CHAPTER - III

SCHIFF BASE COMPLEXES OF en,pn AS ALIPHATIC DIAMINES AND p-PHENYLENE DIAMINE, BENZIDINE AS AROMATIC DIAMINES

CHAPTER - III

Binary and ternary Schiff base complexes of hydroxy ketones and hydroxy aldehydes have been reported by Bhattacharya and coworkers[1-4].

Ternary Schiff base complexes of [MLL'] type where M = Cu(II), Ni(II) and L = 2-hydroxy acetophenone or 2-hydroxy-3-methoxy acetophenone and L'=acetylacetone using ethylene diamine and propylene diamine as primary amines are also reported in the literature[5-7].

Binuclear Cu(II) complexes of the type Cu (TSB) CuX_2 and Cu (TSB) Cu $(ClO_4)_2$ where X = Cl^-, ClO_4^-, TSB = various tetradentate Schiff bases obtained by the condensation of ethylenediamine or 1,3-propylenediamine with salicylaldehyde on one end and hydroxy ketone at the other end are reported in the literature[8-9]. Some polymeric complexes of Ni(II), Co(II) and Cu(II) are also reported in the literature[10-12].

Schiff base complexes of aromatic heterocyclic ligands containing diamines are reported to show number of

applications likes antibacterial, antifungal and anti-inflammatory agents[13-15]. They are also used as pigments and anticorrosive agents[16-22].

Various types of polymeric Schiff base complexes containing heterocyclic hydroxy aldehydes and ketones with polymethylene diamines are reported by Judd[23], Berg and Alam[24].

Stereochemical Properties of Schiff base Complexes :

It is reported in the literature that interaction of diamines with salicylaldehyde or acetylacetone and their substituted derivatives produce tetradentate ligands. Fig.3.01 (n = 2-4) atoms

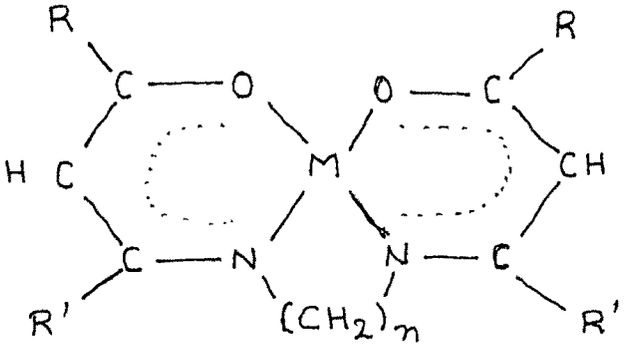


Fig. 3.01

The ligands appear constrained to coordinate in a planar cis fashion and this indeed appears to be the gross stereochemistry of metal complexes with most such

ligands. The N,N'-ethylene bis (salicylaldimine) copper(II) complex is dimeric in the solid state[25], with intermolecular Cu-O bonding at 2.41 A° causing the copper atoms to exist in a pyramidal 5-coordinate environment. The ethylene bridge is twisted into the gauche position and the benzene rings and chelate rings slope slightly away from the copper atoms so that a separation of about 4.0 A° occurs at the extremities of the dimers which however approach to 3.18 A° at the molecular centre. This linkage via Cu-O intermolecular bonds does not give rise to any significant magnetic exchange interaction between the copper ions, possibly due to the long Cu-O bonds or the Cu-O-Cu bond angle. The corresponding nickel complex is diamagnetic and therefore presumably planar although a full structural study has not yet been carried out.

Increasing the methylene chain for such complexes may cause a change in stereochemistry from cisplanar to tetrahedral or less likely to trans - planar. Holm[26] examined nickel complexes upto tetramethylene but did not achieve a change in magnetic moment. The greater length of the methylene chains may prevent both ends of the same ligand coordinating to a single metal. Pfieffer has postulated a dimeric structure for the copper salicylaldimine complex with 2,2'-dimethoxy benzidine where it appears certain that the two ends from the same molecule cannot meet (Fig.3.02)

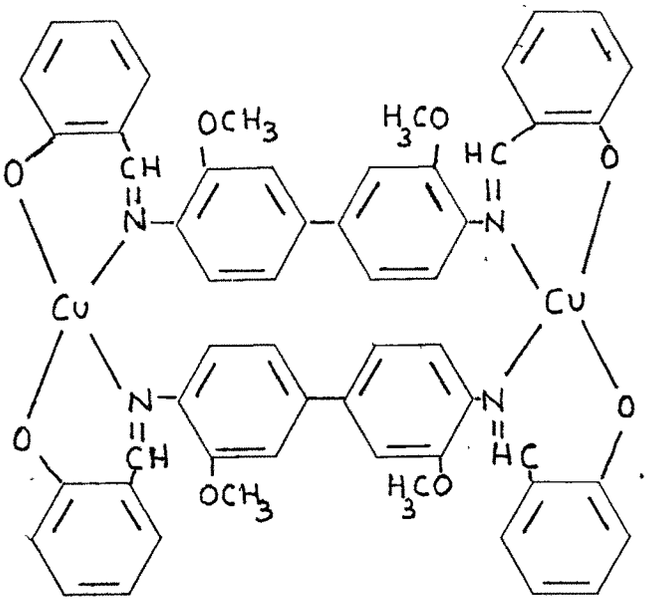


Fig. 3·02

An interesting example of competition between metal and ligand stereochemistries has been found in the structure of NN'-(2,2'-biphenyl) bis (salicylaldiminato) copper(II). This complex was predicted[27] to be tetrahedral because of the considerable strain to be expected for a square - planar configuration with the bi-phenyl system remaining planar. In fact the complex is distorted only slightly as far as the CuO_2N_2 framework is concerned. The structure has been achieved by the twisting of the ligand at various points to accommodate the strain including twisting along the C-C bond joining the two phenyl rings.

Mixed Schiff base complexes of the types $[ML2H_2O]$ and $[ML'2H_2O]_2$ where M = Cu(II), Ni(II) and Zn(II) and L = organic Schiff base ligands derived from 7 formyl 8-hydroxy quinoline and salicylaldehyde or

0-hydroxy naphthaldehyde or 0-hydroxy acetophenone or 2,4-dihydroxy acetophenone or 2-hydroxy 4-methoxy acetophenone or 0-hydroxy acetonaphthone and en, pn L'=organic Schiff bases of above mentioned aldehydes and ketones with benzidine and p-phenylenediamine as the primary amines have not been reported earlier. Such complexes have been isolated and characterized in the present investigation.

EMPERIMENTAL

Ethylenediamine, propylenediamine, p-phenylenediamine, pi-pyridine (BDH) were used. Acetone, DMF, chloroform and Ethanol were of Analar grade.

Preparation of organic Schiff bases : [Fig. 3.7 to 3.9]

7 formyl 8 hydroxy quinoline (0.1 mole) in 50 ml (1:1 alcohol and chloroform) mixture and hydroxy aldehydes (i.e. salicylaldehyde or 0-hydroxy naphthaldehyde) or hydroxy ketones (i.e. 0-hydroxy acetophenone or 2,4-dihydroxy acetophenone or 2-hydroxy 4-methoxy acetophenone or 0-hydroxy acetonaphthone) or 2-amino 5-chloro benzophenone (0.1 mole) in 50 ml 1:1 alcohol and chloroform) mixture were taken in R.B.

flask and then added aliphatic diamines (i.e. en or pn) (0.18 mole in 50 ml of 1:1 alcohol and chloroform mixture) or aromatic diamines (i.e. p-phenylene diamine or benzidine) in 50 ml of (1:1 acohol and chloroform mixture) and 2-3 ml pipyridene as a catalyst, refluxed it for 8 hrs and cooled it by adding ice to it. The mixture of three solids Schiff bases precipitated out. They were seperated by extraction and distillation. Bis hydroxy ketones (0-hydroxy acetophenone or 2,4-dihydroxy acetophenone or 2-hydroxy 4-methoxy acetophenone or 0-hydroxy acetonaphthone) and bis 2-amino 5-chloro benzophenone or bis hydroxy aldehydes (i.e. salicylaldehyde or 0-hydroxy naphthaldehyde) removed by 50 % alcohol . Bis 7-formyl 8-hydroxy quinoline is insoluble in pyridine and benzene (i.e. common organic solvents). Mixed Schiff bases of 7-formyl 8-hydroxy quinoline at one end and 0-hydroxy aldehydes (i.e. Salicyladehyde or 0-hydroxy naphthaldehyde) or 0-hydroxy ketones (i.e. 0-hydroxy acetophenone or 2,4-dihydroxy acetophenone or 2-hydroxy 4-methoxy acetophenone or 0-hydroxy acetonaphthone) or 2-amino 5-chloro benzophenone at another end of diamines, were extracted with petroleum ether , ether or ethyl acetate or butylacetate or monochloro benzene or dichloroethane. It was recrystallized with ether or ethyl acetate, the purity was checked by TLC. Technique. m.p recorded (Table 3.1)

Schiff base ligands:

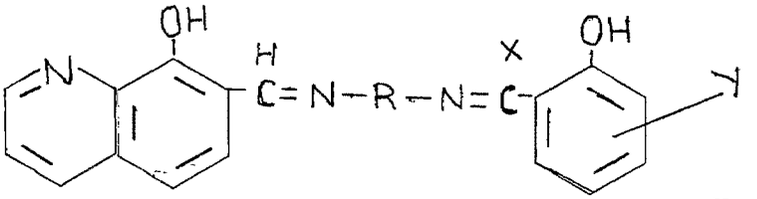


Fig.3.7

X = H, CH_3
Y = H, 4-OH, 4-OCH_3

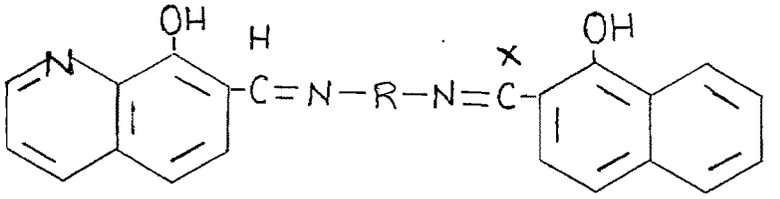


Fig.3.8

X = H, CH_3

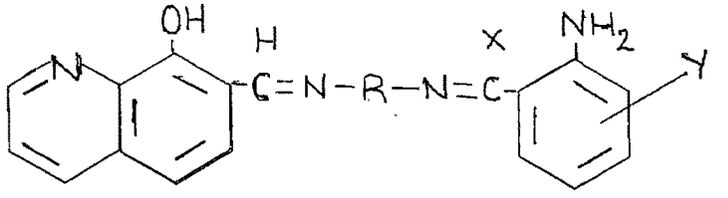


Fig.3.9

X = C_6H_5 ,
Y = 5 - Cl .

Name of Schiff bases derived by using Aliphatic diamines (en, pn) and Aromatic diamines (p-phenylene diamine, Benzidine).

SB-1. (N-7 Aldimine 8 Hydroxy Quinoline N'-Salicylaldimine ethylene).

SB-2. (N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy Acetophenomine ethylene).

SB-3. (N-7 Alidimine 8 Hydroxy Quinoline N'-2,4 dihydroxy Acetophenomine ethylene).

SB-4. (N-7 Aldimine 8 Hydroxy Quinoline N'-2 hydroxy 4 methoxy Acetophenomine ethylene).

SB-5. (N-7 Aldimine 8 Hydroxy Quinoline N'-2 hydroxy Naphthaldimine ethylene).

SB-6. (N-7 Aldimine 8 Hydroxy Quinoline N'-2 hydroxy Acetonaphthomine ethylene).

SB-7. (N-7 Aldimine 8 Hydroxy Quinoline N'-2 Amino 5 chloro Benzophenomine ethylene).

SB-8. (N-7 Aldimine 8 Hydroxy Quinoline N'-Salicylaldimine propylene).

SB-9. (N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy Acetophenomine propylene).

SB-10. (N-7 Aldimine 8 Hydroxy Quinoline N'-2,4-dihydroxy Acetophenomine propylene).

SB-11. (N-7 Aldimine 8 Hydroxy Quinoline N'-2 hydroxy 4 methoxy Acetophenomine propylene).

SB-12. (N-7 Aldimine 8 Hydroxy Quinoline N'-2 hydroxy Naphthaldimine propylene).

SB-13. (N-7 Aldimine 8 Hydroxy Quinoline N'-2 hydroxy Acetonaphthomine propylene).

SB-14. (N-7 Aldimine 8 Hydroxy Quinoline N'-2 amino 5 chloro Benzophenomine propylene).

SB-15. 1,4(N-7 Aldimine 8 Hydroxy Quinoline N'-Salicylaldimine) phenylene.

SB-16. 1,4(N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy Acetophenomine) phenylene.

SB-17. 1,4(N-7 Aldimine 8 Hydroxy Quinoline N'-2,4-dihydroxy Acetophenomine) phenylene.

SB-18. 1,4(N-7 Aldimine 8 Hydroxy Quinoline N'-2 hydroxy 4 methoxy Acetophenomine) phenylene.

SB-19. 1,4(N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy Naphthaldimine) phenylene.

SB-20. 1.4(N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy Acetonaphthomine) phenylene.

SB-21. 1,4(N-7 Aldimine 8 Hydroxy Quinoline N'-2 amino 5 chloro Benzophenomine) phenylene.

SB-22. 1,8(N-7 Aldimine 8 Hydroxy Quinoline N'-Salikcylaldimine) biphenyl.

SB-23. 1,8(N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy Acetophenomine) biphenyl.

SB-24. 1,8(N-7 Aldimine 8 Hydroxy Quinoline N'-2,4 dihydroxy Acetophenomine) biphenyl.

SB-25. 1,8(N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy 4 methoxy Acetophenomine) biphenyl.

SB-26. 1,8(N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy Naphthaldimine) biphenyl.

SB-27 1,8(N-7 Aldimine 8 Hydroxy Quinoline N'-O-hydroxy Acetonaphthomine) biphenyl.

SB-28. 1,8(N-7 Aldimine 8 Hydroxy Quinoline N'-2 amino 5 chloro Benzophenomine) biphenyl.

Preperation of Mixed Schiff base Complexes of Cu(II), Ni(II) & Zn(II) : [Fig. 3.1 to 3.6]

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 Acetophenominato) 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),

were dissolved in 50 ml DMF and warmed, to this

an excess of DMF solution of en or pn or p-phenylene-diamine or benzidine was added. The reaction mixture was refluxed for about 4 hrs. It was then filtered, washed with ether, dried and analysed.

Alternatively the above complexes could be prepared by taking (0.1 mole) metal salt solution and mixing it with equimolar DMF solutions of (0.1 mole) ligands. The reaction mixture was stirred vigorously and refluxed for about 6 hrs. The compounds obtained were washed with ether, dried,recrystallized and analyzed.

NI(II) complexes could also be obtained by raising the pH by adding sodium acetate solution to the beakar containing metal acetate and equimolar DMF solution of (0.1 mole) ligands.

TLC analysis was carried out using a mixture of chloroform and acetone as solvent. Magnetic,conductance and electronic spectral studies were carried out as detailed in the earlier sections.

Physical Measurement :

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 3.2).

The purity of complexes was checked by TLC technique using silica gel with chloroform + acetone (3: 2) mixture as adsorbent and U.V. light as visualisation agent.

The molar conductance of the complexes were measured in D.M.F. with Toshniwal conductivity bridge. The magnetic susceptibility was measured 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 shown in Table 3.3 .

TGA analysis was carried out to ensure the presence of water molecules in the complexes.

Results and Discussion :

The analytical data [Table-3.2] shows that the composition of the complexes is $[ML2H_2O]$ where M = Cu(II), Ni(II) and Zn(II) and L = mixed schiff bases derived from ethylenediamine or propylenediamine but in case of L' = mixed Schiff base derived from p-phenylenediamine and benzidine, the composition of the complexes corresponds to $[ML'2H_2O]_2$.

The DMF solution of complexes showed very poor molar conductivity (6.2 - 9.1 ohm^{-1} cm^2 mol^{-1}) indicating the neutral nature of the complexes.

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 three shoulder bands at 12680, 14850 and 20630 cm^{-1} which may be assigned to (Fig.3.1) E. Curve 3.1

$$^2B_{1g} \longrightarrow {}^2A_{1g}$$

$$^2B_{1g} \longrightarrow {}^2B_{2g} \quad \text{and}$$

$$^2B_{1g} \longrightarrow {}^2E_g \quad \text{transitions}$$

The E_g ground state is highly susceptible to Jahn-Teller configurational stability due to which Cu(II) ion in the complexes shows distorted octahedral geometry[27].

The electronic spectra of Ni(II) complexes in DMF showed three bands at 9220, 14530 and 25340 cm^{-1} which are assigned to (Fig. 3.2) E. curve 3.2

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

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

$$^3A_{2g} \longrightarrow {}^3T_{1g}P \quad (\nu_3)$$

transition respectively[28]. The spectral parameter β was calculated by utilising Equation[29,30] :

$$\beta = (\nu_2 + \nu_3 - 3\nu_1)/15.$$

The lower values of β (814 cm^{-1}) indicated considerable covalent nature of the metal ligand bond. The lowering of ν_2 / ν_1 ratio (1.57) from 1.8 showed high spin octahedral configuration for Ni(II) complexes.

The structure of the complexes is supported by magnetic measurement data Table 3.2. The μ_{eff} values reported for the complexes are slightly higher than the spin only value of respective metal ions, indicating the spin free octahedral environment around the metal ions[31,32].

The mixed Schiff base free ligands show a broad I.R. band at $\sim$ 3380 cm^{-1} which is due to the intramolecular hydrogen bonding involving hydrogen of the phenolic group and nitrogen atom of the imine group[33,34]. This band is absent in the spectra of the metal complexes indicating the replaclement of phenolic hydrogen by metal ion and formation of M-O bond. The free ligands also show a strong band at $\sim$ 1620 cm^{-1} corresponding to νC = N, which suffered a negative shift of 60-75 cm^{-1} in the complexes, indicating coordination of azomethine nitrogen[35,36]. The coordinated nature of water molecules is confirmed by a broad band in the region of 3400 - 3500 cm^{-1} due to stretching mode and band at $\sim$ 800 cm^{-1} due to rocking mode in the complexes. This is also supported by TGA data.

The new bands observed in the far IR spectra of the metal complexes at $\sim$450 cm^{-1} and $\sim$ 400 cm^{-1} are due to ν_{M-O} and ν_{M-N} respectively[37].

The TGA data of the mixed Schiff base complexes show that they lost weight between 150° and 250°C, the weight loss corresponds to the presence of two coordinated water molecules. The decomposition temperatures show that order of thermal stability of the complexes is found to be Zn > Ni > Cu as reported in the literature[38]. The complexes undergo thermal decomposition in the single stage. The slow rate of decomposition starts in the beginning upto 300°C. The decomposition is completed at 550°C, (Figure T-3.3 to 3.6) where maximum weight loss is observed. The final residues obtained are found to correspond to their metal oxides.

FIGURES

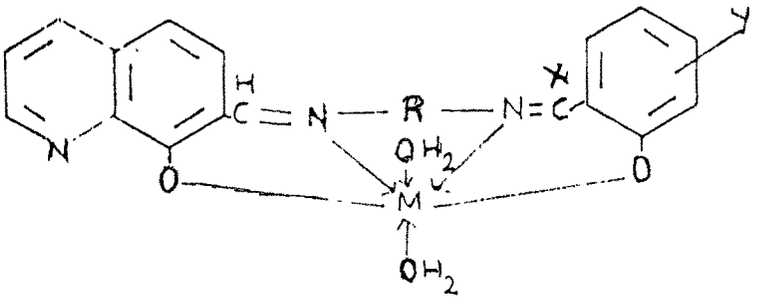


Fig.3.1

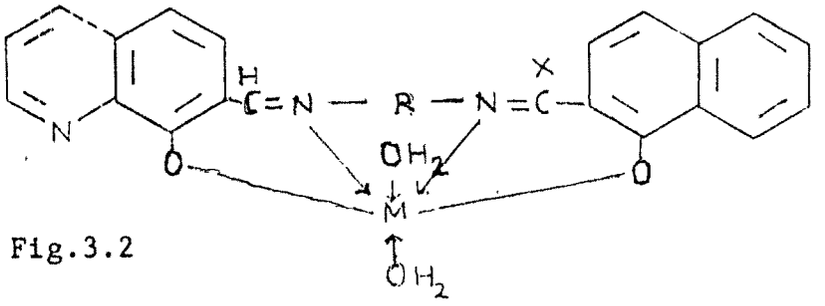


Fig.3.2

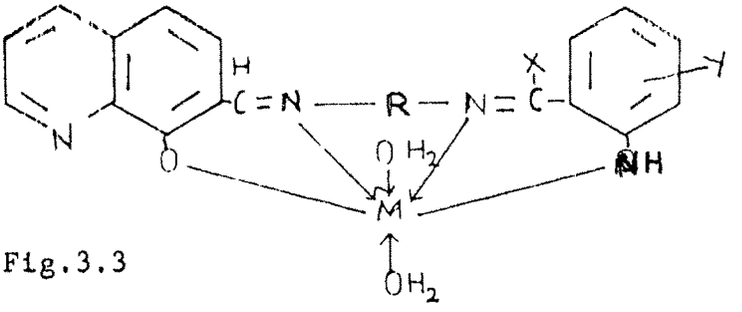


Fig.3.3

X=H, CH_3, C_6H_5
Y=H, 4-OH, 4-OCH_3, 5-Cl
R=-$(CH_2)_2$-, -$(CH_2)_3$-
R'=-C_6H_4-, -$C_{12}H_8$-
m= Cu(II), Ni(II), Zn(II)

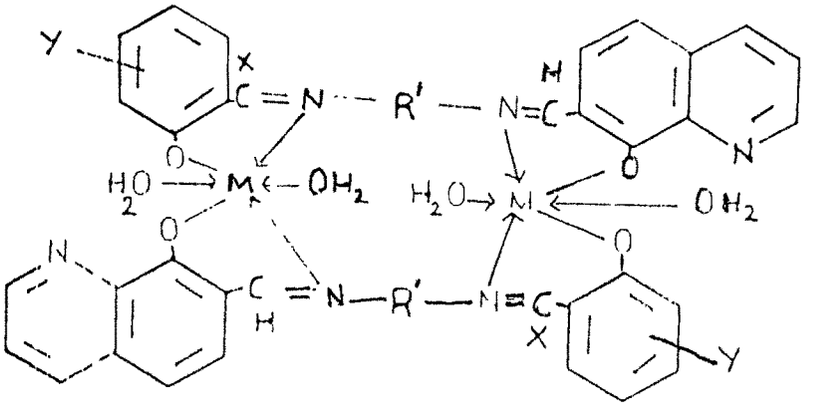


Fig.3,4

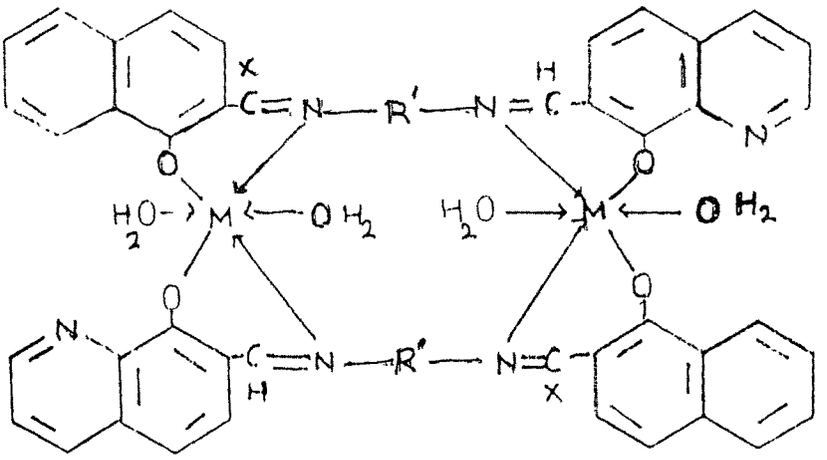


Fig.3.5

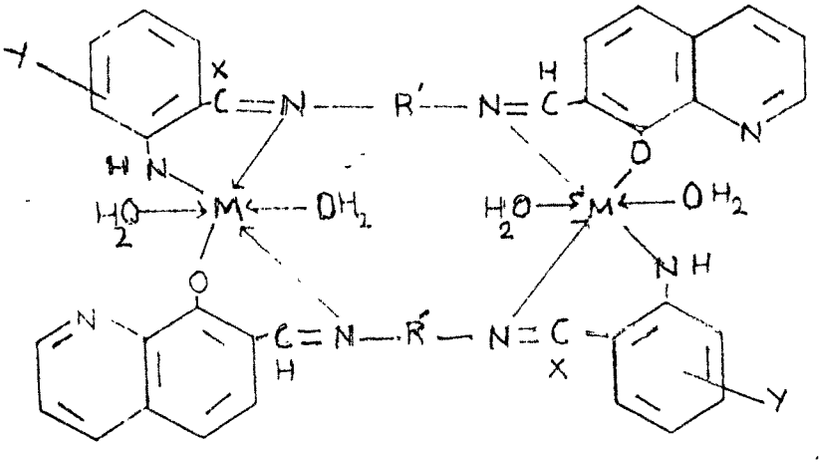


Fig.3.6

TABLE-T 3.1

	Type of Compound	Colour	M.p. °C	% Cal (Found)		
				C	H	N
SB_1	$C_{19}H_{17}O_2N_3$	Pinkish red	138	71.47 (71.52)	5.32 (5.48)	13.16 (13.60)
SB_2	$C_{20}H_{19}O_2N_3$	"	142	72.07 (72.18)	5.70 (5.82)	12.61 (12.56)
SB_3	$C_{20}H_{19}O_3N_3$	"	138	68.76 (68.98)	5.44 (5.52)	12.03 (12.16)
SB_4	$C_{21}H_{21}O_3N_3$	Blackish	129	69.42 (69.56)	5.78 (5.82)	11.57 (11.86)
SB_5	$C_{23}H_{19}O_2N_3$	"	140	74.79 (75.12)	5.14 (5.60)	11.38 (11.42)
SB_6	$C_{24}H_{21}O_2N_3$	"	142	75.19 (75.26)	5.48 (5.52)	10.96 (11.12)
SB_7	$C_{25}H_{21}ON_4Cl$	Yellowish pink	136	70.01 (70.12)	4.90 (5.12)	13.06 (13.18)
SB_8	$C_{20}H_{19}O_2N_3$	Reddish blue	146	72.07 (72.16)	5.70 (5.82)	12.61 (12.86)
SB_9	$C_{21}H_{21}O_2N_3$	"	126	72.62 (72.86)	6.05 (6.16)	12.10 (12.32)
SB_{10}	$C_{21}H_{21}O_3N_3$	"	131	69.42 (69.56)	5.78 (5.82)	11.57 (11.62)
SB_{11}	$C_{22}H_{23}O_3N_3$	Reddish black	134	70.02 (70.12)	6.10 (6.26)	11.14 (11.26)
SB_{12}	$C_{24}H_{21}O_2N_3$	Reddish brown	142	75.19 (75.21)	5.48 (5.53)	10.96 (11.12)
SB_{13}	$C_{25}H_{23}O_2N_3$	"	146	75.56 (75.62)	5.79 (5.82)	10.57 (10.62)
SB_{14}	$C_{26}H_{23}ON_4Cl$	Yellowish red	134	72.81 (73.12)	5.36 (5.42)	9.80 (9.96)
SB_{15}	$C_{23}H_{17}O_2N_3$	Blackish blue	128	75.20 (75.32)	4.63 (4.72)	11.44 (11.52)

Table cont...

SB_{16}	$C_{24}H_{19}O_2N_3$	Blackish blue	108	75.59 (75.62)	4.98 (5.12)	11.02 (11.16)
SB_{17}	$C_{24}H_{19}O_3N_3$	Reddish blue	118	72.54 (72.62)	4.78 (5.11)	10.57 (10.62)
SB_{18}	$C_{25}H_{21}O_3N_3$	Black	126	72.99 (73.12)	5.10 (5.26)	10.21 (10.32)
SB_{19}	$C_{27}H_{19}O_2N_3$	Blackish brown	113	97.69 (77.82)	4.55 (4.62)	10.07 (10.16)
SB_{20}	$C_{28}H_{21}O_2N_3$	"	145	77.96 (78.12)	4.87 (4.92)	7.42 (7.56)
SB_{21}	$C_{29}H_{21}ON_4Cl$	Orange	136	73.03 (73.12)	4.40 (4.52)	11.75 (11.82)
SB_{22}	$C_{29}H_{21}O_2N_3$	"	112	78.55 (78.62)	4.74 (4.82)	9.48 (9.62)
SB_{23}	$C_{30}H_{23}O_2N_3$	"	126	78.77 (78.86)	5.03 (5.12)	9.19 (9.26)
SB_{24}	$C_{30}H_{23}O_3N_3$	Reddish blue	118	76.10 (76.24)	4.86 (4.92)	8.87 (8.94)
SB_{25}	$C_{31}H_{25}O_3N_3$	Brown	132	76.38 (76.78)	5.13 (5.26)	8.62 (8.56)
SB_{26}	$C_{33}H_{23}O_2N_3$	"	142	80.32 (80.46)	4.66 (4.82)	8.51 (8.96)
SB_{27}	$C_{34}H_{25}O_2N_3$	Brick red	118	80.47 (80.62)	4.93 (5.11)	8.28 (8.56)
SB_{28}	$C_{35}H_{25}ON_4Cl$	Yellow	126	76.01 (76.12)	4.52 (4.26)	10.13 (10.52)

Schiff base Complexes

TABLE-T 3.2

Elemental Analysis

	Type of Compounds	Calculated (Found) C%	N%	H%	M%	μ eff B.M.
	Fig.3.1 X=H, Y=H $R' = -(CH_2)_2-$					
SB 1. a	$[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Ni$	55.47 (55.50)	10.22 (10.34)	4.62 (4.70)	14.11 (14.20)	3.12
b	$[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Cu$	54.74 (54.82)	10.08 (10.12)	4.56 (4.62)	15.24 (15.32)	2.16
c	$[C_{19}H_{15}O_2N_3 \cdot 2H_2O]Zn$	54.54 (54.63)	10.04 (10.18)	4.54 (4.58)	15.55 (15.62)	-
	X=CH_3, Y=H, $R' = -(CH_2)_2-$					
SB 2. a	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Ni$	56.47 (56.52)	9.88 (10.12)	4.94 (5.04)	13.64 (13.72)	3.10
b	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Cu$	55.75 (55.82)	9.75 (9.82)	4.88 (4.96)	14.75 (14.84)	2.10
c	$[C_{20}H_{17}O_2N_3 \cdot 2H_2O]Zn$	55.55 (55.62)	9.72 (9.85)	4.86 (4.92)	15.04 (15.14)	-
	X=CH_3, Y=4-OH, $R' = -(CH_2)_2-$					
SB 3. a	$[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Ni$	54.42 (54.50)	9.52 (9.64)	4.79 (4.82)	13.15 (13.20)	3.08

cont....

Table cont...

	b	$[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Cu$	53.75 (54.00)	9.40 (9.50)	4.70 (4.84)	14.22 (14.34)	2.04
	c	$[C_{20}H_{17}O_3N_3 \cdot 2H_2O]Zn$	53.57 (53.62)	9.37 (9.42)	4.68 (4.74)	14.51 (15.12)	-
		$X=CH_3$, $Y=4-OCH_3$, $R'=-(CH_2)_2-$					
SB 4	a	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Ni$	55.38 (55.42)	9.23 (9.30)	5.05 (5.15)	12.74 (12.84)	3.02
	b	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Cu$	54.72 (54.83)	9.12 (9.26)	4.99 (5.05)	13.78 (13.89)	1.98
	c	$[C_{21}H_{19}O_3N_3 \cdot 2H_2O]Zn$	54.54 (54.62)	9.09 (9.12)	4.99 (5.05)	14.06 (14.16)	1.98
		Fig. 3.2					
		$X=4$, $R'=-(CH_2)_2-$, $Y=H$					
SB 5	a	$[C_{23}H_{17}O_2N_3 \cdot 2H_2O]Ni$	59.86 (60.12)	9.11 (9.42)	4.55 (4.62)	12.58 (13.04)	3.08
	b	$[C_{23}H_{17}O_2N_3 \cdot 2H_2O]Cu$	59.16 (60.04)	9.00 (9.12)	4.50 (4.62)	13.61 (13.72)	2.04

cont...

Table cont...

	c	$[C_{23}H_{17}O_2N_3.2H_2O]Zn$	-	8.97 (9.16)	4.48 (4.52)	13.88 (13.96)	--
		$X=CH_3$, $R'=-(CH_2)_2-$ $Y=H$					
SB 6	a	$[C_{24}H_{19}O_2N_2.2H_2O]Ni$	60.63 (60.74)	8.84 (9.04)	4.84 (5.12)	12.21 (12.32)	3.02
	b	$[C_{24}H_{19}O_2N_2.2H_2O]Cu$	59.93 (60.12)	8.74 (8.92)	4.78 (4.94)	13.21 (13.42)	2.04
	c	$[C_{24}H_{19}O_2N_2.2H_2O]Zn$	59.75 (60.16)	8.71 (8.84)	4.77 (4.78)	13.48 (13.52)	--
		Fig. 3.3					
		$X=C_6H_5$, $Y=5-Cl$, $R'=-(CH_2)_2-$					
SB 7							
	a	$[C_{25}H_{19}ON_4Cl.2H_2O]Ni$	57.52 (57.84)	10.73 (10.82)	4.60 (4.74)	11.12 (11.20)	3.12
	b	$[C_{25}H_{19}ON_4Cl.2H_2O]Cu$	56.92 (57.12)	10.62 (10.74)	4.55 (4.62)	12.04 (12.12)	2.06
	c	$[C_{25}H_{19}ON_4Cl.2H_2O]Zn$	56.76 (56.88)	10.59 (10.63)	4.54 (4.61)	12.29 (12.32)	--

Elemental Analysis

Types of Compounds	Calculated(Found) C%	N%	H%	M%	eff B.M.
Fig.3. X=H, Y=H, R'=$-(CH_2)_3-$					
SB 8.					
a $[C_{20}H_{17}O_2N_3.2H_2O]Ni$	56.47 (56.52)	9.88 (9.92)	4.94 (5.02)	13.64 (14.12)	3.04
b $[C_{20}H_{17}O_2N_3.2H_2O]Cu$	55.74 (55.82)	9.75 (9.84)	4.87 (4.94)	14.75 (14.84)	2.02
c $[C_{20}H_{17}O_2N_3.2H_2O]Zn$	55.55 (55.68)	9.72 (9.78)	4.86 (4.92)	15.04 (15.12)	-
X=CH_3, Y=H, R'=$-(CH_2)_3-$					
SB 9.					
a $[C_{21}H_{19}O_2N_3.2H_2O]Ni$	57.40 (57.62)	9.57 (9.62)	5.24 (5.32)	13.21 (13.26)	3.12
b $[C_{21}H_{19}O_2N_3.2H_2O]Cu$	56.69 (56.72)	9.45 (9.54)	5.17 (5.24)	14.28 (14.32)	2.06
c $[C_{21}H_{19}O_2N_3.2H_2O]Zn$	56.50 (56.62)	9.42 (9.56)	5.16 (5.18)	14.57 (14.62)	-

cont...

Table cont.....

SB 10. $X=CH_3$, $Y=4\text{-}OH$,

$R'=-(CH_2)_3-$

a.	$[C_{21}H_{19}O_3N_3.2H_2O]Ni$	55.38 (55.42)	9.23 (9.32)	5.85 (5.12)	12.74 (13.12)	3.06
b.	$[C_{21}H_{19}O_3N_3.2H_2O]Cu$	54.72 (54.84)	9.12 (9.24)	4.99 (5.04)	13.78 (14.12)	1.98
c.	$[C_{21}H_{19}O_3.2H_2O]Zn$	54.54 (54.62)	9.09 (9.12)	4.97 (5.08)	14.06 (14.12)	--

SB 11, $X=CH_3$, $Y=4\text{-}OCH_3$,

$R'=(CH_2)_3-$

a.	$[C_{22}H_{21}O_3N_3.2H_2O]Ni$	55.86 (56.12)	8.95 (9.12)	5.75 (5.84)	12.36 (12.42)	2.98
b.	$[C_{22}H_{21}O_3N_3.2H_2O]Cu$	55.27 (55.32)	8.86 (9.04)	5.69 (5.72)	13.30 (13.42)	2.02
c.	$[C_{22}H_{21}O_3N_3.2H_2O]Zn$	55.04 (55.12)	8.82 (9.02)	5.67 (5.74)	13.65 (13.75)	--

Fig. 3.2

SB 12. $X=H$, $Y=H$, $R'=-(CH_2)_3-$

a.	$[C_{24}H_{19}O_2N_3.2H_2O]Ni$	60.63 (60.72)	8.84 (9.12)	4.84 (4.92)	12.27 (12.42)	3.12

Table cont..

b.	$[C_{24}H_{19}O_2N_3 \cdot 2H_2O]Cu$	59.93 (60.12)	8.74 (8.84)	4.78 (4.86)	13.21 (13.42)	2.18
c.	$[C_{24}H_{19}O_2N_3 \cdot 2H_2O]Zn$	59.75 (60.16)	8.77 (8.82)	4.77 (5.12)	13.48 (13.52)	--
SB 13.	$X=CH_3$, $Y=H$, $R'=-(CH_2)_3-$					
a.	$[C_{25}H_{21}O_2N_3 \cdot 2H_2O]Ni$	60.66 (60.72)	8.49 (8.56)	5.05 (5.12)	12.84 (13.12)	3.14
b.	$[C_{25}H_{21}O_2N_3 \cdot 2H_2O]Cu$	61.34 (61.42)	8.58 (8.62)	5.11 (5.24)	11.86 (11.92)	2.06
c.	$[C_{25}H_{21}O_2N_3 \cdot 2H_2O]Zn$	60.48 (60.54)	8.46 (8.92)	5.04 (5.24)	13.10 (13.14)	--
Fig. B" 3·3						
SB 14.	$X=C_6H_5$, $Y=5-Cl$, $R'=-(CH_2)_3-$					
a.	$[C_{26}H_{21}ON_4Cl \cdot 2H_2O]Ni$	58.37 (58.42)	10.47 (10.62)	4.57 (4.62)	10.85 (11.12)	3.04
b.	$[C_{26}H_{21}ON_4Cl \cdot 2H_2O]Cu$	57.77 (57.84)	10.37 (10.52)	4.62 (4.74)	11.76 (12.12)	2.02
c.	$[C_{26}H_{21}ON_4Cl \cdot 2H_2O]Zn$	57.62 (57.48)	10.34 (10.42)	4.61 (4.84)	12.00 (12.21)	--

Elemental Analysis

Type of Compounds	Calculated(Found) C%	N%	H%	M%	μ eff B.M.
Fig. 3.4					
SB 15. X=H, Y=H, $R' = C_6H_4$					
a. $[C_{23}H_{15}O_2N_3 \cdot 2H_2ONi]_2$	60.13 (60.12)	9.15 (9.24)	4.14 (4.18)	12.63 (13.02)	3.12
b. $[C_{23}H_{15}O_2N_3 \cdot 2H_2OCu]_2$	59.41 (60.06)	9.04 (9.20)	4.09 (4.04)	13.67 (13.89)	2.04
c. $[C_{23}H_{15}O_2N_3 \cdot 2H_2OZn]_2$	59.22 (59.02)	9.01 (9.12)	4.07 (4.18)	13.94 (14.11)	--
SB 16. $X=CH_3$, Y=H, $R' = C_6H_4$					
a. $[C_{24}H_{17}O_2N_3 \cdot 2H_2ONi]_2$	60.88 (60.12)	8.87 (8.92)	4.43 (4.58)	12.26 (12.10)	3.16
b. $[C_{24}H_{17}O_2N_3 \cdot 2H_2OCu]_2$	60.18 (59.50)	8.77 (8.60)	4.38 (4.48)	13.27 (13.50)	2.06
c. $[C_{24}H_{17}O_2N_3 \cdot 2H_2OZn]_2$	60.00 (59.60)	8.75 (8.82)	4.37 (4.39)	13.54 (13.50)	--
SB 17. $X=CH_3$, Y=4-OH, $R'=C_6H_4$					
a. $[C_{24}H_{17}O_3N_3 \cdot 2H_2ONi]_2$	58.89 (58.75)	8.58 (8.52)	4.29 (4.18)	11.86 (11.92)	3.04

cont...

Tab. cont...

b. $[C_{24}H_{17}O_3N_3 \cdot 2H_2OCu]_2$	58.24 (58.12)	8.49 (8.56)	4.24 (4.02)	12.84 (13.11)	1.98
c. $[C_{24}H_{17}O_3N_3 \cdot 2H_2OZn]_2$	58.06 (58.02)	8.46 (8.50)	4.23 (4.16)	13.10 (13.12)	--
SB 18. $X=CH_3$, $Y=4\text{-}OCH_3$, $R'=C_6H_4$					
a. $[C_{25}H_{19}O_3N_3 \cdot 2H_2ONi]_2$	59.64 (59.20)	8.34 (8.42)	4.57 (4.65)	11.53 (12.02)	3.02
b. $[C_{25}H_{19}O_3N_3 \cdot 2H_2OCu]_2$	58.99 (58.82)	8.25 (8.30)	4.52 (4.66)	12.48 (12.46)	2.04
c. $[C_{25}H_{19}O_3N_3 \cdot 2H_2OZn]_2$	58.82 (58.62)	8.23 (8.36)	4.50 (4.62)	12.74 (12.64)	--
Fig 3.5					
SB 19. $X=H$, $Y=H$, $R'=C_6H_4$					
a. $[C_{27}H_{17}O_2N_3 \cdot 2H_2ONi]_2$	63.65 (63.50)	8.25 (8.24)	4.12 (8.16)	11.39 (11.34)	2.98
b. $[C_{27}H_{17}O_2N_3 \cdot 2H_2OCu]_2$	62.97 (62.86)	8.16 (8.10)	4.08 (4.52)	12.34 (12.32)	1.96
c. $[C_{27}H_{17}O_2N_3 \cdot 2H_2OZn]_2$	62.79 (62.56)	8.13 (8.40)	4.06 (4.10)	12.59 (12.62)	--

cont....

Table cont...

SB 20.	$X=CH_3$, $Y=H$, $R'=C_6H_4$					
	a. $[C_{28}H_{19}O_2N_3.2H_2ONi]_2$	64.24 (64.50)	8.03 (8.50)	4.39 (4.42)	11.08 (11.52)	3.12
	b. $[C_{28}H_{19}O_2N_3.2H_2OCu]_2$	63.57 (63.62)	7.94 (8.12)	4.35 (4.45)	12.01 (12.12)	2.02
	c. $[C_{28}H_{19}O_2N_3.2H_2OZn]_2$	63.39 (64.12)	7.92 (8.16)	4.33 (4.50)	12.26 (12.48)	--
	Fig 3.6					
SB 21.	$X=C_6H_5$, $Y=5-Cl$, $R'=C_6H_4$					
	a. $[C_{29}H_{19}ON_4Cl.2H_2ONi]_2$	61.21 (61.32)	9.85 (9.92)	4.04 (4.12)	10.20 (10.32)	3.12
	b. $[C_{29}H_{19}ON_4Cl.2H_2OCu]_2$	60.62 (60.78)	9.75 (9.82)	4.00 (4.50)	11.06 (11.12)	2.02
	c. $[C_{29}H_{19}ON_4Cl.2H_2OZn]_2$	60.46 (60.52)	9.73 (9.86)	3.99 (4.12)	11.29 (11.42)	--

Elemental Analysis

Type of Compounds	Calculated/Found C%	N%	H%	M%	μ eff B.M.
Fig.3.4 SB 22. X=H, Y=H, R' = $-C_6H_4-C_6H_4-$					
a $[C_{29}H_{19}O_2N_3.2H_2ONi]_2$	65.04 (65.12)	7.85 (7.62)	4.29 (4.60)	10.84 (10.64)	3.04
b $[C_{29}H_{19}O_2N_3.2H_2OCu]_2$	64.38 (64.20)	7.77 (7.76)	4.25 (4.74)	11.74 (12.12)	2.12
c $[C_{29}H_{19}O_2N_32H_2OZn]_2$	64.20 (63.86)	7.74 (7.80)	4.24 (4.56)	11.99 (12.12)	-
$X=CH_3$, Y=H, R' = $-C_6H_4-C_6H_4-$					
SB 23. a $[C_{30}H_{21}O_3N_3.2H_2ONi]_2$	65.57 (65.62)	7.65 (7.63)	4.55 (4.62)	10.56 (11.12)	3.12
b $[C_{30}H_{21}O_2N_3.2H_2OCu]_2$	64.92 (65.12)	7.57 (8.12)	4.51 (4.60)	11.45 (11.52)	2.06
c $[C_{30}H_{21}O_2N_3.2H_2OZn]_2$	64.75 (65.12)	7.55 (8.12)	4.49 (4.50)	11.69 (11.50)	-
$X=CH_3$, Y=4-OH, R' = $-C_6H_4-C_6H_4-$					

cont.....

Table cont..

SB 24	a. $[C_{30}H_{21}O_3N_3 \cdot 2H_2ONi]_2$	63.71 (63.52)	7.43 (7.50)	4.42 (4.82)	10.26 (10.50)	3.12
	b. $[C_{30}H_{21}O_3N_3 \cdot 2H_2OCu]_2$	63.10 (63.12)	7.36 (7.20)	4.38 (4.82)	11.13 (11.12)	2.06
	c. $[C_{30}H_{23}O_3N_3 \cdot 2H_2OZn]_2$	62.93 (63.12)	7.34 (7.42)	4.37 (4.42)	11.36 (11.42)	-
SB 25.	X=CH_3, Y=4-OCH_3 R' = $-C_6H_4-C_6H_4-$					
	a. $[C_{31}H_{23}O_3N_3 \cdot 2H_2ONi]_2$	64.24 (64.12)	7.25 (7.32)	4.66 (5.12)	10.01 (10.10)	3.06
	b. $[C_{31}H_{23}O_3N_3 \cdot 2H_2OCu]_2$	63.64 (63.50)	7.18 (7.21)	4.61 (5.06)	10.85 (10.72)	2.04
	c. $[C_{31}H_{23}O_3N_3 \cdot 2H_2OZn]_2$	63.48 (63.32)	7.16 (7.62)	4.60 (4.72)	11.09 (10.82)	-
	Fig 3.5					
SB 26.	X=H, R' = $-C_6H_4-C_6H_4-$					
	a. $[C_{33}H_{21}O_2N_3 \cdot 2H_2ONi]_2$	67.69 (67.50)	7.17 (7.20)	4.27 (4.32)	9.91 (10.12)	3.02
	b. $[C_{33}H_{21}O_2N_3 \cdot 2H_2OCu]_2$	67.06 (67.12)	7.11 (7.12)	4.23 (4.30)	10.75 (10.12)	2.06
	c. $[C_{33}H_{21}O_2N_3 \cdot 2H_2OZn]_2$	66.89 (66.72)	7.09 (7.12)	4.22 (4.62)	10.97 (11.12)	-

cont...

Table cont....

SB 27. $X=CH_3$, $R' = -C_6H_4-C_6H_4-$

a.	$[C_{34}H_{23}O_2N_3 \cdot 2H_2ONi]_2$	66.55 (66.50)	9.13 (9.12)	4.40 (4.52)	9.46 (10.62)	3.06
b.	$[C_{34}H_{23}O_2N_3 \cdot 2H_2OCu]_2$	65.96 (66.20)	9.05 (9.12)	4.36 (4.62)	10.24 (9.82)	2.02
c.	$[C_{34}H_{23}O_2N_3 \cdot 2H_2OZn]_2$	65.80 (66.40)	9.03 (9.12)	4.35 (4.52)	10.48 (10.82)	--

Fig. 3.6

SB 28. $X = C_6H_5$, $Y = 5\text{-}Cl$,

$R' = C_6H_4-C_6H_4-$

a.	$[C_{35}H_{23}ON_4Cl \cdot 2H_2ONi]_2$	65.16 (65.20)	8.68 (8.72)	4.10 (4.15)	8.99 (9.12)	3.12
b.	$[C_{35}H_{23}ON_4Cl \cdot 2H_2OCu]_2$	64.61 (64.72)	8.61 (8.82)	4.13 (4.12)	8.77 (9.82)	2.04
c.	$[C_{35}H_{23}ON_4Cl \cdot 2H_2OZn]_2$	64.46 (64.52)	8.59 (8.62)	4.14 (4.20)	9.98 (10.12)	--

TABLE-T 3.3

IR Characteristics frequencies cm^{-1} Mononuclear Complexes

SB_1 ligand $C_{19}H_{17}O_2N_3$	SB_1-Cu $[C_{19}H_{15}O_2N_3 2H_2O]Cu$	SB_1-Ni $[C_{19}H_{15}O_2N_3 2H_2O]Ni$	SB_1-Zn $[C_{19}H_{15}O_2N_3 2H_2O]Zn$
2900(s)	3350(w)	3350(w)	3350(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1580(vs)	1570(vs)
1520(m)	1510(m)	1510(m)	1510(m)
1420(s)	1410(s)	1405(s)	1410(s)
1330(m)	1320(m)	1315(m)	1315(m)
1160(s)	1150(s)	1160(s)	1160(s)
1140(s)	1130(s)	1140(s)	1135(s)
	1100(s)	1110(s)	1110(s)
	800(s)	790(s)	790(s)
	450(m)	470(s)	445(m)
	380(s)	410(m)	380(s)

W = Wide

S = Strong

Vs= Very strong

m = medium

cont...

Table cont..

SB_2 ligand $C_{20}H_{19}O_2N_3$	SB_2-Cu $[C_{20}H_{17}O_2N_3 2H_2O]Cu$	SB_2-Ni $[C_{20}H_{17}O_2N_3 2H_2O]Ni$	SB_3-Zn $[C_{20}H_{17}O_2N_3 2H_2O]Zn$
2900(s)	3350(w)	3400(w)	3300(w)
1630(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(m)	1570(s)
1520(m)	1510(m)	1510(m)	1510(m)
1325(m)	1410(s)	1405(m)	1410(s)
1660(s)	1320(m)	1310(s)	1310(s)
1140(s)	1160(s)	1155(s)	1150(m)
	1140(m)	1140(s)	1130(m)
	1110(s)	1110(s)	1110(s)
	800(s)	780(s)	790(s)
	450(m)	460(m)	440(s)
	370(s)	410(s)	380(s)

cont.....

Table cont...

SB_3 ligand $C_{20}H_{19}O_3N_3$	SB_3-Cu $[C_{20}H_{17}O_3N_3 2H_2O]Cu$	SB_3-Ni $[C_{20}H_{17}O_3N_3 2H_2O]Ni$	SB_3-Zn $[C_{20}H_{17}O_3N_3 2H_2O]Zn$
2900(m)	3300(w)	3300(w)	3320(w)
2810(s)	3200(s)	3210(s)	3215(s)
1630(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1515(m)	1510(m)
1420(s)	1408(s)	1404(s)	1408(s)
1330(m)	1320(m)	1315(m)	1310(m)
1160(s)	1155(s)	1150(m)	1160(s)
1140(s)	1140(m)	1140(m)	1135(m)
	1110(s)	1110(s)	1110(s)
	800(s)	790(s)	785(s)
	450(s)	465(s)	460(m)
	375(m)	410(m)	380(s)

cont....

Table cont....

SB_4-ligand $C_{21}H_{21}O_3N_3$	SB_4-Cu $[C_{21}H_{19}O_3N_3 2H_2O]Cu$	SB_4-Ni $[C_{21}H_{19}O_3N_3 2H_2O]Ni$	SB_4-Zn $[C_{21}H_{19}O_3N_3 2H_2O]Zn$
2900(m)	3300(w)	3300(w)	3320(w)
1630(s)	1600(s)	1600(s)	1590(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1530(m)	1520(m)	1510(m)	1520(m)
1425(s)	1410(s)	1415(s)	1410(s)
1320(m)	1315(m)	1310(m)	1315(m)
1240(s)	1230(s)	1235(s)	1240(m)
1160(s)	1160(s)	1150(m)	1155(s)
1140(m)	1140(s)	1135(s)	1130(s)
1040(s)	1110(s)	1110(s)	1110(s)
	1040(s)	1030(s)	1035(s)
	810(m)	790(s)	780(m)
	460(s)	470(s)	455(m)
	370(m)	410(m)	385(s)

cont....

Table cont...

SB_5 ligand $C_{23}H_{19}O_2N_3$	SB_5-Cu $[C_{23}H_{17}O_2N_3 2H_2O]Cu$	SB_5-Ni $[C_{23}H_{17}O_2N_3 2H_2O]Ni$	SB_5-Zn $[C_{23}H_{17}O_2N_3 2H_2O]Zn$
3000(s)	3350(w)	3360(w)	3360(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1525(m)	1510(m)	1510(m)	1510(m)
1320(m)	1400(s)	1410(s)	1410(s)
1160(s)	1320(m)	1310(m)	1415(s)
1140(s)	1155(s)	1150(s)	1150(s)
	1140(s)	1140(m)	1140(m)
	1110(s)	1110(m)	1110(m)
	800(s)	790(s)	785(s)
	460(m)	465(m)	470(s)
	390(m)	390(s)	385(m)

cont....

Table cont.....

SB_6 ligand $C_{24}H_{21}O_2N_2$	SB_6-Cu $[C_{24}H_{19}O_2N_2 2H_2O]Cu$	SB_6-Ni $[C_{24}H_{19}O_2N_2 2H_2O]Ni$	SB_6-Zn $[C_{24}H_{19}O_2N_2 2H_2O]Zn$
2950(s)	3320(w)	3320(w)	3320(w)
1630(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1400(s)	1410(s)	1410(s)
1315(m)	1320(m)	1310(m)	1310(m)
1160(s)	1150(s)	1160(s)	1160(s)
1135(s)	1135(s)	1140(m)	1140(m)
	1110(s)	1110(s)	1110(s)
	810(m)	790(s)	785(s)
	465(m)	470(s)	465(m)
	395(s)	385(m)	390(s)

cont.....

Table cont...

SB_7 ligand	SB_7-Cu	SB_7-Ni	SB_7-Zn
$C_{25}H_{21}ON_4Cl$	$[C_{25}H_{19}ON_4Cl2H_2O]Cu$	$[C_{25}H_{19}ON_4Cl2H_2O]Ni$	$[C_{25}H_{19}ON_4Cl2H_2O]Zn$
3460(m)	3340(m)	3330(m)	3320(m)
2900(s)	3200(v)	3210(v)	3200(v)
1625(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1515(m)	1520(m)
1320(m)	1310(m)	1315(s)	1310(s)
1160(s)	1240(m)	1220(s)	1240(m)
1140(s)	1160(s)	1160(m)	1150(s)
730(s)	1140(s)	1135(s)	1130(s)
	1110(m)	1110(m)	1110(m)
	780(s)	775(s)	770(s)
	680(s)	690(s)	680(s)
	460(m)	460(m)	570(s)
	390(s)	380(s)	390(m)

cont....

Table cont...

SB_8 ligand $C_{20}H_{19}O_2N_3$	SB_8-Cu $[C_{20}H_{17}O_2N_3 2H_2O]Cu$	SB_8-Ni $[C_{20}H_{17}O_2N_3 2H_2O]Ni$	SB_8-Zn $[C_{20}H_{17}O_2N_3 2H_2O]Zn$
2900(s)	3400(w)	3350(w)	3350(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1525(m)	1515(m)	1510(m)	1510(m)
1420(m)	1420(s)	1425(s)	1420(s)
1320(s)	1320(m)	1325(m)	1320(s)
1155(s)	1160(s)	1150(s)	1160(s)
1145(s)	1140(s)	1130(s)	1140(s)
	1110(m)	1108(m)	1110(s)
	800(s)	790(s)	800(s)
	460(m)	450(m)	460(m)
	390(s)	380(s)	390(s)

Table cont....

Table cont..

SB_9 ligand $C_{21}H_{21}O_2N_3$	SB_9-Cu $[C_{21}H_{19}O_2N_3 2H_2O]Cu$	SB_9-Ni $[C_{21}H_{19}O_2N_3 2H_2O]Ni$	SB_9-Zn $[C_{21}H_{19}O_2N_3 2H_2O]Zn$
2910(s)	3320(w)	3360(w)	3280(w)
1630(v)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1525(m)	1515(m)	1510(m)	1515(m)
1320(m)	1410(s)	1408(m)	1410(s)
1160(s)	1320(m)	1315(s)	1310(s)
1135(s)	1160(s)	1160(s)	1165(s)
	1140(m)	1145(s)	1140(m)
	1110(s)	1108(s)	1110(m)
	800(s)	790(s)	810(s)
	460(m)	460(m)	470(s)
	385(s)	380(s)	385(m)

Table cont....

Table cont...

SB_{10} ligand $C_{21}H_{21}O_3N_3$	SB_{10}-Cu $[C_{21}H_{19}O_3N_3 2H_2O]Cu$	SB_{10}-Ni $[C_{21}H_{19}O_3N_3 2H_2O]Ni$	SB_{10}-Zn $[C_{21}H_{19}O_3N_3 2H_2O]Zn$
2960(s)	3400(w)	3400(w)	3410(w)
2865(s)	2900(s)	2900(s)	3000(s)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1525(m)	1510(m)	1510(m)	1520(m)
1425(m)	1410(s)	1408(s)	1410(s)
1325(s)	1320(m)	1315(m)	1310(s)
1160(s)	1160(s)	1155(s)	1150(s)
1140(s)	1140(s)	1140(s)	1135(m)
	1110(m)	1100(s)	1100(m)
	800(s)	810(s)	820(s)
	450(m)	470(m)	440(m)
	380(s)	410(s)	390(s)

cont.....

Table cont...

SB_{11} ligand $C_{22}H_{23}O_3N_3$	SB_{11}-Cu $[C_{22}H_{21}O_3N_3 2H_2O]Cu$	SB_{11}-Ni $[C_{22}H_{21}O_3N_3 2H_2O]Ni$	SB_{11}-Zn $[C_{22}H_{21}O_3N_3 2H_2O]Zn$
2900(m)	3300(w)	3300(w)	3310(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(s)	1510(s)	1520(s)	1550(s)
1420(s)	1410(s)	1415(s)	1410(s)
1310(m)	1315(m)	1315(m)	1310(m)
1235(s)	1230(s)	1220(s)	1235(m)
1160(s)	1165(s)	1160(m)	1165(s)
1140(m)	1135(s)	1130(s)	1140(m)
1050(s)	1108(s)	1110(s)	1115(s)
	1035(m)	1040(m)	1030(s)
	806(m)	802(s)	800(s)
	456(s)	450(s)	450(m)
	372(m)	386(m)	380(s)

cont.....

Table cont....

SB_{12} ligand $C_{24}H_{21}O_2N_3$	SB_{12}-Cu $[C_{24}H_{19}O_2N_3 2H_2O]Cu$	SB_{12}-Ni $[C_{24}H_{19}O_2N_3 2H_2O]Ni$	SB_{12}-Zn $[C_{24}H_{19}O_2N_3 2H_2O]Zn$
3000(s)	3350(w)	3340(w)	3350(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1515(m)	1510(m)
1315(m)	1400(s)	1410(s)	1408(s)
1160(s)	1320(m)	1310(m)	1315(m)
1140(s)	1155(s)	1150(s)	1155(s)
	1140(s)	1140(s)	1145(s)
	1110(s)	1108(s)	1106(s)
	800(s)	790(s)	800(s)
	460(m)	450(m)	460(m)
	390(s)	395(m)	390(s)

cont.....

Table cont....

SB_{13} ligand $C_{25}H_{23}O_2N_3$	SB_{13}-Cu $[C_{25}H_{21}O_2N_3 2H_2O]Cu$	SB_{13}-Ni $[C_{25}H_{21}O_2N_3 2H_2O]Ni$	SB_{13}-Zn $[C_{25}H_{21}O_2N_3 2H_2O]Zn$
2910(s)	3310(w)	3300(w)	3310(w)
1630(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(s)	1510(s)	1510(s)
	1410(s)	1408(m)	1410(s)
1315(m)	1310(m)	1310(m)	1312(m)
1160(s)	1150(s)	1160(s)	1150(s)
1130(s)	1130(s)	1140(m)	1120(s)
	1110(m)	1110(s)	1100(s)
	805(s)	800(s)	795(s)
	460(m)	475(m)	460(m)
	395(s)	380(s)	385(m)

cont.....

Table cont...

SB_{14} ligand	SB_{14}-Cu	SB_{14}-Ni	SB_{14}-Zn
$C_{26}H_{23}ON_4Cl$	$[C_{26}H_{21}ON_4Cl_2H_2O]Cu$	$[C_{26}H_{21}ON_4Cl_2H_2O]Ni$	$[C_{26}H_{21}ON_4Cl_2H_2O]Zn$
3440(m)	3310(s)	3300(s)	3310(s)
2900(s)	3200(v)	3220(v)	3200(v)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(m)	1515(m)	1508(s)	1505(s)
1320(m)	1310(m)	1315(s)	1310(m)
1460(s)	1240(m)	1210(s)	1210(s)
1142(s)	1160(s)	1160(m)	1155(s)
730(m)	1140(s)	1130(m)	1130(m)
	1110(m)	1110(m)	1110(s)
	780(s)	770(s)	780(s)
	660(v)	670(s)	675(s)
	460(m)	465(m)	460(s)
	390(s)	395(s)	390(m)

cont.....

Table cont...

SB_{15} $C_{23}H_{17}O_2N_3$	SB_{15}-Cu $(C_{23}H_{15}O_2N_3 2H_2OCu)_2$	SB_{15}-Ni $(C_{23}H_{15}O_2N_3 2H_2ONi)_2$	SB_{15}-Zn $(C_{23}H_{15}O_2N_3 2H_2OZn)_2$
2900(s)	3400(w)	3380(w)	3400(w)
1625(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(m)	1520(m)	1510(m)	1510(m)
1420(s)	1410(s)	1410(s)	1415(s)
1320(m)	1310(s)	1310(s)	1320(m)
1160(s)	1150(s)	1160(m)	1150(s)
1140(s)	1130(s)	1135(s)	1130(s)
	1110(m)	1110(s)	1110(s)
	810(s)	820(s)	825(s)
	540(s)	545(s)	540(s)
	430(m)	440(s)	440(m)

cont....

Table cont..

SB_{16} ligand $C_{24}H_{19}O_2N_3$	SB_{16}-Cu $(C_{24}H_{17}O_2N_3 2H_2O Cu)_2$	SB_{16}-Ni $(C_{24}H_{17}O_2N_3 2H_2O Ni)_2$	SB_{16}-Zn $(C_{24}H_{17}O_2N_3 2H_2O Zn)_2$
2900(s)	3350(w)	3360(w)	3340(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1510(m)	1510(m)
1310(m)	1420(s)	1410(s)	1415(s)
1155(s)	1310(m)	1308(s)	1310(s)
1140(s)	1160(s)	1150(s)	1160(s)
	1140(s)	1135(m)	1140(s)
	1108(m)	1110(s)	1110(m)
	810(s)	805(s)	800(s)
	550(s)	550(m)	540(m)
	440(m)	430(s)	440(s)

cont.....

Table cont....

SB_{17} ligand $C_{24}H_{19}O_3N_3$	SB_{17}-Cu $(C_{24}H_{17}O_3N_3 2H_2OCu)_2$	SB_{17}-Ni $(C_{24}H_{17}O_3N_3 2H_2ONi)_2$	SB_{17}-Zn $(C_{24}H_{17}O_3N_3 2H_2OZn)_2$
2960(s)	3400(w)	3380(w)	3380(w)
2820(s)	3150(s)	3100(s)	3160(s)
1630(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(m)	1510(m)	1515(m)	1510(m)
1415(s)	1408(s)	1406(s)	1410(m)
1320(m)	1310(m)	1310(m)	1320(s)
1160(s)	1160(s)	1155(s)	1160(s)
1140(s)	1140(s)	1140(s)	1135(s)
	1110(s)	1108(m)	1110(s)
	820(s)	830(m)	820(s)
	540(m)	540(s)	540(s)
	430(s)	435(s)	440(s)

cont....

Table cont...

SB_{18} ligand $C_{25}H_{21}O_3N_3$	SB_{18}-Cu $(C_{25}H_{19}O_3N_3 2H_2O Cu)_2$	SB_{18}-Ni $(C_{25}H_{19}O_3N_3 2H_2O Ni)_2$	SB_{18}-Zn $(C_{25}H_{19}O_3N_3 2H_2O Zn)_2$
2900(s)	3280(w)	3305(w)	3300(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(m)	1520(m)	1515(m)	1520(m)
1420(s)	1410(s)	1410(m)	1410(s)
1310(s)	1310(s)	1310(s)	1320(s)
1240(s)	1230(s)	1220(s)	1220(m)
1160(s)	1160(m)	1155(s)	1180(s)
1140(m)	1140(s)	1140(m)	1140(m)
1040(s)	1110(s)	1108(s)	1108(s)
	1040(s)	1045(s)	1040(s)
	805(m)	795(m)	805(m)
	540(s)	530(s)	540(s)
	430(s)	440(m)	430(m)

cont.....

Table cont...

SB_{19} ligand $C_{27}H_{19}O_2N_3$	SB_{19}-Cu $(C_{27}H_{17}O_2N_3 2H_2OCu)_2$	SB_{19}-Ni $(C_{27}H_{19}O_2N_3 2H_2ONi)_2$	SB_{19}-Zn $(C_{27}H_{19}O_2N_3 2H_2OZn)_2$
2950(s)	3360(w)	3350(w)	3350(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(m)	1520(m)	1515(m)	1520(m)
1310(m)	1400(s)	1410(s)	1410(s)
1160(s)	1320(m)	1310(s)	1310(m)
1140(s)	1160(s)	1150(s)	1160(s)
	1140(s)	1135(s)	1140(m)
	1108(s)	1110(s)	1108(s)
	820(s)	810(m)	810(s)
	540(m)	540(m)	550(m)
	430(s)	420(s)	410(s)

cont....

Table cont...

SB_{20} ligand $C_{28}H_{21}O_2N_3$	SB_{20}-Cu $(C_{28}H_{19}O_2N_3 2H_2O Cu)_2$	SB_{20}-Ni $(C_{28}H_{19}O_2N_3 2H_2O Ni)_2$	SB_{20}-Zn $(C_{28}H_{19}O_3N_3 2H_2O Zn)_2$
2950(s)	3320(w)	3300(w)	3300(w)
1630(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(m)	1400(s)	1410(s)	1410(s)
1310(m)	1320(m)	1310(m)	1310(m)
1160(s)	1150(s)	1160(s)	1160(s)
1130(s)	1140(s)	1140(s)	1140(s)
	1110(s)	1100(s)	1110(m)
	810(m)	790(m)	785(s)
	540(s)	545(s)	540(s)
	430(s)	435(s)	450(s)

cont.....

Table cont....

SB_{21} ligand $C_{29}H_{21}ON_4Cl$	SB_{21}-Cu $(C_{29}H_{19}ON_4Cl2H_2OCu)_2$	SB_{21}-Ni $(C_{29}H_{19}ON_4Ck2H_2ONi)_2$	SB_{21}-Zn $(C_{29}H_{19}ON_4Cl2H_2OZn)_2$
3460(m)	3310(s)	3320(s)	3310(s)
2900(s)	3200(v)	3210(v)	3200(v)
1625(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1515(m)	1520(m)
1310(m)	1310(m)	1310(s)	1320(s)
1160(s)	1240(m)	1245(s)	1240(m)
1140(s)	1160(s)	1165(s)	1160(s)
730(s)	1140(s)	1135(s)	1130(s)
	1110(m)	1110(m)	1100(s)
	780(s)	775(s)	780(s)
	680(s)	690(s)	680(s)
	550(m)	540(m)	545(m)
	440(s)	440(s)	450(s)

cont....

Table cont....

SB_{22} ligand $C_{29}H_{21}O_2N_3$	SB_{22}-Cu $(C_{29}H_{19}O_2N_3 2H_2OCu)_2$	SB_{22}-Ni $(C_{29}H_{19}O_2N_3 2H_2ONi)_2$	SB_{22}-Zn $(C_{29}H_{19}O_2N_3 2H_2OZn)_2$
2900(s)	3350(w)	3400(w)	3400(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1525(m)	1510(m)	1510(m)	1520(m)
1420(m)	1410(s)	1420(s)	1420(s)
1310(s)	1320(m)	1310(m)	1320(m)
1150(s)	1160(s)	1160(s)	1160(s)
1140(s)	1140(s)	1140(s)	1140(s)
	1110(m)	1108(m)	1110(s)
	800(s)	790(s)	810(s)
	540(m)	530(m)	530(m)
	460(s)	440(s)	420(s)

cont....

Table cont..

SB_{23} ligand $C_{30}H_{23}O_2N_3$	SB_{23}-Cu $(C_{30}H_{21}O_2N_3 2H_2O Cu)_2$	SB_{23}-Ni $(C_{30}H_{21}O_2N_3 2H_2O Ni)_2$	SB_{23}-Zn $(C_{30}H_{21}O_2N_3 2H_2O Zn)_2$
2900(s)	3390(w)	3390(w)	3410(w)
1630(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1515(m)	1510(m)
1310(m)	1410(s)	1408(m)	1415(m)
1160(s)	1320(s)	1310(s)	1320(s)
1140(s)	1160(s)	1150(s)	1160(s)
	1140(m)	1145(s)	1140(s)
	1110(s)	1108(s)	1110(s)
	810(m)	815(m)	810(m)
	540(s)	540(s)	550(m)
	460(m)	450(s)	460(s)

cont.....

Table cont...

SB_{24} ligand $C_{30}H_{23}O_3N_3$	SB_{24}-Cu $(C_{30}H_{21}O_3N_3 2H_2OCu)_2$	SB_{24}-Ni $(C_{30}H_{21}O_3 2H_2ONi)_2$	SB_{24}-Zn $(C_{30}H_{21}O_3N_3 2H_2OZn)_2$
2960(s)	3400(w)	3410(w)	3420(w)
2865(s)	2910(s)	2900(s)	2880(s)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1520(m)	1510(m)
1410(m)	1410(s)	1408(s)	1410(s)
1320(s)	1320(m)	1315(m)	1320(m)
1160(s)	1160(s)	1150(m)	1160(s)
1140(s)	1140(s)	1135(s)	1145(vs)
	1110(s)	1108(m)	1110(s)
	800(m)	820(s)	810(s)
	530(s)	540(s)	550(s)
	460(s)	460(m)	450(m)

cont....

Table cont...

SB_{25} ligand $C_{31}H_{25}O_3N_3$	SB_{25}-Cu $(C_{31}H_{23}O_3N_3 2H_2O Cu)_2$	SB_{25}-Ni $(C_{31}H_{23}O_3N_3 2H_2O Ni)_2$	SB_{25}-Zn $(C_{31}H_{23}O_3N_3 2H_2O Zn)_2$
2900(s)	3360(w)	3370(w)	3360(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1520(s)	1510(s)	1510(s)	1515(s)
1410(s)	1420(m)	1420(m)	1410(m)
1310(m)	1415(s)	1310(s)	1315(m)
1230(s)	1235(s)	1230(s)	1230(s)
1160(s)	1160(s)	1160(s)	1150(s)
1140(m)	1130(s)	1140(m)	1135(m)
1040(s)	1108(m)	1110(s)	1110(s)
	1030(m)	1040(s)	1040(s)
	1030(m)	1040(s)	1040(s)
	806(m)	815(s)	810(s)
	540(s)	550(s)	540(s)
	460(s)	450(s)	460(s)

cont.....

Table cont...

SB_{26} ligand $C_{33}H_{23}O_2N_3$	SB_{26}-Cu $(C_{33}H_{21}O_2N_32H_2OCu)_2$	SB_{26}-Ni $(C_{33}H_{21}O_2N_32H_2ONi)_2$	SB_{26}-Zn $(C_{33}H_{21}O_2N_32H_2OZn)_2$
3000(s)	3410(w)	3430(w)	3410(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(s)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1515(m)	1510(m)
1315(m)	1400(s)	1410(s)	1408(s)
1160(s)	1325(m)	1315(m)	1310(m)
1140(s)	1155(s)	1150(m)	1160(s)
	1140(s)	1130(s)	1145(s)
	1108(s)	1100(s)	1106(s)
	840(s)	830(m)	810(s)
	550(m)	560(m)	550(m)
	460(s)	450(s)	460(s)

cont.....

Table cont...

SB_{26} $C_{33}H_{23}O_2N_3$	SB_{26}-Cu $(C_{33}H_{21}O_2N_3 2H_2OCu)_2$	SB_{26}-Ni $(C_{33}H_{21}O_2N_3 2H_2ONi)_2$	SB_{26}-Zn $(C_{33}H_{21}O_2N_3 2H_2OZn)_2$
3000(s)	3410(w)	3430(w)	3410(w)
1620(s)	1600(s)	1600(s)	1600(s)
1570(s)	1570(vs)	1570(vs)	1570(vs)
1520(m)	1510(m)	1515(m)	1510(m)
1315(m)	1400(s)	1410(s)	1408(s)
1160(s)	1325(m)	1315(m)	1310(m)
1140(s)	1155(s)	1150(m)	1160(s)
	1108(s)	1100(s)	1106(s)
	840(s)	830(m)	810(s)
	550(m)	560(m)	550(m)
	460(s)	450(s)	460(s)

cont....

Table cont..

SB_{27} ligand $C_{34}H_{25}O_2N_3$	SB_{27}-Cu $(C_{34}H_{23}O_2N_3 2H_2O Cu)_2$	SB_{27}-Ni $(C_{34}H_{23}O_2N_3 2H_2O Ni)_2$	SB_{27}-Zn $(C_{34}H_{23}O_2N_3 2H_2O Zn)_2$
2910(s)	3410(w)	3400(w)	3410(w)
1630(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(s)	1520(s)	1515(s)	1510(s)
1320(m)	1410(s)	1408(m)	1410(m)
1160(s)	1330(m)	1320(m)	1330(m)
1140(s)	1150(s)	1160(s)	1150(s)
	1130(s)	1140(s)	1130(s)
	1108(m)	1110(s)	1108(s)
	820(m)	815(s)	815(s)
	540(s)	540(m)	560(m)
	460(s)	420(s)	430(d)

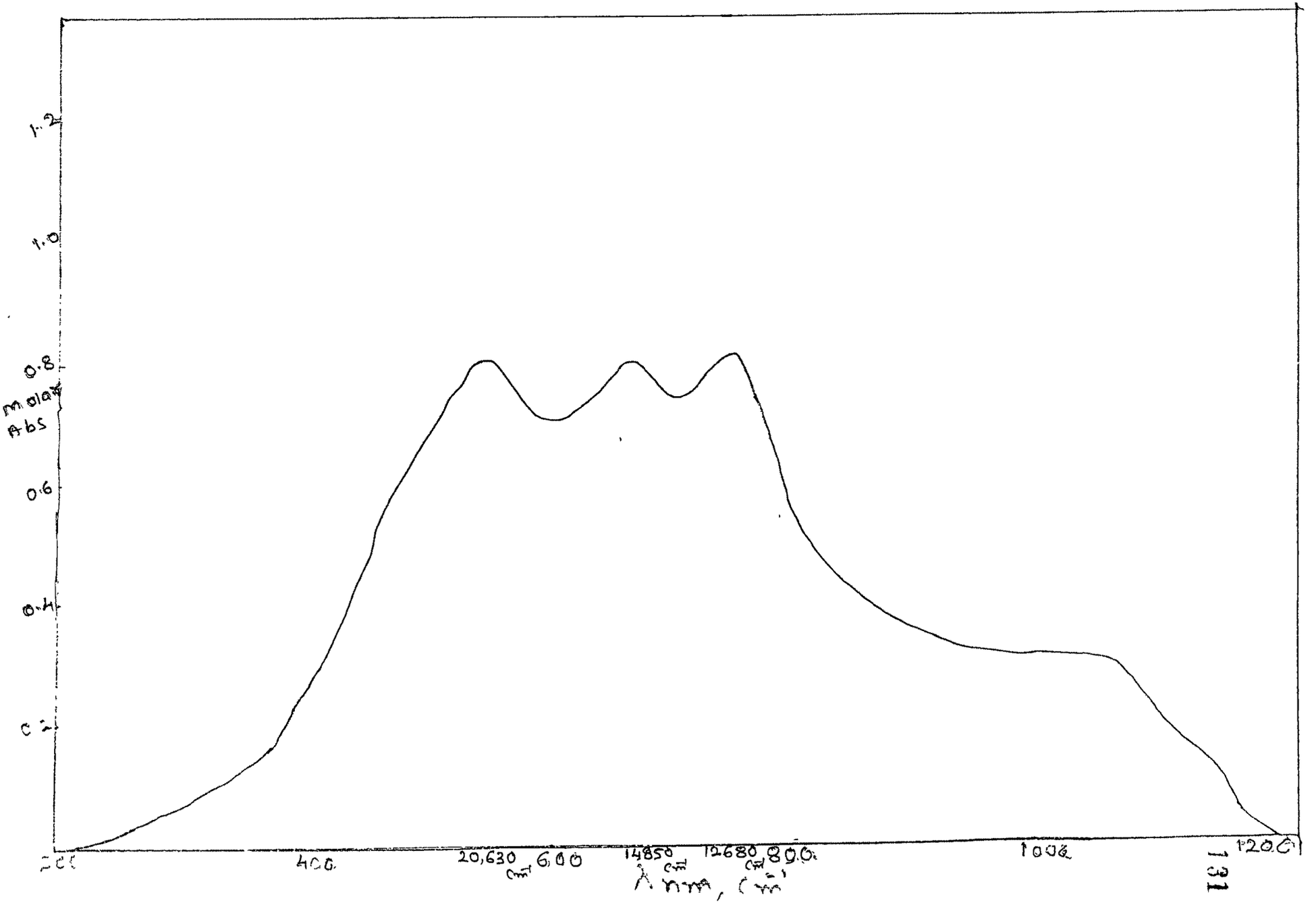
cont.....

Table cont...

SB_{28} ligand $C_{35}H_{25}ON_4Cl$	SB_{28}-Cu $(C_{35}H_{23}ON_4Cl2H_2OCu)_2$	SB_{28}-Ni $(C_{35}H_{23}ON_4Cl2H_2ONi)_2$	SB_{28}-Zn $(C_{35}H_{23}ON_4Cl2H_2OZn)_2$
3450(m)	3380(w)	3400(w)	3400(w)
2900(s)	3180(s)	3210(s)	3220(s)
1620(s)	1600(s)	1600(s)	1600(s)
1570(vs)	1570(vs)	1570(vs)	1570(vs)
1510(s)	1515(m)	1508(s)	1506(s)
1320(m)	1310(m)	1315(s)	1310(m)
1160(s)	1240(m)	1210(s)	1210(s)
1145(s)	1160(s)	1160(m)	1155(s)
740(m)	1140(s)	1130(m)	1140(s)
	1108(m)	1110(m)	1110(s)
	780(s)	790(s)	790(m)
	670(s)	675(s)	675(s)
	540(m)	540(m)	545(s)
	430(s)	440(s)	460(m)

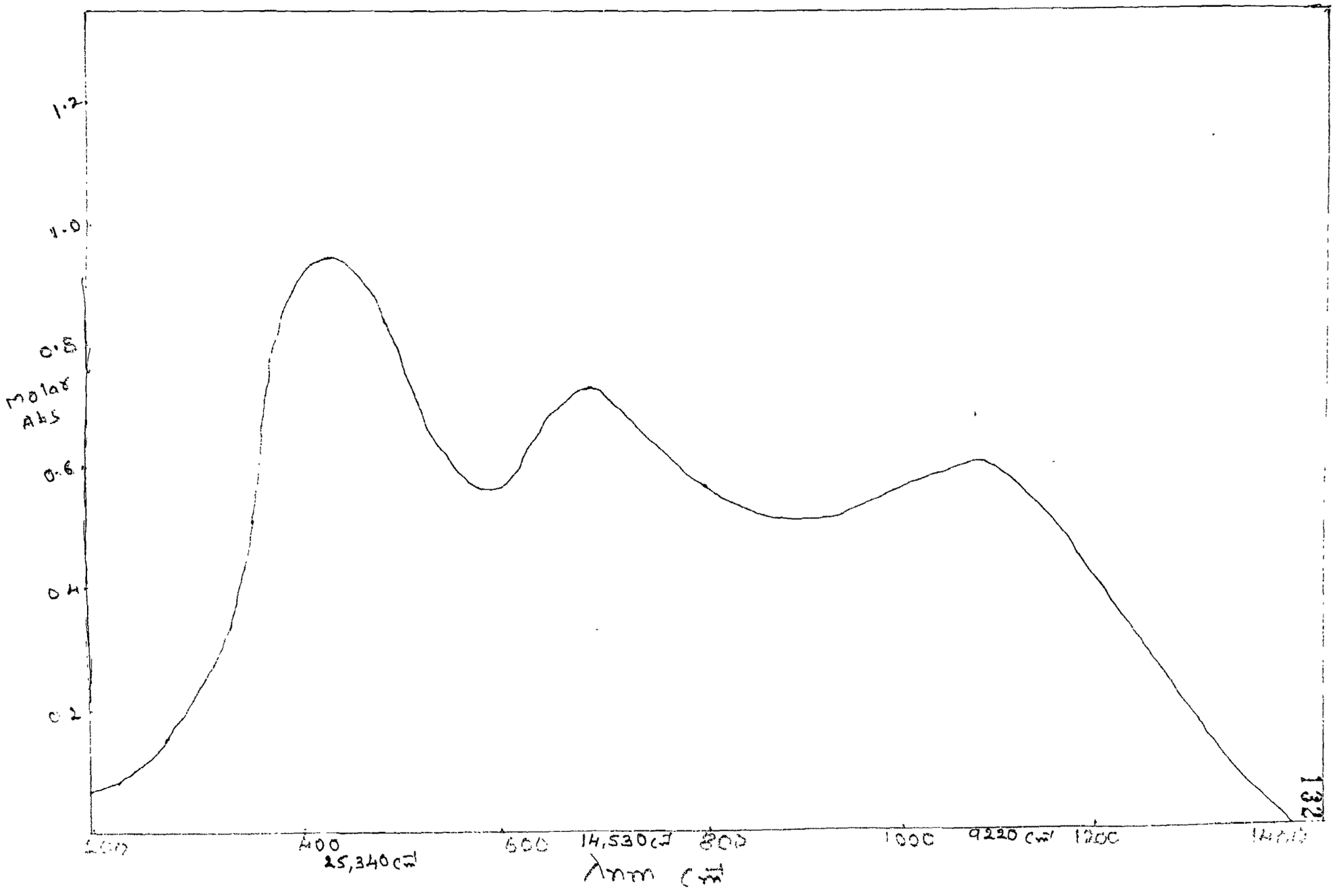
E.Curve- 3.1

Electronic spectra of Cu(II) complexes



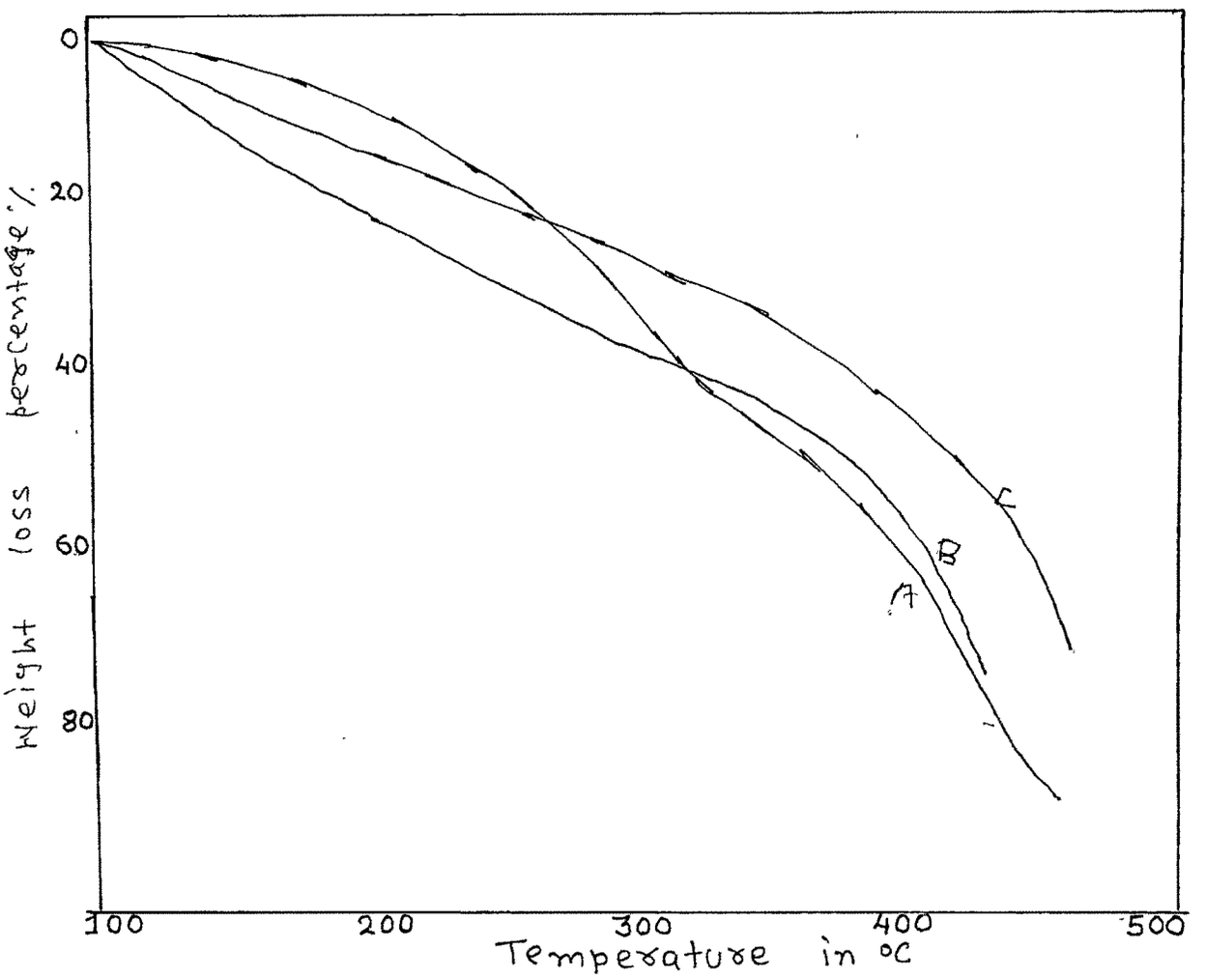
E.Curve-3.2

Electronic spectra of Ni(II) Complexes



T.Curve-3.3

TGA-Curve of Schiff base complexes using en



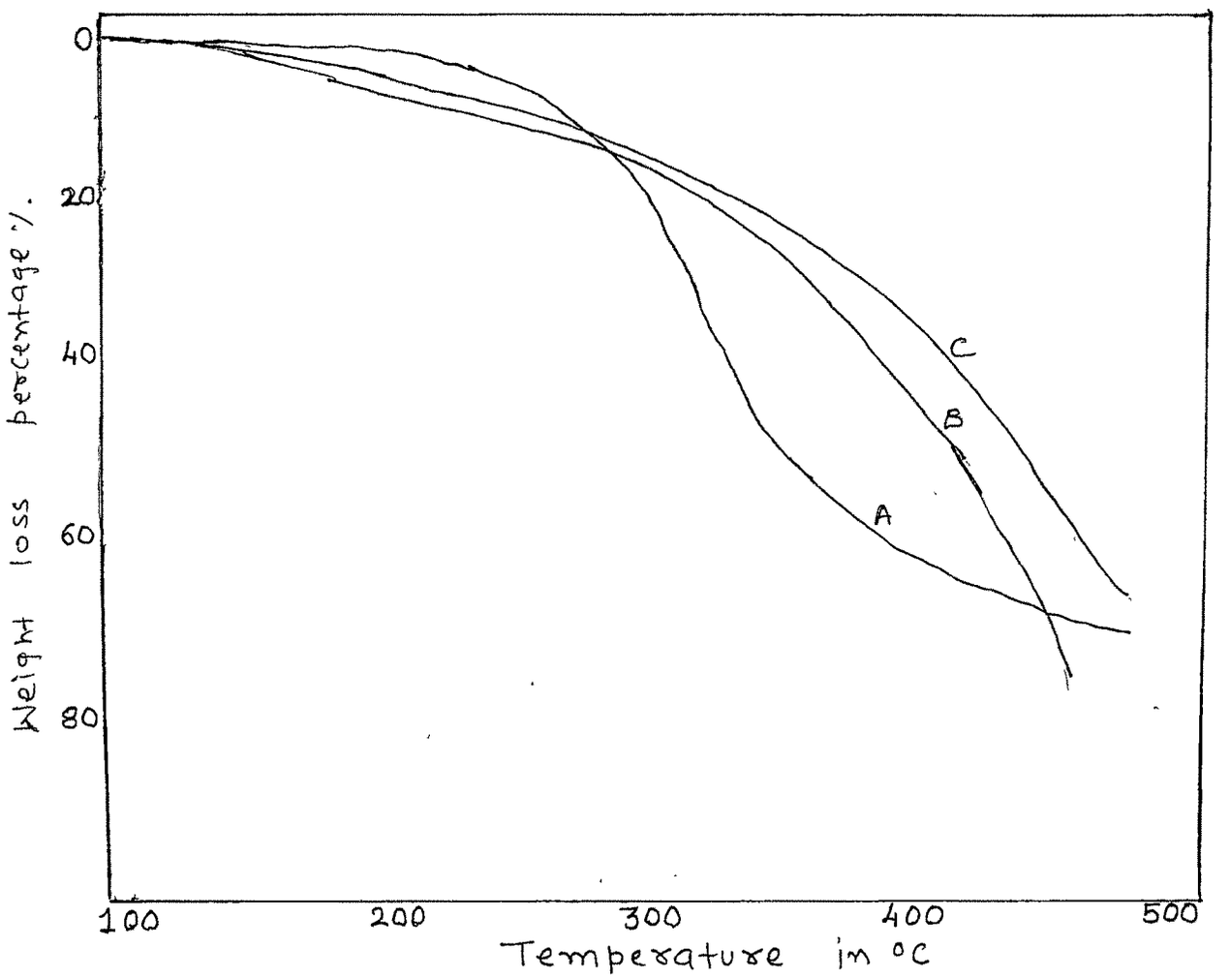
Where

C = Zn(II)

B = Ni(II)

A = Cu(II)

T.Curve-3.5
TGA-Curve of Schiff base complexes using phenylene diamine



Where

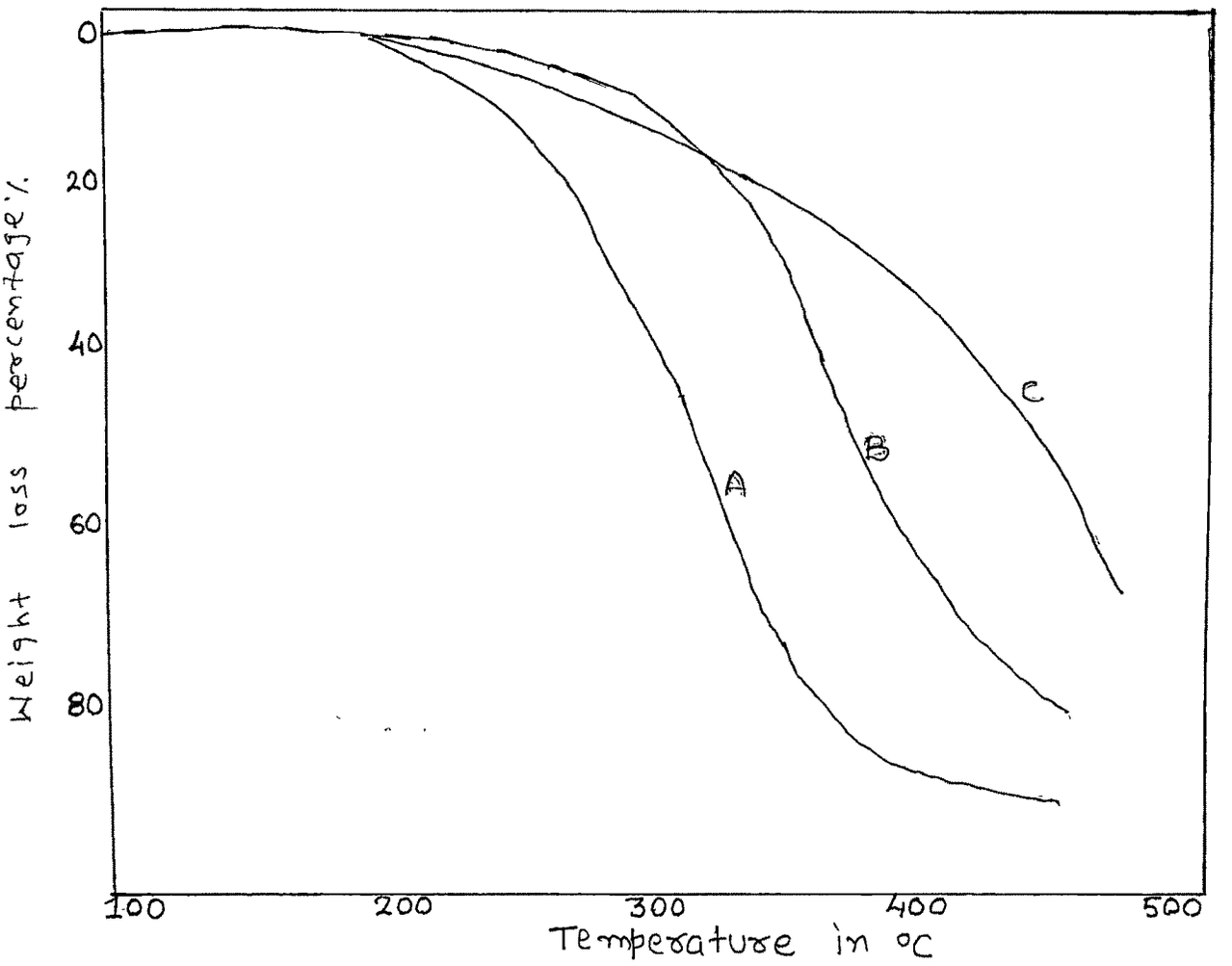
C = Zn(II)

B = Ni(II)

A = Cu(II)

T.Curve-3.6

TGA-Curve of Schiff base complexes using Benzidine



Where

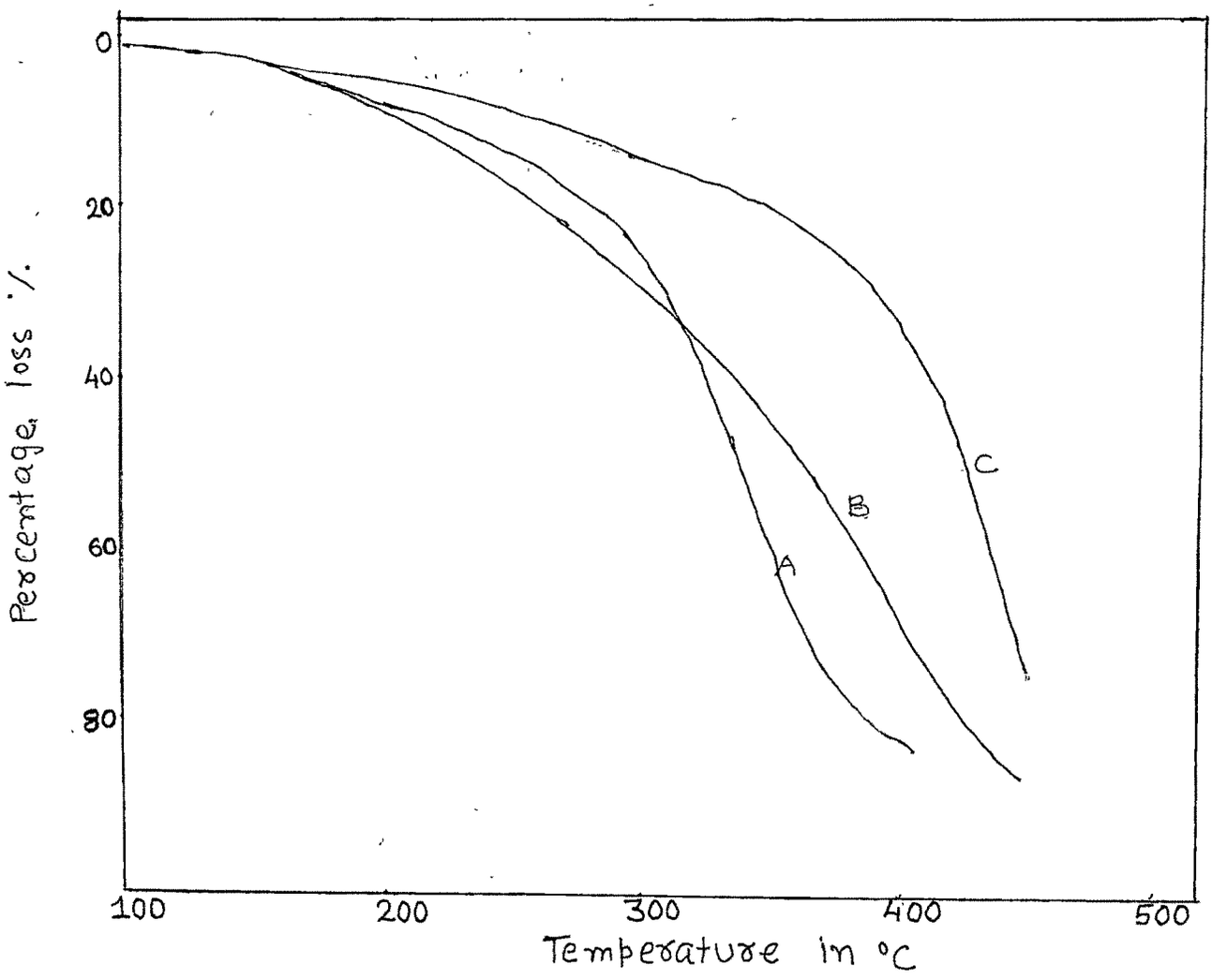
C = Zn (II)

B = Ni (II)

A = Cu (II)

T.Curve-3.4

TGA-Curve of Schiff base complexes using pn



Where

C = Zn (II)

B = Ni (II)

A = Cu (II)

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