.06

cont...

Table cont...

	b	$[C_{30}H_{23}N_3O_2S_2\cdot 2H_2O]Cu$	58.01 (58.12)	6.76 (6.85)	4.35 (4.66)	10.23 (10.52)	2.04
	c	$[C_{30}H_{23}N_3O_2S_2\cdot 2H_2O]Zn$	57.87 (58.12)	6.75 (6.82)	4.34 (4.78)	10.45 (10.16)	--
		Fig. 4.9					
		$X=CH_3$, $R=C_6H_4COOH$					
MSB 36.	a	$[C_{35}H_{23}N_3O_6Ni_2]$	59.40 (59.50)	5.94 (6.11)	3.25 (3.52)	16.40 (16.50)	3.01
	b	$[C_{35}H_{23}N_3O_6Cu_2]$	58.89 (59.12)	5.84 (5.96)	3.20 (3.42)	17.68 (17.62)	1.92
	c	$[C_{35}H_{23}N_3O_6Zn_2]$	58.25 (58.52)	5.82 (5.96)	3.19 (3.30)	18.03 (18.50)	--
		$X=C_6H_5$, $Y=5\text{-}Cl$, $R=C_6H_5$ Fig. 4.7					
MSB 37.	a	$[C_{35}H_{25}N_4OCl\cdot 2H_2O]Ni$	64.96 (65.12)	8.66 (8.16)	4.48 (4.52)	8.97 (9.12)	3.04
	b	$[C_{35}H_{25}N_4OCl\cdot 2H_2O]Cu$	64.41 (64.52)	8.58 (8.62)	4.44 (4.56)	9.73 (10.16)	2.06
	c	$[C_{35}H_{25}N_4OCl\cdot 2H_2O]Zn$	64.26 (64.36)	8.56 (8.59)	4.43 (4.66)	9.94 (10.12)	--

cont....

Table cont...

		$X=C_6H_5$, Y=5-Cl, $R=C_6H_4 2CH_3$					
MSB 38.	a	$[C_{37}H_{29}N_4OCl.2H_2O]Ni$	65.82 (65.92)	8.30 (8.50)	4.89 (5.34)	8.59 (9.11)	3.06
	b	$[C_{37}H_{29}N_4OCl.2H_2O]Cu$	65.29 (65.36)	8.23 (8.30)	4.85 (5.24)	9.33 (9.50)	2.02
	c	$[C_{37}H_{29}N_4OCl.2H_2O]Zn$	65.15 (65.25)	8.21 (8.42)	4.84 (5.11)	9.53 (9.62)	—
		$X=C_6H_5$, Y=5-Cl, $R=C_6H_4$-4-CH_3					
MSB 39.	a	$[C_{37}H_{29}N_4OCl.2H_2O]Ni$	65.82 (66.12)	8.30 (8.50)	4.89 (5.11)	8.59 (9.12)	3.14
	b	$[C_{37}H_{29}N_4OCl.2H_2O]Cu$	65.29 (66.02)	8.23 (8.62)	4.85 (5.16)	9.33 (9.43)	2.06
	c	$[C_{37}H_{29}N_4OCl.2H_2O]Zn$	65.15 (65.50)	8.21 (8.50)	4.84 (5.10)	9.53 (10.12)	—
		$X=C_6H_5$, Y=5-Cl, $R=C_5H_4N$					
MSB 40.	a	$[C_{33}H_{24}N_6OCl.2H_2O]Ni$	60.96 (61.12)	12.93 (13.11)	4.31 (4.50)	8.92 (9.12)	3.12

cont.

Table cont..

	b	$[C_{33}H_{24}N_6OCl.2H_2O]Cu$	60.45 (60.52)	12.82 (13.14)	4.27 (4.32)	9.69 (10.12)	2.02
	c	$[C_{33}H_{24}N_6OCl.2H_2O]Zn$	60.31 (60.42)	12.79 (13.02)	4.26 (4.42)	9.90 (10.14)	--
		$X=C_6H_5$, Y=5-Cl, $R=C_4H_3S$					
MSB 41.	a	$[C_{31}H_{21}N_4OClS_2.2H_2O]Ni$	56.49 (56.62)	8.50 (8.90)	3.79 (4.12)	8.60 (9.12)	3.02
	b	$[C_{31}H_{21}N_4OClS_2.2H_2O]Cu$	56.02 (56.12)	8.43 (8.62)	3.76 (3.82)	9.56 (9.62)	2.01
	c	$[C_{31}H_{21}N_4OClS_2.2H_2O]Zn$	55.89 (56.02)	8.41 (8.52)	3.75 (3.86)	9.76 (9.82)	--
		Fig.4.10					
		$X=C_6H_5$, Y=5-Cl, $R=C_6H_4COOH$					
MSB 42.	a	$[C_{37}H_{23}N_4O_5ClNi_2]$	58.84 (59.12)	7.42 (8.52)	3.05 (3.18)	15.37 (15.52)	3.01
	b	$[C_{37}H_{23}N_4O_5ClCu_2]$	58.00 (58.42)	7.31 (7.86)	3.00 (3.16)	16.59 (17.11)	1.98
	c	$[C_{37}H_{23}N_4O_5ClZn_2]$	57.77 (58.12)	7.28 (7.30)	2.99 (3.11)	16.91 (17.22)	--

T. 4.4

Mononuclear Schiff base Complexes

IR Characteristic frequencies cm^{-1}

Type of Compounds	MSB_1-Cu	MSB_1-Ni	MSB_1-Zn
MSB_1	$[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Cu$	$[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Ni$	$[C_{29}H_{21}N_3O_2 \cdot 2H_2O]Zn$
Fig. 4.5			
X = H, Y = H,	3300 (w)	3300 (w)	3310 (w)
$R = C_6H_5$	1590 (s)	1595 (s)	1590 (s)
	1570 (m)	1570 (m)	1570 (s)
	1410 (s)	1415 (s)	1415 (s)
	1160 (s)	1165 (s)	1160 (s)
	1145 (s)	1140 (m)	1145 (s)
	1110 (m)	1115 (m)	1115 (m)
	800 (s)	795 (s)	795 (m)
	510 (m)	515 (m)	520 (m)
	420 (m)	435 (m)	415 (s)

W= Wide
m= medium
S = Strong
Vs= Very strong

cont...

Table cont...

Fig. 4.5

MSB_2	MSB_2-Cu	MSB_2-Ni	MSB_2-Zn
X = H, Y = H,	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Cu$	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Ni$	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Zn$
R = C_6H_4 2CH_3			
	3300 (w)	3290 (w)	3320 (w)
	1585 (s)	1580 (s)	1585 (s)
	1570 (m)	1570 (m)	1570 (m)
	1410 (s)	1420 (s)	1410 (s)
	1160 (s)	1165 (s)	1160 (s)
	1140 (s)	1150 (s)	1145 (s)
	1115 (m)	1115 (m)	1110 (m)
	815 (s)	800 (s)	795 (m)
	515 (m)	512 (m)	515 (m)
	415 (m)	410 (m)	410 (m)
MSB_3	MSB_3-Cu	MSB_3-Ni	MSB_3-Zn
X = H, Y = H,	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Cu$	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Ni$	$[C_{31}H_{25}N_3O_2 \cdot 2H_2O]Zn$
R = C_6H_4 4CH_3			
	3285 (w)	3300 (w)	3290 (w)
	1590 (s)	1600 (s)	1595 (s)
	1570 (Vs)	1570 (m)	1570 (vs)
	1510 (s)	1510 (s)	1510 (s)
	1415 (s)	1410 (s)	1410 (s)
	1160 (s)	1160 (s)	1165 (s)
	1145 (m)	1145 (m)	1140 (m)
	1110 (m)	1110 (m)	1115 (m)
	800 (s)	790 (s)	800 (s)
	520 (m)	530 (m)	520 (m)
	410 (m)	420 (m)	410 (m)

Table cont.

MSB_4	MSB_4-Cu	MSB_4-Ni	MSB_4-Zn
X = H, Y = H	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Cu$	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Ni$	$[C_{27}H_{19}N_5O_2 \cdot 2H_2O]Zn$
R = C_5H_4N	3300 (w)	3300 (w)	3290 (w)
	1600 (s)	1600 (s)	1600 (s)
	1580 (vs)	1580 (vs)	1580 (vs)
	1570 (m)	1570 (m)	1570 (m)
	1510 (v)	1510 (s)	1510 (s)
	1415 (s)	1410 (s)	1415 (s)
	1160 (s)	1165 (s)	1160 (s)
	1140 (s)	1145 (m)	1145 (m)
	1110 (m)	1110 (m)	1110 (m)
	795 (s)	800 (s)	790 (s)
	520 (m)	535 (m)	520 (m)
	410 (m)	415 (m)	410 (m)
MSB_5	MSB_5-Cu	MSB_5-Ni	MSB_5-Zn
X = H, Y = H	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Cu$	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Ni$	$[C_{25}H_{17}N_3O_2S_2 \cdot 2H_2O]Zn$
R = C_4H_3S	3310 (w)	3305 (w)	3300 (w)
	1600 (s)	1600 (s)	1600 (s)
	1570 (m)	1570 (m)	1570 (vs)
	1545 (s)	1545 (s)	1540 (s)
	1510 (m)	1515 (m)	1510 (m)
	1410 (m)	1410 (m)	1415 (m)
	1160 (s)	1160 (s)	1165 (m)
	1140 (s)	1140 (m)	1140 (s)
	780 (s)	780 (d)	795 (s)
	490 (m)	490 (m)	480 (m)
	405 (m)	405 (m)	410 (m)

cont....

Table cont...

Fig. 4.8 Binuclear Complexes

MSB$_6$ X = H, Y = H, R = C_6H_4COOH	MSB$_6$-Cu [$C_{31}H_{19}N_3O_6Cu_2$]	MSB$_6$-Ni [$C_{31}H_{19}N_3O_6Ni_2$]	MSB$_6$-Zn [$C_{31}H_{19}N_3O_6Zn_2$]
	1600(s)	1600(s)	1600(s)
	1570(m)	1570(m)	1570(vs)
	1546(s)	1545(s)	1540(s)
	1510(m)	1515(m)	1510(m)
	1410(m)	1410(m)	1415(m)
	1160(s)	1160(s)	1165(m)
	1140(s)	1140(m)	1140(s)
	780(s)	780 (s)	795(s)
	470(m)	470(m)	480(m)
	390(m)	380(m)	375(m)

Fig. 4.5 Mononuclear

MSB$_7$ X = CH_3, Y = H R = C_6H_5	MSB$_7$-Cu [$C_{30}H_{23}N_3O_2 \cdot 2H_2O$]Cu	MSB$_7$-Ni [$C_{30}H_{23}N_3O_2 \cdot 2H_2O$]Ni	MSB$_7$-Zn [$C_{30}H_{23}N_3O_2 \cdot 2H_2O$]Zn
	3300(w)	3285(w)	3320(w)
	1590(s)	1600(s)	1600(s)
	1570(m)	1570(m)	1570(vs)
	1410(s)	1410(s)	1415(s)
	1160(s)	1160(m)	1160(m)
	1145(s)	1140(s)	1140(m)
	1110(m)	1115(m)	1110(m)
	800(s)	800(s)	790(s)
	510(s)	510(s)	515(s)
	430(m)	430(m)	425(m)

cont...

MSB_8 $X = CH_3$, $Y = H$, $R = C_6H_4$ $2CH_3$	MSB_8-Cu $[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Cu$	MSB_8-Ni $[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Ni$	MSB_8-Zn $[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Zn$
	3300(w)	3290(w)	3310(w)
	1595(s)	1600(s)	1595(s)
	1570(m)	1570(vs)	1570(m)
	1410(s)	1415(s)	1410(s)
	1165(s)	1160(s)	1160(s)
	1140(m)	1140(s)	1140(m)
	1110(m)	1110(m)	1115(m)
	800(m)	815(s)	795(s)
	510(s)	515(m)	510(m)
	420(m)	415(m)	415(m)
MSB_9 $X = CH_3$, $Y = H$, $R = C_6H_4$ $4CH_3$	MSB_9-Cu $[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Cu$	MSB_9-Ni $[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Ni$	MSB_9-Zn $[C_{32}H_{27}N_3O_2 \cdot 2H_2O]Zn$
	3300(w)	3290(w)	3300(w)
	1600(s)	1600(s)	1590(s)
	1570(vs)	1570(vs)	1570(m)
	1510(s)	1515(s)	1510(s)
	1420(s)	1410(s)	1415(s)
	1165(s)	1160(s)	1160(m)
	1140(m)	1145(s)	1140(s)
	800(s)	790(m)	795(m)
	520(m)	515(s)	510(s)
	410(m)	420(s)	415(m)

cont...

Table cont..

MSB_{10} $X = CH_3$, $Y = H$, $R = C_5H_4N$	MSB_{10}-Cu $[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Cu$	MSB_{10}-Ni $[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Ni$	MSB_{10}-Zn $[C_{28}H_{21}N_5O_2 \cdot 2H_2O]Zn$
	3300(w)	3280(w)	3305(w)
	1595(s)	1590(s)	1595(s)
	1580(vs)	1575(vs)	1570(vs)
	1570(m)	1570(m)	1570(m)
	1510(s)	1515(s)	1520(s)
	1410(s)	1410(s)	1415(s)
	1160(s)	1160(m)	1160(s)
	1140(m)	1140(s)	1140(m)
	1115(m)	1105(m)	1110(m)
	815(s)	805(m)	810(s)
	520(m)	510(m)	515(s)
	415(m)	415(m)	415(m)
MSB_{11} $X = CH_3$, $Y = H$, $R = C_4H_3S$	MSB_{11}-Cu $[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Cu$	MSB_{11}-Ni $[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Ni$	MSB_{11}-Zn $[C_{26}H_{19}N_3O_2S_2 \cdot 2H_2O]Zn$
	3300(w)	3310(w)	3300(w)
	1600(s)	1600(m)	1595(s)
	1570(m)	1570(s)	1570(vs)
	1510(s)	1515(s)	1510(s)
	1415(s)	1410(s)	1410(s)
	1160(s)	1165(s)	1160(s)
	1140(m)	1140(m)	1140(m)
	1070(s)	1070(s)	1070(s)
	800(s)	815(m)	805(s)
	515(m)	520(m)	515(m)
	410(m)	415(m)	410(m)

cont..

Table cont.

Fig. 4.8			
MSB_{12}	MSB_{12}-Cu	MSB_{12}-Ni	MSB_{12}-Zn
$X = CH_3$, $Y = H$,	$[C_{32}H_{21}N_3O_6Cu_2]$	$[C_{32}H_{21}N_3O_6Ni_2]$	$[C_{32}H_{21}N_3O_6Zn_2]$
$R = C_6H_4COOH$	1600(s)	1600(s)	1600(s)
	1570(m)	1570(m)	1570(m)
	1545(s)	1540(s)	1545(s)
	1510(m)	1515(m)	1510(m)
	1410(m)	1410(m)	1415(m)
	1160(s)	1160(s)	1165(m)
	1140(m)	1140(m)	1140(m)
	780(s)	780(s)	795(s)
	470(m)	470(m)	480(m)
Fig. 4.5	390(m)	380(m)	375(m)
MSB_{13}	MSB_{13}-Cu	MSB_{13}-Ni	MSB_{13}-Zn
$X = CH_3$, $Y = 4\text{-}OH$,	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Cu$	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Ni$	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Zn$
$R = C_6H_5$	3300(w)	3300(w)	3310(w)
	2900(s)	2950(s)	2900(s)
	1590(s)	1600(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1410(s)	1410(s)	1410(s)
	1160(s)	1160(s)	1160(s)
	1145(s)	1140(s)	1140(s)
	1110(m)	1115(m)	1110(m)
	815(s)	800(s)	790(s)
	510(s)	510(m)	515(m)
	430(m)	430(m)	420(m)

cont...

Table cont.

MSB_{14}	MSB_{14}-Cu	MSB_{14}-Ni	MSB_{14}-Zn
X = CH_3, Y = 4-OH	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Cu$	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Ni$	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Zn$
R = C_6H_4 2CH_3	3300(w)	3290(w)	3310(w)
	2900(s)	2915(s)	2910(s)
	1600(s)	1595(s)	1590(s)
	1570(vs)	1570(s)	1570(vs)
	1410(s)	1415(s)	1410(s)
	1165(s)	1160(s)	1160(s)
	1140(s)	1140(s)	1140(s)
	1110(m)	1115(m)	1115(m)
	800(s)	810(s)	810(m)
	510(m)	520(m)	510(m)
	430(m)	410(m)	410(m)
MSB_{15}	MSB_{15}-Cu	MSB_{15}-Ni	MSB_{15}-Zn
X = CH_3, Y = 4-OH,	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Cu$	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Ni$	$[C_{32}H_{27}N_3O_3 \cdot 2H_2O]Zn$
R = C_6H_4 4CH_3	3300(w)	3290(w)	3300(w)
	2900(s)	2920(s)	2905(s)
	1600(s)	1605(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1410(s)	1410(s)	1415(s)
	1165(s)	1160(s)	1160(s)
	1140(m)	1140(s)	1140(m)
	1110(m)	1110(m)	1110(m)
	800(m)	795(m)	815(s)
	510(s)	510(s)	495(m)
	420(m)	410(m)	415(m)

cont...

Table cont..

MSB_{16}	MSB_{16}–Cu	MSB_{16}–Ni	MSB_{16}–Zn
$X = CH_3$, $Y = 4$–OH,	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Cu$	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Ni$	$[C_{28}H_{21}N_5O_3 \cdot 2H_2O]Zn$
$R = C_5H_4N$	3300(w)	3310(w)	3310(w)
	2900(s)	2910(s)	2900(s)
	1600(s)	1600(s)	1600(s)
	1580(vs)	1580(m)	1580(s)
	1570(m)	1570(m)	1570(vs)
	1410(s)	1415(s)	1410(s)
	1165(s)	1160(s)	1160(s)
	1140(m)	1140(m)	1140(m)
	1110(s)	1110(s)	1115(s)
	815(m)	805(s)	795(s)
	500(m)	520(m)	510(m)
	410(s)	420(m)	410(m)
MSB_{17}	MSB_{17}–Cu	MSB_{17}–Ni	MSB_{17}–Zn
$X = CH_3$; $Y = 4$–OH,	$[C_{26}H_{19}N_3O_3 \cdot 2H_2O]Cu$	$[C_{26}H_{19}N_3O_3 \cdot 2H_2O]Ni$	$[C_{26}H_{19}N_3O_3 \cdot 2H_2O]Zn$
$R = C_4H_3S$	3300(w)	3305(w)	3315(w)
	2900(s)	2900(s)	2915(s)
	1600(s)	1600(s)	1600(s)
	1570(vs)	1570(m)	1570(vs)
	1410(s)	1415(s)	1410(s)
	1165(s)	1165(s)	1160(s)
	1140(s)	1145(s)	1140(m)
	1070(s)	1070(s)	1070(s)
	815(m)	805(s)	795(m)
	510(m)	520(m)	490(m)
	410(s)	410(m)	410(s)

cont...

Table cont.

Fig. 4.8

BINUCLEAR COMPLEXES

MSB_{18}	MSB_{18}-Cu	MSB_{18}-Ni	MSB_{18}-Zn
$X = CH_3$, $Y = 4-OH$	$[C_{32}H_{21}N_3O_7Cu_2]$	$[C_{32}H_{21}N_3O_6Ni_2]$	$[C_{32}H_{21}N_3O_7Zn_2]$
$R = C_6H_4COOH$	2900(s)	2910(s)	2900(s)
	1600(s)	1590(s)	1590(s)
	1570(vs)	1570(vs)	1570(m)
	1545(s)	1540(s)	1545(s)
	1510(m)	1510(m)	1515(m)
	1410(m)	1410(m)	1415(m)
	1160(s)	1165(s)	1160(s)
	1140(s)	1145(s)	1145(s)
	720(s)	785(s)	790(s)
	470(s)	475(m)	480(m)
	390(m)	390(s)	370(s)

Fig. 4.5

MSB_{19}	MSB_{19}-Cu	MSB_{19}-Ni	MSB_{19}-Zn
$X = CH_3$, $Y = 4-OCH_3$	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Cu$	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Ni$	$[C_{31}H_{25}N_3O_3 \cdot 2H_2O]Zn$
	3300(w)	3290(w)	3295(w)
	1590(s)	1600(v)	1600(s)
	1570(vs)	1570(m)	1570(m)
	1410(s)	1410(s)	1410(s)
	1240(s)	1245(s)	1240(s)
	1160(s)	1160(m)	1165(s)
	1140(m)	1145(s)	1140(s)
	1110(m)	1110(m)	1115(m)
	1040(s)	1040(s)	1045(m)
	815(s)	815(m)	810(s)
	510(m)	500(s)	520(m)
	530(m)	420(s)	410(s)

cont..

Table cont...

Ligand	Cu complex	Ni complex	Zn complex
MSB_{20}	MSB_{20}-Cu	MSB_{20}-Ni	MSB_{20}-Zn
$X = CH_3$, $Y = 4\text{-}OCH_3$	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Cu$	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Ni$	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Zn$
$R = C_6H_4\ 2CH_3$	3300 (w)	3310 (w)	3300 (w)
	1600 (s)	1590 (s)	1600 (s)
	1570 (m)	1570 (s)	1570 (s)
	1410 (s)	1415 (m)	1410 (s)
	1240 (s)	1230 (s)	1235 (s)
	1160 (s)	1165 (s)	1160 (s)
	1145 (m)	1140 (m)	1145 (m)
	1100 (m)	1110 (s)	1100 (s)
	1040 (s)	1045 (s)	1040 (s)
	815 (s)	800 (s)	815 (s)
	500 (m)	510 (s)	515 (m)
	420 (s)	425 (m)	415 (m)
MSB_{21}	MSB_{21}-Cu	MSB_{21}-Ni	MSB_{21}-Zn
$X = CH_3$, $Y = 4\text{-}OCH_3$	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Cu$	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Ni$	$[C_{33}H_{29}N_3O_3 \cdot 2H_2O]Zn$
$R = C_6H_4\ 4CH_3$	3320 (w)	3310 (w)	3300 (w)
	1595 (vs)	1600 (m)	1600 (vs)
	1570 (vs)	1570 (m)	1570 (vs)
	1410 (s)	1415 (s)	1410 (s)
	1240 (s)	1245 (s)	1240 (s)
	1165 (s)	1155 (m)	1160 (m)
	1140 (m)	1145 (m)	1140 (s)
	1100 (s)	1110 (s)	1110 (m)
	1040 (s)	1040 (vs)	1040 (s)
	810 (s)	815 (m)	790 (m)
	515 (m)	510 (m)	520 (s)
	420 (s)	410 (s)	430 (s)

MSB_{22} X = CH_3, Y = 4-OCH_3 R = C_5H_4N	MSB_{22}-Cu $[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Cu$	MSB_{22}-Ni $[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Ni$	MSB_{22}-Zn $[C_{29}H_{23}N_5O_3 \cdot 2H_2O]Zn$
	3250(w)	3300(w)	3250(w)
	1600(s)	1590(s)	1600(s)
	1580(vs)	1580(vs)	1580(vs)
	1570(s)	1570(m)	1570(m)
	1410(s)	1415(s)	1410(s)
	1245(m)	1240(s)	1240(s)
	1160(s)	1165(m)	1160(m)
	1140(s)	1140(s)	1140(s)
	1110(s)	1110(s)	1110(s)
	1040(m)	1040(s)	1040(s)
	815(m)	810(m)	820(m)
	520(s)	510(s)	520(s)
	410(m)	420(m)	415(s)

MSB_{23} X = CH_3, Y = 4-OCH_3 R = C_4H_3S	MSB_{23}-Cu $[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Cu$	MSB_{23}-Ni $[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Ni$	MSB_{23}-Zn $[C_{27}H_{21}N_3O_3S_2 \cdot 2H_2O]Zn$
	3250(w)	3300(w)	3250(w)
	1600(s)	1590(s)	1590(s)
	1570(vs)	1570(vs)	1570(m)
	1410(s)	1415(s)	1410(s)
	1240(s)	1240(s)	1245(s)
	1160(m)	1160(s)	1165(s)
	1140(s)	1145(m)	1140(s)
	1110(m)	1100(s)	1110(m)
	1070(s)	1070(s)	1070(s)
	800(s)	815(s)	795(s)
	510(s)	520(m)	490(s)
	415(m)	410(m)	420(m)

BINUCLEAR COMPLEXES

Fig. 4.5

Ligand	MSB_{24}-Cu	MSB_{24}-Ni	MSB_{24}-Zn
MSB_{24}	$[C_{33}H_{23}N_3O_7Cu_2]$	$[C_{33}H_{23}N_3O_7Ni_2]$	$[C_{33}H_{23}N_3O_7Zn_2]$
$X = CH_3$, $Y = 4\text{-}OCH_3$	1600 (s)	1590 (s)	1600 (s)
$R = C_6H_4COOH$	1570 (m)	1570 (m)	1570 (vs)
	1540 (s)	1545 (s)	1540 (m)
	1510 (m)	1515 (m)	1510 (s)
	1410 (s)	1410 (s)	1415 (s)
	1240 (s)	1240 (s)	1245 (s)
	1160 (s)	1160 (d)	1165 (s)
	1140 (m)	1140 (m)	1140 (m)
	790 (s)	770 (s)	780 (s)
	460 (m)	460 (s)	480 (s)
	390 (m)	385 (m)	370 (m)

Fig. 4.6

Ligand	MSB_{25}-Cu	MSB_{25}-Ni	MSB_{25}-Zn
MSB_{25}	$[C_{33}H_{25}N_3O_2 \cdot 2H_2O]Cu$	$[C_{33}H_{25}N_3O_2 \cdot 2H_2O]Ni$	$[C_{33}H_{25}N_3O_2 \cdot 2H_2O]Zn$
$X = H_1$, $R = C_6H_5$	3300 (w)	3250 (w)	3300 (w)
	1600 (s)	1590 (s)	1590 (s)
	1570 (m)	1570 (m)	1570 (m)
	1410 (s)	1410 (s)	1410 (d)
	1160 (s)	1160 (s)	1160 (s)
	1140 (m)	1140 (s)	1140 (m)
	1110 (s)	1110 (s)	1100 (m)
	800 (m)	790 (s)	780 (s)
	510 (m)	510 (m)	490 (s)
	415 (s)	440 (m)	410 (m)

cont....

Table cont..

MSB$_{26}$	MSB$_{26}$-Cu	MSB$_{26}$-Ni	MSB$_{26}$-Zn
X = H, R = C_6H_4 2CH_3	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Cu$	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Ni$	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Zn$
	3250(w)	3300(w)	3310(w)
	1595(s)	1600(s)	1600(s)
	1570(m)	1570(vs)	1570(m)
	1410(s)	1415(s)	1410(s)
	1160(s)	1165(s)	1160(s)
	1140(m)	1140(m)	1140(s)
	1110(s)	1110(s)	1110(m)
	810(s)	810(s)	810(s)
	510(m)	500(m)	490(s)
	420(s)	410(s)	390(m)

MSB$_{27}$	MSB$_{27}$-Cu	MSB$_{27}$-Ni	MSB$_{27}$-Zn
X = H, R = C_6H_4 4CH_3	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Cu$	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Ni$	$[C_{35}H_{29}N_3O_2 \cdot 2H_2O]Zn$
	3280(w)	3260(w)	3260(w)
	1590(s)	1600(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1510(s)	1510(s)	1510(s)
	1415(s)	1410(s)	1415(m)
	1160(s)	1160(m)	1160(s)
	1145(m)	1140(s)	1140(s)
	1110(m)	1110(s)	1110(s)
	800(s)	790(s)	800(s)
	510(m)	530(m)	520(m)
	420(m)	410(s)	410(s)

cont....

MSB_{28} X = H, R = C_5H_4N	MSB_{28}-Cu $[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Cu$	MSB_{28}-Ni $[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Ni$	MSB_{28}-Zn $[C_{31}H_{23}N_5O_2 \cdot 2H_2O]Zn$
	3260(w)	3250(w)	3270(w)
	1600(s)	1600(s)	1600(vs)
	1580(m)	1580(m)	1580(s)
	1570(vs)	1570(vs)	1570(m)
	1510(s)	1510(s)	1510(s)
	1415(s)	1410(s)	1415(s)
	1160(s)	1165(s)	1160(s)
	1140(m)	1140(m)	1145(m)
	1110(s)	1110(m)	1110(s)
	790(m)	800(s)	790(m)
	510(s)	535(m)	510(s)
	390(s)	410(s)	420(m)
MSB_{29} X = H, R = C_4H_3S	MSB_{29}-Cu $[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Cu$	MSB_{29}-Ni $[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Ni$	MSB_{29}-Zn $[C_{29}H_{21}N_3O_2S_2 \cdot 2H_2O]Zn$
	3300(w)	3310(w)	3280(w)
	1600(s)	1590(s)	1600(s)
	1570(vs)	1570(m)	1570(vs)
	1510(s)	1510(s)	1510(s)
	1415(s)	1410(m)	1410(m)
	1165(s)	1160(s)	1165(s)
	1140(m)	1140(s)	1140(s)
	1070(s)	1075(s)	1070(s)
	790(s)	815(s)	800(s)
	515(m)	510(m)	510(m)
	410(m)	420(m)	410(m)

cont...

Fig. 9

MSB_{30}	MSB_{30}-Cu	MSB_{30}-Ni	MSB_{30}-Zn
X = H, R = C_6H_4COOH	$[C_{35}H_{23}N_3O_6Cu_2]$	$[C_{35}H_{23}N_3O_6Ni_2]$	$[C_{35}H_{23}N_3O_6Zn_2]$
	1600(s)	1600(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1545(s)	1540(s)	1540(s)
	1510(m)	1510(m)	1510(s)
	1420(m)	1415(s)	1410(s)
	1160(s)	1160(m)	1165(m)
	1140(m)	1140(s)	1145(s)
	790(s)	785(s)	780(s)
	470(m)	480(m)	480(m)
	390(s)	390(s)	390(s)

Fig. 6

MSB_{31}	MSB_{31}-Cu	MSB_{31}-Ni	MSB_{31}-Zn
X = CH_3, R = C_6H_5	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Cu$	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Ni$	$[C_{34}H_{27}N_3O_2 \cdot 2H_2O]Zn$
	3250(w)	3300(w)	3320(w)
	1590(s)	1600(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1410(s)	1415(s)	1410(s)
	1160(m)	1160(s)	1165(s)
	1140(s)	1140(m)	1140(m)
	1110(m)	1115(s)	1110(s)
	780(s)	790(s)	790(s)
	490(m)	510(m)	520(s)
	410(s)	420(m)	410(m)

cont...

MSB_{32}	MSB_{32}-Cu	MSB_{32}-Ni	MSB_{32}-Zn
X = CH_3, R = $C_6H_4 2CH_3$	[$C_{36}H_{31}N_3O_2 \cdot 2H_2O$]Cu	[$C_{36}H_{31}N_3O_2 \cdot 2H_2O$]Ni	[$C_{36}H_{31}N_3O_2 \cdot 2H_2O$]Zn
	3300(w)	3250(w)	3280(w)
	1595(s)	1600(s)	1600(s)
	1570(m)	1570(vs)	1570(vs)
	1410(s)	1410(m)	1405(s)
	1160(s)	1160(s)	1165(m)
	1140(m)	1140(s)	1140(s)
	1110(m)	1110(s)	1110(s)
	790(m)	790(m)	780(m)
	490(s)	510(s)	520(s)
	410(s)	390(s)	395(m)
MSB_{33}	MSB_{33}-Cu	MSB_{33}-Ni	MSB_{33}-Zn
X = CH_3, R = C_6H_4 $4CH_3$	[$C_{36}H_{31}N_3O_2 \cdot 2H_2O$]Cu	[$C_{36}H_{31}N_3O_2 \cdot 2H_2O$]Ni	[$C_{36}H_{31}N_3O_2 \cdot 2H_2O$]Zn
	3250(w)	3270(w)	3250(w)
	1600(s)	1600(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1510(s)	1515(s)	1510(s)
	1420(s)	1410(s)	1410(s)
	1160(s)	1160(s)	1160(m)
	1140(m)	1140(m)	1140(s)
	800(m)	800(s)	790(s)
	510(m)	490(s)	480(s)
	410(s)	380(s)	390(m)

cont...

MSB_{34} X = CH_3, R = C_5H_4N	MSB_{34}-Cu $[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Cu$	MSB_{34}-Ni $[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Ni$	MSB_{34}-Zn $[C_{32}H_{25}N_5O_2 \cdot 2H_2O]Zn$
	3300(w)	3250(w)	3300(w)
	1600(s)	1600(s)	1590(s)
	1580(m)	1580(m)	1580(vs)
	1570(vs)	1570(vs)	1570(m)
	1500(s)	1510(s)	1515(s)
	1415(s)	1410(s)	1410(s)
	1160(s)	1165(m)	1160(s)
	1140(m)	1140(s)	1140(m)
	1110(s)	1110(s)	1110(s)
	815(m)	810(s)	820(s)
	510(s)	510(m)	500(m)
	410(s)	420(s)	430(s)

MSB_{35} X = CH_3, R = C_4H_3S	MSB_{35}-Cu $[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Cu$	MSB_{35}-Ni $[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Ni$	MSB_{35}-Zn $[C_{30}H_{23}N_3O_2S_2 \cdot 2H_2O]Zn$
	3250(w)	3300(w)	3250(w)
	1600(s)	1600(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1510(s)	1515(s)	1510(s)
	1415(s)	1410(s)	1410(s)
	1160(s)	1150(s)	1160(s)
	1145(m)	1140(s)	1140(m)
	1070(s)	1070(s)	1070(s)
	790(m)	780(s)	800(m)
	520(s)	515(m)	500(s)
	410(s)	410(m)	405(s)

cont...

3INUCLEAR COMPLEXES

Fig. 4.9

MSB_{36}

X = CH_3,

R = C_6H_4COOH

MSB_{36}-Cu	MSB_{36}-Ni	MSB_{36}-Zn
$[C_{35}H_{23}N_3O_6Cu_2]$	$[C_{35}H_{23}N_3O_6Ni_2]$	$[C_{35}H_{23}N_3O_6Zn_2]$
1600(s)	1600(s)	1590(s)
1570(vs)	1570(vs)	1570(vs)
1540(s)	1540(s)	1545(s)
1510(m)	1510(s)	1510(m)
1410(s)	1415(m)	1410(s)
1160(s)	1160(s)	1165(s)
1140(s)	1135(s)	1135(s)
770(s)	775(s)	790(m)
490(m)	465(m)	475(s)
385(m)	390(s)	385(m)

Fig. 4.7

MSB_{37}

X = C_6H_5, Y = 5-Cl,

R = C_6H_5

MSB_{37}-Cu	MSB_{37}-Ni	MSB_{37}-Zn
$[C_{35}H_{25}N_4OCl.2H_2O]Cu$	$[C_{35}H_{25}N_4OCl.2H_2O]Ni$	$[C_{35}H_{25}N_4OCl.2H_2O]Zn$
3300(w)	3300(w)	3350(w)
3200(s)	3210(s)	3210(s)
1600(s)	1600(s)	1590(s)
1570(vs)	1570(vs)	1570(vs)
1510(s)	1515(s)	1510(s)
1415(m)	1410(s)	1415(s)
1340(s)	1340(s)	1335(s)
1160(s)	1160(s)	1160(m)
1140(m)	1140(m)	1140(s)
1110(s)	1110(s)	1110(m)
785(m)	780(m)	795(m)
690(s)	690(s)	700(s)
460(m)	470(m)	465(s)
390(s)	395(s)	390(s)

cont...

MSB_{38}	MSB_{38}-Cu	MSB_{38}-Ni	MSB_{38}-Zn
$X = C_6H_5$, $Y = 5$-Cl	$[C_{37}H_{29}N_4OCl.2H_2O]Cu$	$[C_{37}H_{29}N_4OCl_2.2H_2O]Ni$	$[C_{37}H_{29}N_4OCl.2H_2O]Zn$
$R = C_6H_42CH_3$	3400 (w)	3350 (w)	3300 (w)
	3250 (s)	3210 (s)	3200 (s)
	1600 (s)	1600 (s)	1600 (s)
	1570 (vs)	1570 (vs)	1570 (m)
	1510 (s)	1510 (s)	1510 (s)
	1410 (m)	1415 (m)	1410 (m)
	1340 (s)	1335 (m)	1330 (s)
	1160 (s)	1160 (m)	1170 (s)
	1140 (s)	1140 (s)	1135 (s)
	1110 (m)	1110 (m)	1110 (m)
	780 (s)	795 (s)	790 (s)
	690 (s)	585 (s)	680 (s)
	460 (m)	470 (m)	470 (m)
	390 (m)	395 (s)	390 (s)

MSB_{39}	MSB_{39}-Cu	MSB_{39}-Ni	MSB_{39}-Zn
$X = C_6H_5$, $Y = 5$-Cl	$[C_{37}H_{29}N_4OCl.2H_2O]Cu$	$[C_{37}H_{29}N_4OCl.2H_2O]Ni$	$[C_{37}H_{29}N_4OCl.2H_2O]Zn$
	3350 (v)	3360 (v)	3350 (v)
	3250 (s)	3250 (s)	3200 (s)
	1600 (s)	1590 (s)	1600 (s)
	1570 (vs)	1570 (vs)	1570 (vs)
	1510 (s)	1520 (s)	1520 (m)
	1420 (m)	1410 (m)	1410 (s)
	1340 (s)	1335 (m)	1330 (s)
	1160 (s)	1160 (s)	1160 (s)
	1145 (m)	1140 (s)	1140 (m)
	1110 (s)	1110 (s)	1110 (m)
	780 (s)	790 (m)	785 (s)
	690 (s)	685 (s)	680 (s)
	450 (m)	460 (m)	465 (s)

MSB_{40} X = C_6H_5, Y = 5-Cl, R = C_5H_4N	MSB_{40}-Cu $[C_{33}H_{24}N_6OCl.2H_2O]Cu$	MSB_{40}-Ni $[C_{33}H_{24}N_6OCl.2H_2O]Ni$	MSB_{40}-Zn $[C_{33}H_{24}N_6OCl.2H_2O]Zn$
	3350(w)	3300(w)	3350(w)
	3240(s)	3200(s)	3210(s)
	1600(s)	1600(s)	1600(s)
	1580(vs)	1580(vs)	1580(vs)
	1570(m)	1570(m)	1570(vs)
	1460(m)	1410(m)	1440(s)
	1335(s)	1330(m)	1320(s)
	1160(s)	1160(s)	1170(s)
	1145(m)	1140(s)	1140(s)
	1110(s)	1110(m)	1110(s)
	1780(s)	790(m)	780(m)
	690(s)	695(s)	690(m)
	460(m)	465(s)	465(s)
	390(m)	410(s)	390(s)
MSB_{41} X = C_6H_5, Y = 5-Cl, R = C_4H_3S	MSB_{41}-Cu $[C_{31}H_{21}N_4OClS_2.2H_2O]Cu$	MSB_{41}-Ni $[C_{31}H_{21}N_4OClS_2.2H_2O]Ni$	MSB_{41}-Zn $[C_{31}H_{21}N_4OClS_2.2H_2O]Zn$
	3340(w)	3330(w)	3330(w)
	3200(s)	3210(s)	3210(s)
	1600(s)	1600(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1410(m)	1415(m)	1410(s)
	1340(s)	1330(m)	1335(s)
	1160(s)	1165(s)	1160(s)
	1140(s)	1140(m)	1140(m)
	1110(s)	1110(m)	1110(m)
	780(s)	790(s)	790(s)
	690(s)	670(s)	675(s)
	450(m)	460(m)	455(m)
	390(s)	400(s)	390(s)

cont...

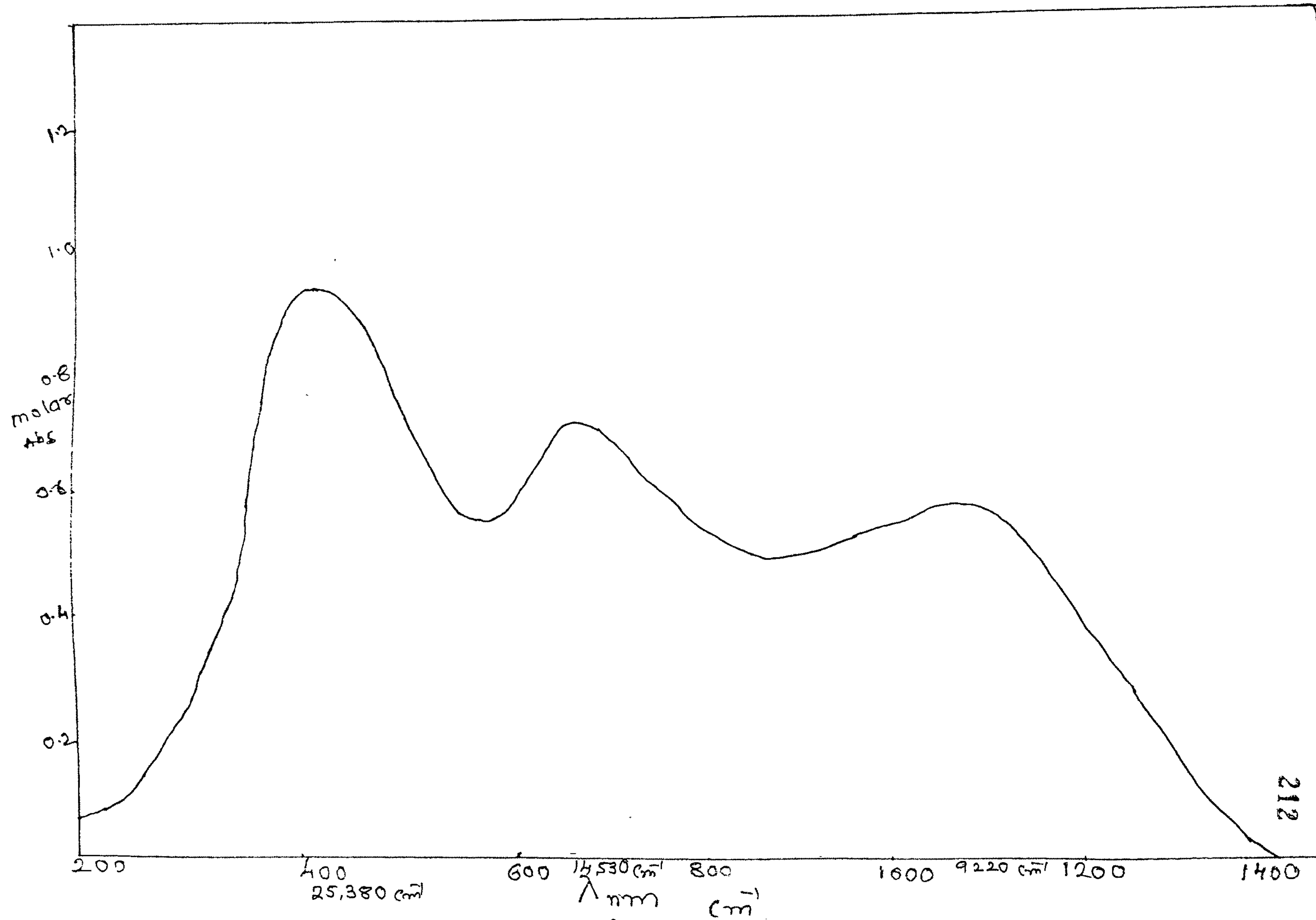
Fig. 4.10

BINUCLEAR COMPLEXES

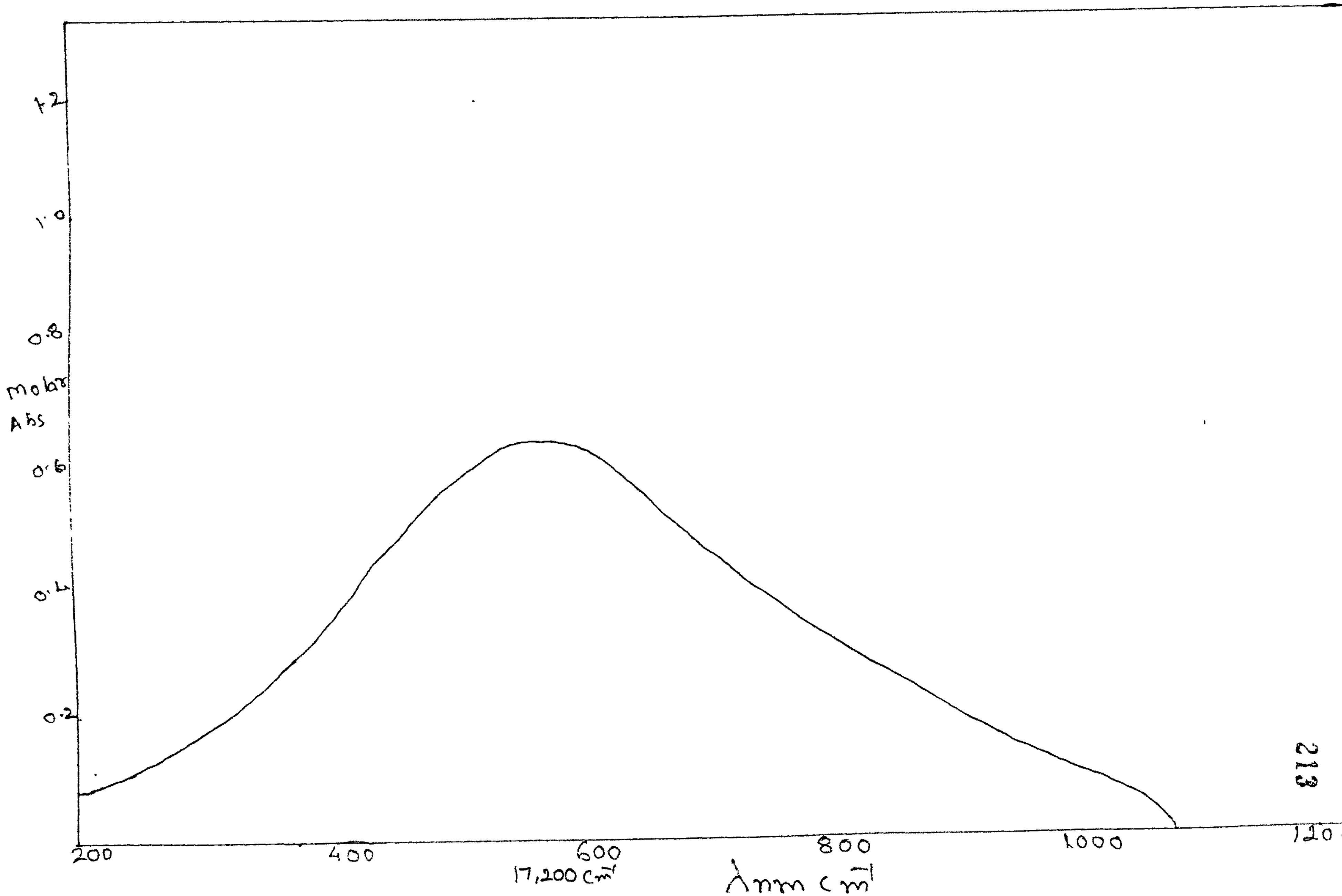
MSB_{42}	MSB_{42}-Cu	MSB_{42}-Ni	MSB_{42}-Zn
X = C_6H_5, Y = 5-Cl,	$[C_{37}H_{23}N_4O_5ClCu_2]$	$[C_{37}H_{23}N_4O_5ClNi_2]$	$[C_{37}H_{23}N_4O_5ClZn_2]$
R = C_6H_4COOH	3250(s)	3200(s)	3200(s)
	1600(s)	1600(s)	1600(s)
	1570(vs)	1570(vs)	1570(vs)
	1545(s)	1555(s)	1540(s)
	1510(m)	1510(m)	1520(m)
	1415(s)	1410(s)	1410(s)
	1340(s)	1340(s)	1335(s)
	1160(s)	1160(s)	1160(m)
	1140(m)	1140(m)	1140(s)
	1110(s)	1110(s)	1115(s)
	780(s)	795(s)	790(s)
	690(s)	695(s)	690(s)
	460(m)	470(m)	465(m)
	390(s)	395(s)	390(s)

E,Curve -4.2

Electronic spectra of Ni(II) complexes

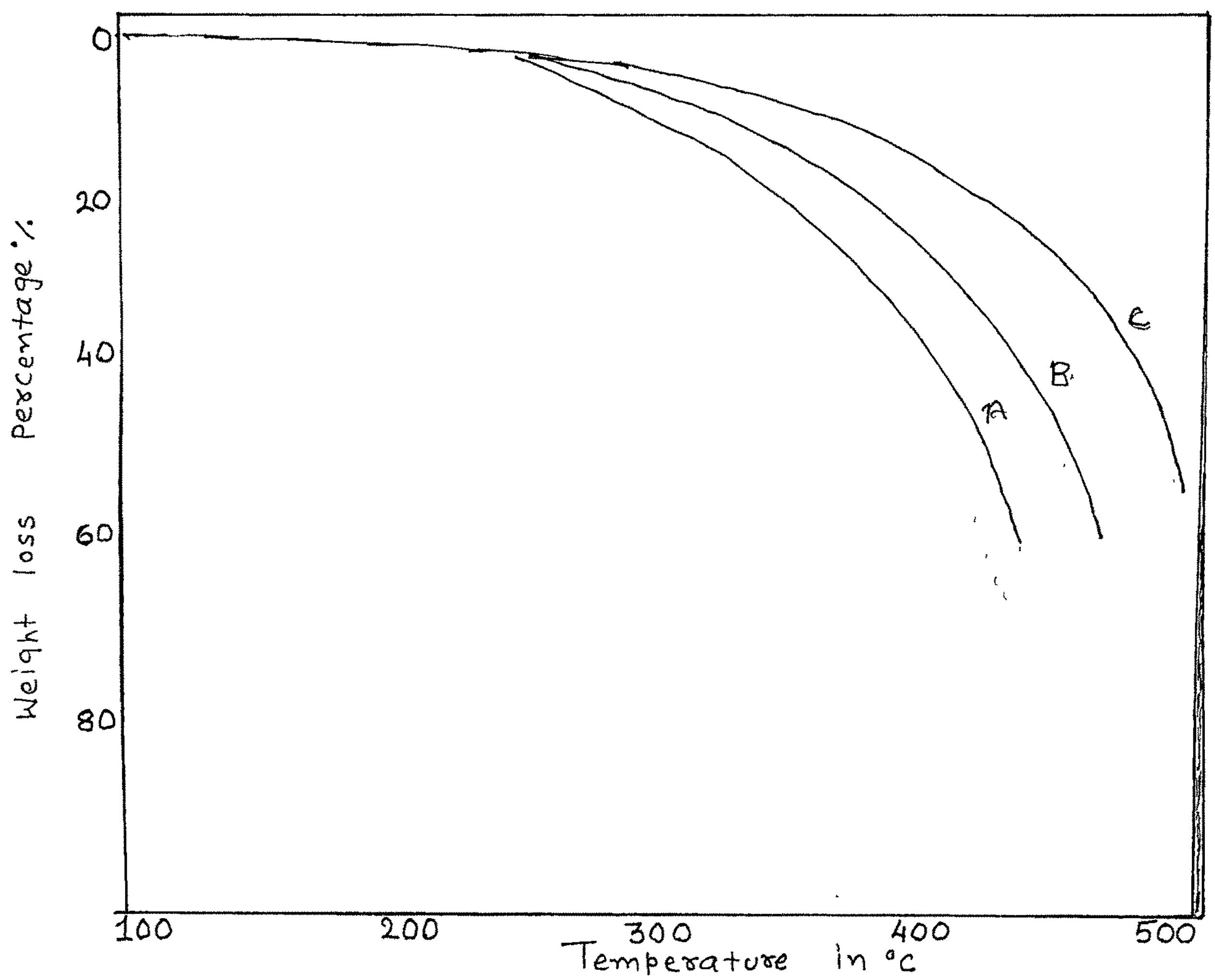


E.Curve-4.1 Electronic spectra of Cu(II) Complexes



T. Curve - 4.4

TGA-Curve of Binuclear Complexes :



Where

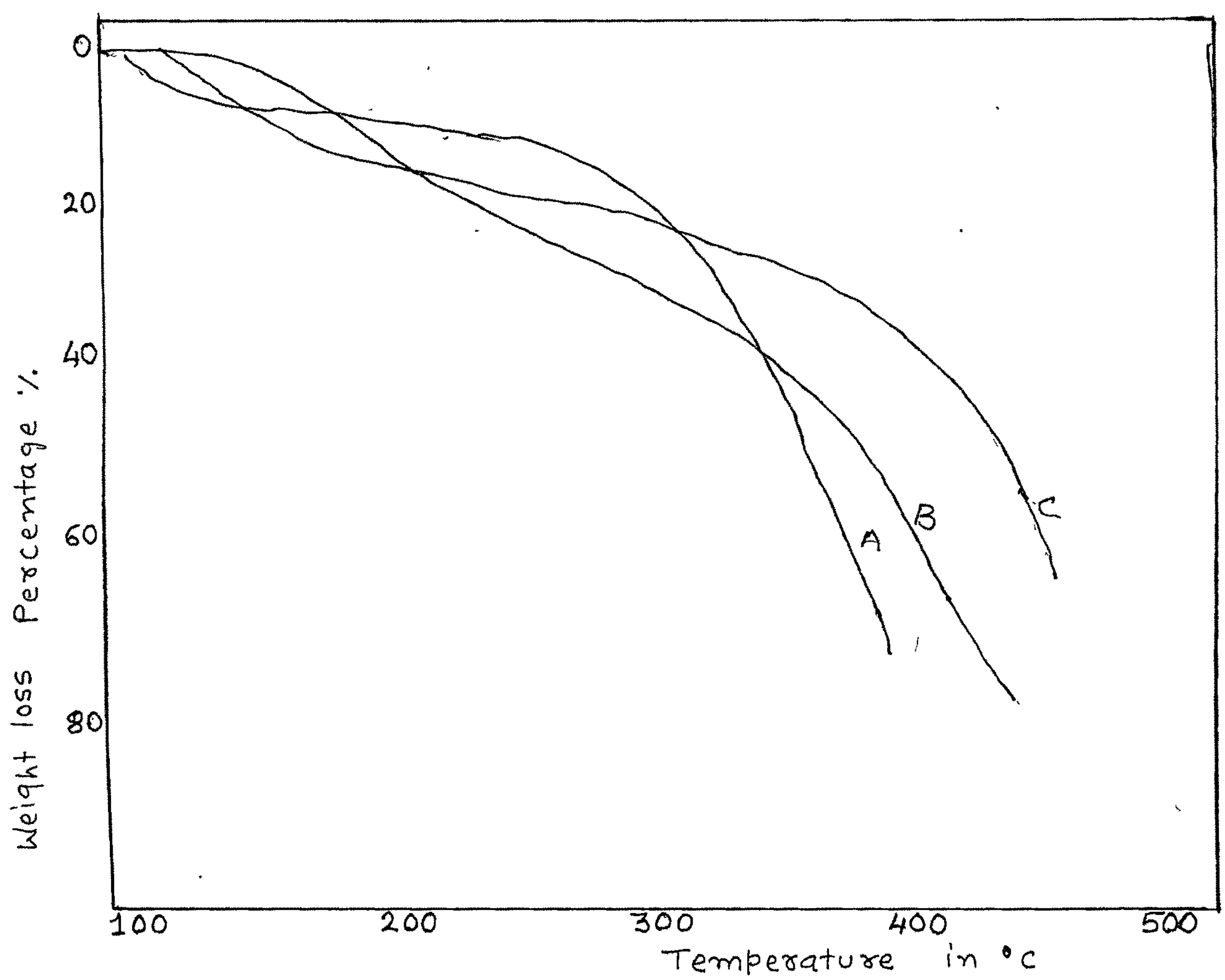
C = Zn(II)

B = Ni(II)

A = Cu(II)

T.Curve - 4.3

TGA- Curve of Mononuclear Complexes :



Where

C = Zn (II)

B = Ni (II)

A = Cu (II)

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