CHAPTER - V

COMPLEX FORMATION BETWEEN BIVALENT METAL IONS AND vic-HYDROXY-THIOSEMICARBAZONE

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5.1 INTRODUCTION

Aldehyde and ketones give easily crystallizable thiosemicarbazone derivatives, and this property is used for the identification of the individual compounds. The first application of thiosemicarbazone derivative appeared in 1945[1]. From 1945 onward research activities are seen in the field of chemistry of thiosemicarbazone derivatives. It is interesting to note that pharmacology of thiosemicarbazone is expanded dramatically.[2-5] Similarly thiosemicarbazone derivatives are used in analytical chemistry.[1,6] But Chemistry of thiosemicarbazone in solution phase is neglected. Campbell wrote about the chemistry of transition metal complexes of thiosemicarbazone and thiosemicarbazide in 1975.[7]

" There is very little thermodynamic data available for the transition metal complexes and virtually none for those of thiosemicarbazones... There has been a great deal of work on the pharmacology of thiosemicarbazones and it has frequently been suggested that their activity is related to their ability to chelate trace metals. Most of the chemical research has concentrated on structure and bonding in these complexes in the solid state. Very little is known of their properties in solution and virtually nothing is known about their reactions. Clearly a great deal remains to be done before we can even start to rationalize the role of metal thiosemicarbazone species in the pharmacological field."

The same situation remains even in 1985.

In present work vic-hydroxy aldehyde thiosemicarbazones have been studied in ethanol-water mixture at 25°, 35° and 45°C temperature to determine stability constants and thermodynamic parameters.

5.2 EXPERIMENTAL

Preparation of Thiosemicarbazones

Thiosemicarbazones of different aldehydes were prepared by general procedure[8] of condensation with certain modifications.

4 g of thiosemicarbazide (B.D.H.) was dissolved in 80 ml of distilled water on hot plate. 5.26 g of the aldehyde was mixed with 40 ml of ethanol and both the solutions were mixed in a round bottom flask. To enhance the reaction rate 2-3 drops of glacial acetic acid were added. The mixture was refluxed on water bath for three hours. On cooling crystals separate out. The product was recrystallised by using ethanol.

Aldehyde Used	Thiosemicarbazone Obtained	M.P.
Salicylaldehyde	Salicylaldehyde thiosemicarbazone	230^{o} C
4-CH_3-Salicylaldehyde	4-methyl salicylaldehyde thiosemicarbazone	236^{o} C
5-Nitro-Salicylaldehyde	5-nitro salicylaldehyde thiosemicarbazone	225^{o} C
3-Resorcylaldehyde	3-Resorcylaldehyde thiosemicarbazone	233^{o} C

5.3 INSTRUMENTATION

Potentiometric titrations were carried out as described in second chapter at temperature 25^{o}, 35^{o} and 45^{o}C by using Elico Digital pH meter model LI-120 and Philips glass calomel combination electrode.

Table 5.A.1

Salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M t = $25^{o}C$ μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml.

I		II			III		
$[HClO_4]$ vs NaOH E^{o} = 0.02 M		$[HClO_4+L]$ vs NaOH T_L^{o} = 0.002 M			$[HClO_4+L+Mg^{++}]$vs NaOH $T_{Mg^{++}}^{o}$ = 0.001 M		
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.09	0.00	2.09	colour-less	0.00	2.09	colour-less
0.20	2.20	0.20	2.22		0.20	2.20	
0.40	2.30	0.40	2.37		0.40	2.33	
0.60	2.62	0.60	2.63		0.60	2.62	
0.70	2.87	0.70	2.84		0.70	2.86	
0.74	3.13	0.74	2.99		0.74	3.00	
0.78	3.66	0.78	3.43		0.78	3.43	
0.82	11.00	0.82	6.66		0.82	5.60	
0.86	11.41	0.86	9.63	yellow	0.86	9.12	yellow
0.90	11.66	0.90	10.69		0.90	9.88	
0.94	11.77	0.94	11.15		0.94	10.38	
0.98	11.87	0.98	11.35		0.98	10.68	
1.02	11.94	1.02	11.50		1.02	11.28	
1.06	12.03	1.06	11.65		1.06	ppt.	
1.10	12.10	1.10	11.75				
1.14	12.16	1.14	11.85				

Table 5.A.1 (contd.)

Salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M　　t = 25°C　　μ = 0.1 M

Medium = 50 % v/v Ethanol-water　　V^o = 40.00 ml

IV

$[HClO_4+L+Cd^{++}]$ vs NaOH

$T^o_{Cd^{++}}$ = 0.001 M

Vol. of NaOH(ml)	pH	
0.00	2.09	colour-
0.20	2.20	less
0.40	2.36	
0.60	2.56	
0.70	2.81	
0.74	2.96	
0.78	3.24	
0.82	3.81	yellow
0.86	6.19	
0.90	6.64	
0.94	ppt.	

V

$[HClO_4+L+Zn^{++}]$ vs NaOH

$T^o_{Zn^{++}}$ = 0.001 M

Vol. of NaOH(ml)	pH	
0.00	2.09	colour-
0.20	2.20	less
0.40	2.35	
0.60	2.60	
0.70	2.88	
0.74	3.05	
0.78	3.40	
0.82	4.70	yellow
0.86	6.10	
0.90	ppt	

VI

$[HClO_4+L+Mn^{++}]$ vs NaOH

$T^o_{Mn^{++}}$ = 0.001 M

Vol. of NaOH(ml)	pH	
0.00	2.09	colour-
0.20	2.20	less
0.40	2.34	
0.60	2.57	
0.70	2.75	
0.74	3.00	
0.78	3.27	
0.82	4.10	yellow
0.86	7.50	
0.90	8.41	
0.94	ppt	

VII

$[HClO_4+L+Ni^{++}]$ vs NaOH

$T^o_{Ni^{++}}$ = 0.001 M

Vol. of NaOH(ml)	pH	
0.00	2.09	colour-
0.20	2.19	less
0.40	2.31	
0.60	2.59	
0.70	2.89	
0.74	3.10	
0.78	3.46	
0.82	ppt	

VIII

$[HClO_4+L+Co^{++}]$ vs NaOH

$T^o_{Co^{++}}$ = 0.001 M

Vol. of NaOH(ml)	pH	
0.00	2.09	colour-
0.20	2.20	less
0.40	2.36	
0.60	2.63	
0.70	2.92	
0.74	3.10	
0.78	3.44	
0.82	pinkish yellow ppt.	

IX

$[HClO_4+L+Cu^{++}]$ vs NaOH

$T^o_{Cu^{++}}$ = 0.001 M

Vol. of NaOH(ml)	pH	
0.00	2.09	green
0.20	2.19	
0.40	2.32	
0.60	2.55	
0.70	2.76	
0.74	2.90	
0.78	3.10	
0.82	ppt	

Table 5.A.1'

Salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 35°C   μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml

I			II			III		
$[HClO_4]$ vs NaOH			$[HClO_4$+L] vs NaOH			$[HClO_4+L+Mg^{++}]$vs NaOH		
E^o = 0.02 M			T_L^o = 0.002 M			$T^o_{Mg^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.19		0.00	2.19		0.00	2.19	colour-
0.20	2.25		0.20	2.25		0.20	2.25	
0.40	2.37		0.40	2.37		0.40	2.37	
0.60	2.58		0.60	2.59		0.60	2.62	
0.70	2.81		0.70	2.81		0.70	2.81	
0.74	3.02		0.74	3.02		0.74	3.02	
0.78	3.50		0.78	3.50		0.78	3.50	
0.82	9.15		0.82	7.97	yellow	0.82	7.73	yellow
0.86	10.12		0.86	8.80		0.86	8.61	
0.90	10.33		0.90	9.52		0.90	9.05	
0.94	10.47		0.94	10.12		0.94	9.20	
0.98	10.57		0.98	10.33		0.98	ppt.	
1.02	10.64		1.02	10.47				
1.06	10.69		1.06	10.58				
1.10	10.75		1.10	10.66				
1.14	10.79		1.14	10.73				
1.18	10.84		1.18	10.79				
1.22	10.87		1.22	10.83				
1.26	10.90		1.26	10.87				
1.30	10.93		1.30	10.90				
1.34	10.96		1.34	10.93				
1.38	10.98		1.38	10.95				
1.42	11.00		1.42	10.97				
1.46	11.02		1.46	10.99				
1.50	11.03		1.50	11.00				

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Table 5.A.1' (contd.)

Salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 35°C μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml

IV $[HClO_4+L+Cd^{++}]$ vs NaOH $T^{o}_{Cd^{++}}$ = 0.001 M		V $[HClO_4+L+Zn^{++}]$ vs NaOH $T^{o}_{Zn^{++}}$ = 0.001 M		VI $[HClO_4+L+Mn^{++}]$ vs NaOH $T^{o}_{Mn^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.19 colour-	0.00	2.19 colour-	0.00	2.19 colour-
0.20	2.25 less	0.20	2.25 less	0.20	2.26 less
0.40	2.37	0.40	2.37	0.40	2.38
0.60	2.62	0.60	2.62	0.60	2.63
0.70	2.81	0.70	2.81	0.70	2.81
0.74	3.02	0.74	2.99	0.74	3.00
0.78	3.50	0.78	3.50	0.78	3.50
0.82	5.60 yellow	0.82	4.94 yellow	0.82	6.50
0.86	6.80	0.86	5.57	0.86	ppt.
		0.94	ppt.		

VII $[HClO_4+L+Ni^{++}]$ vs NaOH $T^{o}_{Ni^{++}}$ = 0.001 M		VIII $[HClO_4+L+Co^{++}]$ vs NaOH $T^{o}_{Co^{++}}$ = 0.001 M		IX $[HClO_4+L+Cu^{++}]$ vs NaOH $T^{o}_{Cu^{++}}$ = 0.001 M	
0.00	2.18	0.00	2.19 colour-	0.00	2.18 colour-
0.20	2.24	0.20	2.25 less	0.20	2.25
0.40	2.33	0.40	2.42'-brown	0.40	2.41
0.60	2.55	0.60	2.75	0.60	2.70
0.70	2.81	0.70	ppt	0.70	2.81
0.74	3.05			0.74	ppt.
0.78	3.50				
0.82	red brown ppt.				

Table 5.A.1"

Salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 45°C μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml

I		II			III		
[$HClO_4$]vs NaOH		[$HClO_4$+L]vs NaOH			[$HClO_4$+L+Mg^{++}]vs NaOH		
E^{o} = 0.02 M		T_L^{o} = 0.002 M			$T_{Mg^{++}}^{o}$ = 0.001 M		
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.34	0.00	2.35	colour-	0.00	2.34	colour-
0.20	2.43	0.20	2.44	less	0.20	2.40	less
0.40	2.56	0.40	2.60		0.40	2.56	
0.60	2.81	0.60	2.82		0.60	2.80	
0.70	3.05	0.70	3.05		0.70	3.03	
0.74	3.25	0.74	3.25		0.74	3.23	
0.78	3.61	0.78	3.62		0.78	3.53	
0.82	9.51	0.82	8.16	yellow	0.82	8.03	yellow
0.86	10.05	0.86	8.85		0.86	8.73	
0.90	10.30	0.90	9.60		0.90	8.95	
0.94	10.44	0.94	10.00		0.94	ppt.	
0.98	10.56	0.96	10.15				
1.02	10.63	1.02	10.24				
1.06	10.69	1.06	10.44				
1.10	10.73	1.10	10.51				
1.14	10.77	1.14	10.57				
1.18	10.81	1.18	10.63				
1.22	10.84	1.22	10.68				
1.26	10.87	1.26	10.73				
1.30	10.90	1.30	10.76				
1.34	10.93	1.34	10.78				
1.38	10.95	1.38	10.80				
1.42	10.97	1.42	10.83				
1.46	11.00	1.46	10.85				
1.50	11.02	1.50	10.88				
1.54	11.04	1.54	10.90				
1.58	11.05	1.58	10.92				
1.62	11.07	1.62	10.93				
		1.66	10.95				
		1.70	10.97				
		1.74	10.98				
		1.78	11.00				
		1.82	11.02				
		1.86	11.03				
		1.90	11.04				
		1.94	11.05				
		1.98	11.06				
		2.02	11.07				

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Table 5.A.1* (contd.)

Salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 45°C   μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml

IV $[HClO_4+L+Cd^{++}]$ vs NaOH $T^o_{Cd^{++}}$ = 0.001 M			V $[HClO_4+L+Zn^{++}]$ vs NaOH $T^o_{Zn^{++}}$ = 0.001 M			VI $[HClO_4+L+Mn^{++}]$ vs NaOH $T^o_{Mn^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.34	colour-	0.00	2.35	colour-	0.00	2.35	colour-
0.20	2.42	less	0.20	2.43	less	0.20	2.42	less
0.40	2.56		0.40	2.57		0.40	2.57	
0.60	2.80		0.60	2.81		0.60	2.81	
0.70	3.06		0.70	3.06		0.70	3.05	
0.74	3.22		0.74	3.24		0.74	3.25	
0.78	3.75		0.78	3.66		0.78	3.70	
0.82	5.80		0.82	5.15		0.82	6.25	
0.86	ppt		0.86	6.07	yellow	0.86	7.71	
			0.90	8.42		0.90	ppt.	
			0.94	ppt.				

VII $[HClO_4+L+Ni^{++}]$ vs NaOH $T^o_{Ni^{++}}$ = 0.001 M			VIII $[HClO_4+L+Co^{++}]$ vs NaOH $T^o_{Co^{++}}$ = 0.001 M			IX $[HClO_4+L+Cu^{++}]$ vs NaOH $T^o_{Cu^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.34	colour-	0.00	2.34	colour-	0.00	2.35	green
0.20	2.44	less	0.20	2.44	less	0.20	2.42	
0.40	2.56		0.40	2.59	red-	0.40	2.58	
0.60	2.82		0.60	2.84	brown	0.60	2.81	
0.70	3.05		0.70	ppt.		0.70	3.06	
0.74	3.34					0.74	3.42	
0.78	3.84					0.78	ppt.	
0.82	ppt.							

Table 5.A.2

4 Methyl salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M $t = 25^{o}C$ $\mu = 0.1$ M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml

I		II		III	
$[HClO_4]$ vs NaOH		$[HClO_4]$ vs NaOH		$[HClO_4 + L + Mg^{++}]$ vs NaOH	
E^{o} = 0.02 M		T_L^{o} = 0.002 M		$T_{Mg^{++}}^{o}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.09	0.00	2.09	0.00	2.09
0.20	2.17	0.20	2.18	0.20	2.19
0.40	2.30	0.40	2.29	0.40	2.30
0.60	2.53	0.60	2.54	0.60	2.55
0.70	2.87	0.70	2.85	0.70	2.78
0.74	3.13	0.74	3.06	0.74	2.99
0.78	3.66	0.78	3.46	0.78	3.45
0.82	11.00	0.82	9.15	0.82	6.20
0.86	11.41	0.86	10.03	0.86	8.41
0.90	11.66	0.90	11.03	0.90	9.25
0.94	11.77	0.94	11.44	0.94	ppt.
0.98	11.87	0.98	11.64		
1.02	11.94	1.02	11.76		
1.06	12.03	1.06	11.87		
1.10	12.10	1.10	11.96		
1.14	12.16	1.14	12.03		

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Table 5.A.2 (contd.)

4-Methyl salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 25°C   μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml.

IV $[HClO_4+L+Cd^{++}]$ vs NaOH $T^o_{Cd^{++}}$ = 0.001 M		V $[HClO_4+L+Zn^{++}]$ vs NaOH $T^o_{Zn^{++}}$ = 0.001 M		VI $[HClO_4+L+Mn^{++}]$ vs NaOH $T^o_{Mn^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.09	0.00	2.09	0.00	2.09
0.20	2.19	0.20	2.19	0.20	2.20
0.40	2.30	0.40	2.34	0.40	2.39
0.60	2.52	0.60	2.58	0.60	2.72
0.70	2.82	0.70	2.78	0.70	3.16
0.74	3.01	0.74	3.03	0.74	3.63
0.78	3.32	0.78	3.41	0.78	ppt.
0.82	5.63	0.82	4.75		
0.86	7.10	0.86	6.15		
0.90	white ppt.	0.90	7.19		
		0.94	yellow ppt.		

VII $[HClO_4+L+Ni^{++}]$ vs NaOH $T^o_{Ni^{++}}$ = 0.001 M		VIII $[HClO_4+L+Co^{++}]$ vs NaOH $T^o_{Co^{++}}$ = 0.001 M		IX $[HClO_4+L+Cu^{++}]$ vs NaOH $T^o_{Cu^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.09	0.00	2.09	0.00	2.09 green
0.20	2.24	0.20	2.20	0.20	2.17
0.40	2.42	0.40	2.30	0.40	2.29
0.60	2.78	0.60	2.60	0.60	2.52
0.70	3.16	0.70	2.90	0.70	2.70
0.74	4.50	0.74	3.05	0.74	2.92
0.78	ppt.	0.78	3.14	0.78	3.14
		0.82	4.30	0.82	3.63
		0.86	5.46	0.84	4.62
		0.90	ppt.	0.86	ppt.

Table 5.A.2'

4-Methyl salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M t = $35^{o}C$ μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml

I		II			III		
[$HClO_4$] vs NaOH E^{o} = 0.02 M		[$HClO_4$+L] vs NaOH T_L^{o} = 0.02 M			[$HClO_4$+L+Mg^{++}]vs NaOH $T^{o}_{Mg^{++}}$ = 0.001 M		
0.00	2.19	0.00	2.21	colourless	0.00	2.21	colourless
0.20	2.25	0.20	2.30		0.20	2.30	
0.40	2.37	0.40	2.43		0.40	2.43	
0.60	2.68	0.60	2.68		0.60	2.68	
0.70	2.94	0.70	2.94		0.70	2.94	
0.74	3.18	0.74	3.18		0.74	3.18	
0.78	3.75	0.78	3.75		0.78	3.75	
0.82	9.15	0.82	7.55	yellow	0.82	6.58	
0.86	10.12	0.86	9.33		0.86	8.20	
0.90	10.33	0.90	9.93		0.90	8.98	
0.94	10.47	0.94	10.21		0.94	ppt.	
0.98	10.57	0.98	10.44				
1.02	10.64	1.02	10.57				
1.06	10.69	1.06	10.65				
1.10	10.75	1.10	10.73				
1.14	10.79	1.14	10.79				
1.18	10.84	1.18	10.84				
1.22	10.87	1.22	10.88				
1.26	10.90	1.26	10.92				
1.30	10.93	1.30	10.96				
1.34	10.96	1.34	10.99				
1.38	10.98	1.40	11.03				
1.42	11.00	1.50	11.08				
1.46	11.02						
1.50	11.03						

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Table 5.A.2' (contd.)

4-Methyl salicylaldehyde thiosemicarbazone used as a ligand

N' =.98 M   t = 35°C μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml

IV $[HClO_4+L+Cd^{++}]$ vs NaOH $T^o_{Cd^{++}}$ = 0.001 M		V $[HClO_4+L+Zn^{++}]$ vs NaOH $T^o_{Zn^{++}}$ = 0.001 M		VI $[HClO_4+L+Mn^{++}]$ vs NaOH $T^o_{Mn^{++}}$ = 0.001 M	
0.00	2.21 colour-	0.00	2.21 colour-	0.00	2.21 colour-
0.20	2.30 less	0.20	2.30 less	0.20	2.30 less
0.40	2.43	0.40	2.44	0.40	2.45
0.60	2.68	0.60	2.69	0.60	2.75
0.70	2.94	0.70	3.00	0.70	3.18
0.74	3.18	0.74	3.20	0.74	3.25
0.78	3.75	0.78	3.75	0.78	ppt.
0.82	5.71	0.82	5.39		
0.86	white ppt.	0.86	6.50		
		0.90	yellow ppt.		

VII $[HClO_4+L+Ni^{++}]$ vs NaOH $T^o_{Ni^{++}}$ = 0.001 M		VIII $[HClO_4+L+Co^{++}]$ vs NaOH $T^o_{Co^{++}}$ = 0.001 M		IX $[HClO_4+L+Cu^{++}]$ vs NaOH $T^o_{Cu^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.21	0.00	2.21 colour-less	0.00	2.21 green
0.20	2.30	0.20	2.31 red-	0.20	2.28
0.40	2.47	0.40	2.45 brown	0.40	2.38
0.60	2.81	0.60	2.70	0.60	2.80
0.70	3.55	0.70	2.94	0.70	3.45
0.74	4.36	0.74	3.18	0.74	6.11 brown
0.78	red brown	0.78	3.75	0.78	ppm
		0.82	5.11		
		0.86	ppt.		

Table 5.A.2"

4-Methyl salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M t = 45^oC μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml

I		II			III		
[$HClO_4$] vs NaOH		[$HClO_4$+L]vs NaOH			[$HClO_4$+L+Mg^{++}]vs NaOH		
E^o = 0.02 M		T^o_L = 0.002 M			$T^o_{Mg^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.35	0.00	2.35	colour-	0.00	2.35	colour-
0.20	2.42	0.20	2.43	less	0.20	2.42	less
0.40	2.53	0.40	2.53		0.40	2.53	
0.60	2.75	0.60	2.76		0.60	2.76	
0.70	2.97	0.70	3.02		0.70	3.02	
0.74	3.13	0.74	3.21		0.74	3.21	
0.78	3.45	0.78	3.57		0.78	3.57	
0.82	8.90	0.82	7.25	yellow	0.82	6.60	yellow
0.86	10.00	0.86	9.05		0.86	8.26	
0.90	10.29	0.90	9.70		0.90	ppt.	
0.94	10.43	0.94	10.07				
0.98	10.53	0.98	10.23				
1.02	10.61	1.02	10.37				
1.06	10.67	1.06	10.46				
1.10	10.73	1.10	10.54				
1.14	10.76	1.14	10.60				
1.18	10.80	1.18	10.64				
1.22	10.83	1.22	10.69				
1.26	10.88	1.26	10.73				
1.30	10.91	1.30	10.77				
1.66	11.06	1.34	10.80				
1.70	11.09	1.38	10.83				
1.80	11.11	1.42	10.87				
		1.46	10.90				
		1.50	10.93				
		1.54	10.95				
		1.58	10.97				
		1.62	11.00				
		1.66	11.02				
		1.70	11.04				
		1.74	11.05				
		1.78	11.07				
		1.82	11.08				
		1.86	11.10				
		1.90	11.11				

...

Table 5.A.2" (contd.)

4-Methyl salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 35°C   μ = 0.1 M

Medium = 50 % v/v Ethanol-water   V° = 40.00 ml

IV		V		VI	
[$HClO_4$+L+Cd^{++}]vs NaOH		[$HClO_4$+L+Zn^{++}]vs NaOH		[$HClO_4$+L+Mn^{++}]vs NaOH	
$T^{o}_{Cd^{++}}$ = 0.001 M		$T^{o}_{Zn^{++}}$ = 0.001 M		$T^{o}_{Mn^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.35 colour-	0.00	2.35 colour	0.00	3.34 colour-
0.20	2.42 less	0.20	2.42 less	0.20	2.43 less
0.40	2.53	0.40	2.54	0.40	2.59
0.60	2.76	0.60	2.75	0.60	2.80
0.70	3.02	0.70	3.01	0.70	3.05
0.74	3.21	0.74	3.21	0.74	3.32
0.78	3.57	0.78	3.55	0.78	yellow ppt
0.82	5.66 yellow	0.82	5.40 yellow		
0.86	ppt.	0.86	6.72		
		0.90	ppt.		

VII		VIII		IX	
[$HClO_4$+L+Ni^{++}]vs NaOH		[$HClO_4$+L+Co^{++}]vs NaOH		[$HClO_4$+L+Cu^{++}]vs NaOH	
$T^{o}_{Ni^{++}}$ = 0.001 M		$T^{o}_{Co^{++}}$ = 0.001 M		$T^{o}_{Cu^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.35 colour	0.00	2.35 colour	0.00	2.35 green
0.20	2.43 less	0.20	2.44 less	0.20	2.44
0.40	2.58	0.40	2.57	0.40	2.59
0.60	2.82	0.60	2.83	0.60	2.86
0.70	3.35	0.70	3.05	0.70	3.19
0.74	3.96	0.74	3.21	0.74	3.48
0.78	red brown ppt.	0.78	3.60	0.78	ppt.
		0.82	5.01		
		0.86	ppt.		

Table 5.A.3

5-Nitro salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M t = 25°C μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml.

I		II			III		
$[HClO_4]$ vs NaOH		$[HClO_4 + L]$ vs NaOH			$[HClO_4 + L + Mg^{++}]$ vs NaOH		
E^{o} = 0.02 M		T_L^{o} = 0.002 M			$T^{o}_{Mg^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.09	0.00	2.08	colour-less	0.00	2.08	colour-less
0.20	2.17	0.20	2.18		0.20	2.18	
0.40	2.30	0.40	2.32		0.40	2.31	
0.60	2.53	0.60	2.55		0.60	2.54	
0.70	2.87	0.70	2.90		0.70	2.88	
0.74	3.13	0.74	3.13		0.74	3.13	
0.78	3.66	0.78	3.67		0.78	3.67	
0.82	11.00	0.82	6.44		0.82	5.91	
0.86	11.41	0.86	10.81	yellow	0.86	9.25	yellow
0.90	11.66	0.90	11.23		0.90	10.00	
0.94	11.77	0.94	11.38		0.94	10.42	
0.98	11.87	0.98	11.55		0.98	ppt.	
1.02	11.94	1.02	11.64				
1.06	12.03	1.06	11.70				
1.10	12.10	1.10	11.78				
1.14	12.16	1.14	11.82				
		1.18	11.89				
		1.22	11.92				
		1.26	11.96				
		1.30	11.99				
		1.34	12.02				
		1.38	12.05				
		1.42	12.09				

pp...

Table 5.A.3 (contd.)

5-Nitro salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M t = $25^{o}C$ μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml

IV $[HClO_4+L+Cd^{++}]$ vs NaOH $T^{o}_{Cd^{++}}$ = 0.001 M		V $[HClO_4+L+Zn^{++}]$ vs NaOH $T^{o}_{Zn^{++}}$ = 0.001 M		VI $[HClO_4+L+Mn^{++}]$ vs NaOH $T^{o}_{Mn^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.08 colour-	0.00	2.08 colour-	0.00	2.09 colour-
0.20	2.20 less	0.20	2.18 less	0.20	2.18 less
0.40	2.36	0.40	2.31	0.40	2.31
0.60	2.60	0.60	2.56	0.60	2.54
0.70	3.05	0.70	2.82	0.70	2.85
0.74	3.65	0.74	3.04	0.74	3.05
0.78	4.78	0.78	3.34	0.78	3.44
0.82	yellow	0.82	4.05 yellow	0.82	5.30
		0.86	5.32	0.86	6.43
		0.90	6.52	0.90	7.89
		0.94	ppt.	0.94	ppt.

VII $[HClO_4+L+Ni^{++}]$ vs NaOH $T^{o}_{Ni^{++}}$ = 0.001 M		VIII $[HClO_4+L+Co^{++}]$ vs NaOH $T^{o}_{Co^{++}}$ = 0.001 M		IX $[HClO_4+L+Cu^{++}]$ vs NaOH $T^{o}_{Cu^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.09	0.00	2.09 colour-	0.00	green
0.20	2.16	0.20	2.19 less		coloured
0.40	2.32	0.40	2.33		ppt.
0.60	2.63	0.60	2.55 yellow		
0.70	3.05	0.70	2.86		
0.74	3.43	0.74	3.05		
0.78	yellow ppt.	0.78	3.32		
		0.82	3.76		
		0.86	4.56		
		0.90	ppt.		

Table 5.A.3'

5-Nitro salicylaldehyde thiosemicarbazone used as a licand

N' = 0.98 M   t = 35°C μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml.

I			II			III		
[$HClO_4$] vs NaOH E^o = 0.02 M			[$HClO_4$ + L]vs NaOH T_L^o = 0.002 M			[$HClO_4$+L+Mg^{++}]vs NaOH $T_{Mg^{++}}^o$ = 0.001 M		
Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.21		0.00	2.21	colour-less	0.00	2.21	colour less
0.20	2.30		0.20	2.30		0.20	2.31	
0.40	2.41		0.40	2.42		0.40	2.44	
0.60	2.64		0.60	2.64		0.60	2.64	
0.70	2.88		0.70	2.86		0.70	2.86	
0.74	3.03		0.74	3.01		0.74	3.01	
0.78	3.35		0.78	3.35		0.78	3.26	
0.82	8.60		0.82	6.40	yellow	0.82	5.92	yellow
0.86	10.10		0.86	8.92		0.86	7.55	
0.90	10.13		0.90	9.70		0.90	8.65	
0.94	10.49		0.94	10.04		0.94	ppt.	
0.98	10.60		0.98	10.32				
1.02	10.69		1.02	10.44				
1.06	10.76		1.06	10.56				
1.10	10.81		1.10	10.64				
1.14	10.86		1.14	10.70				
1.18	10.90		1.18	10.76				
1.22	10.94		1.22	10.81				
1.26	10.97		1.26	10.86				
1.30	11.01		1.30	10.89				
1.34	11.03		1.34	10.92				
1.38	11.05		1.38	10.95				
1.42	11.08		1.42	10.98				

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Table 5.A.3' (contd.)

5-Nitro salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 35^{o}C μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml

IV $[HClO_4+L+Cd^{++}]$vs NaOH $T^{o}_{Cd^{++}}$ = 0.001 M			V $[HClO_4+L+Zn^{++}]$vs NaOH $T^{o}_{Zn^{++}}$ = 0.001 M			VI $[HClO_4+L+Mn^{++}]$vs NaOH $T^{o}_{Mn^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.21	colour-	0.00	2.21	colour-	0.00	2.21	colour-
0.20	2.32	less	0.20	2.30	less	0.20	2.32	less
0.40	2.44		0.40	2.43		0.40	2.44	
0.60	2.62		0.60	2.65		0.60	2.64	
0.70	2.82		0.70	2.90		0.70	3.84	
0.74	2.98		0.74	3.02		0.74	3.02	
0.78	3.26		0.78	3.26		0.78	3.26	
0.82	5.15	yellow	0.82	4.75	yellow	0.82	5.18	yellow
0.86	5.90		0.86	5.55		0.86	6.35	
0.90	6.20		0.90	ppt.		0.90	7.25	
0.94	ppt.					0.94	ppt.	

VII $[HClO_4+L+Ni^{++}]$vs NaOH $T^{o}_{Ni^{++}}$ = 0.001 M			VIII $[HClO_4+L+Co^{++}]$vs NaOH $T^{o}_{Co^{++}}$ = 0.001 M			IX $[HClO_4+L+Cu^{++}]$vs NaOH $T^{o}_{Cu^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.22	slight-	0.00	2.21	colour-	0.00	green ppt.	
0.20	2.32	yellow	0.20	2.31	less			
0.40	2.45		0.40	2.44				
0.60	2.79		0.60	2.64				
0.70	3.12		0.70	2.87				
0.74	3.40		0.74	2.90				
0.78	ppt.		0.78	3.15				
			0.82	3.60	yellow			
			0.86	ppt.				

Table 5.A.3"

5-Nitro salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M t = $45^{o}C$ μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml

I [$HClO_4$]vs NaOH E^{o} = 0.02 M		II [$HClO_4$] vs NaOH T_L^{o} = 0.002 M			III [$HClO_4$+L+Mg^{++}]vs NaOH $T^{o}_{Mg^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.35	0.00	2.34	colour-	0.00	2.35	colour
0.20	2.42	0.20	2.42	less	0.20	2.43	less
0.40	2.55	0.40	2.54		0.40	2.56	
0.60	2.78	0.60	2.77		0.60	2.78	
0.70	3.04	0.70	3.03		0.70	3.05	
0.74	3.19	0.74	3.18		0.74	3.20	
0.78	3.51	0.78	3.50		0.78	3.49	
0.82	9.38	0.82	6.25	yellow	0.82	5.75	yellow
0.86	10.10	0.86	9.10		0.86	7.30	
0.90	10.26	0.90	9.65		0.90	8.61	
0.94	10.40	0.94	9.99		0.94	9.00	
0.98	10.48	0.98	10.24		0.98	ppt.	
1.02	10.56	1.02	10.39				
1.06	10.65	1.06	10.50				
1.10	10.70	1.10	10.56				
1.14	10.73	1.14	10.62				
1.18	10.77	1.18	10.66				
1.22	10.80	1.22	10.72				
1.26	10.83	1.26	10.75				
1.30	10.86	1.30	10.78				
1.34	10.88	1.34	10.81				
1.38	10.90	1.38	10.84				
1.42	10.92	1.42	10.86				
1.46	10.94	1.46	10.89				
1.50	10.96	1.50	10.91				
1.54	10.98	1.54	10.93				
1.58	10.99	1.58	10.95				
1.62	11.00	1.62	10.97				
1.66	11.02	1.66	10.99				
1.70	11.04	1.70	11.00				
		1.74	11.01				
		1.78	11.02				

...

Table 5.A.3" (contd.)

5 Nitro salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 45°C μ = 0.1 M
Medium = 50 % v/v Ethanol-water V^o = 40.00 ml

IV		V		VI	
$[HClO_4+L+Cd^{++}]$ vs NaOH		$[HClO_4+L+Zn^{++}]$ vs NaOH		$[HClO_4+L+Mn^{++}]$ vs NaOH	
$T^o_{Cd^{++}}$ = 0.001 M		$T^o_{Zn^{++}}$ = 0.001 M		$T^o_{Mn^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.35 colour-	0.00	2.35 colour-	0.00	2.35 colour-
0.20	2.44 less	0.20	2.45 less	0.20	2.44 less
0.40	2.56	0.40	2.54	0.40	2.55
0.60	2.78	0.60	2.77	0.60	2.78
0.70	3.05	0.70	3.03	0.70	3.04
0.74	3.19	0.74	3.20	0.74	3.20
0.78	3.48	0.78	3.51	0.78	3.51
0.82	4.95 yellow	0.82	4.74 yellow	0.82	4.96 yellow
0.86	5.90	0.86	5.54	0.86	6.34
0.90	6.60	0.90	ppt.	0.90	7.32
0.94	ppt.			0.94	ppt.

VII		VIII		IX	
$[HClO_4+L+Ni^{++}]$ vs NaOH		$[HClO_4+L+Co^{++}]$ vs NaOH		$[HClO_4+L+Cu^{++}]$ vs NaOH	
$T^o_{Ni^{++}}$ = 0.001 M		$T^o_{Co^{++}}$ = 0.001 M		$T^o_{Cu^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.35 colour-	0.00	2.35 colour-	0.00	bluish green ppt.
0.20	2.44 less	0.20	2.44 less		
0.40	2.56	0.40	2.56 yellow		
0.60	2.78	0.60	2.78		
0.70	2.95	0.70	2.95		
0.74	3.05	0.74	3.04		
0.78	3.25	0.78	3.20		
0.82	ppt.	0.82	3.50		
		0.86	red brown ppt.		

Table 5.A.4

Resorcylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 25°C μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml

I			II			III		
[$HClO_4$]vs NaOH			[$HClO_4$+L]vs NaOH			[$HClO_4$+L+Mg^{++}]vs NaOH		
E^o = 0.02 M			T^o_L = 0.002 M			$T^o_{Mg^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.09	colour-	0.00	2.09	colour-	0.00	2.09	colour
0.20	2.18	less	0.20	2.18	less	0.20	2.18	less
0.40	2.30		0.40	2.30		0.40	2.30	
0.60	2.57		0.60	2.55		0.60	2.57	
0.70	2.85		0.70	2.84		0.70	2.84	
0.74	3.15		0.74	3.15		0.74	3.14	
0.78	6.44		0.78	5.80		0.78	5.79	
0.82	9.98		0.82	7.35	yellow	0.82	7.35	yellow
0.86	10.28		0.86	8.65		0.86	8.50	
0.90	10.45		0.90	9.35		0.90	9.07	
0.94	10.56		0.94	9.75		0.94	9.39	
0.98	10.66		0.98	10.10		0.98	ppt.	
1.02	10.74		1.02	10.31				
1.06	10.79		1.06	10.45				
1.10	10.84		1.10	10.56				
1.14	10.89		1.14	10.66				
1.18	10.93		1.18	10.71				
1.22	10.95		1.22	10.77				
1.26	10.99		1.26	10.82				
1.30	11.01		1.30	10.86				
1.34	11.03		1.34	10.90				
1.38	11.06		1.38	10.93				
			1.42	10.96				
			1.46	10.99				
			1.50	11.01				
			1.54	11.03				
			1.58	11.05				

Table. 5.A.4 (contd.)

Resorcylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 25°C   μ = 0.1

Medium = 50 % v/v Ethanol-water V^{o} = 40.00 ml

IV $[HClO_4+L+Cd^{++}]$ vs NaOH $T^{o}_{Cd^{++}}$ = 0.001 M		V $[HClO_4+L+Zn^{++}]$ vs NaOH $T^{o}_{Zn^{++}}$ = 0.001 M		VI $[HClO_4+L+Mn^{++}]$ vs NaOH $T^{o}_{Mn^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.09 colour-	0.00	2.09 colour-	0.00	2.09 colour
0.20	2.19 less	0.20	2.20 less	0.20	2.19 less
0.40	2.30	0.40	2.32	0.40	2.30
0.60	2.57	0.60	2.57	0.60	2.58
0.70	2.79	0.70	2.79	0.70	2.80
0.74	3.14	0.74	3.15	0.74	3.11
0.78	3.90	0.78	3.70	0.78	3.71
0.82	5.81 yellow	0.82	5.01 yellow	0.82	5.65 red yellow
0.86	white ppt.	0.86	5.95	0.86	7.09
		0.90		0.90	

VII $[HClO_4+L+Ni^{++}]$ vs NaOH $T^{o}_{Ni^{++}}$ = 0.001 M		VIII $[HClO_4+L+Co^{++}]$ vs NaOH $T^{o}_{Co^{++}}$ = 0.001 M		IX $[HClO_4+L+Cu^{++}]$ vs NaOH $T^{o}_{Cu^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.09 colour-	0.00	2.09 colour-	0.00	2.09 green
0.20	2.18 less	0.20	2.18 less	0.20	2.18
0.40	2.30	0.40	2.30 yellow	0.40	2.30
0.60	2.51	0.60	2.51	0.60	2.50
0.70	2.80	0.70	2.81	0.70	2.70
0.74	2.98	0.74	3.00 red-	0.74	2.80
0.78	3.30	0.78	3.32 yellow	0.78	3.01
0.82	4.32 yellow	0.82	3.95	0.82	3.36 yellow
0.86	5.31	0.86	dark violet	0.86	4.18
				0.90	ppt.

Table 5.A.4'

Resorcylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M $\quad$ t = 35^{o}C $\quad$ μ = 0.1 M

Medium = 50 % v/v Ethanol-water $\quad$ V^{o} = 40.00 ml

I		II			III		
[$HClO_4$] vs NaOH		[$HClO_4$+L) vs NaOH			[$HClO_4$+L+Mg^{++}]vs NaOH		
E^{o} = 0.02 M		T_L^{o} = 0.002 M			$T_{Mg^{++}}^{o}$ = 0.001 M		
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.21	0.00	2.21	colour-less	0.00	2.21	colour-less
0.20	2.30	0.20	2.30		0.20	2.31	
0.40	2.44	0.40	2.44		0.40	2.45	
0.60	2.64	0.60	2.67		0.60	2.67	
0.70	2.88	0.70	2.88		0.70	2.88	
0.74	3.03	0.74	3.04		0.74	3.05	
0.78	3.35	0.78	3.32		0.78	3.34	
0.82	8.60	0.82	6.63	yellow	0.82	6.10	yellow
0.86	10.10	0.16	8.15		0.86	8.12	
0.90	10.30	0.90	8.94		0.90	8.80	
0.94	10.49	0.94	9.61		0.94	ppt.	
0.98	10.60	0.98	9.94				
1.02	10.69	1.02	10.19				
1.06	10.76	1.06	10.39				
1.10	10.81	1.10	10.50				
1.14	10.86	1.14	10.64				
1.18	10.90	1.18	10.73				
1.22	10.94	1.22	10.81				
1.26	10.97	1.26	10.85				
1.30	11.01	1.30	10.89				
1.34	11.03	1.34	10.92				
1.38	11.05	1.38	10.94				
1.42	11.08	1.42	10.98				
1.46	11.10	1.46	10.99				
1.50	11.11	1.50	11.00				
1.54	11.13	1.54	11.01				
		1.58	11.02				
		1.62	11.04				
		1.66	11.05				
		1.70	11.06				
		1.74	11.07				
		1.78	11.08				
		1.82	11.09				
		1.86	11.10				
		1.90	11.11				
		1.94	11.12				
		1.98	11.13				

...

Table 5.A.4' (contd.)

Resorcylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M   t = 35°C   μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml

IV		V		VI	
$[HClO_4+L+Cd^{++}]$ vs NaOH		$[HClO_4+L+Zn^{++}]$ vs NaOH		$[HClO_4+L+Mn^{++}]$ vs NaOH	
$T^o_{Cd^{++}}$ = 0.001 M		$T^o_{Zn^{++}}$ = 0.001 M		$T^o_{Mn^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.21 colour-	0.00	2.21 colour-	0.00	2.21 colour-
0.20	2.30 less	0.20	2.30 less	0.20	2.30 less
0.40	2.44	0.40	2.43	0.40	2.44
0.60	2.67	0.60	2.65	0.60	2.68
0.70	2.89	0.70	2.86	0.70	2.88
0.74	3.05	0.74	3.03	0.74	3.03
0.78	3.28	0.78	3.28	0.78	3.28
0.82	4.53 yellow	0.82	4.15 yellow	0.82	4.40 yellow
0.86	6.08	0.86	5.55	0.86	6.84
0.90	white ppt.	0.90	6.16 dark yellow	0.90	7.25 dark
				0.94	colouration

VII		VIII		IX	
$[HClO_4+L+Ni^{++}]$ vs NaOH		$[HClO_4+L+Co^{++}]$ vs NaOH		$[HClO_4+L+Cu^{++}]$ vs NaOH	
$T^o_{Ni^{++}}$ = 0.001 M		$T^o_{Co^{++}}$ = 0.001 M		$T^o_{Cu^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.21 colour-	0.00	2.21 colour-	0.00	2.21 green
0.20	2.31 less	0.20	2.31 less	0.20	2.30
0.40	2.46	0.40	2.44 red-brown	0.40	2.42
0.60	2.68	0.60	2.66 winered	0.60	2.63
0.70	2.88	0.70	2.86	0.70	2.82
0.74	3.12	0.74	2.96	0.74	2.96
0.78	3.20	0.78	3.15	0.78	3.15 terbidit
0.82	3.78 yellow	0.82	3.39	0.82	3.44
0.86	5.15	0.86	3.95	0.86	4.25
0.90	6.12	0.90	5.00 non-transperant red colour	0.90	

Table 5.A.4"

Resorcylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M t = 45°C μ = 0.1 M

Medium 50 % v/v Ethanol-water V^{o} = 40.00 ml.

I		II			III		
[$HClO_4$] vs NaOH		[$HClO_4$ + L]vs NaOH			[$HClO_4$+L+Mg^{++}]vs NaOH		
E^{o} = 0.02 M		T^{o}_{L} = 0.002 M			$T^{o}_{Mg^{++}}$ = 0.001 M		
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH		Vol. of NaOH(ml)	pH	
0.00	2.35	0.00	2.35	colour-	0.00	2.35	colour-
0.20	2.40	0.20	2.41	less	0.20	2.42	less
0.40	2.56	0.40	2.56		0.40	2.56	
0.60	2.78	0.60	2.78		0.60	2.79	
0.70	3.01	0.70	3.01		0.70	3.02	
0.74	3.18	0.74	3.18		0.74	3.18	
0.78	3.40	0.78	3.40		0.78	3.40	
0.82	9.50	0.82	7.60	yellow	0.82	7.00	yellow
0.86	10.10	0.86	8.58		0.86	8.15	
0.90	10.30	0.90	9.34		0.90	8.69	
0.94	10.44	0.94	9.72		0.94	8.94	
0.98	10.53	0.98	10.02		0.98	ppt.	
1.02	10.61	1.02	10.24				
1.06	10.70	1.06	10.39				
1.10	10.74	1.10	10.51				
1.14	10.79	1.14	10.60				
1.18	10.83	1.18	10.68				
1.22	10.86	1.22	10.71				
1.26	10.90	1.26	10.75				
1.30	10.92	1.30	10.80				
1.34	10.94	1.34	10.84				
1.38	10.96	1.38	10.87				
1.42	10.99	1.42	10.90				
1.46	11.00	1.46	10.92				
1.50	11.02	1.50	10.94				
1.54	11.03	1.54	10.96				
1.58	11.04	1.58	10.98				
1.62	11.06	1.62	10.99				
1.66	11.07	1.66	11.00				
1.70	11.09	1.70	11.02				
1.74	11.10	1.74	11.03				
1.78	11.11	1.78	11.04				
1.82	11.12	1.82	11.05				
1.86	11.13	1.86	11.06				
1.90	11.14	1.90	11.07				

...

Table 5.A.4" (contd.)

Resorcylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M t = 45°C μ = 0.1 M

Medium = 50 % v/v Ethanol-water V^o = 40.00 ml

IV		V		VI	
$[HClO_4+L+Cd^{++}]$ vs NaOH		$[HClO_4+L+Zn^{++}]$ vs NaOH		$[HClO_4+L+Mn^{++}]$ vs NaOH	
$T^o_{Cd^{++}}$ = 0.001 M		$T^o_{Zn^{++}}$ = 0.001 M		$T^o_{Mn^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.35 colour-	0.00	2.35 colour-	0.00	2.35 colour-
0.20	2.42 less	0.20	2.45 less	0.20	2.45 less
0.40	2.56	0.40	2.57	0.40	2.56
0.60	2.80	0.60	2.80	0.60	2.78
0.70	3.02	0.70	3.00	0.70	3.02
0.74	3.18	0.74	3.14	0.74	3.17
0.78	3.40	0.78	3.34	0.78	3.45
0.82	4.5 yellow	0.82	4.18 yellow	0.82	4.88 yellow
0.86	5.75	0.86	5.54	0.86	7.04 red brown
0.90	6.76	0.90	6.55	0.90	7.38 dark colouration
0.94	white ppt.	0.94	yellow terbidity		

VIII		VIII		IX	
$[HClO_4+L+Ni^{++}]$ vs NaOH		$[HClO_4+L+Co^{++}]$ vs NaOH		$[HClO_4+L+Cu^{++}]$ vs NaOH	
$T^o_{Ni^{++}}$ = 0.001 M		$T^o_{Co^{++}}$ = 0.001 M		$T^o_{Cu^{++}}$ = 0.001 M	
Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH	Vol. of NaOH(ml)	pH
0.00	2.35 colour-	0.00	2.35 colour-	0.00	2.35 green
0.20	2.44 less	0.20	2.44 less	0.20	2.44
0.40	2.58	0.40	3.57 -redbrown	0.40	2.57
0.60	2.79	0.60	2.78	0.60	2.78
0.70	3.02	0.70	2.96 wine red	0.70	2.96
0.74	3.15	0.74	3.10	0.74	3.10
0.78	3.32	0.78	3.30	0.78	3.30
0.82	3.80 yellow	0.82	3.62	0.82	3.62 yellow
0.86	4.72 turbidity	0.86	4.50 non-transperant red colour	0.86	4.50 redbrown
0.90	dark colouration			0.90	ppt.

Table 5.B.1

Salicylaldehyde thiosemicarbazone used as a ligand

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml
$E^{o} = 0.02$ M $t = 25^{o}$ C $T_{L}^{o} = 0.002$ M

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A F$
4.0	0.7825	0.8025	1.7548	- 0.4883
5.0	0.7875	0.8100	1.7241	- 0.4191
5.5	0.7905	0.8137	1.7150	- 0.3999
6.0	0.7930	0.8175	1.7005	- 0.3690
6.5	0.7955	0.8212	1.6841	- 0.3361
7.0	0.7980	0.8250	1.6690	- 0.3056
7.5	0.8005	0.8287	1.6537	- 0.2759
8.0	0.8030	0.8325	1.6385	- 0.2470
8.5	0.8055	0.8387	1.5923	- 0.1624
9.0	0.8090	0.8450	1.5580	- 0.1012
9.2	0.8100	0.8500	1.5090	- 0.0156
9.4	0.8115	0.8550	1.4670	0.0574
9.6	0.8130	0.8600	1.4240	0.1330
9.8	0.8145	0.8650	1.3810	0.2108
10.0	0.8160	0.8700	1.3380	0.2920
10.2	0.8175	0.8812	1.2190	0.6523
10.4	0.3200	0.8925	1.1120	0.9092
10.6	0.8220	0.9050	0.9590	- 1.3690
10.8	0.8250	0.9125	0.9230	- 0.7172
11.0	0.8260	0.9225	0.8050	- 0.6158
11.2	0.8375	0.9450	0.6880	- 0.3434
11.4	0.8600	0.9950	0.3460	+ 0.2765

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.1.2)	11.3	9.2
Graphical	(values from fig.5.1.3)	11.275	9.250

Table 5.B.1'

Salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M   t = 35° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A$F
3.5	0.7850	0.7850	2.0000	-
4.0	0.7872	0.7898	1.9681	- 1.4821
4.5	0.7895	0.7946	1.9375	- 1.1760
5.0	0.7932	0.7984	1.9240	- 1.0849
5.5	0.7960	0.8034	1.9093	- 1.0000
6.0	0.7988	0.8074	1.8946	- 0.9287
6.5	0.8015	0.8114	1.8787	- 0.8600
7.0	0.8042	0.8154	1.8627	- 0.7983
7.5	0.8070	0.8212	1.8260	- 0.6765
8.0	0.8100	0.8275	1.7856	- 0.5640
8.5	0.8140	0.8450	1.6201	- 0.2129
9.0	0.8180	0.8700	1.3625	+ 0.2451
9.5	0.8300	0.8950	1.1795	+ 0.6600
10.0	0.8600	0.9500	0.8985	- 0.9428
10.2	0.8850	0.9800	0.8380	- 0.7137
10.4	0.9300	1.0300	0.7780	- 0.5446
10.5	0.9700	1.0800	0.6575	- 0.2833
10.6	1.0200	1.1400	0.5370	- 0.0644
10.8	1.1400	1.2800	0.2985	+ 0.3711

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.1.2)	10.675	8.725
Graphical	(values from fig.5.1.3)	10.625	8.675

Table 5.B.1"

Salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M t = 45° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A F$
3.5	0.7700	0.7700	2.0000	-
4.0	0.7822	0.7860	1.9620	- 1.4034
4.5	0.7848	0.7930	1.8990	- 0.9495
5.0	0.7852	0.7940	1.8920	- 0.9170
5.5	0.7882	0.8020	1.8307	- 0.6908
6.0	0.7910	0.8100	1.7671	- 0.5177
6.5	0.7950	0.8180	1.7181	- 0.4061
7.0	0.7990	0.8295	1.6262	- 0.2241
7.5	0.8030	0.8400	1.5466	- 0.0812
8.0	0.8070	0.8495	1.4790	+ 0.0365
8.5	0.8110	0.8585	1.4180	+ 0.1437
9.0	0.8125	0.8675	1.3260	+ 0.3155
9.2	0.8150	0.8750	1.1915	+ 0.6256
9.4	0.8200	0.8825	1.0690	+ 1.1446
9.5	0.8225	0.8900	1.0200	+ 1.6902
9.6	0.8250	0.9000	0.9960	- 2.3962
9.8	0.8375	0.9175	0.9470	- 1.2520
10.0	0.8600	0.9500	0.8980	- 0.9447
10.2	0.8800	0.9900	0.6550	- 0.2784
10.4	0.9300	1.0600	0.4120	+ 0.1545
10.5	0.9500	1.1000	0.1680	+ 0.6944

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.1.2)	10.325	7.750
Graphical	(values from fig.5.1.3)	10.325	7.700

Table 5.B.2

4 Methyl salicylaldehyde thiosemicarbazone used as a ligand

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 25^{o}$ C $T_{L}^{o} = 0.002$ M

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A F$
4.0	0.7860	0.7955	1.8835	- 0.8798
4.5	0.7935	0.8050	1.8598	- 0.7877
5.0	0.8000	0.8125	1.8468	- 0.7456
5.5	0.8000	0.8135	1.8307	- 0.6908
6.0	0.8000	0.8150	1.8161	- 0.6472
6.5	0.8000	0.8165	1.7978	- 0.5961
7.0	0.8000	0.8175	1.7855	- 0.5638
7.5	0.8000	0.8190	1.7671	- 0.5179
8.0	0.8000	0.8200	1.7543	0.4872
8.5	0.8000	0.8240	1.6940	- 0.3557
9.0	0.8000	0.8310	1.6200	- 0.2126
9.2	0.8000	0.8350	1.5710	- 0.1683
9.4	0.8000	0.8390	1.5218	- 0.1241
9.6	0.8000	0.8420	1.4800	+ 0.0379
10.0	0.8020	0.8500	1.4100	+ 0.0848
10.5	0.8140	0.8750	1.1570	+ 0.1581
11.0	0.8250	0.9000	1.0810	+ 0.7299
11.2	0.8380	0.9150	0.9345	- 1.1543
11.4	0.8600	0.9600	0.7750	- 0.5371
11.6	0.8875	1.0150	0.5610	- 0.1065
11.8	0.9350	1.0850	0.3885	+ 0.1899

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.2.2)	11.700	9.800
Graphical	(values from fig.5.2.3)	11.700	9.700

Table 5.B.2'

4 Methyl salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M μ = 0.1 M V^o = 40 ml

E^o = 0.02 M t = 35^o C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A F$
4.0	0.7850	0.7900	1.9381	- 1.1805
4.5	0.7882	0.7965	1.8982	- 0.9456
5.0	0.7915	0.8030	1.8590	- 0.7848
5.5	0.7947	0.8095	1.8161	- 0.6472
6.0	0.7980	0.8160	1.7793	- 0.5479
6.5	0.8012	0.8225	1.7400	- 0.4542
7.0	0.8045	0.8290	1.6997	- 0.3674
7.5	0.8077	0.8355	1.6593	- 0.2867
8.0	0.8110	0.8420	1.6201	- 0.2075
8.5	0.8145	0.8512	1.5467	- 0.0810
9.0	0.8175	0.8575	1.5099	- 0.0172
9.5	0.8215	0.8650	1.4670	+ 0.0574
10.0	0.8500	0.9050	1.3260	+ 0.3155
10.5	0.9400	1.0200	1.0230	+ 1.4282
10.8	1.0600	1.1760	0.604	- 0.1933
11.0	1.3000	1.4300	0.403	+ 0.1707

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.2.2)	10.9	9.066
Graphical	(values from fig.5.2.3)	10.9	9.133

Table 5.B.2"

4 Methyl salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M	μ = 0.1 M	V^{o} = 40.00 ml
E^{o} = 0.02 M	t = 45° C	T_L^{o} = 0.002 M

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A$F
5.00	0.7916	0.8060	1.8235	- 0.669
5.5	0.7936	0.8135	1.7561	- 0.4914
6.0	0.7956	0.8200	1.7009	- 0.3699
6.5	0.7976	0.8250	1.6641	- 0.2961
7.0	0.8000	0.8300	1.6324	- 0.2356
7.5	0.8062	0.8402	1.5833	- 0.1461
8.0	0.8125	0.8505	1.5344	- 0.0597
8.5	0.8187	0.8607	1.4850	+ 0.0270
9.0	0.8250	0.8700	1.4480	+ 0.0906
9.5	0.8366	0.8883	1.3670	+ 0.2367
10.0	0.8700	0.9300	1.2660	+ 0.4408
10.2	0.8900	0.9600	1.1440	+ 0.7741
10.4	0.9250	1.0400	0.5920	- 0.1116
10.5	0.9511	1.0800	0.2900	+ 0.3889
10.6	0.9800	1.1300	0.1700	+ 0.6887
10.8	1.3000	1.5000	0.0790	+ 1.0667

Proton-Ligand stability constnants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.2.2)	10.433	8.02
Graphical	(values from fig.5.2.3)	10.433	8.233

Table 5.B.3

5 Nitro salicylaldehyde thiosemicarbazone used as a ligand

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 25^{o}$ C $T_{L}^{o} = 0.002$ M

Medium = 50 % v/v Ethanol-water

pH	v'	V"	$\bar{n}_A$	log $\bar{n}_A F$
4.5	0.7900	0.8000	1.9880	- 1.8156
5.0	0.7950	0.8100	1.8111	- 0.6687
5.5	0.7975	0.8150	1.7855	- 0.5648
6.0	0.7975	0.8175	1.7548	- 0.4883
6.5	0.8000	0.8200	1.7549	- 0.4885
0.7	0.8000	0.8225	1.7243	- 0.4196
7.5	0.8000	0.8250	1.6930	- 0.3736
8.0	0.8025	0.8275	1.6930	- 0.3736
8.5	0.8025	0.8300	1.6630	- 0.2939
9.0	0.8025	0.8350	1.6073	- 0.1893
9.5	0.8050	0.8375	1.6073	- 0.1893
10.0	0.8075	0.8450	1.5405	- 0.0405
10.5	0.8100	0.8525	1.4910	+ 0.0156
11.0	0.8200	0.8750	1.436	+ 0.1218
11.5	0.8750	0.9800	0.716	- 0.4016
11.6	0.8800	1.0200	0.288	+ 0.3931
11.7	0.9150	1.1600	0.227	+ 0.5322

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.3.2)	11.5	10.33
Graphical	(values from fig.5.3.3)	11.6	10.35

Table 5.B.3'

5 Nitro salicylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M	μ = 0.1 M	V^o = 40.00 ml
E^o = 0.02 M	t = 35° C	T_L^o = 0.002 M.

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A$F
4.0	0.7870	0.7900	1.9632	- 1.4179
4.5	0.7912	0.7962	1.9386	- 1.1843
5.0	0.7925	0.8025	1.8774	- 0.8512
5.5	0.7962	0.8087	1.8468	- 0.7425
6.0	0.8000	0.8150	1.8162	- 0.6473
6.5	0.8037	0.8212	1.7857	- 0.5643
7.0	0.8075	0.8275	1.7550	- 0.4887
7.5	0.8112	0.8337	1.7244	- 0.4193
8.0	0.8150	0.8400	1.6940	- 0.3557
8.5	0.8200	0.8500	1.6320	- 0.2349
9.0	0.8250	0.8600	1.5725	- 0.1270
9.5	0.8375	0.8825	1.4119	0.1420
9.6	0.8400	0.8925	1.3580	0.2536
9.8	0.8475	0.9100	1.2410	0.4982
10.0	0.8520	0.9300	1.0470	1.3070
10.4	0.9150	1.0100	0.8420	- 0.7266
10.5	0.9400	1.0400	0.7820	- 0.5547
10.6	0.9800	1.0825	0.7520	- 0.4817
10.8	1.1000	1.2200	0.5440	- 0.1666
11.0	1.3000	1.4500	0.1980	0.7075
11.2	1.6800	1.9000	0.0705	1.1163

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.3.2)	10.9	9.200
Graphical	(values from fig.5.3.3)	11.0	9.200

Table 5.B.3"

5 Nitro salicylaldehyde thiosemicarbazone used as a ligand

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 45^{o}$ C $T_{L}^{o} = 0.002$ M

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A F$
4.5	0.7900	0.8000	1.8774	- 1.2031
5.0	0.7925	0.8075	1.8540	- 0.8547
5.5	0.7950	0.8150	1.7548	- 0.7671
6.0	0.7975	0.8200	1.7254	- 0.4218
6.5	0.8000	0.8250	1.6936	- 0.3548
7.0	0.8030	0.8300	1.6691	- 0.3058
7.5	0.8050	0.8350	1.6324	- 0.2356
8.0	0.8100	0.8425	1.6018	- 0.1794
8.5	0.8125	0.8500	1.5406	- 0.0707
9.0	0.8150	0.8550	1.5211	- 0.0567
9.5	0.8250	0.8825	1.2950	+ 0.3756
10.0	0.8500	0.9400	0.8980	- 0.9447
10.5	0.9600	1.0600	0.7805	- 0.5510
10.6	1.0300	1.1400	0.6680	- 0.3037
10.8	1.2200	1.3400	0.5480	- 0.0837
11.0	1.5600	1.7000	0.3210	+ 0.3254

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.3.2)	10.8	8.8
Graphical	(values from fig.5.3.3)	10.85	8.8

Table 5.B.4

Resorcylaldehyde thiosemicarbazone used as a ligand

$N' = 0.98$ M　　$\mu = 0.1$ M　　$V^{o} = 40.00$ ml

$E^{o} = 0.02$ M　　$t = 25^{o}$ C　　$T_L^{o} = 0.002$ M

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A$F
4.0	0.7633	0.7633	2	-
4.5	0.7675	0.7675	2	-
5.0	0.7720	0.7720	2	-
6.0	0.7765	0.7866	1.876	- 0.8491
6.5	0.7815	0.7984	1.796	- 0.6721
7.0	0.7866	0.8100	1.713	- 0.3952
7.5	0.7916	0.8240	1.602	- 0.1797
8.0	0.7966	0.8385	1.491	- 0.0156
8.5	0.8016	0.8505	1.3030	+ 0.3657
9.0	0.8066	0.8785	1.1190	+ 0.8695
9.2	0.8086	0.8968	0.9190	- 1.0588
9.4	0.8106	0.9151	0.7190	- 0.4080
9.5	0.8126	0.9241	0.6370	- 0.2442
9.6	0.8146	0.9334	0.544	- 0.0766
9.8	0.8166	0.9517	0.345	+ 0.2784
10.0	0.8200	0.9700	0.1620	+ 0.7137
10.2	0.8600	1.0133	0.128	+ 0.8333
10.4	0.9000	1.0600	0.044	+ 1.3369

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.4.2)	9.650	7.9
Graphical	(values from fig.5.4.3)	9.750	7.8

Table 5.B.4'

Resorcylaldehydethiosemicarbazone used as a ligand

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 35° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A$F
5.0	0.7936	0.7975	1.9521	- 1.2983
5.5	0.7966	0 8037	1.9129	- 1.0204
6.0	0.8000	0.8100	1.8774	- 0.8547
6.5	0.8030	0.8150	1.8529	- 0.7633
7.0	0.8060	0.8200	1.8284	- 0.6837
7.5	0.8080	0.8375	1.6385	- 0.2470
8.0	0.8124	0.8500	1.5394	+ 0.0685
8.5	0.8154	0.8775	1.2395	+ 0.5030
8.6	0.8160	0.8800	1.2165	+ 0.5628
8.8	0.8172	0.8900	1.1085	+ 0.9146
9.0	0.8184	0.9000	1.0000	0.0000
9.2	0.8200	0.9150	0.8365	- 0.7290
9.4	0.8275	0.9300	0.6945	- 0.3557
9.5	0.8300	0.9375	0.6835	- 0.3343
9.6	0.8325	0.9400	0.6830	- 0.3333
9.8	0.8400	0.9600	0.5300	- 0.0522
10.0	0.8600	0.9900	0.4090	+ 0.2278
10.2	0.8800	1.0200	0.2880	+ 0.3931
10.4	0.9100	1.0600	0.1660	+ 0.7011
10.5	0.9400	1.1000	0.0470	+ 1.3070

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig. 5.4.2)	9.8	8.050
Graphical	(values from fig. 5.4.3)	9.9	7.875

Table 5.B.4"

Resorcylaldehyde thiosemicarbazone used as a ligand

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 45° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water

pH	V'	V"	$\bar{n}_A$	log $\bar{n}_A$F
4.5	0.80125	0.8037	1.9743	- 1.4778
5.0	0.8025	0.8075	1.9387	- 1.185
5.5	0.8037	0.8112	1.9080	- 0.9943
6.0	0.8050	0.8150	1.8774	- 0.8557
6.5	0.8062	0.8187	1.8468	- 0.7425
7.0	0.8075	0.8225	1.8162	- 0.6477
7.5	0.8087	0.8265	1.7819	- 0.5545
8.0	0.8100	0.8350	1.6937	- 0.3550
8.5	0.8140	0.8550	1.4975	+ 0.0043
8.8	0.8164	0.8700	1.3435	+ 0.2813
9.0	0.8180	0.8800	1.2405	+ 0.4994
9.2	0.8196	0.8900	1.1335	+ 0.8123
9.4	0.8200	0.9056	0.9590	- 1.3690
9.5	0.8215	0.9150	0.8425	- 0.7283
9.6	0.8250	0.9250	0.7750	- 0.5371
9.8	0.8350	0.9550	0.5305	- 0.0530
10.0	0.8550	0.9800	0.4700	+ 0.0522
10.2	0.8800	1.0150	0.3490	+ 0.2708
10.4	0.9300	1.0600	0.2890	+ 0.3910
10.5	0.9600	1.0850	0.1670	+ 0.6976
10.6	1.000	1.1400	0.1100	+ 0.9080
10.8	1.14	1.3000	0.0510	+ 1.2697

Proton-ligand stability constants

Method		log K_1^H	log K_2^H
Half integral	(values from fig.5.4.2)	10.00	8.5
Graphical	(values from fig.5.4.3)	10.150	8.450

Table 5.C.1.1

Stability constant of Magnesium-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}}$ = 0.001 M.

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
8.0	0.8030	0.8325	0.8450	0.1870	3.8195	0.6383
8.2	0.8040	0.8350	0.8490	0.2117	3.6416	0.5710
8.4	0.8050	0.8375	0.8530	0.2342	3.4967	0.5146
8.6	0.8060	0.8400	0.8570	0.2631	3.3367	0.4472
8.8	0.8070	0.8425	0.8600	0.2664	3.2016	0.4399
9.0	0.8090	0.8450	0.8625	0.2753	3.0889	0.4203
9.2	0.8100	0.8500	0.8725	0.3633	3.0201	0.2395
9.4	0.8115	0.8550	0.8825	0.4592	2.9758	0.0709
9.6	0.8130	0.8600	0.8925	0.6281	2.9567	-0.2207
9.8	0.8145	0.8650	0.9025	0.6653	2.9219	-0.2984
10.0	0.8160	0.8700	0.9125	0.7782	2.9066	-0.6452
10.2	0.8175	0.8812	0.9225	0.8305	2.8896	-0.6902

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	2.975
Graphical	(value from fig.5.1.5)	3.025

Table 5.C.1.2

Stability constant of Manganese-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Mn^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.0	0.7825	0.8025	0.8175	0.2096	7.7857	0.5764
4.4	0.7845	0.8055	0.8245	0.2675	7.4000	0.4370
4.8	0.7865	0.8085	0.8300	0.3047	7.0094	0.3583
5.2	0.7885	0.8115	0.8345	0.3281	6.6156	0.3113
5.6	0.7910	0.8145	0.8385	0.3439	6.2195	0.2806
6.0	0.7930	0.8175	0.8425	0.3589	5.8235	0.2711
6.4	0.7950	0.8205	0.8465	0.3753	5.4381	0.2214
6.8	0.7970	0.8235	0.8505	0.3943	5.0331	0.1865
7.0	0.7980	0.8250	0.8525	0.4038	4.8356	0.1691
7.2	0.7990	0.8265	0.8570	0.4485	4.6481	0.0898
7.4	0.8000	0.8280	0.8625	0.5105	4.4657	-0.0183
7.6	0.8010	0.8295	0.8670	0.5569	4.2794	-0.0993
7.8	0.8020	0.8310	0.8725	0.6190	4.1898	-0.2108
8.0	0.8030	0.8325	0.8800	0.7104	3.9197	-0.3906

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig. 5.1.4)	4.5
Graphical	(value from fig. 5.1.5)	4.550

Table 5.C.1.3

Stability constant of Cadmium-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T_{Cd^{++}}^o$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.6	0.7700	0.7880	0.8075	0.2687	8.3701	0.4349
3.8	0.7800	0.7990	0.8200	0.2915	8.1759	0.3857
4.0	0.7825	0.8025	0.8250	0.3147	7.9817	0.3380
4.2	0.7835	0.8040	0.8300	0.3657	7.7950	0.2392
4.4	0.7845	0.8055	0.8350	0.4154	7.6085	0.1484
4.6	0.7855	0.8070	0.8375	0.4309	7.4127	0.1208
4.8	0.7865	0.8085	0.8400	0.4466	7.2172	0.0931
5.0	0.7875	0.8100	0.8425	0.4624	7.0216	0.0655
5.2	0.7885	0.8115	0.8440	0.4710	6.8241	0.0505
5.4	0.7900	0.8130	0.8475	0.4923	6.6303	0.0133
5.6	0.7910	0.8145	0.8500	0.5087	6.4330	-0.0151
5.8	0.7920	0.8160	0.8525	0.5202	6.2386	-0.0352
6.0	0.7930	0.8175	0.8550	0.5623	6.0512	-0.0991
6.2	0.7940	0.8190	0.8625	0.6512	5.8787	-0.2711
6.4	0.7950	0.8205	0.8700	0.7845	5.7239	-0.5612
6.6	0.7960	0.8220	0.8825	0.9475	5.5866	-1.7437

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	
Graphical	(value from fig.5.1.5)	

Table 5.C.1.4

Stability constant of Zinc-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T_{Zn^{++}}^o$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.6	0.7700	0.7880	0.8175	0.4068	8.2062	0.1638
3.8	0.7800	0.7990	0.8300	0.4402	8.0156	0.1043
4.0	0.7825	0.8025	0.8350	0.4628	7.8217	0.0648
4.2	0.7835	0.8040	0.8400	0.5039	7.6334	-0.0068
4.4	0.7845	0.8055	0.8450	0.5560	7.4492	-0.0977
4.6	0.7855	0.8070	0.8475	0.5722	7.2540	-0.1264
4.8	0.7865	0.8085	0.8525	0.6237	7.0698	-0.2195
5.0	0.7875	0.8100	0.8550	0.6400	6.8749	-0.2499
5.2	0.7885	0.8115	0.8575	0.6566	6.6803	-0.2515
5.4	0.7900	0.8130	0.8625	0.7106	6.4982	-0.3548

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	
Graphical	(value from fig.5.1.5)	

Table 5.C.1'.1

Stability constant of Magnesium-salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml
$E^o = 0.02$ M $t = 35^o$ C $T_L^o = 0.002$ M
Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}} = 0.001$ M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
7.6	0.7952	0.8150	0.8235	0.1187	3.8675	0.8706
7.8	0.7960	0.8175	0.8265	0.1272	3.6858	0.8364
8.0	0.7975	0.8200	0.8300	0.1423	3.5190	0.7802
8.2	0.8000	0.8275	0.8385	0.1621	3.3640	0.7134
8.4	0.8025	0.8350	0.8475	0.1914	3.2972	0.6158
8.6	0.8075	0.8450	0.8600	0.2387	3.1172	0.5037
8.8	0.8100	0.8550	0.8750	0.3384	3.0426	0.3012
9.0	0.8150	0.8670	0.8950	0.4965	3.0087	0.0061
9.2	0.8200	0.8775	0.9175	0.7567	2.8119	-0.4928
9.4	0.8275	0.8295	0.9500	1.1680	2.7210	-0.6911

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	2.825
Graphical	(value from fig.5.1.5)	2.850

Table 3.C.3'.2

Stability constant of Manganese-salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml
$E^o = 0.02$ M $t = 35^o$ C $T_L^o = 0.002$ M
Medium = 50 % v/v Ethanol-water $T^o_{Mn^{++}} = 0.001$ M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
5.6	0.7882	0.7990	0.8100	0.1445	5.8401	0.7727
5.8	0.7889	0.8005	0.8125	0.1584	5.6436	0.7226
6.0	0.7896	0.8020	0.8175	0.2058	5.4547	0.5864
6.2	0.7903	0.8035	0.8225	0.2534	5.2666	0.4693
6.4	0.7910	0.8050	0.8250	0.2681	5.0704	0.3361
6.6	0.7913	0.8056	0.8300	0.3247	4.8881	0.3181
6.8	0.7924	0.8066	0.8350	0.3815	4.7052	0.2099
7.0	0.7931	0.8075	0.8375	0.4031	4.5153	0.1705
7.2	0.7938	0.8087	0.8400	0.4242	4.3249	0.1325
7.4	0.7945	0.8100	0.8425	0.4369	4.2360	0.1102
7.6	0.7952	0.8165	0.8565	0.5582	3.9832	-0.1016
7.8	0.7960	0.8185	0.8750	0.7909	3.8835	-0.5773
8.0	0.7975	0.8235	0.8875	0.9109	3.7507	-1.0057

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	4.175
Graphical	(value from fig.5.1.5)	4.225

Table 5.C.1'.3

Stability constant of Cadmium-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^{o} = 40.00 ml

E^{o} = 0.02 M t = 35^{o} C T_{L}^{o} = 0.002 M

Medium = 50 % v/v Ethanol-water $T_{Cd^{++}}^{o}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.2	0.7867	0.7967	0.8075	0.1411	6.2393	0.7845
5.4	0.7875	0.7975	0.8125	0.1960	6.0522	0.7130
5.6	0.7882	0.7990	0.8200	0.2758	5.8719	0.4182
5.8	0.7889	0.8005	0.8250	0.3235	5.6842	0.3203
6.0	0.7896	0.8020	0.8300	0.3718	5.4969	0.2284
6.2	0.7903	0.8035	0.8350	0.4201	5.3101	0.1401
6.4	0.7910	0.8050	0.8450	0.5364	5.1472	-0.0632
6.6	0.7917	0.8058	0.8525	0.6266	4.9743	-0.2248
6.8	0.7924	0.8066	0.8600	0.7171	4.8061	-0.7218
7.0	0.7931	0.8075	0.8700	0.8405	4.6530	-0.7218
7.2	0.7938	0.8087	0.8825	0.9959	4.5203	-2.3854

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	5.2
Graphical	(value from fig.5.1.5)	5.2

Table 5.C.1'.4

Stability constant of Zinc-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^{o} = 40.00 ml

E^{o} = 0.02 M t = 35^{o} C T_{L}^{o} = 0.002 M

Medium = 50 % v/v Ethanol-water $T_{Zn^{++}}^{o}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.4	0.7843	0.7939	0.8050	0.1445	7.0405	0.7724
4.6	0.7849	0.7946	0.8100	0.2006	6.8538	0.6004
4.8	0.7855	0.7953	0.8175	0.2897	6.6759	0.3955
5.0	0.7861	0.7960	0.8225	0.3458	6.4903	0.2763
5.2	0.7867	0.7967	0.8350	0.5002	6.3330	-0.0004
5.4	0.7875	0.7975	0.8475	0.6531	6.1800	-0.2738
5.6	0.7882	0.7990	0.8600	0.8009	6.0301	-0.6045
5.8	0.7889	0.8005	0.8775	1.0160	5.7160	-
6.0	0.7896	0.8020	0.8950	1.2340	5.6248	-

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	6.225
Graphical	(value from fig.5.1.5)	6.375

Table 5.C.1".1

Stability constant of Magnesium-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 45° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}}$ = 0.001 M.

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
8.2	0.8112	0.8200	0.8275	0.1257	2.9812	0.8423
8.4	0.8125	0.8250	0.8375	0.2142	2.9248	0.5645
8.6	0.8133	0.8325	0.8525	0.3498	2.9017	0.2692
8.8	0.8141	0.8450	0.8750	0.5365	2.8098	-0.0635
9.0	0.8150	0.8550	0.8950	0.7386	2.7494	-0.4512
9.2	0.8175	0.8625	0.9125	0.9232	2.7125	-1.2799

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig. 5.1.4)	2.825
Graphical	(value from fig. 5.1.5)	2.850

Table 5.C.1".2

Stability constant of Manganese-salicylaldehyde thiosemicarbazone System

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 45° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Mn^{++}}$ = 00.1 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
6.0	0.8000	0.8025	0.8150	0.1734	4.8706	0.6783
6.2	0.8008	0.8050	0.8187	0.1914	4.6569	0.6258
6.4	0.8016	0.8075	0.8225	0.2125	4.4651	0.5690
6.6	0.8024	0.8084	0.8250	0.2394	4.2766	0.5020
6.8	0.8032	0.8090	0.8300	0.3083	4.1016	0.3581
7.0	0.8050	0.8100	0.8350	0.3768	3.9316	0.2185
7.2	0.8060	0.8112	0.8400	0.4459	3.7737	0.0943
7.4	0.8070	0.8125	0.8475	0.5525	3.6282	-0.915
7.6	0.8080	0.8142	0.8550	0.6570	3.4999	-0.2823
7.8	0.8090	0.8159	0.8650	0.8081	3.4092	-0.6245
8.0	0.8100	0.8175	0.8750	0.9526	3.3427	-1.3031

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	3.7
Graphical	(value from fig.5.1.5)	3.7

Table 5.C.1".3

Stability constant of Cadmium-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 45^o C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Cd^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.0	0.7936	0.7992	0.8150	0.2094	5.8560	0.5770
5.2	0.7948	0.7998	0.8175	0.2299	5.6609	0.5251
5.4	0.7960	0.8004	0.8200	0.2611	5.4690	0.4518
5.6	0.7972	0.8010	0.8212	0.2739	5.2720	0.4240
5.8	0.7984	0.8016	0.8225	0.2870	5.0753	0.3952
6.0	0.8000	0.8025	0.8275	0.3467	4.9467	0.2751
6.2	0.8008	0.8050	0.8350	0.4192	4.7103	0.1416
6.4	0.8016	0.8075	0.8400	0.4200	4.6103	0.1402
6.6	0.8024	0.8084	0.8437	0.5048	4.3343	-0.0083
6.8	0.8032	0.8090	0.8465	0.5505	4.1479	-0.0886

Metal ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	4.350
Graphical	(value from fig.5.1.5)	4.4

Table 5.C.1".4

Stability constant of Zinc-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 45^o C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Zn^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.2	0.7887	0.7950	0.8050	0.1249	6.6349	0.8455
4.4	0.7900	0.7975	0.8100	0.1584	6.4439	0.7253
4.6	0.7912	0.7980	0.8125	0.1860	6.2503	0.6401
4.8	0.7924	0.7986	0.8150	0.2114	6.0565	0.5717
5.0	0.7936	0.7992	0.8175	0.2371	5.8629	0.5076
5.2	0.7948	0.7998	0.8225	0.2965	5.6778	0.3753
5.4	0.7960	0.8004	0.8300	0.3931	5.5033	0.1886
5.6	0.7972	0.8010	0.8400	0.5265	5.3408	-0.0460
5.8	0.7984	0.8016	0.8500	0.6646	5.1835	-0.2971
6.0	0.8000	0.8025	0.8575	0.7807	5.0231	-0.5516
6.2	0.8005	0.8050	0.8700	0.9082	4.8712	-0.9954

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.1.4)	5.475
Graphical	(value from fig.5.1.5)	5.425

Table 5.C.2.1

Stability constant of Magnesium-4 methyl salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
6.8	0.8000	0.8170	0.8275	0.1436	5.4404	0.7754
7.0	0.8000	0.8175	0.8300	0.1716	5.2466	0.6836
7.2	0.8000	0.8180	0.8325	0.1997	5.0533	0.6028
7.4	0.8000	0.8185	0.8350	0.2280	4.8636	0.5296
7.6	0.8000	0.8190	0.8400	0.2774	4.6779	0.4158
7.8	0.8000	0.8195	0.8425	0.3202	4.4923	0.3270
8.0	0.8000	0.8200	0.8475	0.3842	4.3150	0.2059
8.2	0.8000	0.8200	0.8525	0.4605	4.1425	0.0688
8.4	0.8000	0.8240	0.8600	0.5208	3.9719	-0.0362
8.6	0.8000	0.8260	0.8650	0.5685	3.8044	-0.1198
8.8	0.8000	0.8285	0.8725	0.6609	3.6576	-0.2724
9.0	0.8000	0.8310	0.8825	0.7791	3.5415	-0.5475
9.2	0.8000	0.8350	0.8950	0.9361	3.4585	-1.1658

Metal ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	4.00
Graphical	(value from fig.5.2.5)	4.05

Table 5.C.2.2

Stability constant of Cadmium-4 methyl salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Cd^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.4	0.8000	0.8135	0.8180	0.06026	6.9511	1.1935
5.6	0.8000	0.8140	0.8205	0.08714	6.7573	1.0204
5.8	0.8000	0.8145	0.8230	0.1143	6.5699	0.8892
6.0	0.8000	0.8150	0.8275	0.1687	6.3760	0.6917
6.2	0.8000	0.8160	0.8320	0.2235	6.1992	0.5509
6.4	0.8000	0.8165	0.8360	0.2718	6.0012	0.4279
6.6	0.8000	0.8170	0.8410	0.3342	5.8173	0.2993
6.8	0.8000	0.8175	0.8490	0.4378	5.6450	0.0914
7.0	0.8000	0.8180	0.8575	0.5493	5.4729	-0.0859
7.2	0.8000	0.8185	0.8750	0.7852	5.3545	-0.5630

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	5.525
Graphical	(value from fig.5.2.5)	5.550

Table 5.C.2.3

Stability constant of Zinc-4 methyl salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Zn^{++}}$ = 0.001 M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
4.2	0.7890	0.7995	0.8075	0.1048	8.1607	0.9583
4.4	0.7920	0.8035	0.8125	0.1450	7.9701	0.7706
4.6	0.7950	0.8065	0.8200	0.1672	7.7755	0.6973
4.8	0.7975	0.8095	0.8250	0.2049	7.5844	0.5850
5.0	0.8000	0.8125	0.8300	0.2378	7.3926	0.5059
5.2	0.8000	0.8130	0.8330	0.2726	7.2004	0.4262
5.4	0.8000	0.8135	0.8375	0.3214	7.0138	0.3246
5.6	0.8000	0.8140	0.8430	0.3888	6.8315	0.1964
5.8	0.8000	0.8145	0.8500	0.4774	6.6562	0.0393
6.0	0.8000	0.8150	0.8560	0.5534	6.4784	-0.0931
6.2	0.8000	0.8155	0.8625	0.6363	6.3041	-0.2430
6.4	0.8000	0.8160	0.8690	0.7171	6.1307	-0.4040
6.6	0.8000	0.8165	0.8760	0.8114	5.9637	-0.6336
6.8	0.8000	0.8170	0.8840	0.9668	5.8040	-1.0422
7.0	0.8000	0.8175	0.8925	1.030	5.6441	-

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	6.575
Graphical	(value from fig.5.2.5)	6.6

Table 5.C.2.4

Stability constant of Cobalt-4 Methyl salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol water $T^o_{Co^{++}}$ = 0.001 M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
4.2	0.8000	0.7995	0.8159	0.2031	8.1841	0.5937
4.4	0.8000	0.8035	0.8200	0.2174	7.9877	0.5562
4.6	0.8000	0.8065	0.8250	0.2439	7.7941	0.4914
4.8	0.8000	0.8095	0.8325	0.3040	7.6091	0.3597
5.0	0.8000	0.8125	0.8400	0.3661	7.4262	0.2347
5.2	0.8000	0.8130	0.8500	0.4816	7.2576	0.0321
5.4	0.8000	0.8135	0.8600	0.6227	7.0997	-0.2057

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	7.2
Graphical	(value from fig.5.2.5)	7.250

Table 5.C.2'.1

Stability constant of Magnesium-4 methyl salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M t = 35° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
7.0	0.8045	0.8150	0.8275	0.1803	4.8523	0.6577
7.2	0.8058	0.8170	0.8325	0.1820	4.6545	0.6527
7.4	0.8071	0.8190	0.8375	0.2720	4.4797	0.4275
7.6	0.8084	0.8220	0.8425	0.3189	4.2965	0.3296
7.8	0.8097	0.8230	0.8475	0.3670	4.1168	0.2367
8.0	0.8110	0.8250	0.8525	0.4159	3.9423	0.1477
8.2	0.8123	0.8275	0.8600	0.4965	3.7831	0.1061
8.4	0.8136	0.8320	0.8675	0.5598	3.6293	-0.1043
8.6	0.8149	0.8350	0.8775	0.6770	3.5064	-0.3214
8.8	0.8162	0.8400	0.8875	0.7638	3.3931	-0.5097
9.0	0.8175	0.8475	0.9000	0.8724	3.3107	-0.8351
9.2	0.8188	0.8525	0.9175	1.0730	3.2955	-

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	3.775
Graphical	(value from fig.5.2.5)	3.750

Table 5.C.2'.2

Stability constant of Cadmium-4 methyl salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M t = 35° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T^o_{Cd^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.8	0.7902	0.7910	0.8012	0.1334	7.0376	0.8126
5.0	0.7915	0.7925	0.8050	0.1659	6.8451	0.7015
5.2	0.7928	0.7950	0.8100	0.1995	6.6526	0.6034
5.4	0.7941	0.7975	0.8137	0.2173	6.4576	0.5565
5.6	0.7954	0.8000	0.8175	0.2369	6.2622	0.5080
5.8	0.7967	0.8025	0.8225	0.2731	6.0615	0.4256
6.0	0.7980	0.8050	0.8275	0.3100	5.8806	0.3469
6.2	0.7993	0.8070	0.8325	0.3545	5.6923	0.2503
6.4	0.8006	0.8090	0.8375	0.3997	5.5045	0.1726
6.6	0.8019	0.8110	0.8450	0.4814	5.3273	0.0320
6.8	0.8032	0.8130	0.8525	0.5644	5.1518	-0.1125
7.0	0.8045	0.8150	0.8575	0.6131	5.0603	-0.2000
7.2	0.8058	0.8170	0.8625	0.6625	4.7879	-0.2930
7.4	0.8071	0.8190	0.8700	0.7499	4.6103	-0.4766

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	5.275
Graphical	(value from fig.5.2.5)	5.3

Table 5.C.2'.3

Stability constant of Zinc-4 methyl salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 35° C T^o_L = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Zn^{++}}$ = 0.001 M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
5.0	0.7915	0.7925	0.8100	0.2318	6.8610	0.4804
5.2	0.7928	0.7950	0.8162	0.2820	6.6735	0.4059
5.4	0.7941	0.7975	0.8225	0.3354	6.4874	0.2971
5.6	0.7954	0.8000	0.8275	0.3722	6.2971	0.2272
5.8	0.7967	0.8025	0.8350	0.4048	6.1057	0.1673
6.0	0.7980	0.8050	0.8412	0.4987	5.9321	0.0023
6.2	0.7993	0.8070	0.8475	0.5631	5.7510	-0.1102
6.4	0.8006	0.8090	0.8550	0.6454	5.5770	-0.3725
6.6	0.8019	0.8110	0.8650	0.7645	5.4169	-0.5116
6.8	0.8032	0.8130	0.8750	0.8859	5.2617	-0.8901

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	5.925
Graphical	(value from fig.5.2.4)	5.950

Table 5.C.2'.4

Stability constant of Cobalt-4 methyl salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 35° C T^o_L = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Co^{++}}$ = 0.001 M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
4.4	0.7876	0.7880	0.8000	0.1509	7.4415	0.7503
4.6	0.7889	0.7895	0.8050	0.2010	7.2533	0.5993
4.8	0.7902	0.7910	0.8125	0.2811	7.0735	0.4077
5.0	0.7915	0.7925	0.8200	0.3642	6.8949	0.2420
5.2	0.7928	0.7950	0.8275	0.4323	6.7235	0.1183
5.4	0.7941	0.7975	0.84	0.5702	6.5534	-0.1228
5.6	0.7954	0.8000	0.8525	0.7108	6.4016	-0.3908
5.8	0.7967	0.8025	0.8700	0.9217	6.2759	-1.0708

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	6.6650
Graphical	(value from fig.5.2.5)	6.675

Table 5.C.2".1

Stability constant of Magnesium-4 methyl salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 45^{o}$ C $T^{o}_{L} = 0.002$ M

Medium = 50 % v/v Ethanol-water $T^{o}_{Mg^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
7.0	0.8000	0.8175	0.8275	0.1192	3.9834	0.8687
7.2	0.8025	0.8200	0.8325	0.1900	3.8009	0.6297
7.4	0.8050	0.8225	0.8375	0.2309	3.6683	0.5226
7.6	0.8075	0.8250	0.8425	0.2727	3.5091	0.4260
7.8	0.8100	0.8300	0.8487	0.2952	3.3578	0.3780
8.0	0.8125	0.8325	0.8525	0.3195	3.2272	0.3283
8.2	0.8150	0.8375	0.8600	0.3643	3.1218	0.2418
8.4	0.8175	0.8425	0.8675	0.4079	3.0389	0.1618
8.6	0.8200	0.8475	0.8750	0.4564	2.9308	0.0759
8.8	0.8225	0.8525	0.8850	0.5469	2.8530	-0.0817
9.0	0.8250	0.8600	0.9000	0.6770	2.7580	-0.3214
9.2	0.8275	0.8675	0.9125	0.9851	2.6489	-1.8202

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	2.875
Graphical	(value from fig.5.2.5)	2.9

Table 5.C.2".2

Stability constant of Cadmium-4 methyl salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 45^{o}$ C $T^{o}_{L} = 0.002$ M

Medium = 50 % v/v Ethanol-water $T^{o}_{Cd^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.0	0.7916	0.7975	0.8075	0.1345	5.9879	0.8036
5.2	0.7924	0.7995	0.8100	0.1433	5.7902	0.7767
5.4	0.7932	0.8015	0.8125	0.1524	5.5920	0.7456
5.6	0.7940	0.8035	0.8200	0.2322	5.4113	0.5194
5.8	0.7948	0.8055	0.8237	0.2601	5.2182	0.4539
6.0	0.7956	0.8075	0.8275	0.2884	5.0252	0.3923
6.2	0.7964	0.8095	0.8325	0.3363	4.8376	0.2953
6.4	0.7972	0.8115	0.8375	0.3815	4.6575	0.2099
6.6	0.7980	0.8135	0.8450	0.4662	4.4826	0.0587
6.8	0.7990	0.8155	0.8500	0.5144	4.3019	-0.0251
7.0	0.8000	0.8175	0.8575	0.6006	4.1363	-0.1672
7.2	0.8025	0.8220	0.8650	0.6841	3.9768	-0.3357
7.4	0.8050	0.8225	0.8725	0.7696	3.8261	-0.5238
7.6	0.8075	0.8250	0.8800	0.8570	3.6797	-0.7777
7.8	0.8100	0.8300	0.8925	0.9868	3.4468	-1.8737

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	4.35
Graphical	(value from fig.5.2.5)	4.4

Table 5.C.2".3

Stability constant of Zinc-4 methyl salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ml

$E^o = 0.02$ M $t = 45^o$ C $T_L^o = 0.002$ M

Medium = 50 % v/v Ethanol-water $T^o_{Zn^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.0	0.7916	0.7975	0.8125	0.2017	5.9812	0.5975
5.2	0.7924	0.7995	0.8175	0.2457	5.7904	0.4867
5.4	0.7932	0.8015	0.8200	0.2564	5.5930	0.4625
5.6	0.7940	0.8035	0.8275	0.3378	5.4379	0.2924
5.8	0.7948	0.8055	0.8325	0.3859	5.2506	0.2018
6.0	0.7956	0.8075	0.8375	0.4326	5.0635	0.1178
6.2	0.7964	0.8095	0.8450	0.5194	4.8882	-0.0338
6.4	0.7972	0.8115	0.8500	0.5648	4.7077	-0.1132
6.6	0.7980	0.8135	0.8575	0.6513	4.5385	-0.2713
6.8	0.7990	0.8155	0.8675	0.7754	4.3858	-0.5361
7.0	0.8000	0.8175	0.8750	0.8640	4.2268	-0.7721

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	4.850
Graphical	(value from fig.5.2.5)	4.950

Table 5.C.2".4

Stability constant of Cobalt-4 methyl salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml

$E^o = 0.02$ M $t = 45^o$ C $T_L^o = 0.002$ M

Medium = 50 % Ethanol-water v/v $T^o_{Co^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.0	0.7850	0.7825	0.7925	0.1226	6.9853	0.8557
4.2	0.7866	0.7855	0.7975	0.1471	6.7914	0.7633
4.4	0.7882	0.7885	0.8025	0.1716	6.5966	0.6737
4.6	0.7900	0.7915	0.8075	0.2088	6.4055	0.5735
4.8	0.7908	0.7945	0.8125	0.2384	6.2129	0.5044
5.0	0.7916	0.7975	0.8200	0.3024	6.0291	0.3630
5.2	0.7924	0.7995	0.8275	0.3819	5.8497	0.2092
5.4	0.7932	0.8015	0.8375	0.4986	5.6823	0.0024
5.6	0.7940	0.8035	0.8550	0.5837	5.4989	-0.1978
5.8	0.7948	0.8055	0;8650	0.8504	5.3896	-0.7547

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.2.4)	5.650
Graphical	(value from fig.5.2.5)	5.675

Table 5.C.3.1

Stability constant of Magnesium-5 nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M   t = 25° C T_L^o = 0.002 M
Medium = 50 v/v Ethanol-water $T_{Mg^{++}}^o$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
7.4	0.8000	0.8245	0.8325	0.1153	5.8338	0.8850
7.6	0.8000	0.8255	0.8350	0.1374	5.6393	0.7978
7.8	0.8000	0.8265	0.8375	0.1603	5.4450	0.7194
8.0	0.8000	0.8275	0.8425	0.2210	5.2599	0.5791
8.2	0.8000	0.8280	0.8450	0.2574	5.0698	0.4602
8.4	0.8000	0.8285	0.8500	0.3193	4.8869	0.3282
8.6	0.8000	0.8290	0.8550	0.3886	4.7072	0.1968
8.8	0.8000	0.8300	0.8600	0.4505	4.5274	0.0864
9.0	0.8020	0.8325	0.8650	0.4899	4.3433	0.0176
9.2	0.8025	0.8350	0.8700	0.5357	4.1644	-0.062
9.4	0.8025	0.8375	0.8775	0.6240	4.0035	-0.2693
9.6	0.8050	0.8400	0.8850	0.7020	3.8468	-0.3721
9.8	0.8050	0.8425	0.8925	0.8125	3.7134	-0.6315
10.0	0.8060	0.8450	0.9000	0.8149	3.5544	-0.6435

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	4.33
Graphical	(value from fig.5.3.5)	4.4

Table 5.C.3.2

Stability constant of Manganese-5 nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M   t = 25° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T_{Mn^{++}}^o$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.0	0.7965	0.8075	0.8200	0.1643	8.2449	0.7067
5.2	0.7970	0.8090	0.8250	0.2116	8.0562	0.5712
5.4	0.7975	0.8100	0.8300	0.2656	7.8697	0.4417
5.6	0.7980	0.8120	0.8350	0.3083	7.6705	0.3505
5.8	0.7990	0.8140	0.8400	0.3314	7.4765	0.3049
6.0	0.8000	0.8160	0.8450	0.3941	7.3024	0.1868
6.2	0.8000	0.8180	0.8500	0.4408	7.1159	0.1033
6.4	0.8000	0.8200	0.8550	0.4876	6.9292	0.0215
6.6	0.8000	0.8215	0.8600	0.5399	6.7442	-0.0694
6.8	0.8000	0.8225	0.8660	0.6001	6.5628	-0.1763
7.0	0.8000	0.8235	0.8740	0.7185	6.4013	-0.4069
7.2	0.8000	0.8245	0.8810	0.8104	6.3336	-0.6496
7.4	0.8000	0.8255	0.8880	0.9014	6.0641	-1.0610

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	6.9
Graphical	(value from fig.5.3.5)	6.95

Table 5.C.3.3

Stability constant of Cadmium-5 Nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Cd^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.0	0.7850	0.7860	0.8025	0.2312	9.3609	0.5219
4.2	0.7875	0.7880	0.8100	0.2789	9.0726	0.4376
4.4	0.7900	0.7920	0.8150	0.2954	8.9771	0.3776
4.6	0.7925	0.7930	0.8200	0.3482	8.7907	0.2722
4.8	0.7950	0.7940	0.8250	0.4006	8.5046	0.1750
5.0	0.7965	0.7950	0.8300	0.4536	8.3193	0.0808
5.2	0.7970	0.7960	0.8350	0.5098	8.1353	-0.0170
5.4	0.7975	0.8000	0.8450	0.5973	7.9619	-0.1702
5.6	0.7980	0.8040	0.8525	0.6497	7.7783	-0.2682
5.8	0.7990	0.8080	0.8625	0.7485	7.6174	-0.4736
6.0	0.8000	0.8100	0.8700	0.8326	7.4416	-0.6966
6.2	0.8000	0.8120	0.8750	0.8804	7.2601	-0.5669

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	8.133
Graphical	(value from fig.5.3.5)	8.2

Table 5.C.3.4

Stability constant of Zinc-5 nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 25° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Zn^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.6	0.7750	0.7750	0.7950	0.2452	9.6643	0.4903
3.8	0.7825	0.7800	0.8050	0.3065	9.5015	0.3556
4.0	0.7850	0.7850	0.8175	0.3985	9.3040	0.1789
4.2	0.7875	0.7900	0.8260	0.4436	9.1264	0.0976
4.4	0.7900	0.7950	0.8325	0.4643	8.9151	0.0610
4.6	0.7925	0.8000	0.8400	0.5009	8.7327	-0.0016
4.8	0.7950	0.8050	0.8475	0.5562	8.5493	-0.0981
5.0	0.7965	0.8075	0.8560	0.6375	8.3745	-0.2451
5.2	0.7970	0.8090	0.8610	0.6884	8.1910	-0.3443
5.4	0.7975	0.8100	0.8660	0.7439	8.0097	-0.3631
5.6	0.7980	0.8120	0.8710	0.7909	7.8261	-0.5778
5.8	0.7990	0.8140	0.8775	0.8574	7.6410	-0.7791
6.0	0.8000	0.8160	0.8825	0.9036	7.4306	-1.0719

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	8.7
Graphical	(value from fig.5.3.5)	8.7

Table 5.C.3.5

Stability constant of Cobalt-5 Nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M   t = 25° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T^o_{Co^{++}}$ = 0.001 M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
3.0	0.7200	0.7200	0.7300	0.1228	10.2344	0.8537
3.2	0.7450	0.7450	0.7675	0.2765	10.0717	0.4177
3.4	0.7600	0.7600	0.7900	0.3685	9.8956	0.2339
3.6	0.7750	0.7750	0.8100	0.4292	9.7124	0.1248
3.8	0.7825	0.7800	0.8250	0.5517	9.5476	-0.0901
4.0	0.7850	0.7850	0.8350	0.5855	9.3582	-0.1501
4.2	0.7875	0.7900	0.8425	0.6483	9.1779	-0.2656
4.4	0.7900	0.7950	0.8525	0.7120	8.9985	-0.3921
4.6	0.7925	0.8000	0.8625	0.7827	8.8234	-0.5665

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	9.6
Graphical	(value from fig.5.3.5)	9.55

Table 5.C.3'.1

Stability constant of Magnesium-5 Nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M   t = 35° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}}$ = 0.002 M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
6.00	0.8000	0.8150	0.8225	0.1013	6.0304	0.9481
6.2	0.8015	0.8175	0.8260	0.1154	5.7376	0.8894
6.4	0.8030	0.8200	0.8300	0.1300	5.6377	0.8256
6.6	0.8045	0.8225	0.8350	0.1712	5.3479	0.7849
6.8	0.8060	0.8250	0.8390	0.1946	5.2540	0.7169
7.0	0.8075	0.8275	0.8425	0.2095	4.9587	0.5788
7.2	0.8090	0.8300	0.8475	0.2497	4.7702	0.5759
7.4	0.8105	0.8325	0.8550	0.2975	4.5850	0.3731
7.6	0.8120	0.8350	0.8625	0.3922	4.4137	0.1903
7.8	0.8135	0.8375	0.8675	0.4309	4.2302	0.1208
8.0	0.8150	0.8400	0.8750	0.5063	4.0615	-0.0111
8.2	0.8170	0.8440	0.8825	0.5652	3.8939	-0.1139
8.4	0.8190	0.8480	0.8900	0.6259	3.7349	-0.2255
8.6	0.8210	0.8520	0.8975	0.6885	3.5888	-0.3444
8.8	0.8230	0.8560	0.9100	0.8500	3.4939	-0.7433
9.0	0.8250	0.8600	0.9300	1.0910	3.4632	-

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	4.033
Graphical	(value from fig.5.3.5)	4.066

Table 5.C.3'.2

Stability constant of Manganese-5 Nitro salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 35^{o}$ C $T_{L}^{o} = 0.001$ M

Medium = 50 % v/v Ethanol-water $T_{Mn^{++}}^{o} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.0	0.7925	0.8025	0.8150	0.1552	6.9430	0.8358
5.2	0.7940	0.8050	0.8225	0.2301	6.610	0.5245
5.4	0.7955	0.8075	0.8300	0.2891	6.5781	0.3720
5.6	0.7970	0.8100	0.8350	0.3331	6.3870	0.3016
5.8	0.7985	0.8125	0.8425	0.4024	6.2054	0.1718
6.0	0.8000	0.8150	0.8500	0.4833	6.0281	0.0290
6.2	0.8015	0.8175	0.8550	0.5213	5.8391	-0.027
6.4	0.8030	0.8200	0.8625	0.5533	5.6493	-0.0929
6.6	0.8045	0.8225	0.8700	0.6507	5.4789	-0.2702
6.8	0.8060	0.8250	0.8775	0.7303	5.3054	-0.4336
7.0	0.8075	0.8275	0.8925	0.8450	5.1463	-0.7367

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	5.9
Graphical	(value from fig.5.3.5)	6.0

Table 5.C.3'.3

Stability constant of Cadmium-5 Nitro salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 35^{o}$ C $T_{L}^{o} = 0.002$ M

Medium = 50 % v/v Ethanol-water $T_{Cd^{++}}^{o} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.2	0.7940	0.8050	0.8250	0.2629	6.7688	0.4478
5.4	0.7955	0.8075	0.8325	0.3309	6.5862	0.3058
5.6	0.7970	0.8100	0.8425	0.4330	6.4136	0.1171
5.8	0.7985	0.8125	0.8550	0.5833	6.2576	-0.1461
6.0	0.8000	0.8150	0.8700	0.7423	6.1094	-0.3595
6.2	0.8015	0.8175	0.9000	1.1210	6.0747	-

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	6.33
Graphical	(value from fig.5.3.5)	6.35

Table 5.C.3'.4

Stability constant of Zinc-5 Nitro salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml

$E^o = 0.02$ M $t = 35^o$ C $T_L^o = 0.002$ M

Medium 50 % v/v Ethanol-water $T^o_{Zn^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.0	0.7870	0.7900	0.7975	0.07440	7.9241	1.0953
4.2	0.7905	0.7940	0.8025	0.1064	7.7973	0.9242
4.4	0.7910	0.7950	0.8100	0.1886	7.5506	0.6236
4.6	0.7915	0.7975	0.8175	0.2556	7.3668	0.4666
4.8	0.7920	0.8000	0.8225	0.2708	7.1709	0.4301
5.0	0.7925	0.8025	0.8325	0.3723	6.9973	0.2270
5.2	0.7940	0.8050	0.8425	0.4933	6.8308	0.0117
5.4	0.7955	0.8075	0.8525	0.5961	6.6616	-0.1690
5.6	0.7970	0.8100	0.8650	0.7330	6.5059	-0.4386
5.8	0.7985	0.8125	0.8825	0.9379	6.3826	-1.1790

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	6.833
Graphical	(value from fig.5.3.5)	6.85

Table 5.C.3'.5

Stability constant of Cobalt-5 Nitro salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml

$E^o = 0.02$ M $t = 35^o$ C $T_L^o = 0.002$ M

Medium = 50 % v/v Ethanol-water $T^o_{Co^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.0	0.7400	0.7400	0.7500	0.1227	8.9326	0.8543
3.2	0.7500	0.7500	0.7650	0.1841	8.7492	0.6467
3.4	0.7800	0.7800	0.8000	0.2452	8.5744	0.4883
3.5	0.7825	0.7825	0.8125	0.3679	8.4957	0.2350
3.6	0.7850	0.7850	0.8225	0.4597	8.4209	0.0701
3.8	0.7850	0.7850	0.8400	0.6744	8.2862	-0.2167
4.0	0.7875	0.7900	0.8600	0.8580	8.1508	-0.8812

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	8.333
Graphical	(value from fig.5.3.5)	8.4

Table 5.C.3".1

Stability constant of Magnesium-5 Nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 45° C T^o_L = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}}$ = 0.002 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
6.4	0.7995	0.8240	0.8375	0.1957	5.005	0.7049
6.6	0.8006	0.8260	0.8425	0.2393	4.8172	0.5022
6.8	0.8018	0.8280	0.8475	0.2851	4.6446	0.3992
7.0	0.8030	0.8300	0.8525	0.3305	4.4516	0.3066
7.2	0.8038	0.8320	0.8575	0.3776	4.2659	0.2171
7.4	0.8046	0.8340	0.8625	0.4256	4.0855	0.1302
7.6	0.8060	0.8365	0.8675	0.4673	3.9106	0.0569
7.8	0.8080	0.8395	0.8725	0.5009	3.6968	-0.0016
8.0	0.8100	0.8425	0.8775	0.5357	3.5812	-0.0622
8.2	0.8110	0.8455	0.8850	0.6125	3.4487	-0.1990
8.4	0.8120	0.8485	0.8900	0.6518	3.3232	-0.2724
8.6	0.8130	0.8510	0.9000	0.7821	3.2505	-0.5550
8.8	0.8140	0.8530	0.9175	1.013	3.2470	-

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	3.7
Graphical	(value from fig.5.3.5)	3.7

Table 5.C.3".2

Stability constant of Manganese-5 Nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 45° C T^o_L = 0.001 M

Medium = 50 % v/v Ethanol-water $T^o_{Mn^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
5.0	0.7925	0.8075	0.8200	0.1691	6.3961	0.6914
5.2	0.7935	0.8105	0.8250	0.1986	6.2034	0.6058
5.4	0.7945	0.8135	0.8300	0.2290	6.0105	0.5223
5.6	0.7955	0.8160	0.8375	0.3015	5.8287	0.3689
5.8	0.7965	0.8180	0.8425	0.3460	5.6401	0.2765
6.0	0.7975	0.8200	0.8500	0.4263	5.4620	0.1290
6.2	0.7985	0.8220	0.8550	0.4731	5.2733	0.0467
6.4	0.7995	0.8240	0.8625	0.5555	5.0999	-0.0998
6.6	0.8006	0.8260	0.8700	0.6385	4.9289	-0.2470
6.8	0.8018	0.8018	0.8280	0.8775	4.7594	-0.4189
7.0	0.8030	0.8300	0.8875	0.8445	4.6460	-0.7349
7.2	0.8038	0.8320	0.8975	0.9699	4.4612	-1.5081

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	5.233
Graphical	(value from fig.5.3.5)	5.4

Table 5.C.3".3

Stability constant of Cadmium-5 Nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M   t = 45° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T^o_{Cd^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.8	0.7915	0.8045	0.8150	0.1399	6.5891	0.7887
5.0	0.7925	0.8075	0.8225	0.2030	6.4040	0.5940
5.2	0.7935	0.8105	0.8300	0.2669	6.2199	0.4388
5.4	0.7945	0.8135	0.8400	0.3676	6.0459	0.2356
5.6	0.7955	0.8160	0.8475	0.4418	5.8662	0.1009
5.8	0.7965	0.8180	0.8550	0.5225	5.6895	-0.0391
6.0	0.7975	0.8200	0.8650	0.6395	5.5317	-0.2489
6.2	0.7985	0.8220	0.8750	0.7598	5.3654	-0.5001
6.4	0.7995	0.8240	0.8875	0.9162	5.2242	-1.0388

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	5.766
Graphical	(value from fig.5.3.5)	5.8

Table 5.C.3".4

Stability constant of Zinc-5 Nitro salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M   t = 45° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T^o_{Zn^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.2	0.7885	0.7955	0.8050	0.1217	7.1848	0.4858
4.4	0.7895	0.7985	0.8125	0.1892	7.0008	0.3542
4.6	0.7905	0.8015	0.8175	0.2103	6.8064	0.2350
4.8	0.7915	0.8045	0.8250	0.2732	6.6214	0.0593
5.0	0.7925	0.8075	0.8325	0.3383	6.4383	-0.1118
5.2	0.7935	0.8105	0.8425	0.4380	6.2650	0.1082
5.4	0.7945	0.8135	0.8525	0.5412	6.0949	-0.0717
5.6	0.7955	0.8160	0.8625	0.6229	5.9197	-0.2180
5.8	0.7965	0.8180	0.8775	0.8403	5.7587	-0.6999
6.0	0.7975	0.8200	0.8825	0.9592	5.6418	-1.3712

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	6.133
Graphical	(value from fig.5.3.5)	6.225

Table 5.C.3".5

Stability constant of Cobalt-5 Nitro salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml
$E^o = 0.02$ M $t = 45^o$ C $T_L^o = 0.002$ M
Medium = 50 % v/v Ethanol-water $T_{Co^{++}}^o = 0.001$ M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
3.0	0.7000	0.7000	0.7225	0.2463	8.4938	0.4858
3.2	0.7500	0.7500	0.7750	0.3067	8.2294	0.3542
3.4	0.7800	0.7800	0.8100	0.3679	7.9457	0.2350
3.5	0.7820	0.7820	0.8200	0.4659	7.9726	0.0593
3.6	0.7840	0.7840	0.8300	0.5640	7.8013	-0.1118
3.8	0.7875	0.7875	0.8375	0.6253	7.6204	-0.2224
4.0	0.7850	0.79	0.8500	0.7355	7.5567	-0.4442

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.3.4)	7.833
Graphical	(value from fig.5.3.5)	7.95

Table 5.C.4.1

Stability constant of Magnesium-Resorcylaldehyde thiosemicarbozone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 50.00$ ml
$E^o = 0.02$ M $t = 25^o$ C $T_L^o = 0.002$ M
Medium = 50 % v/v Ethanol-water $T_{Mg^{++}}^o = 0.001$ M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
8.4	0.8006	0.8545	0.8566	0.03843	2.8478	1.3987
8.6	0.8026	0.8625	0.8700	0.1418	2.8235	1.0756
8.8	0.8046	0.8705	0.8800	0.1953	2.8266	0.6150
9.0	0.8066	0.8785	0.8966	0.3966	2.7918	0.1822
9.2	0.8086	0.8968	0.9166	0.5281	2.7183	-0.0489
9.4	0.8106	0.9151	0.9400	0.8486	2.6955	-0.7321

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	2.733
Graphical	(value from fig.5.4.5)	2.7

Table 5.C.4.2

Stability constant of Cadmium Resorcylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 25^{o}$ C $T_{L}^{o} = 0.002$ M

Medium = 50 % v/v Ethanol-water $T_{Cd^{++}}^{o} = 0.001$ M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
3.4	0.7432	0.7432	0.7600	0.2062	7.3542	0.5856
3.6	0.7498	0.7498	0.7673	0.2148	7.1563	0.5630
3.8	0.7566	0.7566	0.7746	0.2210	6.9578	0.5471
4.0	0.7633	0.7633	0.7820	0.2294	6.7601	0.5262
4.2	0.7650	0.7660	0.7849	0.2442	6.5631	0.4906
4.4	0.7667	0.7667	0.7878	0.2589	6.3673	0.4568
4.6	0.7684	0.7684	0.7907	0.2736	6.1711	0.4240
4.8	0.7700	0.7700	0.7936	0.2894	5.9753	0.3902
5.0	0.7720	0.7720	0.7966	0.3016	5.7783	0.3646
5.2	0.7725	0.7745	0.8039	0.3651	5.5950	0.2471
5.4	0.7735	0.7770	0.8112	0.4341	5.4136	0.1151
5.6	0.7745	0.7800	0.8185	0.4888	5.2304	0.0195
5.8	0.7755	0.7830	0.8258	0.5500	5.0497	-0.0872
6.0	0.7765	0.7866	0.8333	0.6049	4.8680	-0.2149
6.2	0.7785	0.7913	0.8406	0.6560	4.6868	-0.2803

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	5.16
Graphical	(value from fig.5.4.5)	5.15

Table 5.C.4.3

Stability constant of Zinc-Resorcylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M t = 25° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T^o_{Zn^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.6	0.7498	0.7498	0.7766	0.3290	7.1849	0.3095
3.8	0.7566	0.7566	0.7843	0.3400	6.9879	0.2880
4.0	0.7633	0.7633	0.7920	0.3522	6.7915	0.2647
4.2	0.7650	0.7650	0.7950	0.3681	6.5956	0.2347
4.4	0.7667	0.7667	0.7992	0.3984	6.4037	0.1790
4.6	0.7684	0.7684	0.8034	0.4300	6.2122	0.1224
4.8	0.7700	0.7700	0.8075	0.4599	6.0208	0.0698
5.0	0.7720	0.7720	0.8120	0.4907	5.8297	0.0162
5.2	0.7725	0.7745	0.8220	0.5826	5.6570	-0.1448
5.4	0.7735	0.7770	0.8333	0.7147	5.4994	-0.3988
5.6	0.7745	0.7800	0.8433	0.8037	5.3306	-0.6121
5.8	0.7755	0.7830	0.8533	0.9038	5.1685	-1.9723
6.0	0.7765	0.7866	0.8633	1.0030	5.0101	-

Metal ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	5.8
Graphical	(value from fig.5.4.5)	6.0

Table 5.C.4.4

Stability constant of Nickel-salicylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml
E^o = 0.02 M t = 25° C T_L^o = 0.002 M
Medium = 50 % v/v Ethanol-water $T^o_{Ni^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.0	0.7300	0.7300	0.7400	0.1230	7.7344	0.8531
3.2	0.7366	0.7366	0.7546	0.2210	7.5576	0.5471
3.4	0.7432	0.7432	0.7693	0.3203	7.3829	0.3256
3.6	0.7498	0.7498	0.7839	0.4186	7.2089	0.1427
3.8	0.7566	0.7566	0.7986	0.5153	7.0365	-0.0267
4.0	0.7633	0.7633	0.8133	0.6135	6.8663	-0.2007
4.2	0.7650	0.7650	0.8166	0.6330	6.6724	-0.2367
4.4	0.7667	0.7667	0.8200	0.6539	6.4791	-0.2763
4.6	0.7684	0.7684	0.8233	0.6695	6.2842	-0.3066
4.8	0.7700	0.7700	0.8267	0.6953	6.0931	-0.3583
5.0	0.7720	0.7720	0.8300	0.7112	5.8984	-0.3874
5.2	0.7725	0.7745	0.8380	0.8069	5.7317	-0.6210

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	7.1
Graphical	(value from fig.5.4.5)	7.0

Table 5.C.4.5

Stability constant of Cobalt resorcylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml
$E^o = 0.02$ M $t = 25^o$ C $T_L^o = 0.002$ M
Medium = 50 % v/v Ethanol-water $T^o_{Co^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.0	0.7300	0.7300	0.7400	0.1227	7.7394	0.8543
3.2	0.7366	0.7366	0.7573	0.2542	7.5660	0.4676
3.4	0.7432	0.7746	0.7746	0.3854	7.4000	0.2026
3.6	0.7498	0.7498	0.7920	0.5180	7.2370	-0.0313
3.8	0.7566	0.7566	0.8099	0.6540	7.0790	-0.2765
4.0	0.7633	0.7633	0.8266	0.7767	6.9205	-0.5414
4.2	0.7650	0.7650	0.8333	0.8381	6.7431	-0.7143
4.4	0.7667	0.7667	0.8433	0.9399	6.5827	-1.1942

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	7.25
Graphical	(value from fig.5.4.5)	7.25

Table 5.C.4'.1

Stability constant of Magnesium Resorcylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml
$E^o = 0.02$ M $t = 35^o$ C $T_L^o = 0.002$ m
Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
6.0	0.8000	0.8100	0.8200	0.306	4.8406	0.8232
6.2	0.8012	0.8120	0.8225	0.1378	4.6442	0.7963
6.4	0.8024	0.8140	0.8250	0.1455	4.5492	0.7689
6.6	0.8036	0.8160	0.8300	0.1857	4.2636	0.6440
6.8	0.8048	0.8180	0.8325	0.1933	4.0732	0.6204
7.0	0.8060	0.8200	0.8350	0.2011	3.9020	0.5991
7.2	0.8072	0.8275	0.8430	0.2170	3.7091	0.5573
7.4	0.8074	0.8325	0.8485	0.2339	3.5409	0.5152
7.6	0.8100	0.8400	0.8565	0.2477	3.3846	0.4835
7.8	0.8112	0.8425	0.8595	0.2577	3.2444	0.4595
8.0	0.8124	0.8575	0.8750	0.2786	3.1272	0.4132
8.2	0.8136	0.8600	0.8780	0.3082	3.0347	0.3511
8.4	0.8148	0.8700	0.8890	0.3517	2.9685	0.2756
8.6	0.8160	0.8775	0.8970	0.3929	2.9223	0.1890
8.8	0.8172	0.8800	0.9000	0.4434	2.8959	0.0988
9.0	0.8184	0.8900	0.9125	0.5513	2.8750	-0.0894
9.2	0.8200	0.9150	0.9385	0.6832	2.8200	-0.3438

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	2.866
Graphical	(value from fig.5.4.5)	2.833

Table 5.C.4'.2

Stability constant of Cadmium Resorcylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 35^{o}$ C $T_{L}^{o} = 0.002$ M

Medium = 50 % v/v Ethanol-water $T_{Cd^{++}}^{o} = 0.00$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.2	0.7600	0.7600	0.7690	0.1104	7.6318	0.9063
3.4	0.7800	0.7800	0.7900	0.1227	7.4348	0.8543
3.6	0.7800	0.7800	0.7925	0.1533	7.3422	0.7423
3.8	0.7800	0.7800	0.8000	0.2509	7.0657	0.4752
4.0	0.7850	0.7850	0.8050	0.3066	6.8797	0.3543
4.2	0.7871	0.7871	0.8125	0.3115	6.6810	0.3444
4.4	0.7892	0.7892	0.8175	0.3482	6.4906	0.2722
4.6	0.7912	0.7925	0.8225	0.3707	6.2966	0.2299
4.8	0.7924	0.7950	0.8275	0.4049	6.1057	0.1672
5.0	0.7936	0.7975	0.8325	0.4397	5.9154	0.1052
5.2	0.7948	0.8000	0.8355	0.4495	5.7183	0.0881
5.4	0.7960	0.8025	0.8400	0.4788	5.5265	0.0369
5.6	0.7972	0.8050	0.8450	0.5151	5.3368	-0.063
5.8	0.7974	0.8075	0.8500	0.5518	5.1478	-0.0903
6.0	0.8000	0.8100	0.8575	0.6204	4.9271	-0.2124
6.2	0.8012	0.8120	0.8650	0.6960	4.7984	-0.3597
6.4	0.8024	0.8140	0.8750	0.8072	4.6450	-0.6219

Metal-ligand stability constant

Method		$\log K_1$
Half integral	(value from fig.5.4.4)	5.425
Graphical	(value from fig.5.4.5)	5.5

Table 5.C.4'.3

Stability constant of Zinc-resorcylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml
$E^o = 0.02$ M $t = 35^o$ C $T_L^o = 0.002$ M
Medium = 50 % v/v Ethanol-water $T_{Zn^{++}}^o = 0.001$ M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
3.4	0.7800	0.7800	0.7875	0.09198	7.4276	0.9944
3.6	0.7800	0.7800	0.7975	0.2146	7.2568	0.5635
3.8	0.7800	0.7800	0.8050	0.3066	7.0797	0.3643
4.0	0.7800	0.7850	0.8125	0.3372	6.8878	0.2935
4.2	0.7871	0.7871	0.8175	0.3728	6.6971	0.2232
4.4	0.7892	0.7892	0.8225	0.4038	6.5067	0.1611
4.6	0.7912	0.7925	0.8275	0.4325	6.3134	0.1180
4.8	0.7924	0.7950	0.8325	0.4671	6.1232	0.0572
5.0	0.7936	0.7975	0.8390	0.5339	5.9423	-0.0589
5.2	0.7948	0.8000	0.8450	0.5699	5.7533	-0.1222
5.4	0.7960	0.8025	0.8525	0.6386	5.5748	-0.2462
5.6	0.7972	0.8050	0.8600	0.7082	5.3977	-0.3850
5.8	0.7974	0.8075	0.8650	0.7466	5.2107	-0.4693
6.0	0.8000	0.8100	0.8750	0.8489	5.0476	-0.7496
6.2	0.8012	0.8120	0.8850	0.9585	4.8913	-1.3636

Metal-ligand stability constant

Method	log K_1
Half integral (value from fig.5.4.4)	6.00
Graphical (value from fig.5.4.5)	6.125

Table 5.C.4'.4

Stability constant of Nickel-resorcylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^o = 40.00$ ml
$E^o = 0.02$ M $t = 35^o$ C $T_L^o = 0.002$ M
Medium = 50 % v/v Ethanol-water $T_{Ni^{++}}^o = 0.001$ M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
3.2	0.7600	0.7660	0.7750	0.1841	7.6492	0.6467
3.4	0.7800	0.7800	0.7975	0.2146	7.4566	0.5635
3.6	0.7800	0.7800	0.8125	0.3986	7.3040	0.1786
3.8	0.7800	0.7800	0.8225	0.5212	7.1380	-0.0369
4.0	0.7850	0.7850	0.8300	0.5518	6.9476	-0.0903
4.2	0.7871	0.7871	0.8350	0.5873	6.7586	-0.1532
4.4	0.7892	0.7892	0.8425	0.6536	6.5794	-0.2757
4.6	0.7912	0.7925	0.8475	0.6956	6.3943	-0.3589
4.8	0.7924	0.7950	0.8525	0.7487	6.2113	-0.4741
5.0	0.7936	0.7975	0.8575	0.8028	6.0306	-0.6097
5.2	0.7948	0.8000	0.8625	0.8574	5.9509	-0.7791
5.4	0.7960	0.825	0.8700	0.9450	5.6853	-1.2350

Metal-ligand stability constant

Method	log K_1
Half integral (value from fig.5.4.4)	7.100
Graphical (value from fig.5.4.5)	6.975

Table 5.C.4'.5

Stability constant of Cobalt-resorcylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 35° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Co^{++}}$ = 0.001 M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
3.0	0.7300	0.7300	0.7425	0.1535	7.8418	0.7416
3.2	0.7600	0.7600	0.7875	0.3374	7.6875	0.2932
3.4	0.7800	0.7800	0.8175	0.4601	7.5610	0.0694
3.6	0.7800	0.7800	0.8250	0.5842	7.377	-0.1477
3.8	0.7800	0.7800	0.8450	0.7971	7.2305	-0.5943
4.0	0.7850	0.7850	0.8625	0.9506	7.0877	-1.1843

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	7.425
Graphical	(value from fig.5.4.5)	4.400

Table 5.C.4''.1

Stability constant of Magnesium-resorcylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M t = 45° C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Mg^{++}}$ = 0.001 M

pH	V'	V''	V'''	$\bar{n}$	pL	log $\bar{n}$ F
7.6	0.8090	0.8275	0.8375	0.1382	3.6907	0.7949
7.8	0.8095	0.8300	0.8450	0.2103	3.5375	0.5747
8.0	0.8100	0.8350	0.8510	0.2315	3.3810	0.5212
8.2	0.8116	0.8450	0.8625	0.2595	3.2453	0.4553
8.4	0.8132	0.8500	0.8750	0.3955	3.1582	0.1843
8.6	0.8148	0.8600	0.8925	0.4374	3.0698	0.1093
8.8	0.8164	0.8700	0.9125	0.7754	2.9583	-0.5381
9.0	0.8180	0.8800	0.9475	1.334	2.8555	-

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	3.0775
Graphical	(value from fig.5.4.5)	3.1

Table 5.C.4".2

Stability constant of Cadmium-resorcylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 45^o C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Cd^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
4.6	0.8015	0.8045	0.8225	0.2247	6.6593	0.5379
4.8	0.8020	0.8060	0.8275	0.2639	6.4691	0.4465
5.0	0.8025	0.8075	0.8325	0.3161	6.3260	0.3352
5.2	0.8030	0.8090	0.8400	0.3946	6.1033	0.2859
5.4	0.8035	0.8105	0.8475	0.4739	5.9252	0.1454
5.6	0.8040	0.8120	0.8525	0.5222	5.7404	-0.0387
5.8	0.8045	0.8135	0.8600	0.6033	5.5735	-0.1820
6.0	0.8050	0.8150	0.8675	0.6857	5.3902	-0.3388
6.2	0.8055	0.8165	0.8750	0.7696	5.1189	-0.5238
6.4	0.8060	0.8180	0.8825	0.8535	5.0496	-0.6710

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	5.9
Graphical	(value from fig.5.4.5)	5.8

Table 5.C.4".3

Stability Constant of Zinc-resorcylaldehyde thiosemicarbazone system

N' = 0.98 M μ = 0.1 M V^o = 40.00 ml

E^o = 0.02 M   t = 45^o C T_L^o = 0.002 M

Medium = 50 % v/v Ethanol-water $T^o_{Zn^{++}}$ = 0.001 M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.8	0.7950	0.7950	0.8105	0.1593	7.6421	0.7225
4.0	0.8000	0.8000	0.8150	0.1839	7.4436	0.6472
4.2	0.8005	0.8015	0.8200	0.2281	7.2494	0.5295
4.4	0.8010	0.8030	0.8250	0.2724	7.0604	0.4267
4.6	0.8015	0.8045	0.8325	0.3416	6.8714	0.2849
4.8	0.8020	0.8060	0.8375	0.3959	6.6890	0.1835
5.0	0.8025	0.8075	0.8425	0.4426	6.5034	0.1002
5.2	0.8030	0.8090	0.8500	0.5218	6.3163	-0.0378
5.4	0.8035	0.8105	0.8550	0.5699	6.1389	-0.1222
5.6	0.8040	0.8120	0.8625	0.6510	5.9534	-0.2701
5.8	0.8045	0.8135	0.8700	0.7328	5.7787	-0.4382
6.0	0.8050	0.8150	0.8775	0.8143	5.6059	-0.6420
6.2	0.8055	0.8165	0.8850	0.9012	5.4349	-0.9570

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	6.15
Graphical	(value from fig.5.4.5)	6.2

Table 5.C.4".4

Stability constant of Nickel salicylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 45^{o}$ C $T^{o}_{L} = 0.002$ M

Medium = 50 % v/v Ethanol-water $T^{o}_{Ni^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.4	0.7775	0.7775	0.7950	0.2146	7.8484	0.5635
3.6	0.7875	0.7875	0.8100	0.2758	7.6635	0.4192
3.8	0.7950	0.7950	0.8250	0.3678	7.4873	0.2404
4.0	0.8000	0.8000	0.8385	0.4719	7.3150	0.0489
4.2	0.8005	0.8015	0.8435	0.5178	7.1291	-0.03010
4.4	0.8010	0.8030	0.8535	0.6206	6.9604	-0.2134
4.6	0.8015	0.8045	0.8585	0.6741	6.7778	-0.3157
4.8	0.8020	0.8060	0.8660	0.7543	6.6049	-0.4872
5.0	0.8025	0.8075	0.8710	0.8030	6.4219	-0.7102
5.2	0.8030	0.8040	0.8795	0.8973	6.2578	-0.9457
5.4	0.8035	0.8105	0.8835	0.9348	6.0726	-1.1661

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	7.15
Graphical	(value from fig.5.4.5)	1.175

Table 5.C.4".5

Stability constant of Cobalt resorcylaldehyde thiosemicarbazone system

$N' = 0.98$ M $\mu = 0.1$ M $V^{o} = 40.00$ ml

$E^{o} = 0.02$ M $t = 45^{o}$ C $T^{o}_{L} = 0.002$ M

Medium = 50 % v/v Ethanol-water $T^{o}_{Co^{++}} = 0.001$ M

pH	V'	V"	V"'	$\bar{n}$	pL	log $\bar{n}$ F
3.2	0.7425	0.7425	0.7500	0.09206	8.0276	1.0939
3.4	0.7775	0.7775	0.7925	0.1840	7.8492	0.6522
3.6	0.7875	0.7875	0.8200	0.3985	7.7040	0.1789
3.8	0.7950	0.7950	0.8350	0.4905	7.6299	0.0165
4.0	0.8000	0.8000	0.8425	0.5208	7.4386	-0.0361
4.2	0.8005	0.8015	0.8525	0.6290	7.2716	-0.2178
4.4	0.8010	0.8030	0.8575	0.6763	6.9870	-0.3200
4.6	0.8015	0.8045	0.8625	0.7240	6.8027	-0.4188
4.8	0.8020	0.8060	0.8775	0.8986	6.6668	-0.9476

Metal-ligand stability constant

Method		log K_1
Half integral	(value from fig.5.4.4)	7.4
Graphical	(value from fig.5.4.5)	7.5

Table 5.D.1 : Salicylaldehyde thiosemicarbazone used as a ligand

Metal	Stability constant	Temperature			$-\Delta G^{o}$ K joules/mole			ΔH^{o} K joules/mole		ΔS^{o} Joules/mole		
		25°C	35°C	45°C	25°C	35°C	45°C	Graphical	Calculated	25°C	35°C	45°C
H^{+}	$\log K_1^H$	11.287	10.647	10.325	64.18	62.59	62.63	- 85.95	- 86.02	- 73.27	- 75.82	- 73.35
H^{+}	$\log K_2^H$	9.225	8.7	7.725	52.46	50.95	46.89	-133.06	-137.16	-270.48	-265.83	-271.02
Mg^{++}	$\log K_1$	3.00	2.925	2.837	17.07	17.20	17.22	- 15.96	- 14.80	+ 3.695	+ 4.009	+ 3.95
Mn^{++}	$\log K_1$	4.525	4.2	3.7	25.74	24.69	22.46	- 74.52	- 75.24	-163.66	-161.45	-168.52
Co^{++}	$\log K_1$	-	5.2	4.375	-	30.58	26.56	-151.86	-154.29	-	-393.6	406.725
Zn^{++}	$\log K_1$	7.662	6.3	5.450	43.58	37.05	33.08	-206.96	-198.84	-548.07	-551.07	-546.4

Table 5.D.2 : 4-Methyl salicylaldehyde thiosemicarbazone used as a ligand

Metal	Stability constant	Temperature			$-\Delta G^{o}$ K joules/mole			ΔH^{o}K joules/mole		ΔS^{o} Joules/mole		
		25°C	35°C	45°C	25°C	35°C	45°C	Graphical	Calculated	25°C	35°C	45°C
H^{+}	log K_1^H	11.7	10.9	10.433	66.57	64.10	63.30	-112.12	-113.76	-152.90	-155.88	-153.66
H^{+}	log K_2^H	9.75	9.1	8.216	55.47	53.50	49.86	-139.67	-139.63	-282.49	-279.77	-282.41
Mg^{++}	log K_1	4.025	3.762	2.887	22.39	22.12	17.53	-113.46	-104.84	-304.35	-296.90	-302.05
Cd^{++}	log K_1	5.567	5.287	4.375	31.67	31.09	26.56	-109.78	-109.64	-262.06	-255.36	-261.8
Zn^{++}	log K_1	6.587	5.937	4.9	37.48	34.92	29.75	-156.42	-153.87	-399.02	-394.28	-398.43
Co^{++}	log K_1	7.225	6.662	5.662	41.10	39.13	34.38	-140.22	-142.86	-332.57	-327.92	-332.74

Table 5.D.3 : 5-Nitro salicylaldehyde thiosemicarbazone used as a ligand

Metal	Stability constant	Temperature			$-\Delta G^o$ K joules/mole			ΔH^oK joules/mole		ΔS^o Joules/mole		
		25°C	35°C	45°C	25°C	35°C	45°C	Graphical	Calculated	25°C	35°C	45°C
H^+	log K_1^H	11.55	10.95	10.825	63.51	64.43	65.69	- 68.87	- 64.27	- 10.53	- 14.41	- 10.00
H^+	log K_2^H	10.34	9.2	8.8	58.82	54.09	53.46	-139.67	-167.29	-271.8	-277.5	-271.76
Mg^{++}	log K_1	4.36	4.066	3.7	24.81	23.91	22.46	- 57.90	- 59.95	-111.08	-110.36	-111.49
Mn^{++}	log K_1	6.925	5.95	5.316	39.39	34.99	32.27	-140.39	-144.74	-338.93	-342.28	-339.94
Cd^{++}	log K_1	8.166	6.34	5.783	46.47	37.28	35.10	-211.06	-212.07	-552.26	-557.28	-552.72
Zn^{++}	log K_1	8.7	6.841	6.179	49.49	40.24	37.51	-230.45	-224.80	-607.53	-617.16	-606.69
Co^{++}	log K_1	9.575	8.366	7.891	54.47	49.19	47.94	-150.27	-150.31	-321.39	-327.92	-321.68

Table 5.D.4 : Resorcylaldehyde thiosemicarbazone used as a ligand

Metal	Stability constant	Temperature			$-\Delta G^o$ K joules/mole			ΔH^oK joules/mole		ΔS^o Joules/mole		
		25°C	35°C	45°C	25°C	35°C	45°C	Graphical	Calculated	25°C	35°C	45°C
H^+	$\log K_1^H$	9.7	9.85	10.075	55.18	57.94	61.13	+ 27.41	+ 34.09	+ 270.94	+ 277.01	+ 278.22
H^+	$\log K_2^H$	7.85	7.962	8.475	44.67	46.76	51.45	+ 55.35	+ 57.78	+ 335.75	+ 316.99	+ 335.92
Mg^{++}	$\log K_1$	2.716	2.850	3.0887	15.45	16.76	18.74	+ 35.48	+ 34.135	+ 170.87	+ 169.48	+ 170.49
Cd^{++}	$\log K_1$	5.155	5.462	5.85	29.31	32.13	35.52	+ 61.17	+ 63.18	+ 303.64	+ 302.84	+ 304.1
Zn^{++}	$\log K_1$	5.9	6.062	6.175	33.57	35.65	37.49	+ 25.24	+ 25.004	+ 197.79	+ 197.66	+ 197.29
Ni^{++}	$\log K_1$	7.05	6.975	7.162	40.10	41.02	43.50	+ 39.91	+ 34.96	+ 268.47	+ 262.72	+ 262.31
Co^{++}	$\log K_1$	7.25	7.55	7.45	41.24	43.54	45.51	+ 24.04	+ 22.49	+ 219.02	+ 219.39	+ 218.72

5.4 RESULTS AND DISCUSSION

Salicylaldehyde thiosemicarbazone (SATSC)

Tables 5.A.1, 5.A.1' and 5.A.1" contain the experimental observations of titrations of SATSC. The reagent has been used to study the complexation with Mg^{++}, Cd^{++}, Zn^{++}, Mn^{++}, Ni^{++}, Co^{++} and Cu^{++}. The reagent is colourless in acidic medium, it acquires yellow colour that deepens with addition of more alkali. Figures 5.1.1.a, 5.1.1'.a, 5.1.1".a, 5.1.1.b, 5.1.1'.b and 5.1.1".b are the plots of titration curves. The titration curves show that complexation take place with all the above metal ions. When the ligand is added to Cu^{++} ion solution it becomes green in colour and get precipitated immediately by addition of further excess of alkali. Co^{++} and Ni^{++} also give immediate precipitate by addition of small amount of alkali. In case of Mn^{++}, Ni^{++} and Co^{++} initial colourless solution becomes pink, light green and red-brown respectively. Mn^{++} and Mg^{++} precipitate in alkaline medium. The data for proton ligand stability constants are given in Table 5.B.1, 5.B.1' and 5.B.1" at 25^{o}, 35^{o} and 45^{o}C respectively. The plots of half integral and graphical methods are drawn in Figs. 5.1.2 and 5.1.3 to determine proton ligand stability constants. Tables 5.C.1.1 to 5.C.1.4, 5.c.1'.1 to 5.C.1'.4 and 5.C.1".1 to 5.C.1".4 cover the four metal ions.

The metal-ligand stability constants are calculated by using half integral and graphical methods from figs. 5.1.4 and 5.1.5. The temperature coefficient and Gibbs-Helmholts equations are used to determine the values of overall changes in free energy (ΔG^o), enthalpy (ΔH^o) and entropy (ΔS^o) accompanying the complexation. Δ H is also determined with the help of an isobar equation

$$\frac{d\ (\log B)}{d\ (1/T)} = \frac{-\Delta H}{4.576}$$

The values of Δ H are determined by using figure 5.1.6. The stability constants and thermodynamic parameters are tabulated in Table 5.D.1.

The complex formation has been investigated in the present work in ethanol water mixture at 25°, 35° and 45°C temperature to calculate thermodynamic parameter.

<u>4-Methyl salicylaldehyde thiosemicarbazone</u> (4-MSATSC)

The experimental observations of 4-MSATSC are given in Tables 5.A.2, 5.A.2' and 5.A.2". The ligand is used to study complexation with bivalent metal ions Mg^{++}, Cd^{++}, Zn^{++}, Mn^{++}, Ni^{++}, Co^{++} and Cu^{++}. In acidic medium it is colourless but acquires yellow colour which deepens with addition of more alkali. The titration curves are shown in figs. 5.2.1.a, 5.2.1'.a, 5.2.1".a, 5.2.1.b, 5.2.1.b and 5.2.1".b. Cu^{++} forms deep green colour in acidic medium before titration. Mg^{++} and Cd^{++} give white precipitate. In case of Mn^{++}, Ni^{++} and Co^{++} the initial colourless solution becomes pink, light green and deep orange respectively. The data for proton ligand stability, constants are given in Tables 5.B.2, 5.B.2' and 5.B.2", at 25^{o}, 35^{o} and $45^{o}C$ respectively. The plots of half integral and graphical methods are drawn in Figs 5.2.2 and 5.2.3 to determine proton-ligand stability constants. Tables 5.C.2.1 to 5.C.2.4 and 5.C.2'.1 to 5.C.2'.4 and 5.C.2".1 to 5.C.2".4 cover the four metal ions. The metal-ligand stability constants are calculated by using half integral and graphical methods from Figs. 5.2.4 and 5.2.5. The values of overall changes in free energy (ΔG^{o}), enthalpy (ΔH^{o}) and entropy (ΔS^{o}) accompanying complexation have been determined by using the temperature coefficient and Gibbs-Helmholtz equation. ΔH is also determined with the help of an isobar equation.

The values of ΔH are determined by using fig. 5.2.6. The stability constants and thermodynamic parameter are tabulated in Table 5.D.2.

The complex formation has been investigated in the present work in ethanol-water mixture at 25^{o}, 35^{o} and $45^{o}C$ temperature for first time to calculate thermodynamic parameter.

5-Nitro Salicylaldehyde thiosemicarbazone (5-NSATSC)

Tables 5.A.3, 5.A.3' and 5.A.3" contains the experimental observations of titrations of 5 NSATSC. The reagent has been used to study the complexations with bivalent Mg^{++}, Cd^{++}, Zn^{++}, Mn^{++}, Ni^{++}, Co^{++} and Cu^{++}. The reagent is colourless in acidic medium. It acquires yellow colour that deepens with addition of more alkali. Figs. 5.3.1.a, 5.3.1'.a, 5.3.1".a, 5.3.1.b, 5.3.1'.b and 5.3.1".b are the plots of titration curves. The titration curve shows that complexations take place with all above metal ions. Cu^{++} forms bluish green precipitate before addition of NaOH. Co^{++} gives red brown precipitate. Nickel gives green colour heavy precipitate, Mg^{++}, Cd^{++}, Zn^{++}, Mn^{++} gives precipitate as the titration advances. Table 5.B.3, 5.B.3' and 5.B.3" contain data for proton-ligand stability constants at 25^{o}, 35^{o} and 45^{o}C temperature respectively. The plots of half integral and graphical methods are drawn in Figs. 5.3.2 and 5.3.3 to determine proton-ligand stability constants. Tables 5.C.3.1 to 5.C.3.5, 5.C.3'.1 to 5.C.3'.5 and 5.C.3".1 to 5.C.3".5 cover the five metal ions. The metal-ligand stability constants are determined by using half integral and graphical methods from figs. 5.3.4 and 5.3.5. The temperature coefficient and Gibbs-Helmholtz equations are used to determine the value of overall changes in free energy (ΔG^{o}), enthalpy (ΔH^{o}) and entropy (ΔS^{o}) accompanying the complexation. ΔH is also determined with the help of an isobar equation.

The values of ΔH are determined by using Fig.5.3.6. The stability constants and thermodynamic parameters are tabulated in Table 5.D.3.

The complex formation has been investigated in ethanol water mixture for the first time. This ligand is studied at 25^{o}, 35^{o} and $45^{o}C$ temperature in detail to calculate thermodynamic parameters by us.

3-Resorcylaldehyde thiosemicarbazone (3-RATSC)

The experimental observations of 3-RATSC are given in Table 5.A.4, 5.A.4' and 5.A.4". The ligand is used to study complexations with bivalent metal ions Mg^{++}, Cd^{++}, Zn^{++}, Mn^{++}, Ni^{++}, Co^{++} and Cu^{++}. In acidic medium it is colourless but acquires yellow colour which deepens with addition of more sodium hydroxide. The titration curves are shown in figs. 5.4.1.a, 5.4.1'.a, 5.4.1".a, 5.4.1.b, 5.4.1'.b and 5.4.1".b. Mg^{++} and Cd^{++} get precipitate as the titration advances. Zn^{++} ion gives slight turbidity. In case of Mn^{++}, Ni^{++} and Co^{++} initial colourless solution becomes yellowish red and then nontransparent red coloured solution is formed. Cu^{++} gives green colcur before titration and get precipitate as titration advances. The data for proton-ligand stability constants are given in Tables 5.B.4, 5.B.4' and 5.B.4" at 25^{o}, 35^{o} and $45^{o}C$ temperatures respectively. The plots of half integral and graphical methods are drawn in Figs.5.4.2 and 5.4.3 to determine proton-ligand stability constants. Tables 5.C.4.1 to 5.C.4.5, 5.C.4'.1 to 5.C.4'.5 and 5.c.4".1 to 5.C.4".5 cover the five metal ions. The metal-ligand stability constants are calculated by using half integral and graphical methods from figures 5.4.4 and 5.4.5. The values of overall changes in free energy (ΔG^{o}), enthalpy (ΔH^{o}) and entropy (ΔS^{o}) accompanying complexation have been determined by using the temperature coefficient and Gibbs-Helmholtz equation. Δ H is also determined with the help of an isobar equation.

The values of Δ H are determined by using fig.5.4.6. The stability constants and thermodynamic parameter are tabulated in Table 5.D.4.

The complex formation has been investigated in the present work in ethanol-water mixture at 25^{o}, 35^{o} and 45^{o}C temperature for first time to calculate thermodynamic parameters.

Complex Formation with Thiosemicarbazone Ligands

Thiosemicarbazones of aldehydes and ketones are interesting because pure samples of these derivatives are easily isolable and because of suitable bonding and doner sites as well as ease of getting enveloped around the central metal easily. The applications in analytical and structural chemistry necessitated a clear understanding of kinatic and thermodynamic complex formation reaction in solution.

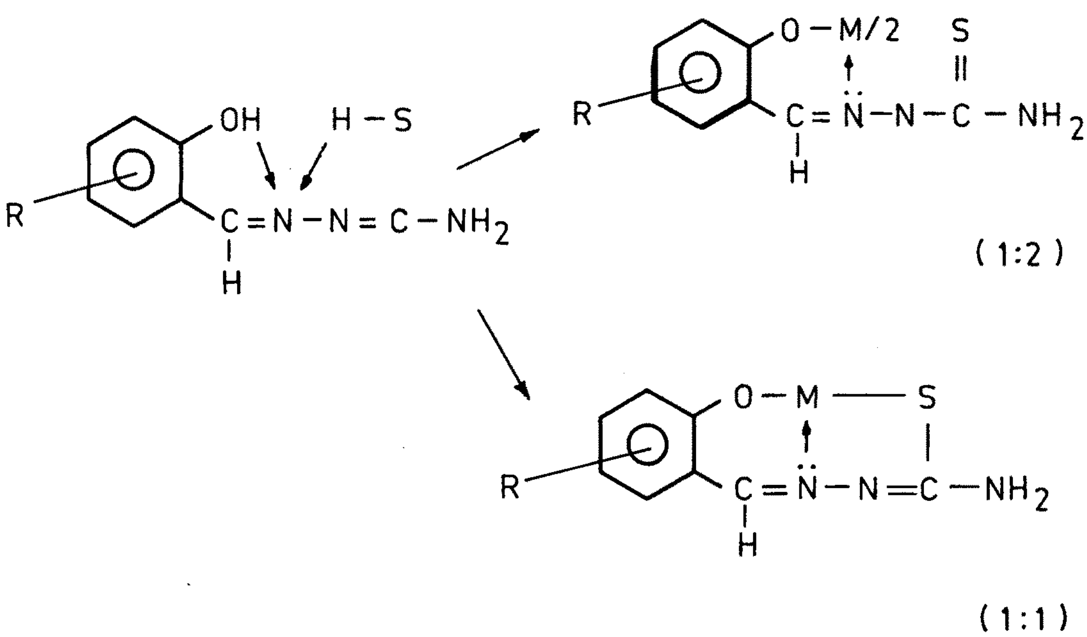
There has been a great deal of work on the pharmacology of thiosemicarbazones. Thiosemicarbazones have been found to be active against influenza[9], protozoa[10], small pox[11], and certain kinds of tumor[12]. They are suggested as possible pesticides[1] and fungicides[14]. It is suggested that their activity is related to their ability to chelate trace metals, therefore, it is required to study the properties of thiosemicarbazone in solution.

In view of the potential interest in ligands with SN donor atom sets it is surprising that relatively few transition metal complexes of thiosemicarbazide and thiosemicarbazone have been studied in detail. There is very little thermodynamic data available for the transition metal complexes of thiosemicarbazide and virtually none for those of thiosemicarbazone.

Thiosemicarbazones ($NH_2CSNHN = CR_1R_2$) usually reacts as chelating ligands with transition metal ions by bonding through the sulphur and hydrazinic nitrogen atoms. Thus it is a bidentate ligand. But there are a few cases where monodentate behaviour is well established and where coordination is through sulphur only.

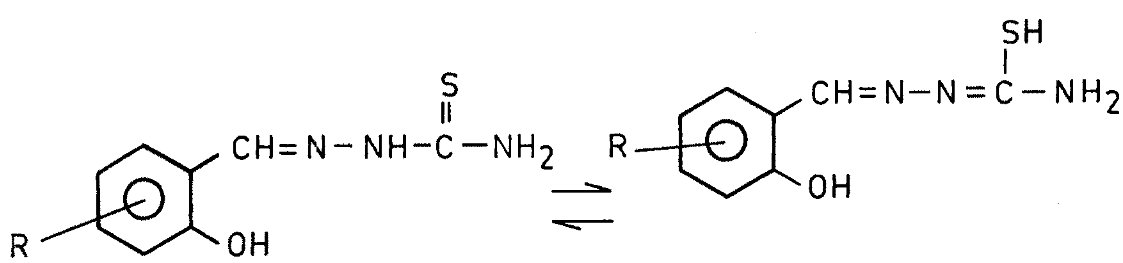
The salicylaldehyde thiosemicarbazone and substituted salicylaldehyde thiosemicarbazones acts as tricoordinated species. It possesses thiol SH proton in addition to phenolic OH, and a donor hydrazinic nitrogen atom. In solution, 1:1

and 1:2 complexes are formed.



R = 4-CH_3, 5-NO_2

Salicylaldehyde thiosemicarbazone and its substituted salicylaldehyde thiosemicarbazones have general structure.



(Thion form)   (Thiol form)

R = 4-CH_3 and 5-NO_2

In the present study 1:1 complexes have been identified in the solution form. 1:2 complexes are precipitated at high pH range, so they are not studied.

Order of Log K_1 Values

Recently a few papers on the determination of stability constants by Calvin-Bjerrum technique are presented for thiosemicarbazone. The stability constant order in these papers are as shown below:

Ref. 15. Cu > Co > Ni

Ref. 16. Cu > Co > Ni > Mn > Zn > Cd

In present work the stability orders are as,

Salicylaldehyde thiosemicarbazone

Zn > Cd > Mn > Mg.

4-Methylsalicylaldehyde thiosemicarbazone

Co > Zn > Cd > Mg

5-Nitrosalicylaldehyde thiosemicarbazone

Co > Zn > Cd > Mn > Mg

Resorcylaldehyde thiosemicarbazone

Co > Ni > Zn > Cd > Mg.

The stability order hold good in present work except Mn as compared to previous work.

Effect of Temperature

Log K_1^H values for proton-ligand stability constants and log K_1 i.e. metal-ligand stability constant for vic-Hydroxythiosemicarbazones decreases with increase in temperature. But in case of Resorcylaldehyde thiosemicarbazone this trend is reversed i.e. log K_1^H , log K_2^H and log K_1 values increases with increase in temperature.

Thermodynamic Parameters

Thiosemicarbazide forms more stable complexes with soft or class (b) metal ions possibly due to large negative value of ΔH[17-18]. In present work we found large negative values of ΔH for salicylaldehyde thiosemicarbazone and substituted salicylaldehyde thiosemicarbazone with divalent metal ions. Thus these ligands form most stable complexes and involved formation of stronger metal-ligand bonds.

References

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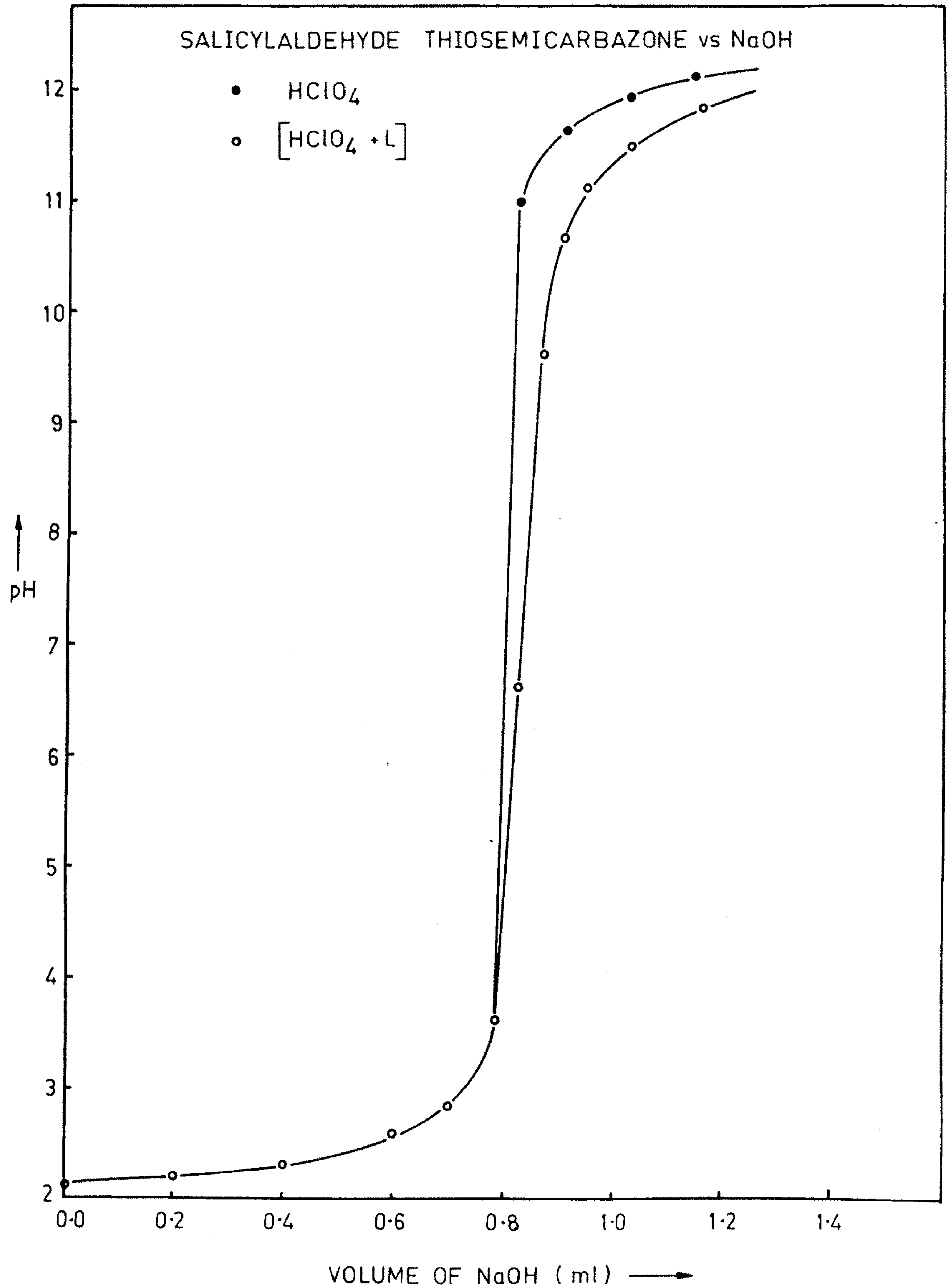


Fig. 5·1·1 a : TITRATION CURVES

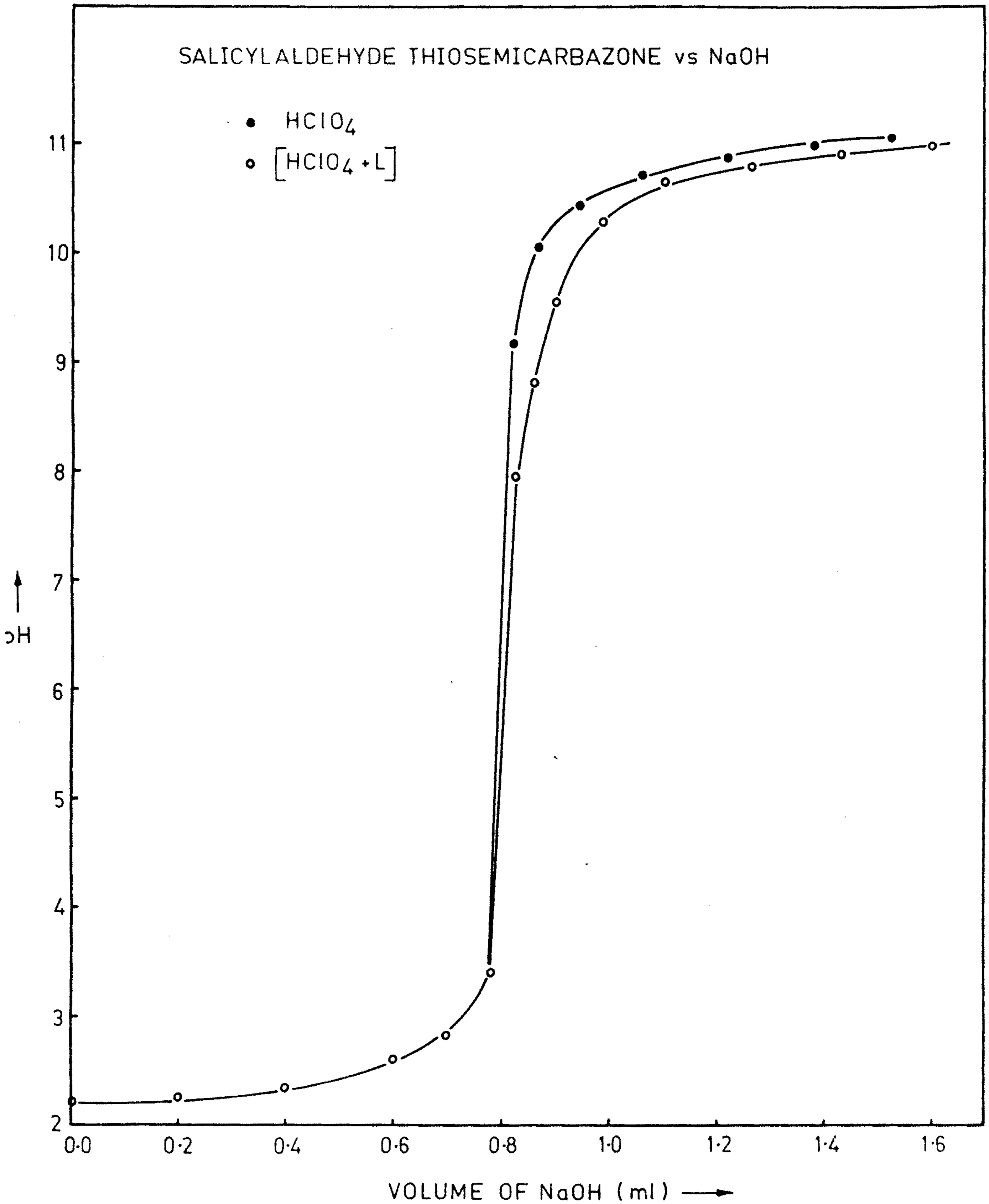
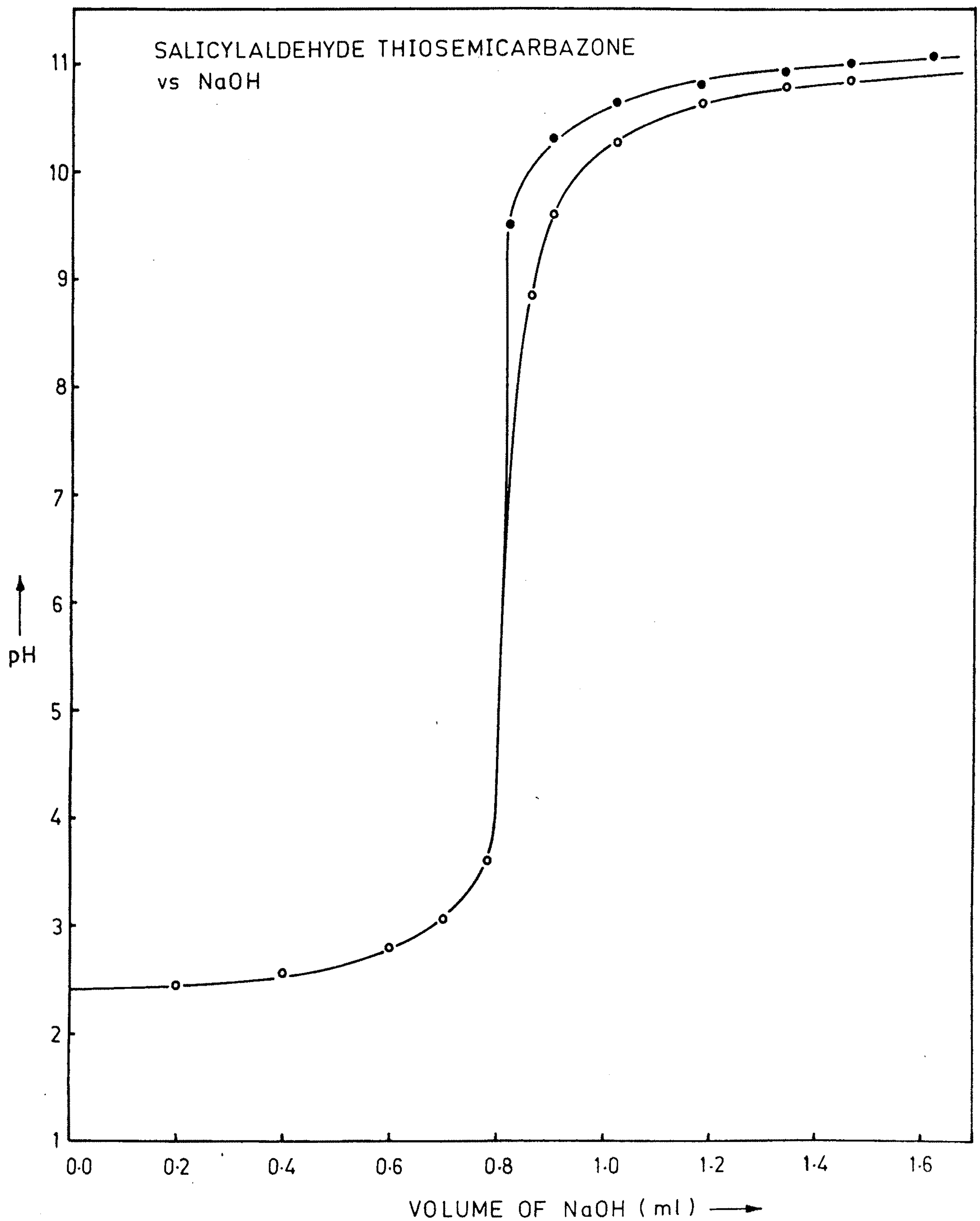


Fig. 5·1·1′a: TITRATION CURVES



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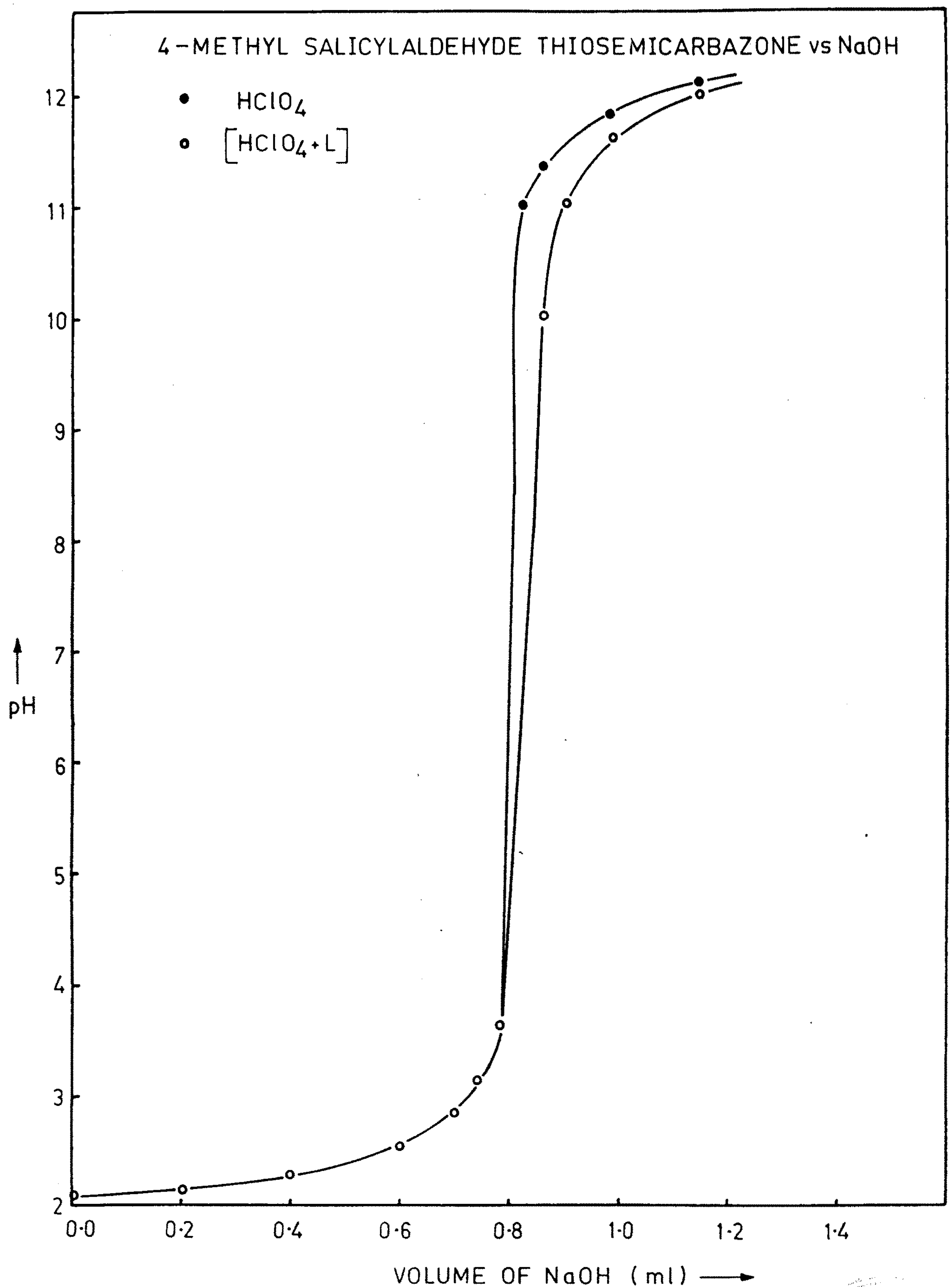

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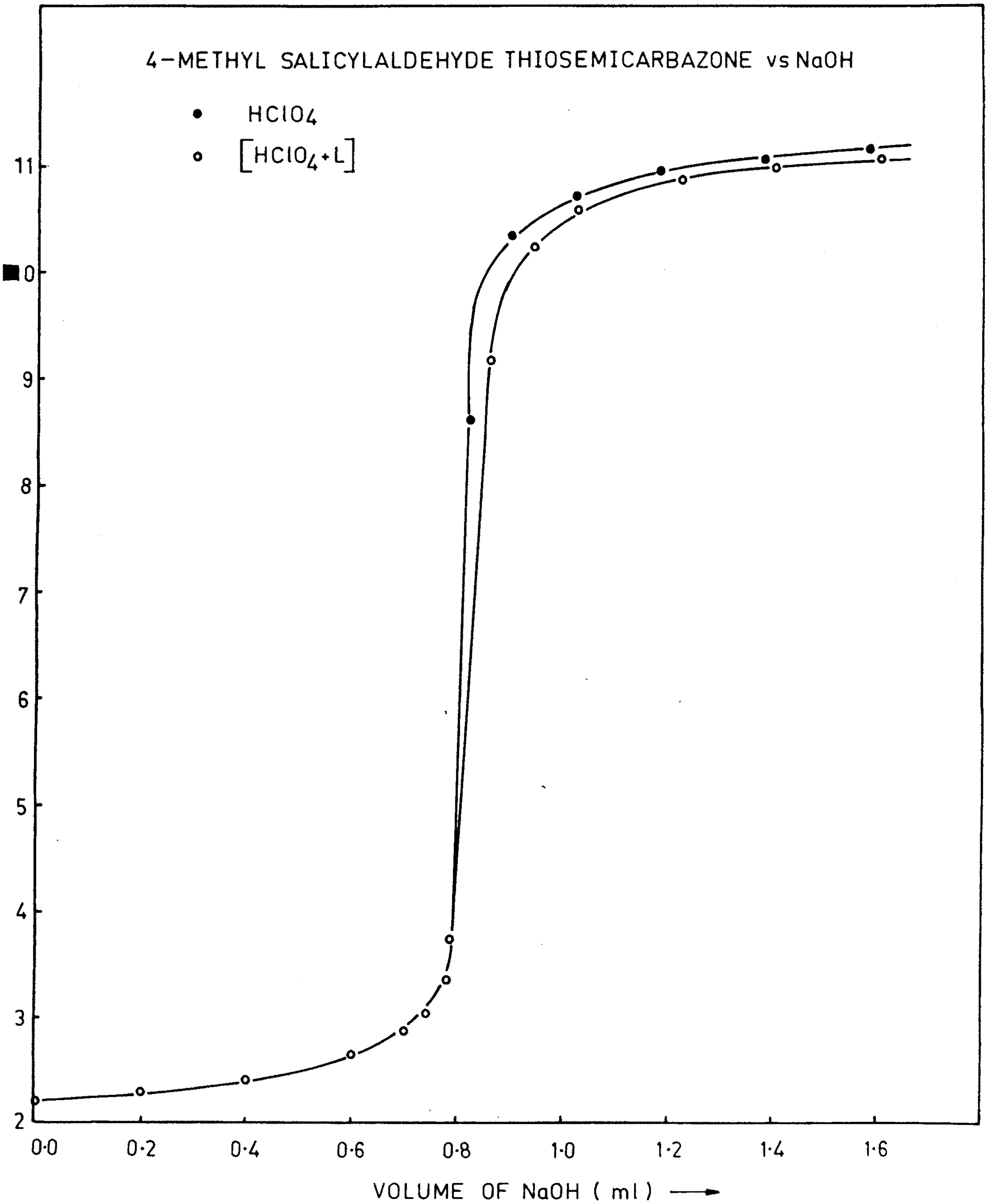

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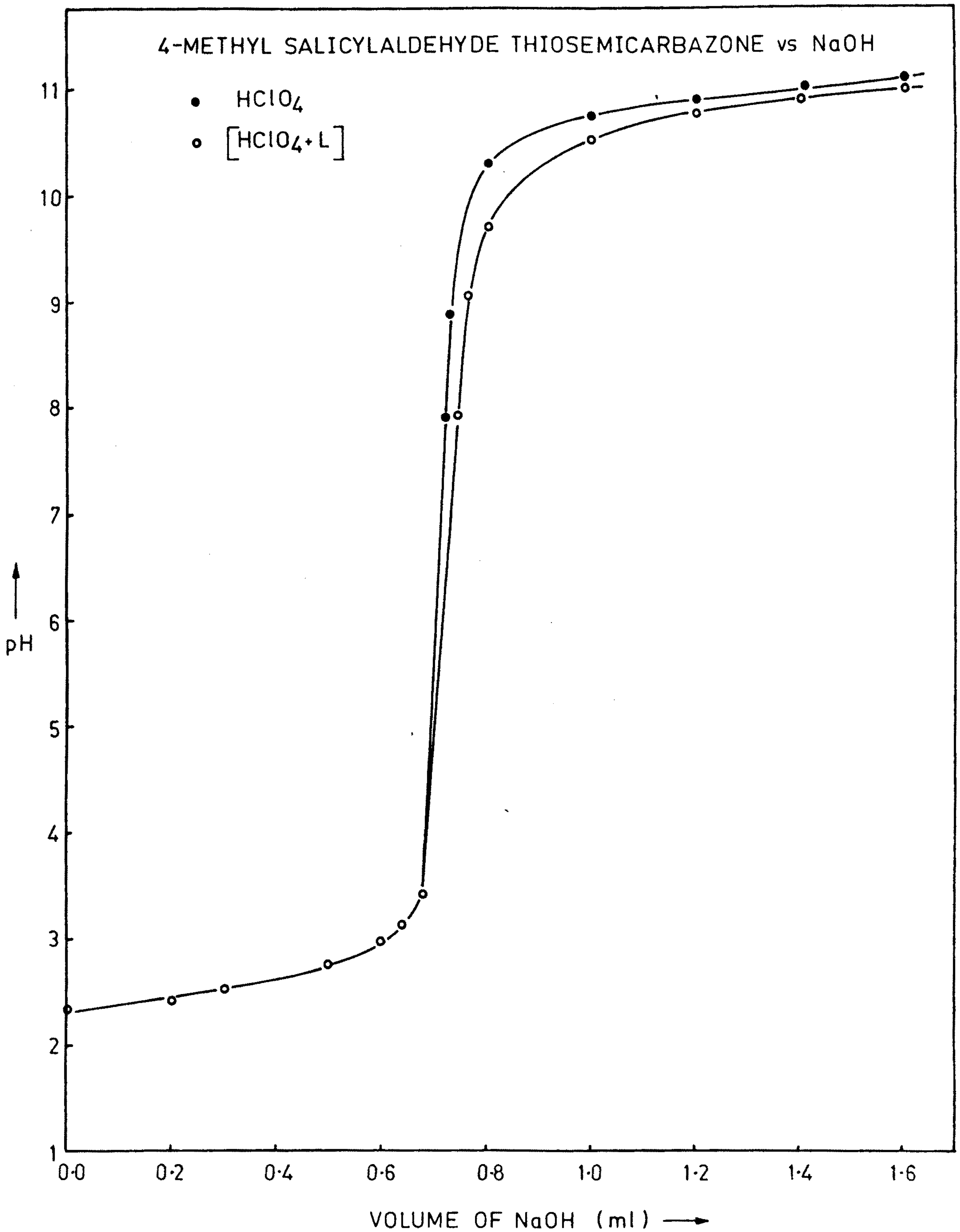

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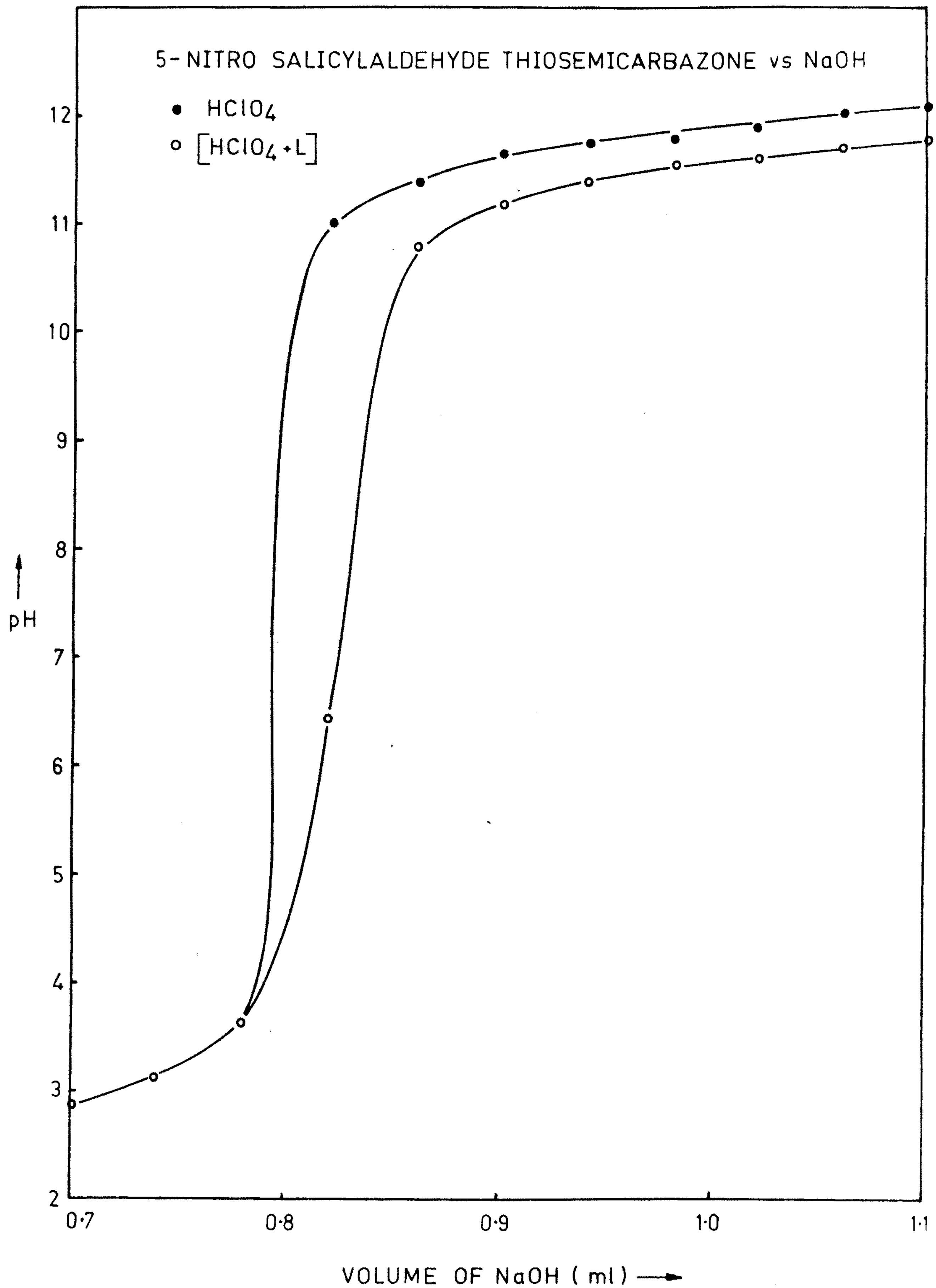

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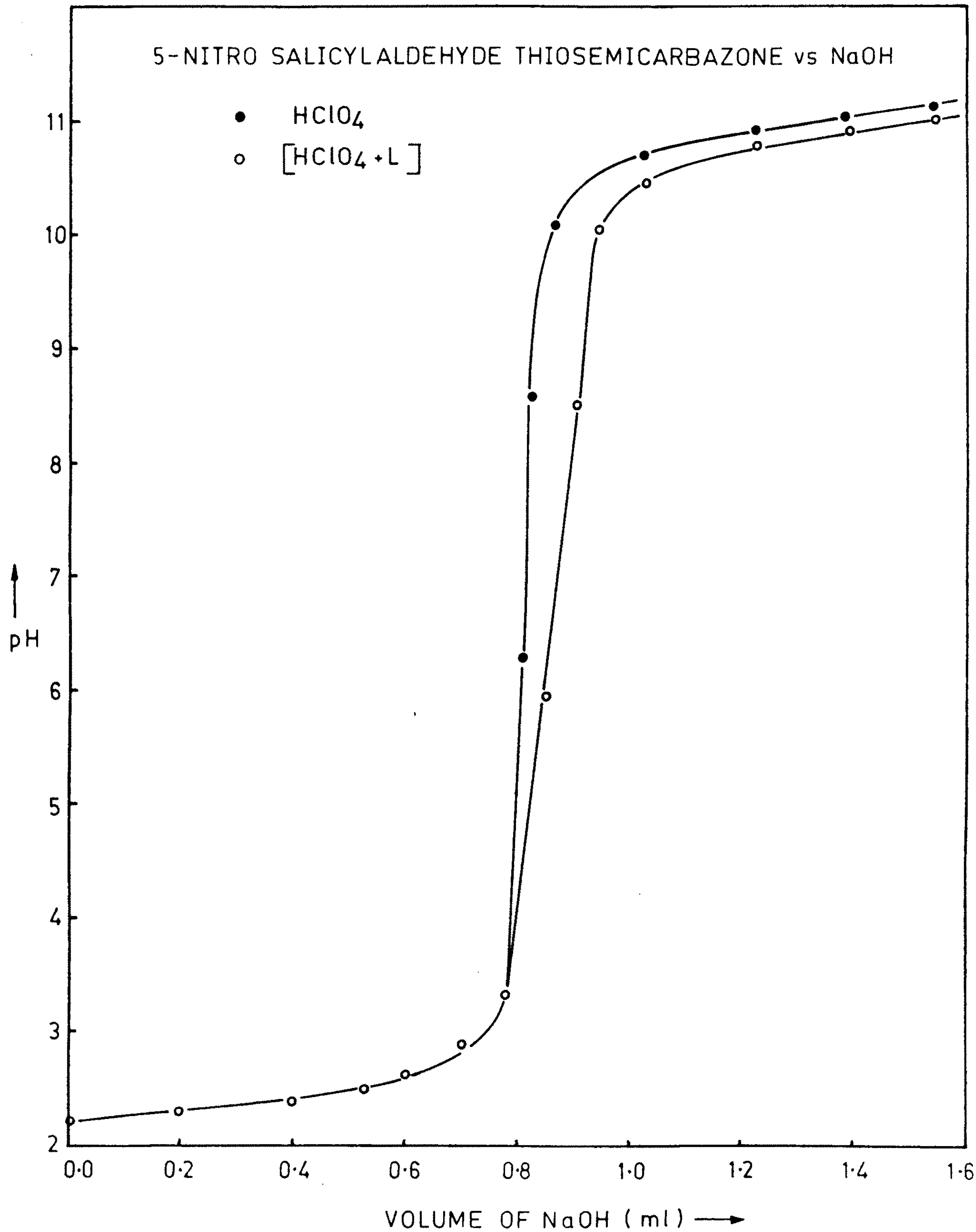
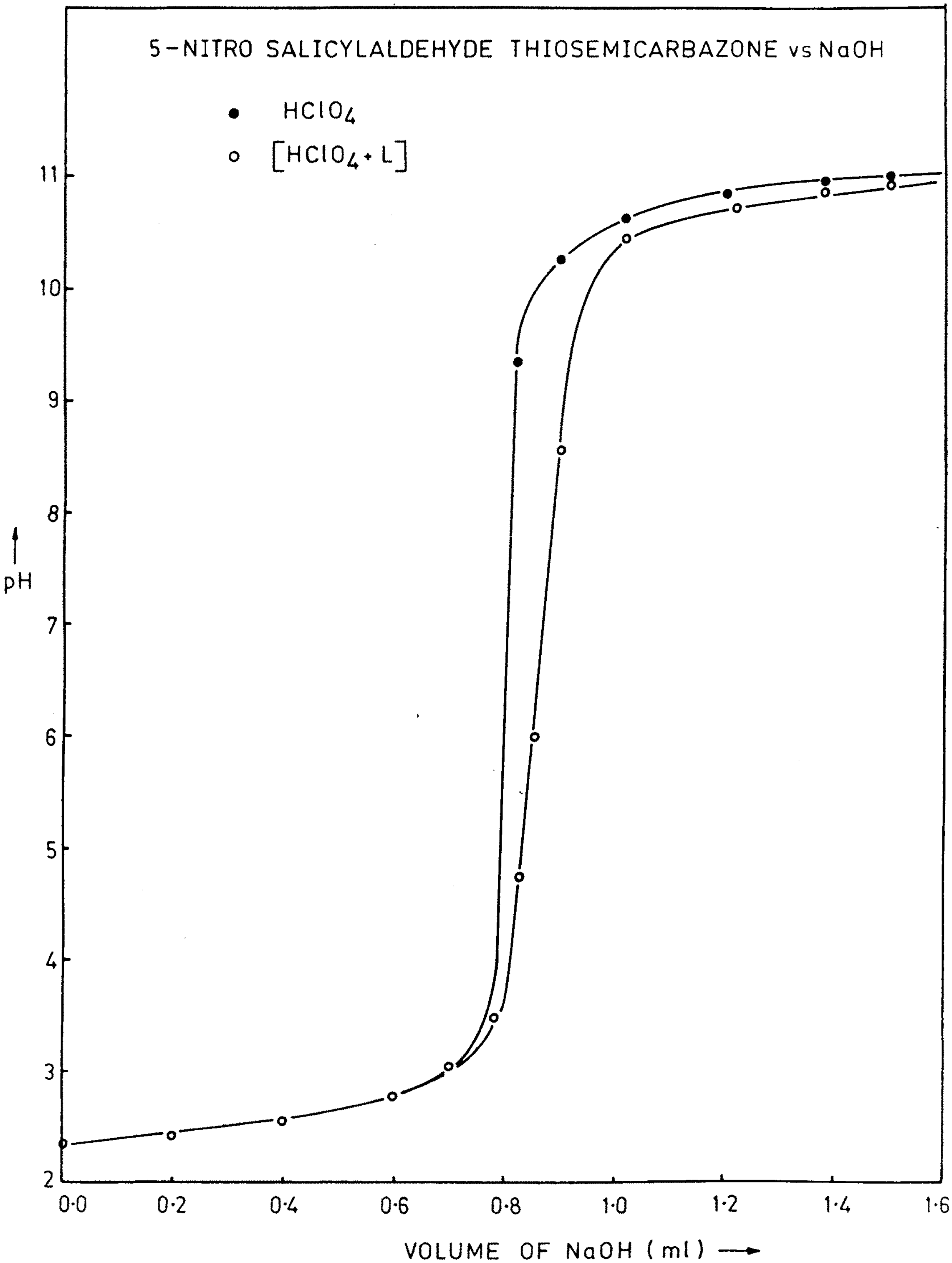


Fig. 5·3·1′a : TITRATION CURVES



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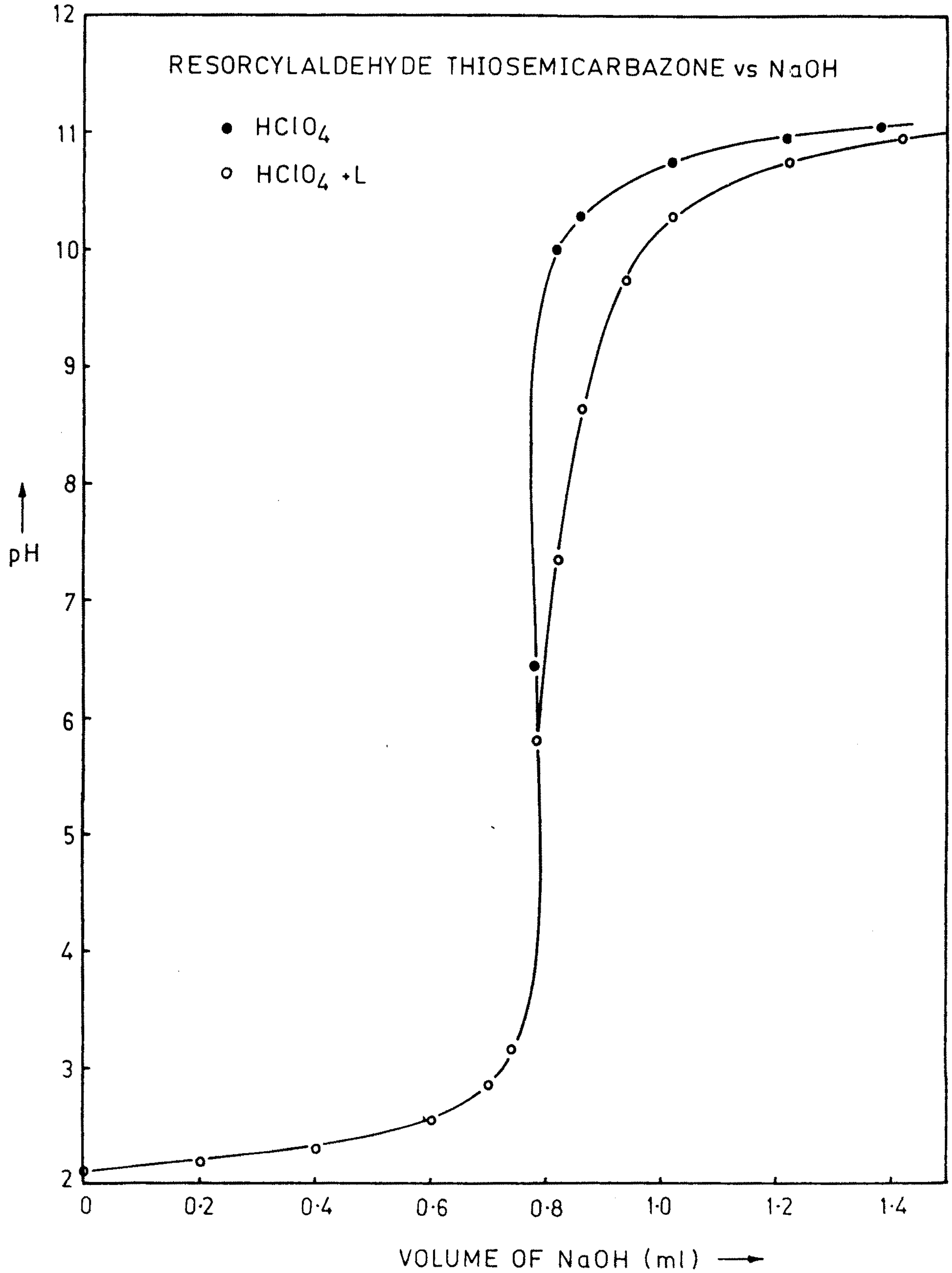

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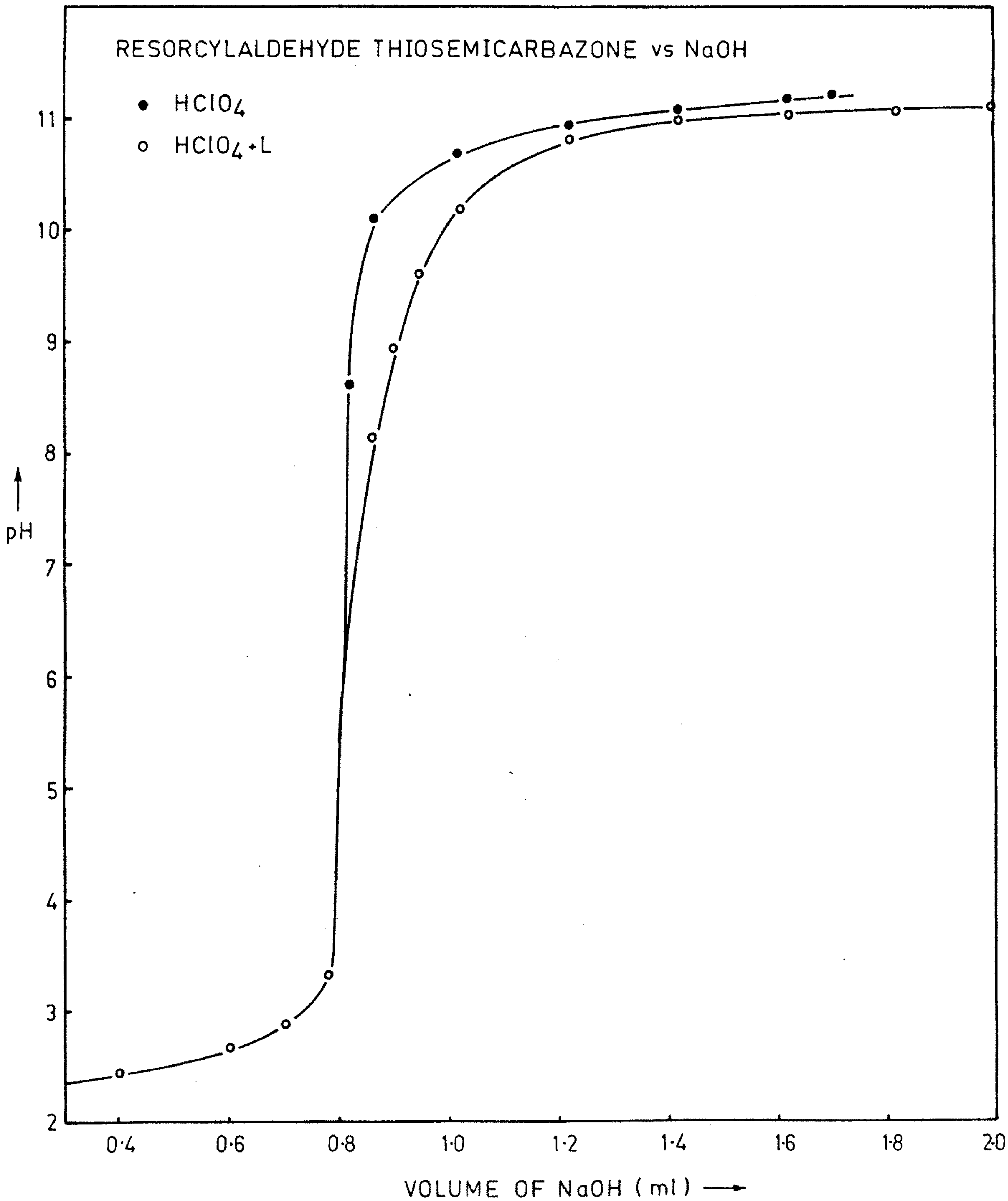

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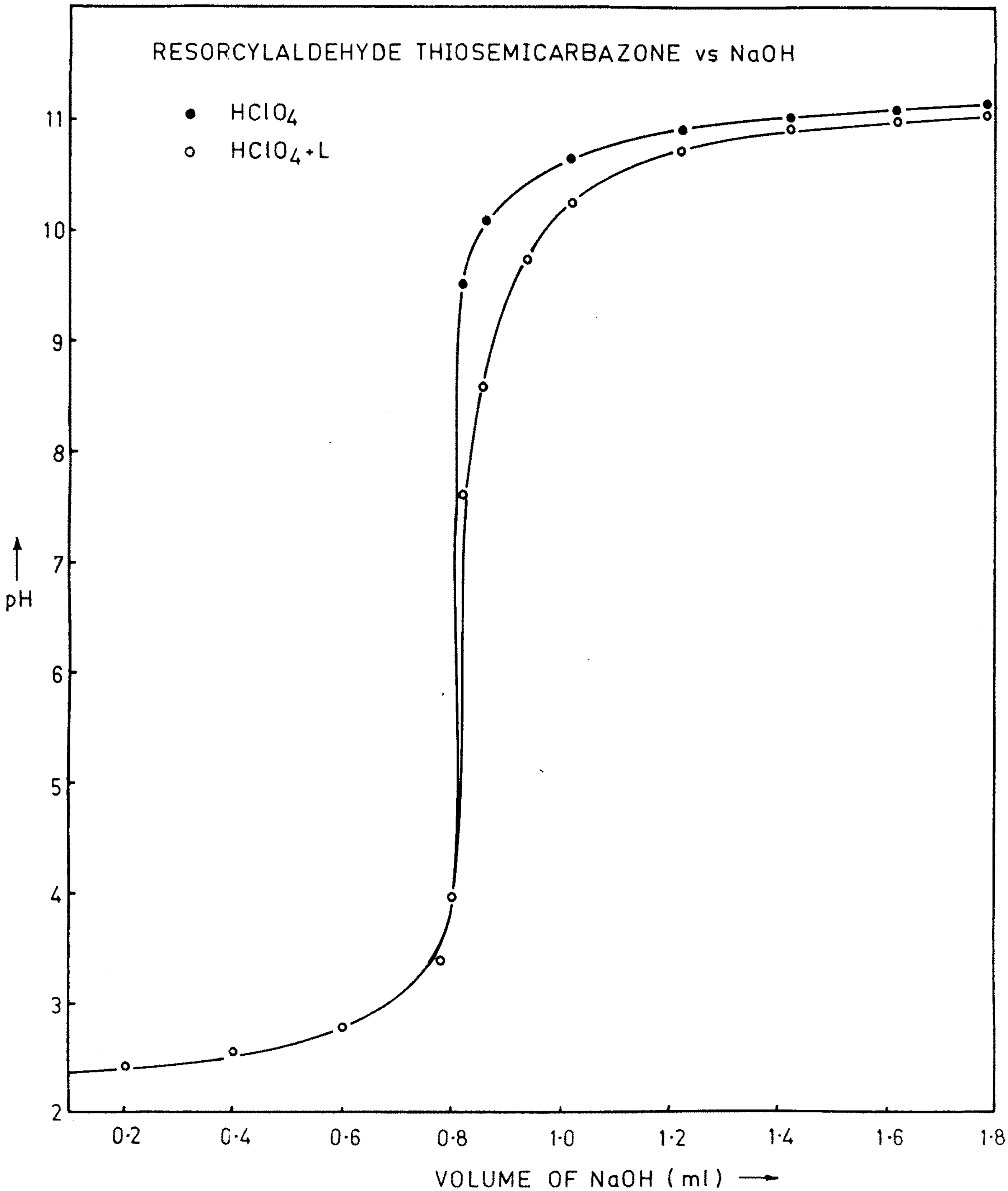

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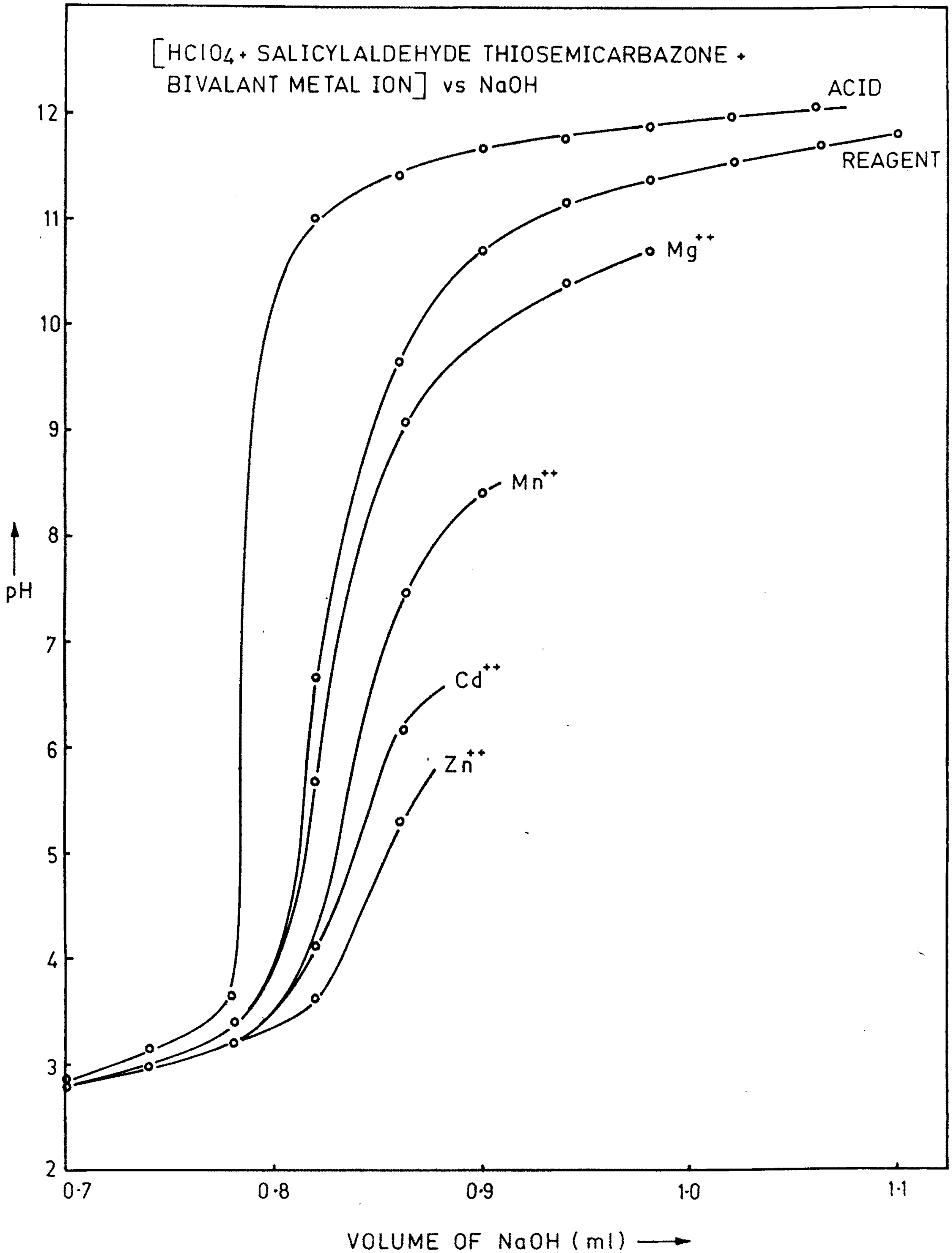

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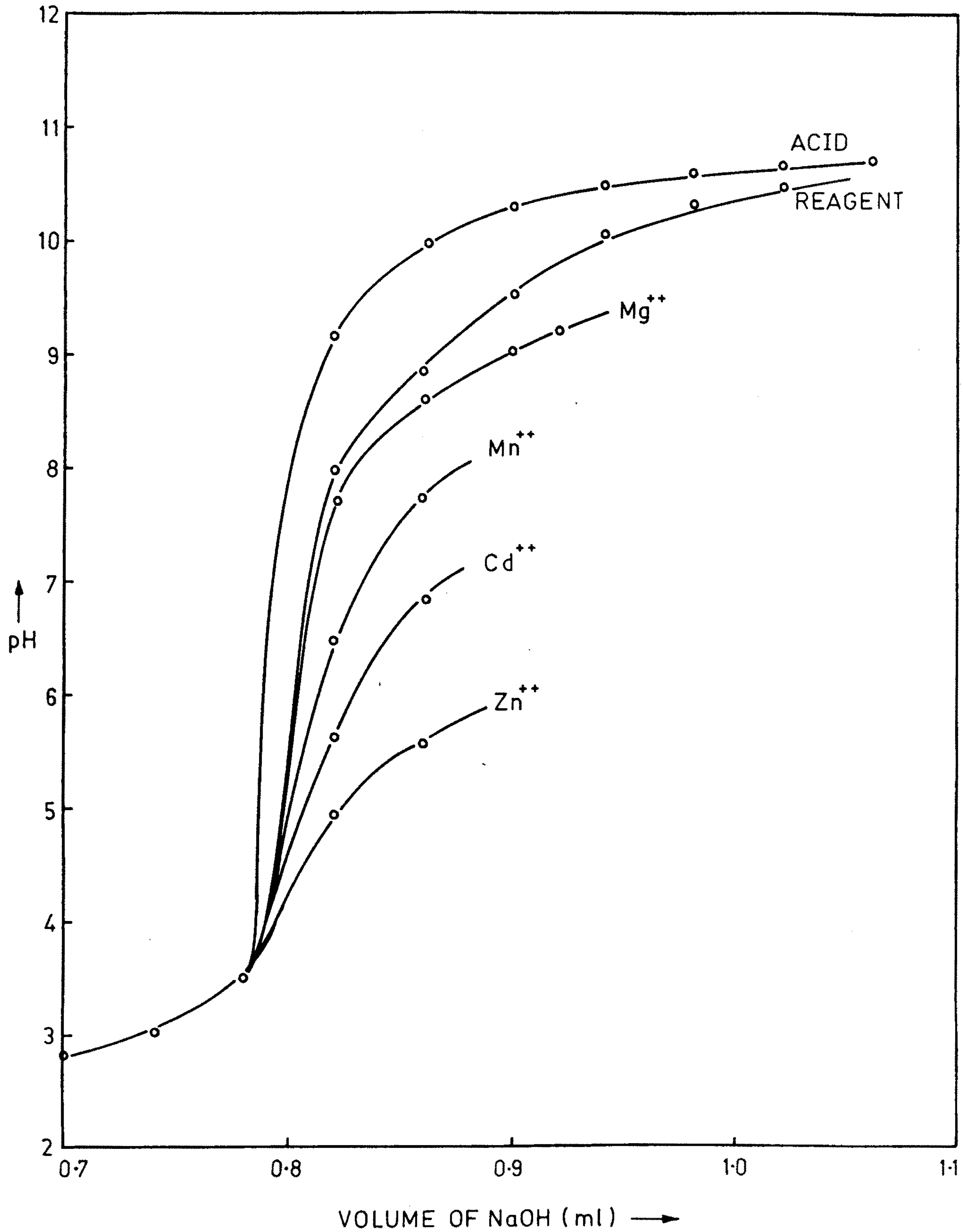
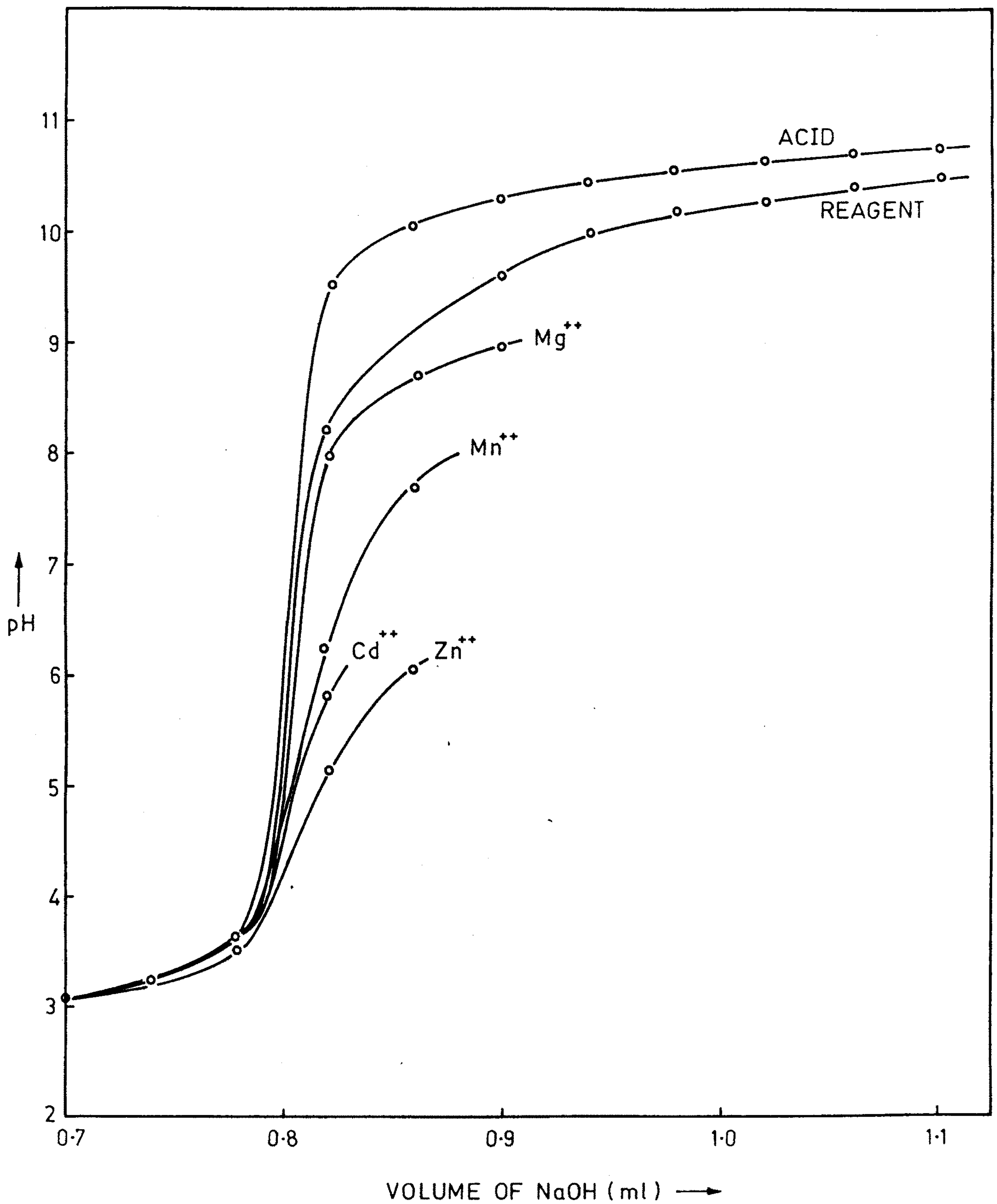


Fig. 5·1·1′ b : TITRATION CURVES [$HClO_4$ + SALICYLALDEHYDE THIOSEMICARBAZONE + BIVALANT METAL ION] vs NaOH .



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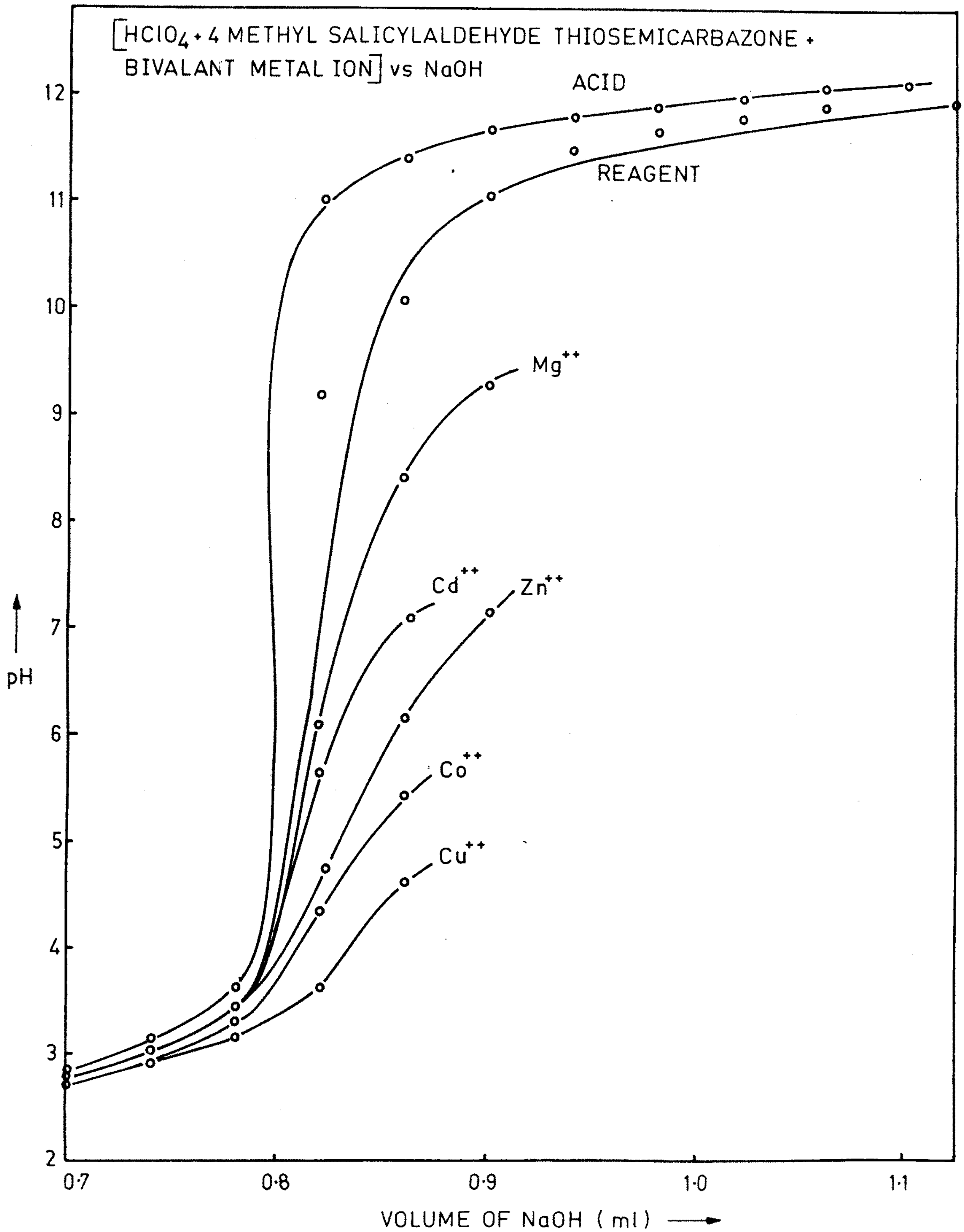

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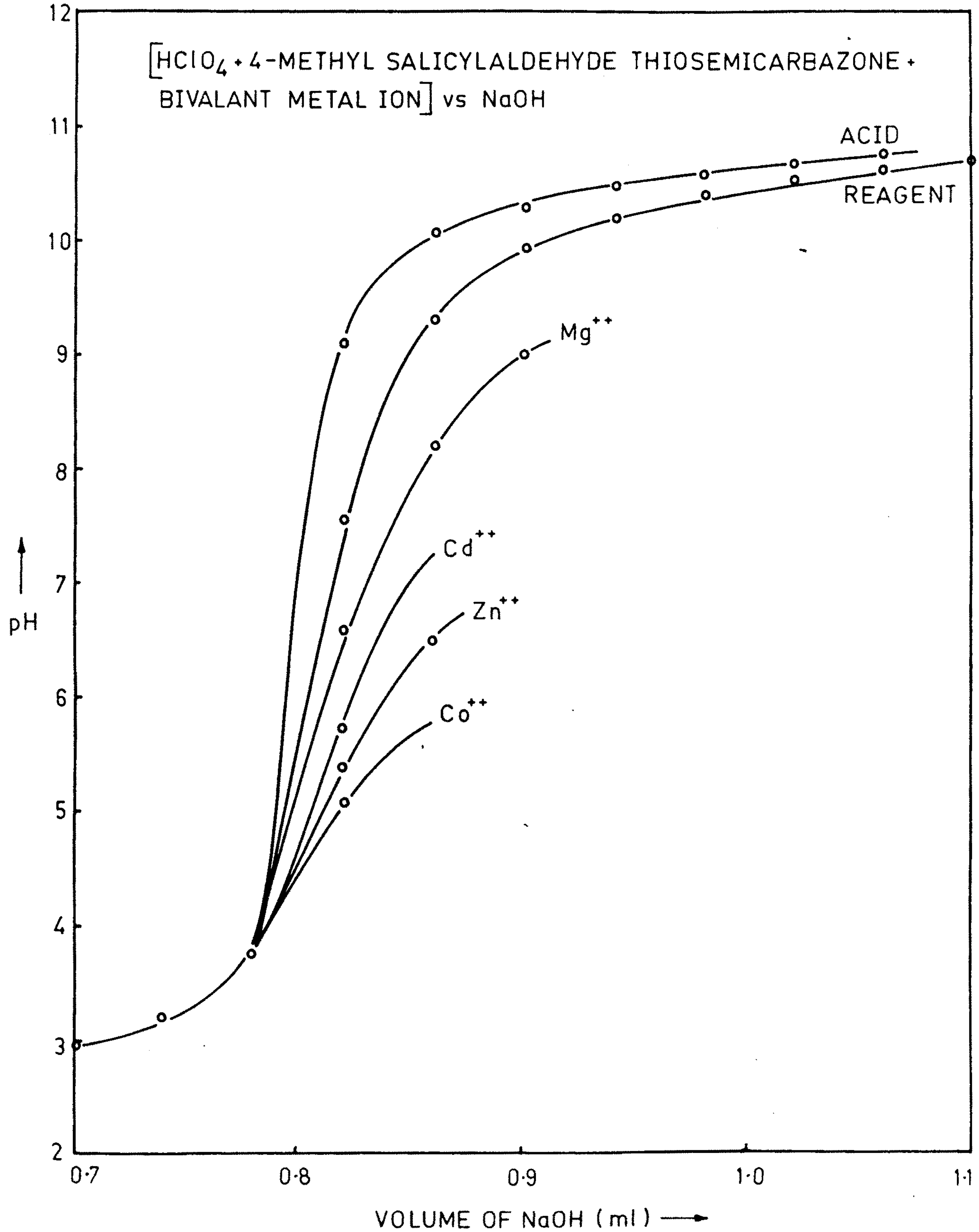

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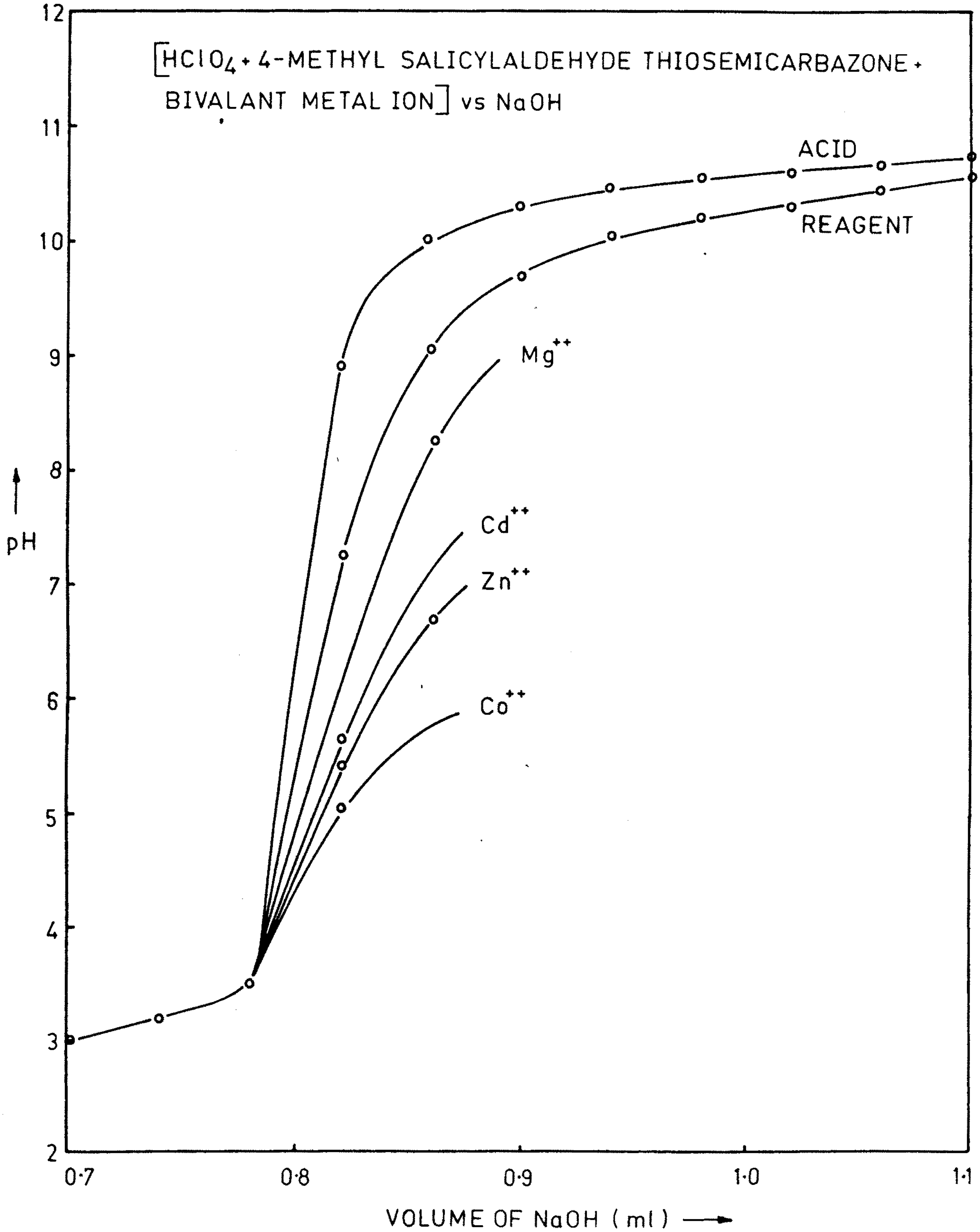

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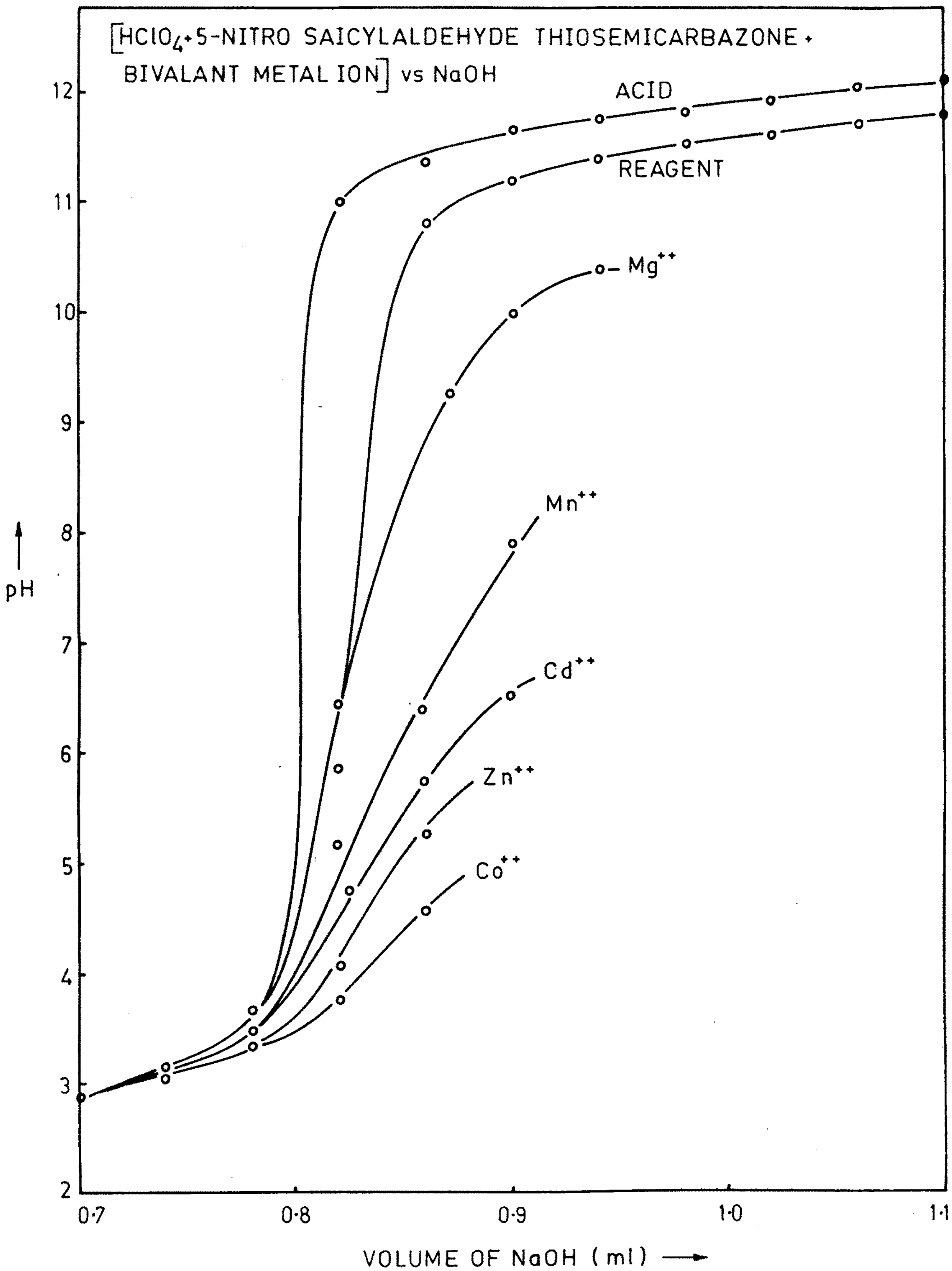

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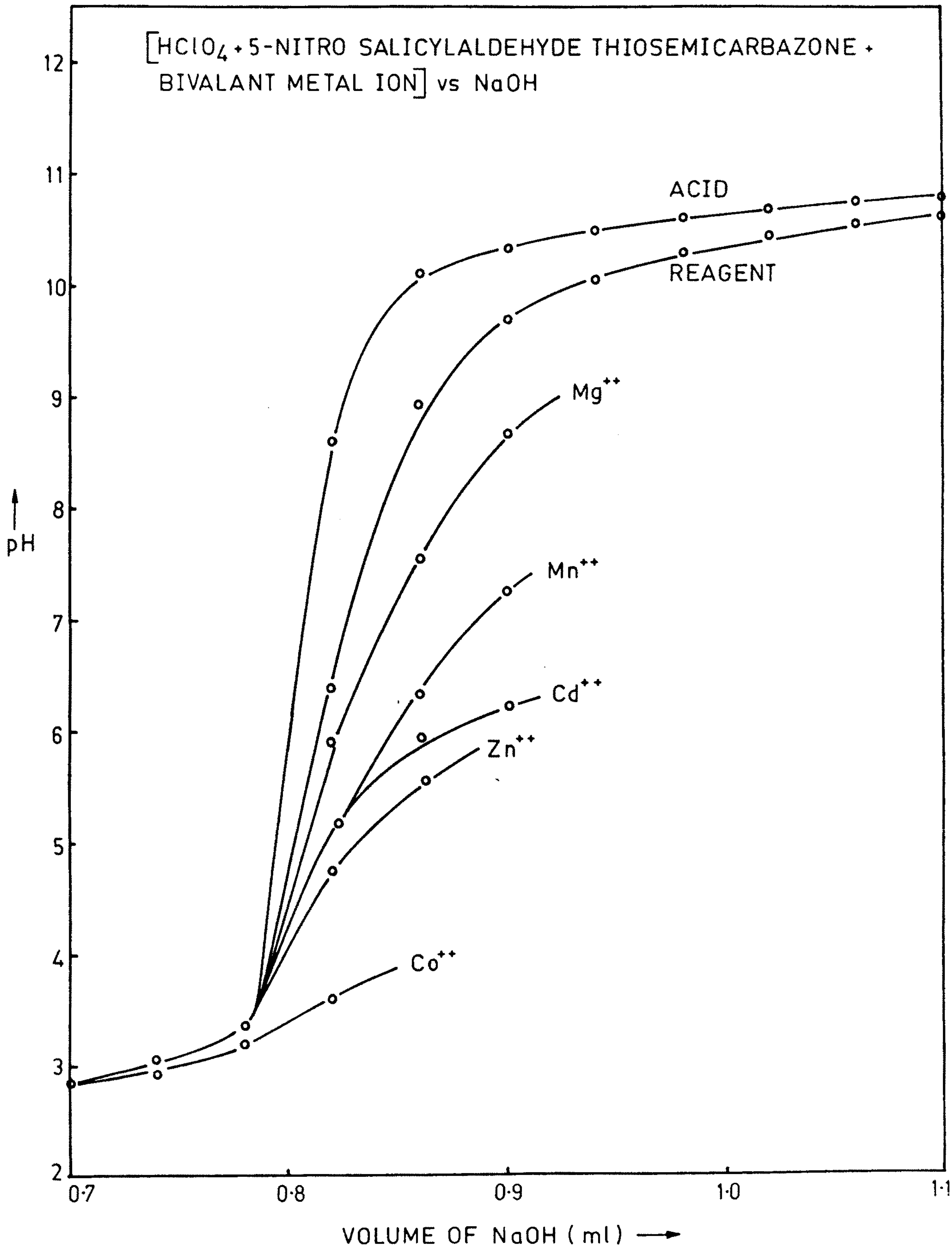

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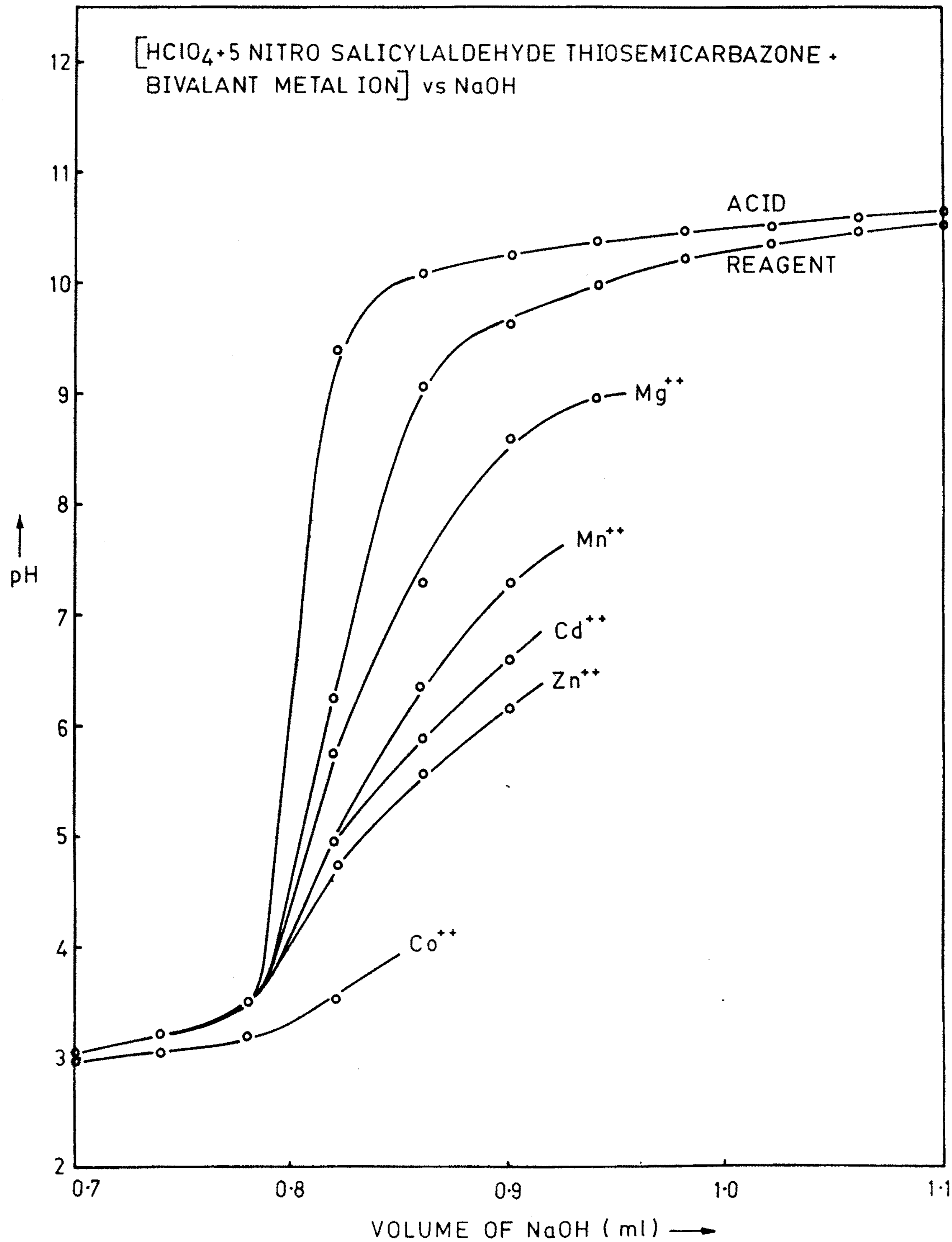

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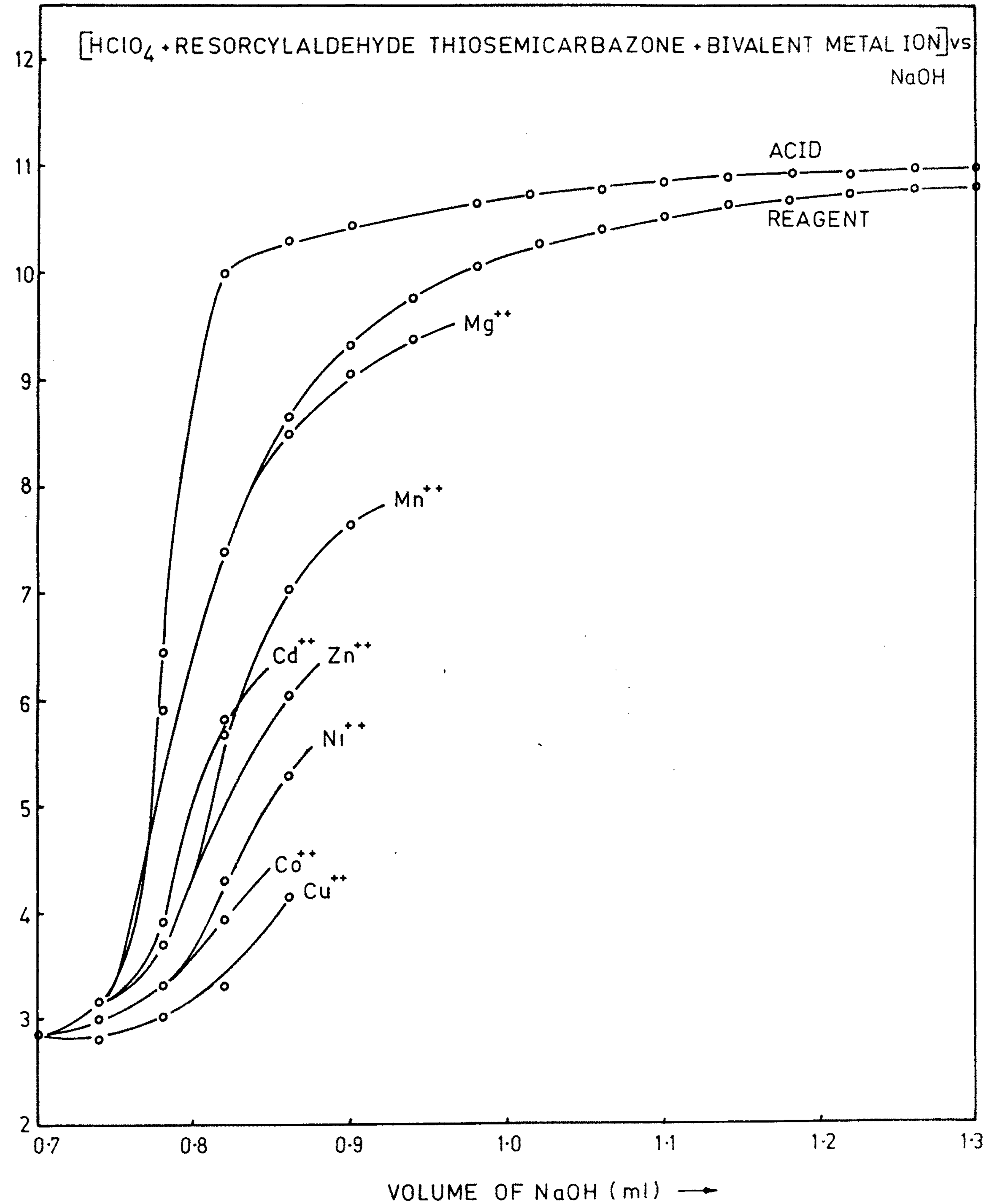

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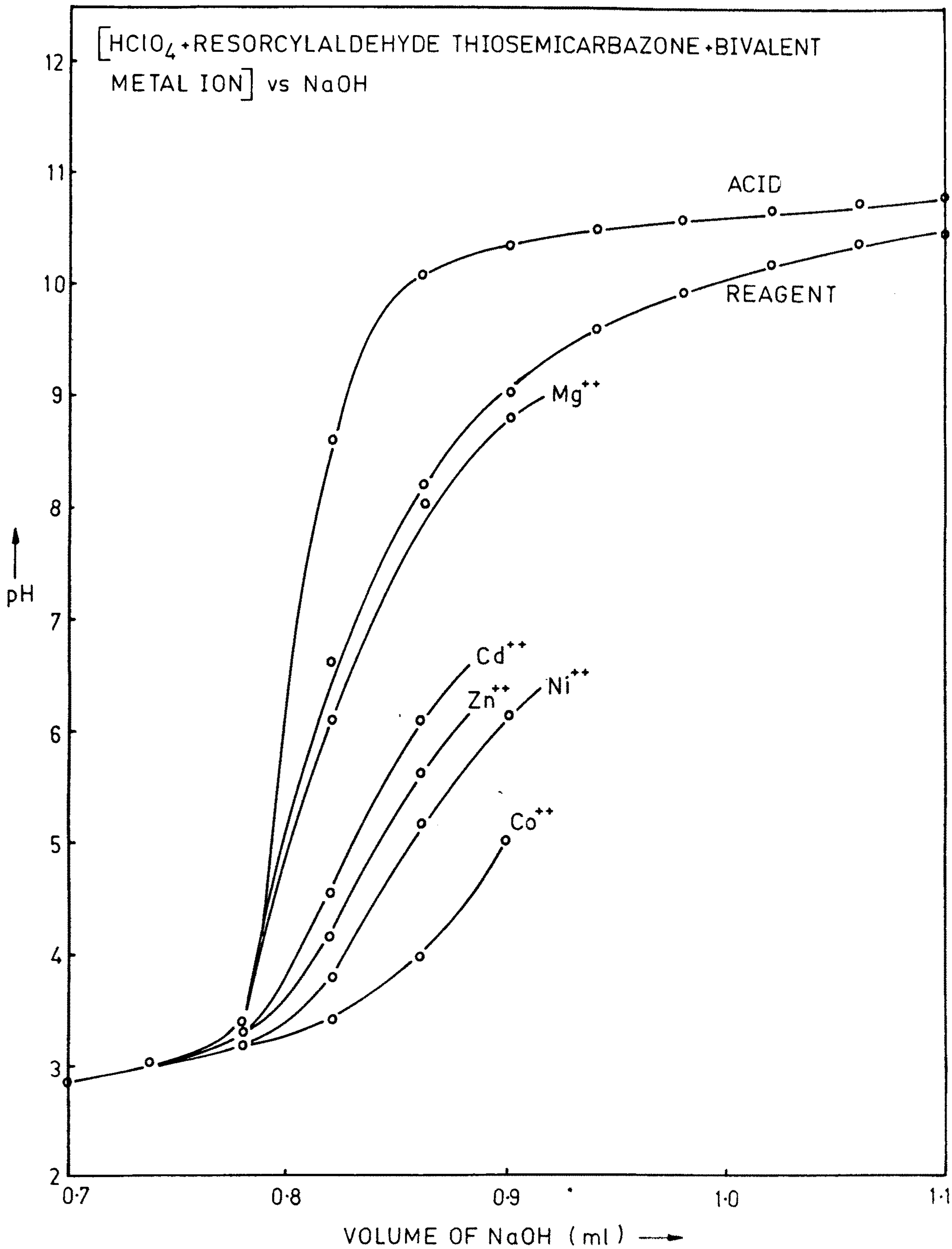

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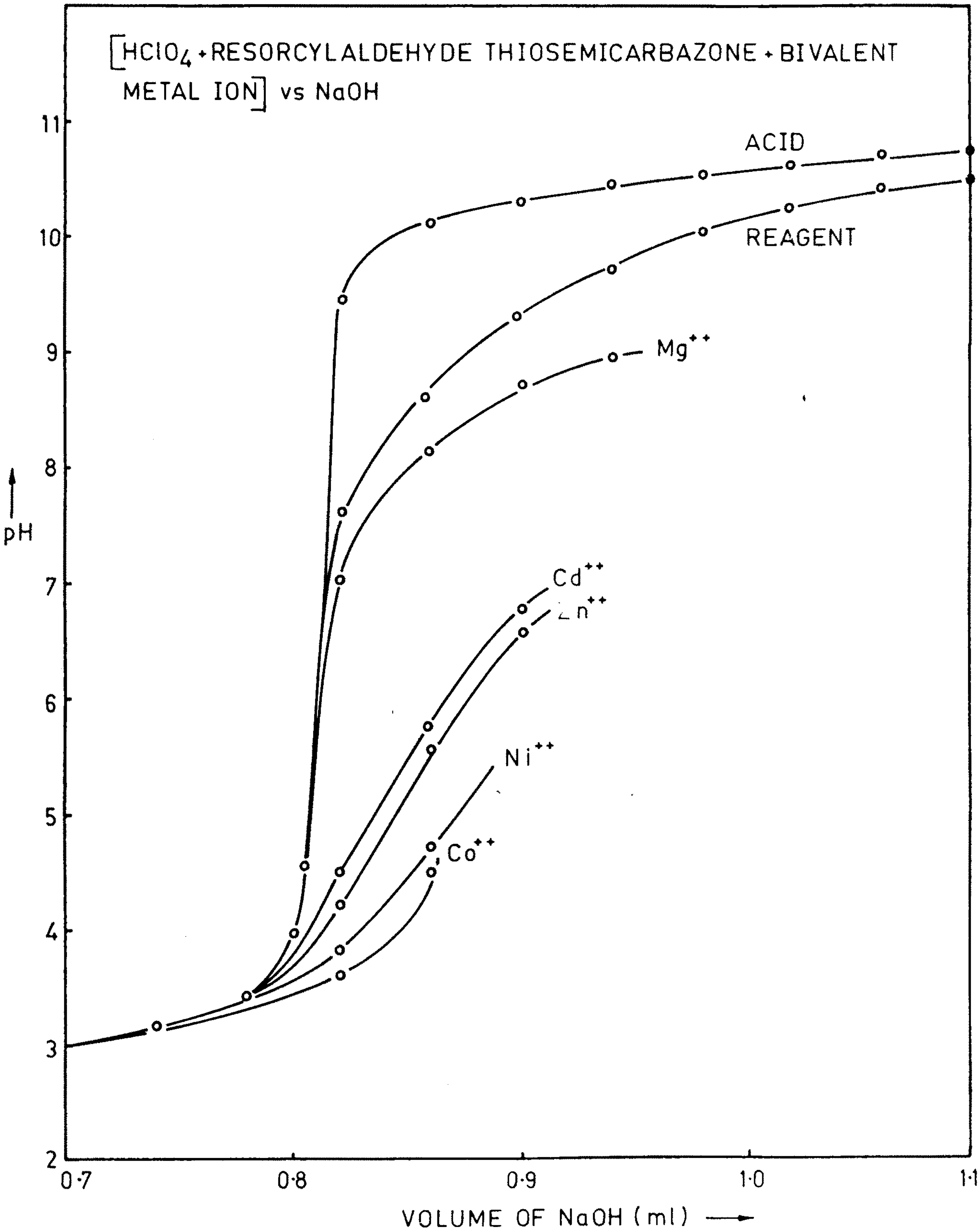

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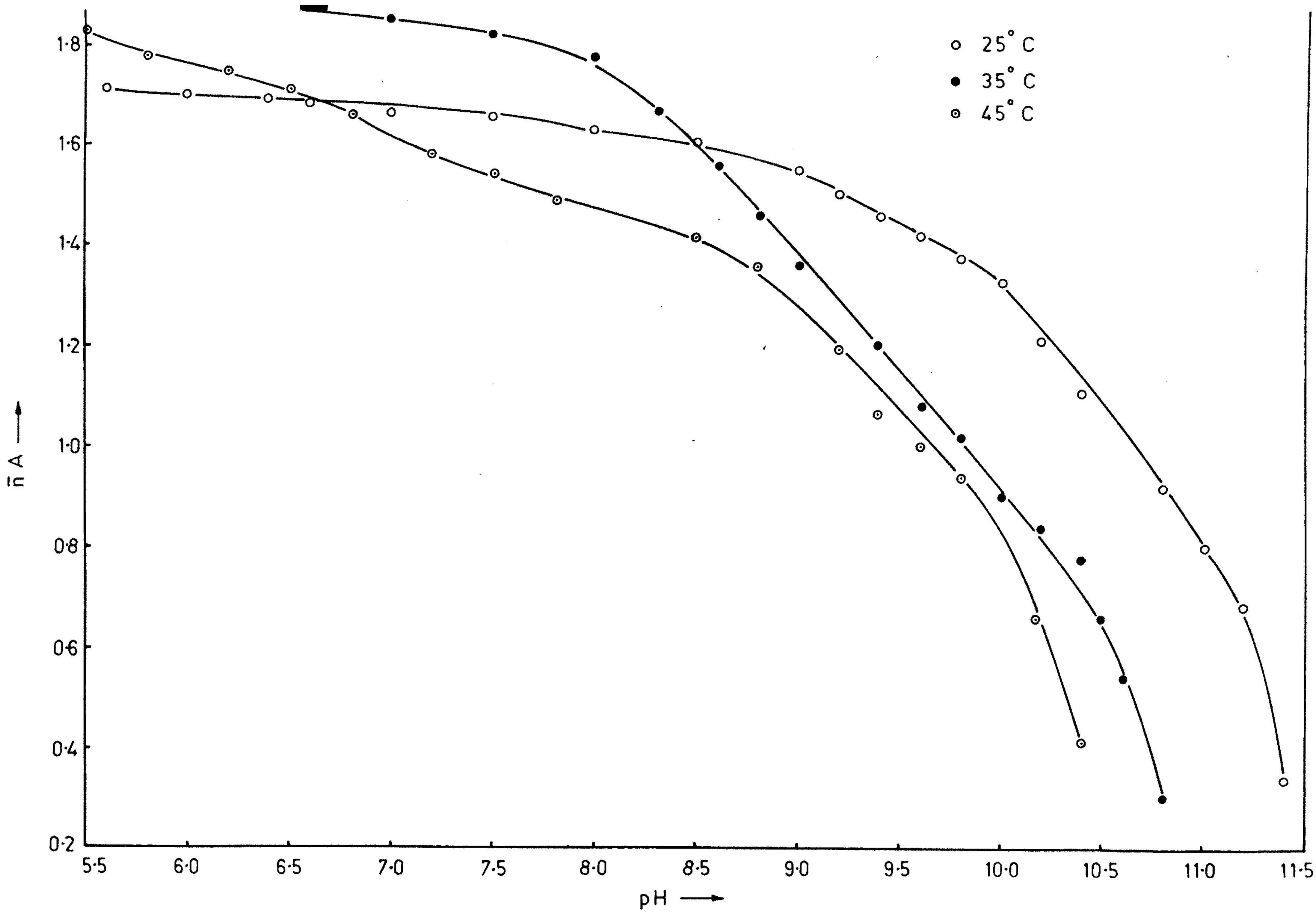
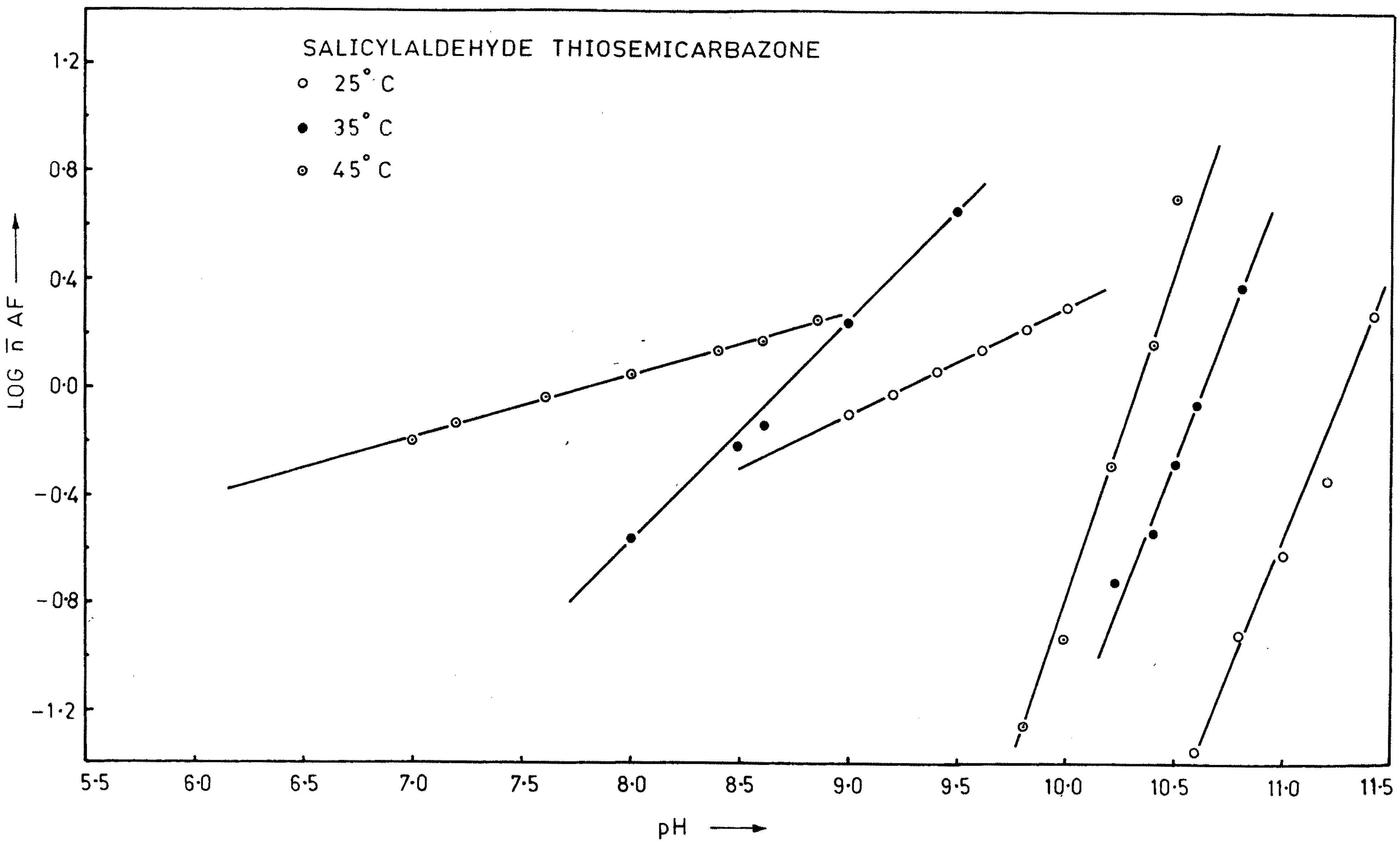


Fig. 5·1·2 : FORMATION CURVES FOR PROTON-LIGAND SYSTEMS



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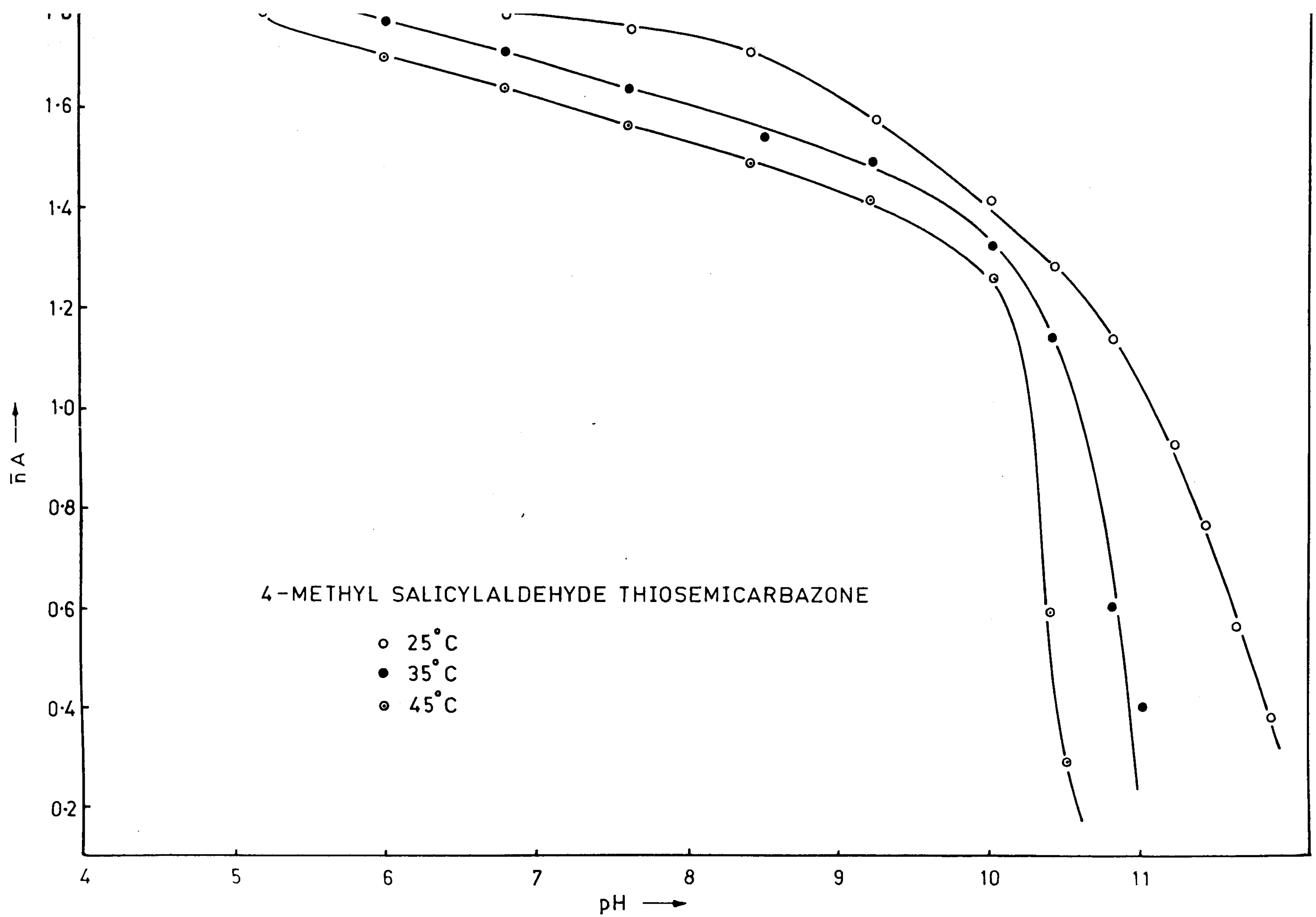


Fig. 5·2·2 : FORMATION CURVES FOR PROTON-LIGAND SYSTEMS

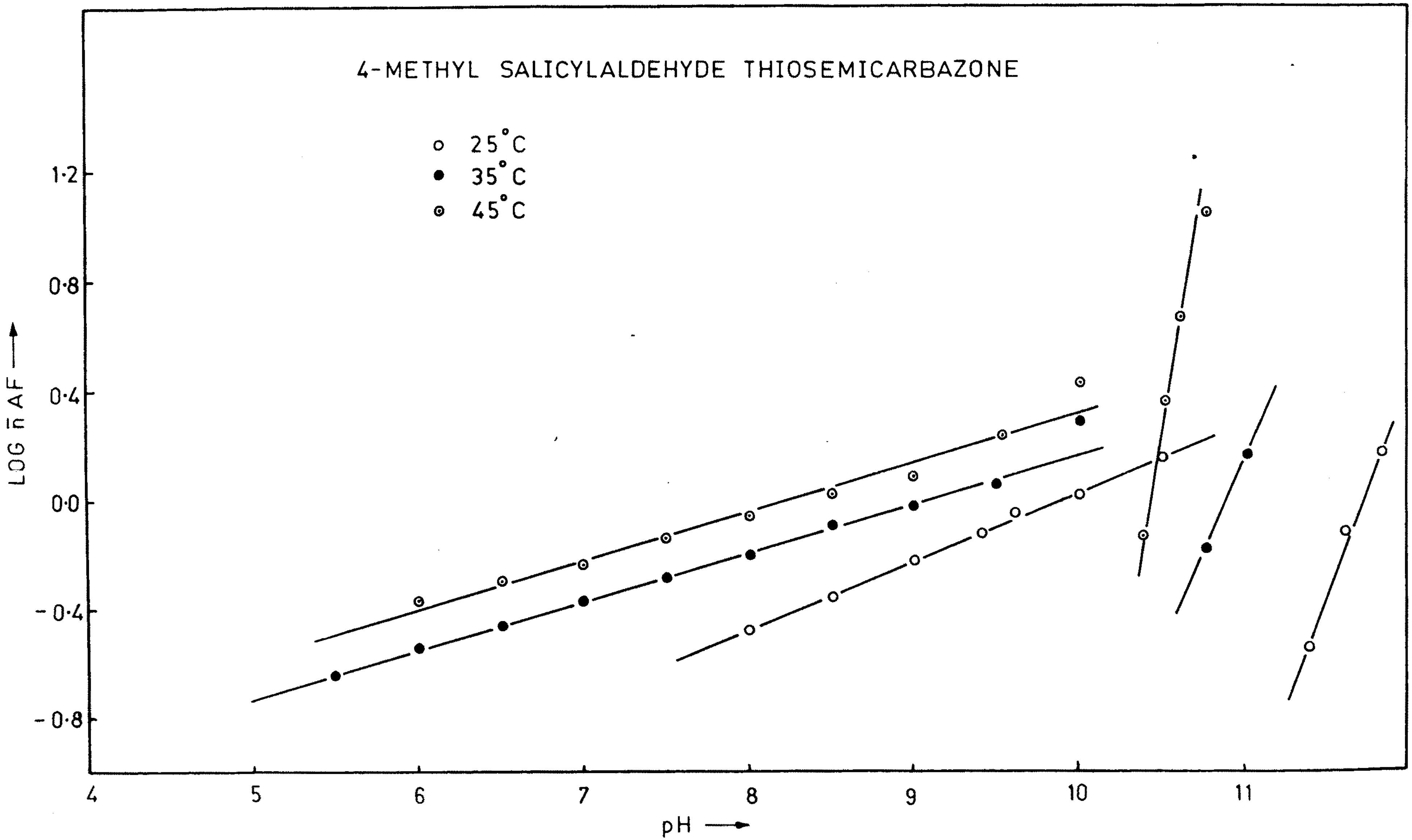


Fig. 5·2·3 : FORMATION CURVES FOR PROTON LIGAND SYSTEMS

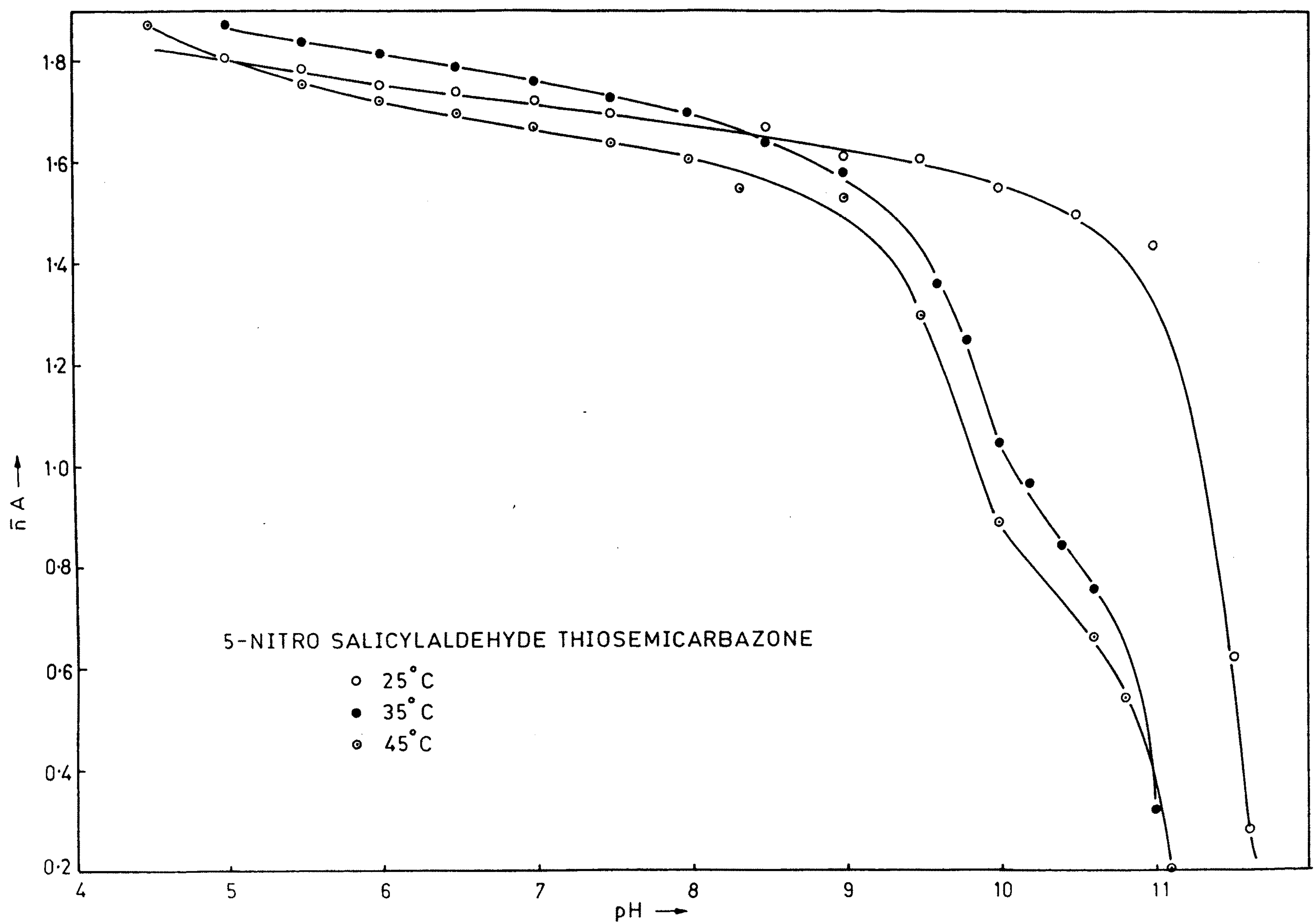
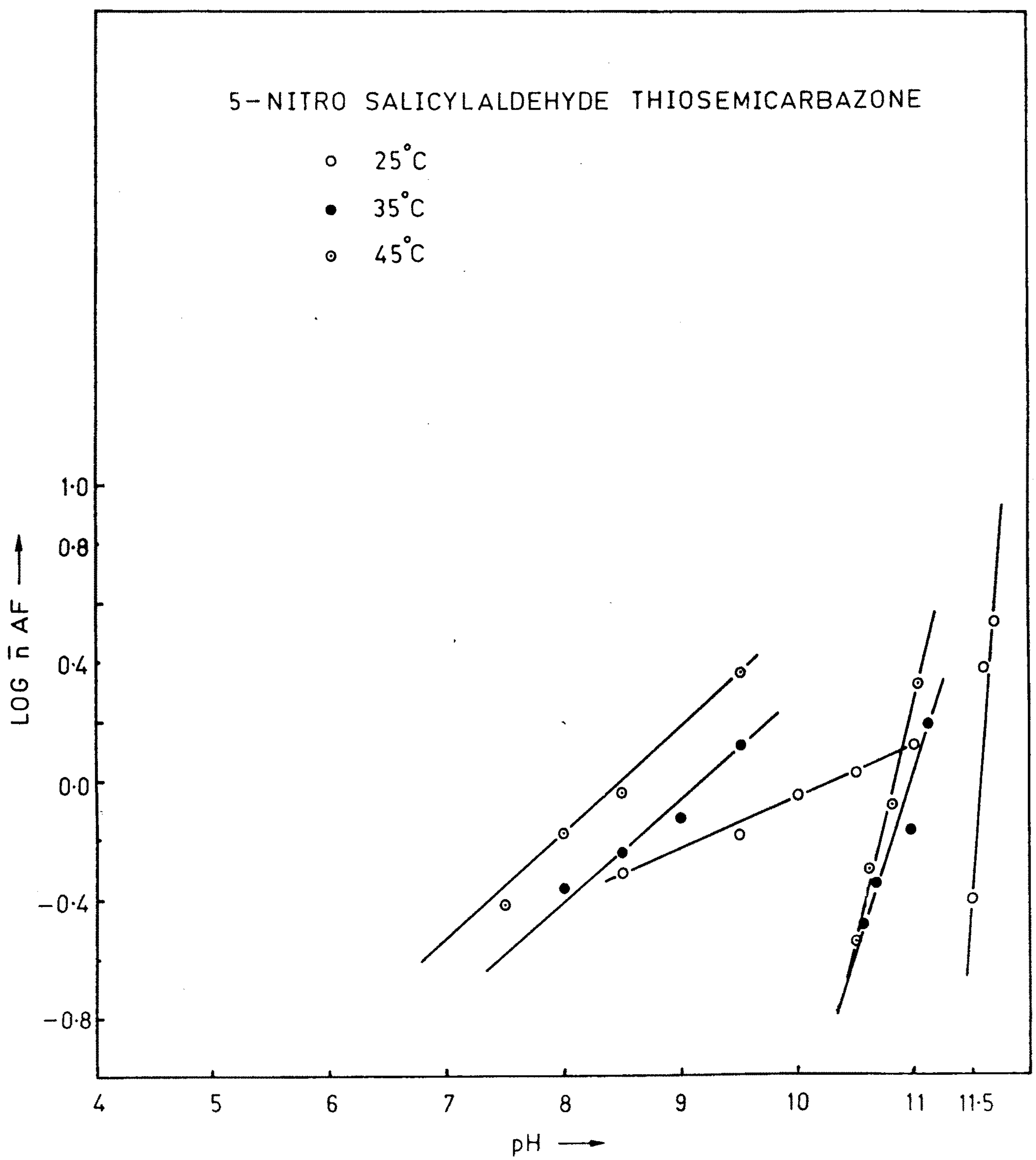


Fig. 5·3·2 : FORMATION CURVES FOR PROTON LIGAND SYSTEMS



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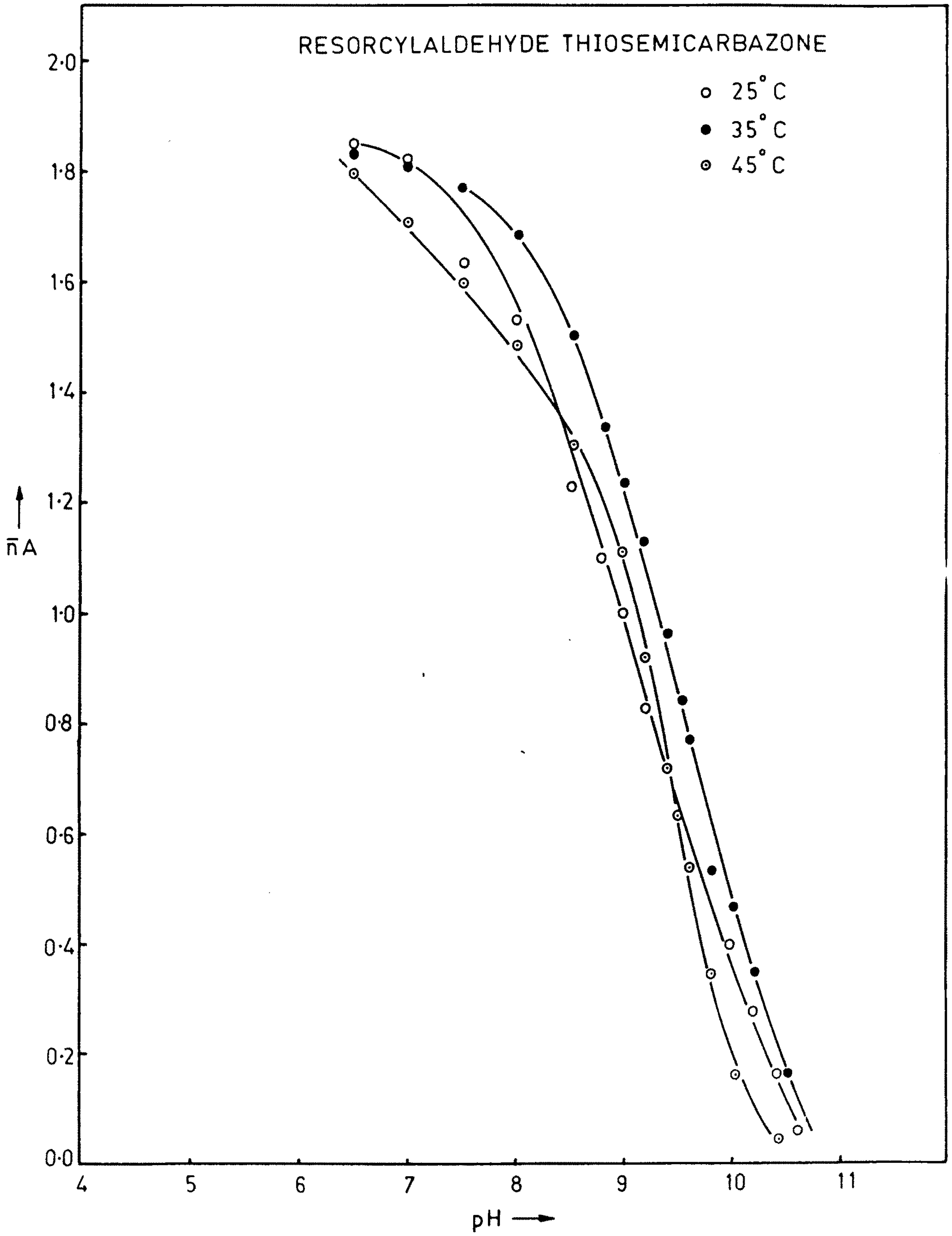


Fig. 5·4·2 : FORMATION CURVE FOR PROTON-LIGAND SYSTEMS

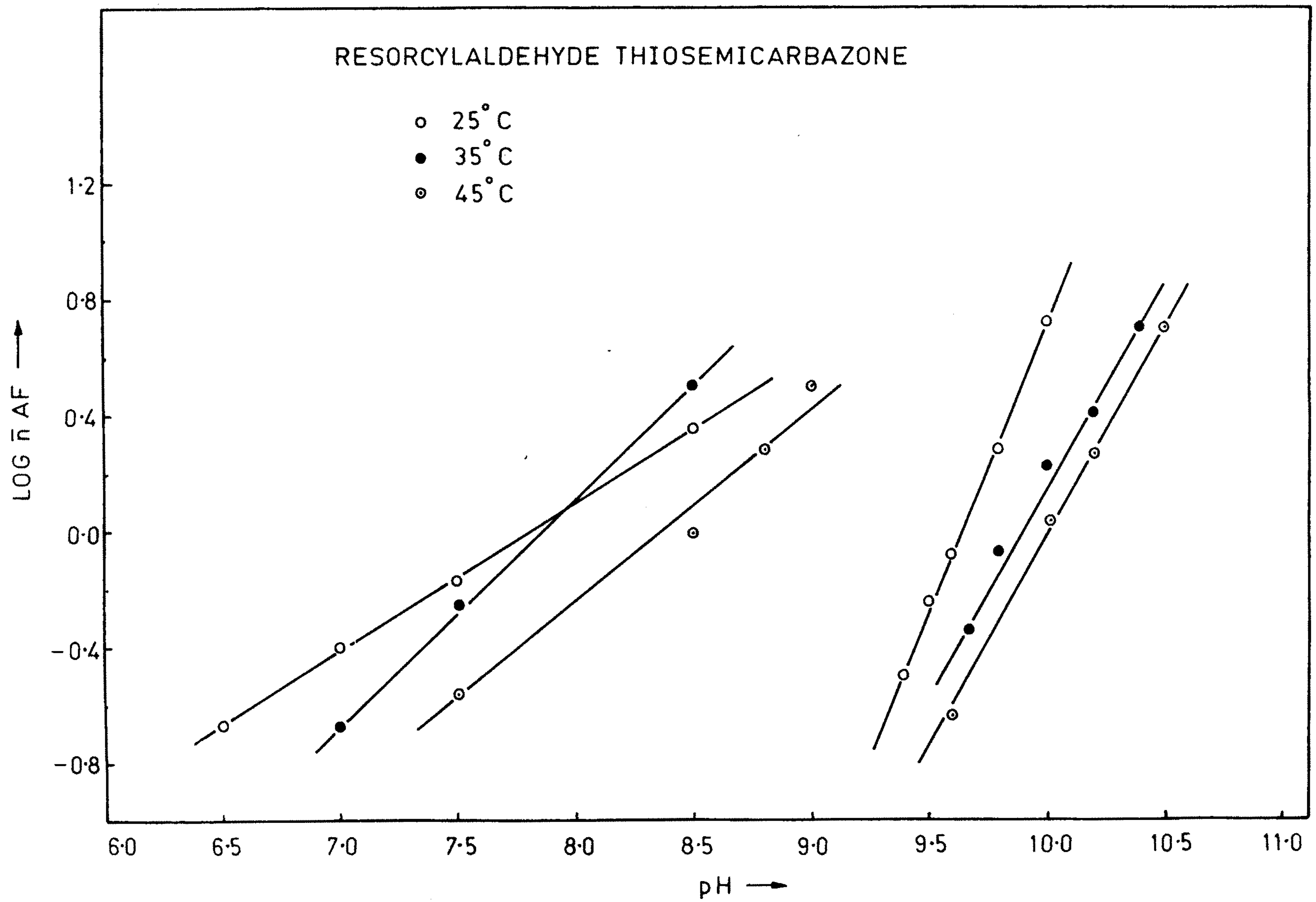


Fig. 5·4·3 : FORMATION CURVE FOR PROTON-LIGAND SYSTEMS

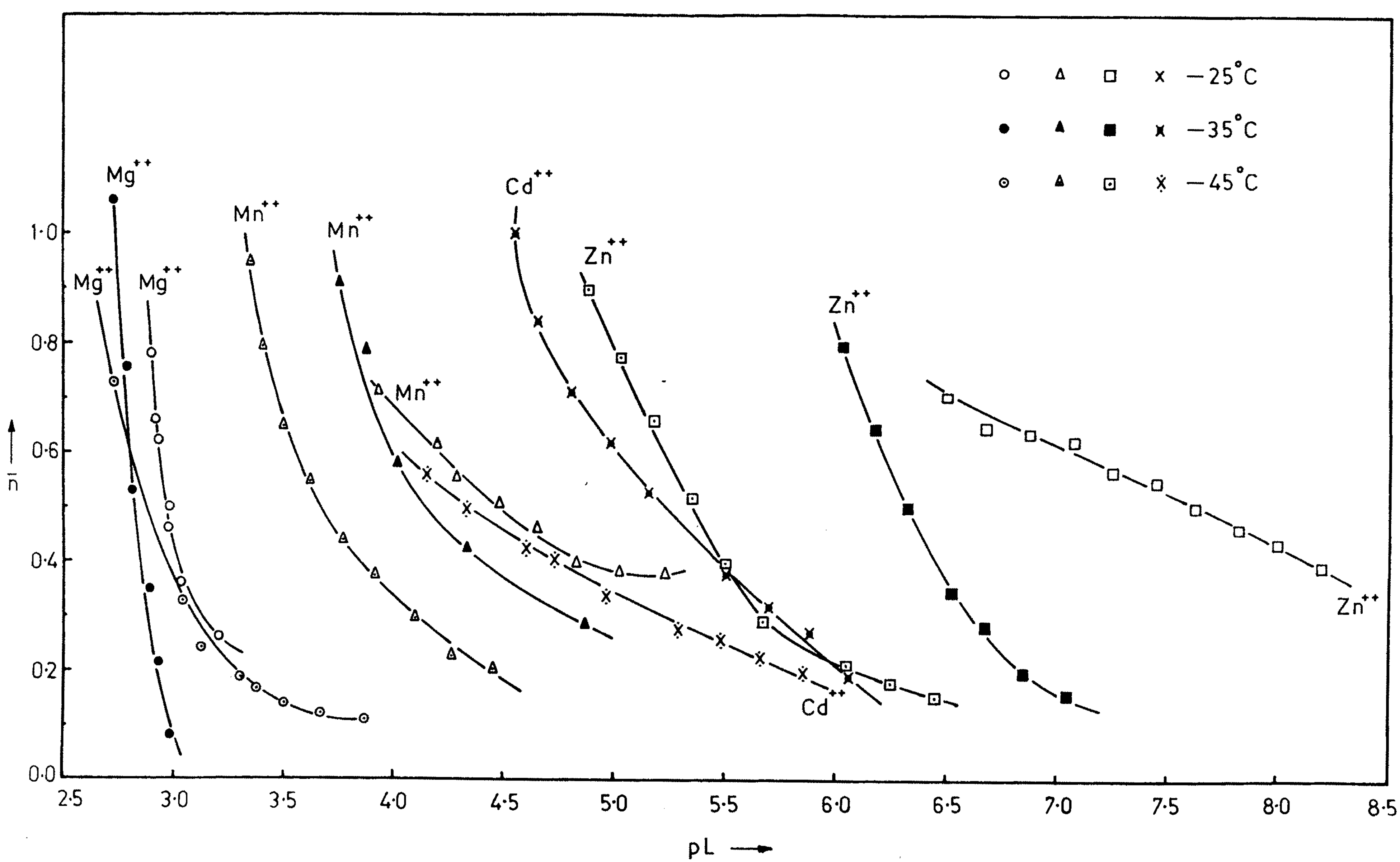


Fig. 5·1·4 : FORMATION CURVES FOR METAL-LIGAND SYSTEMS SALICYLALDEHYDE THIOSEMICARBAZONE.

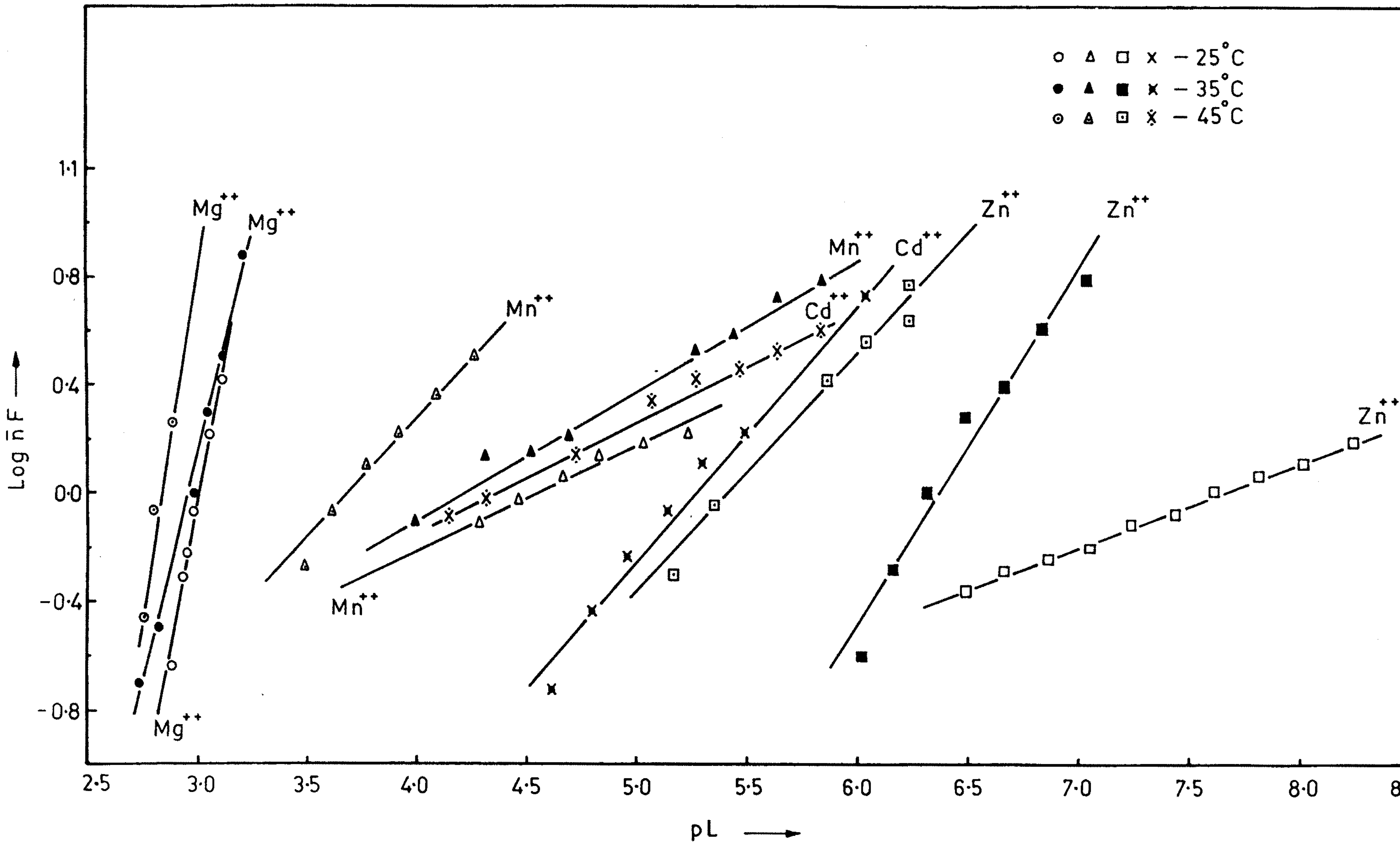


Fig. 5·1·5 : FORMATION CURVES FOR METAL-LIGAND SYSTEMS SALICYLALDEHYDE THIOSEMICARBAZONE.

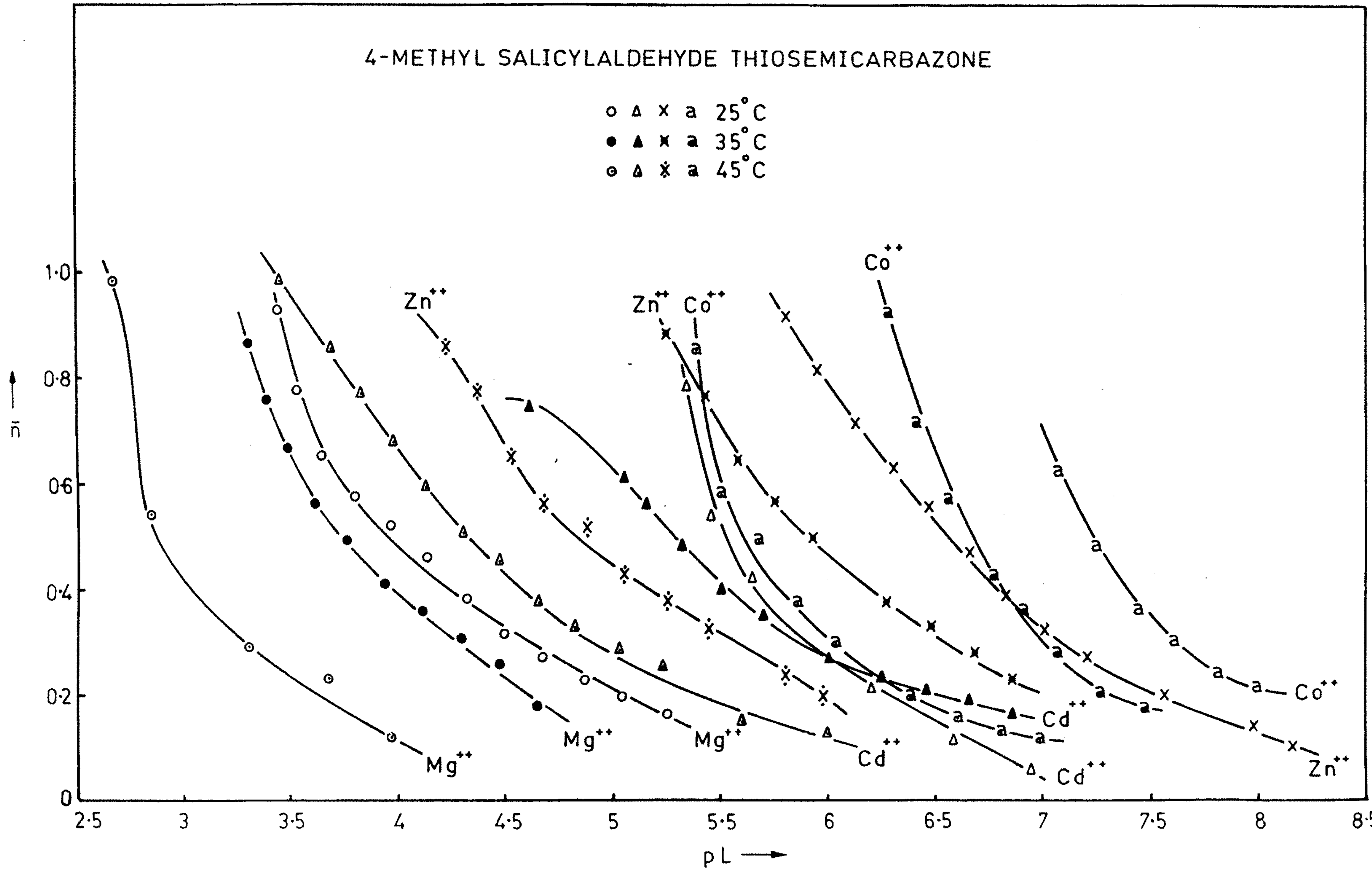


Fig. 5·2·4 : FORMATION CURVES FOR METAL LIGAND SYSTEMS

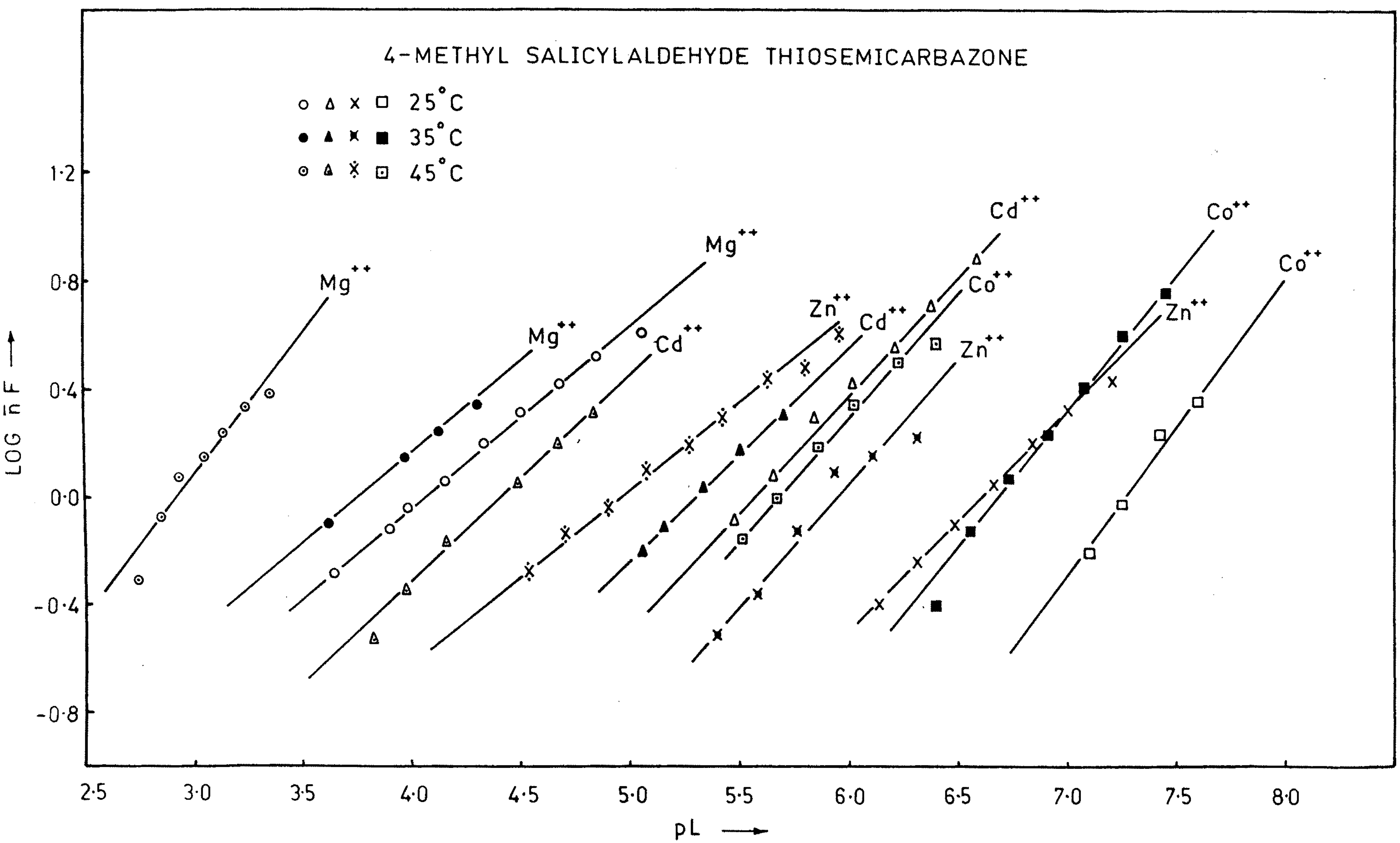


Fig. 5·2·5 : FORMATION CURVES FOR METAL LIGAND SYSTEMS

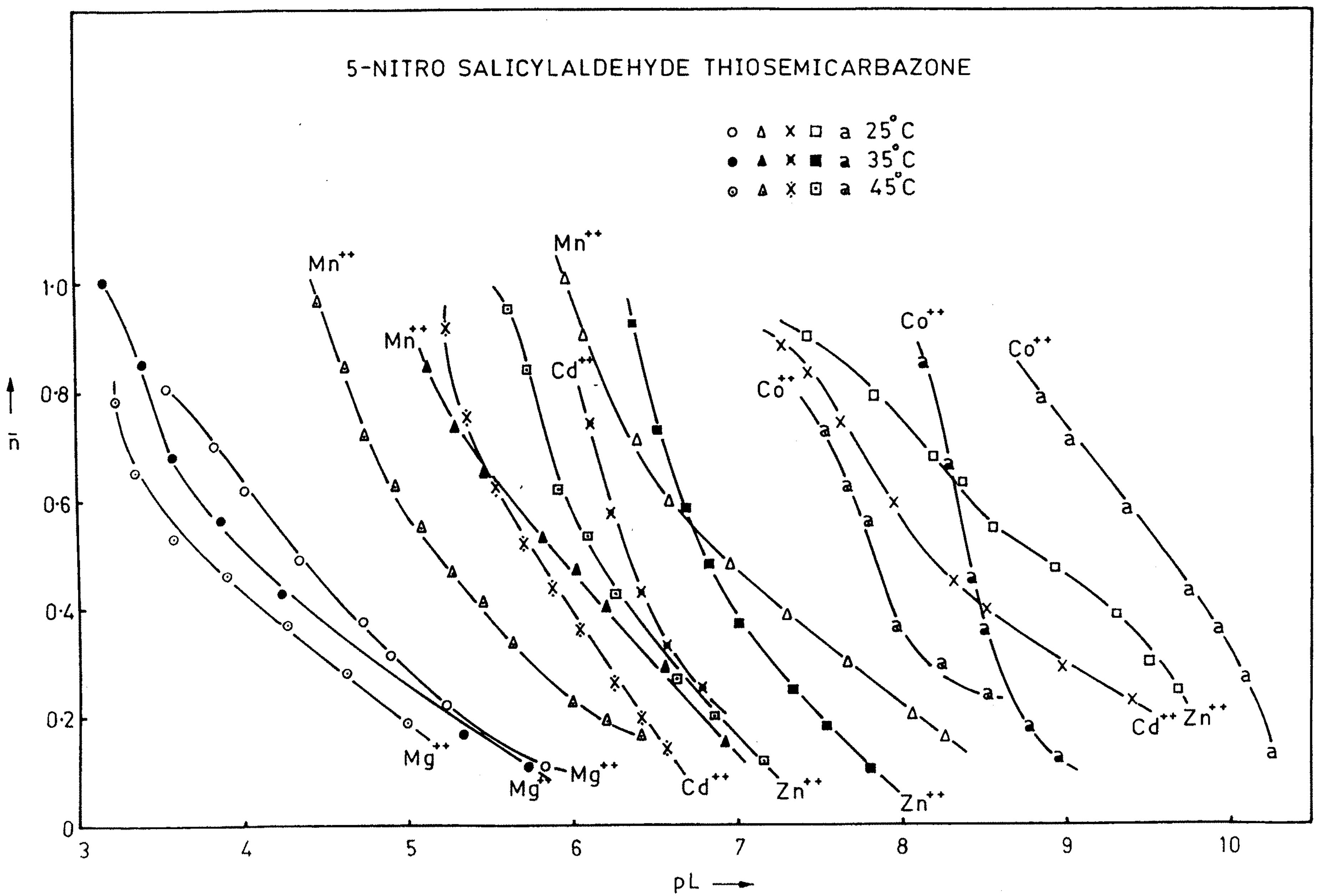
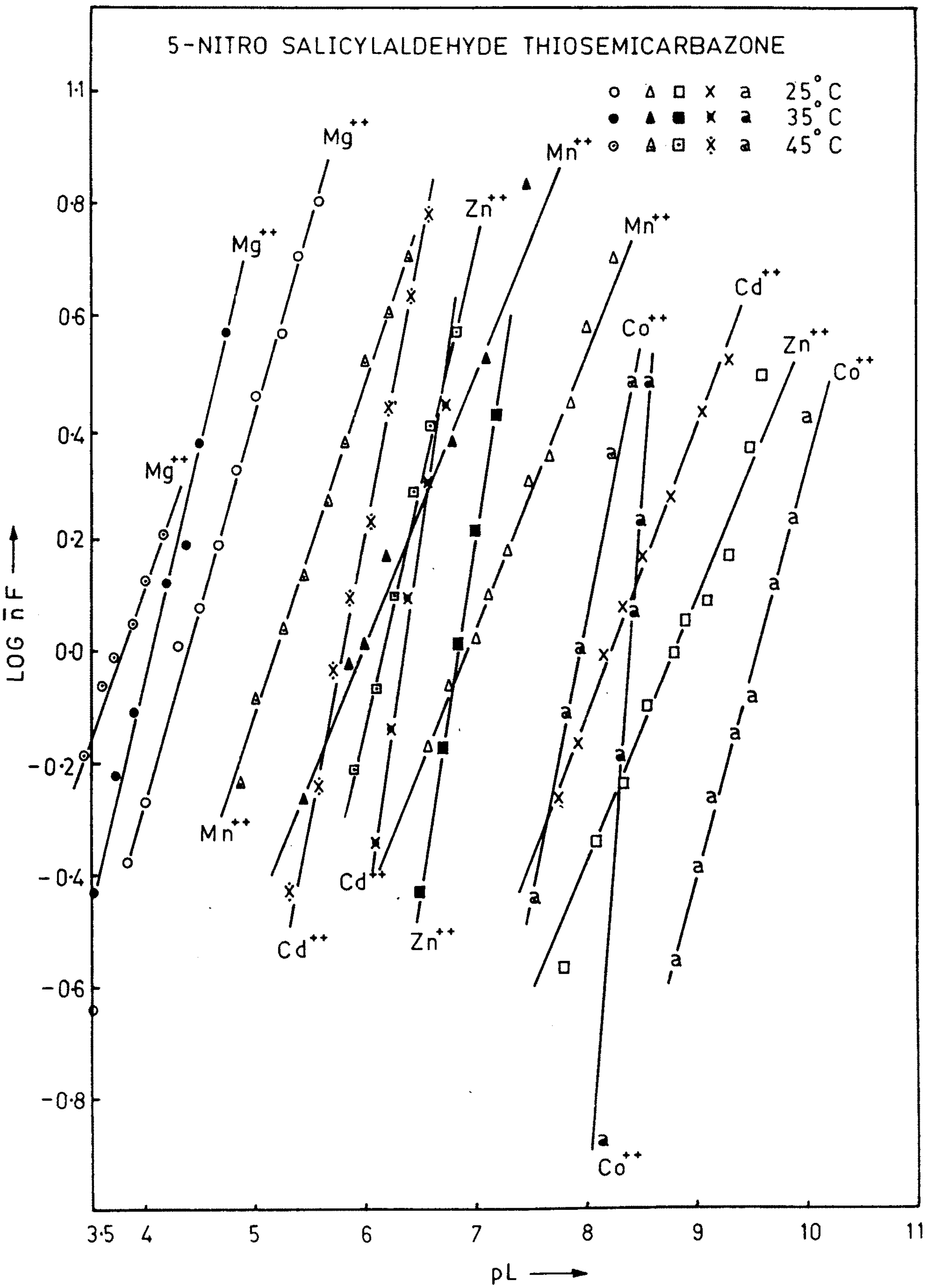


Fig.5·3·4 : FORMATION CURVES FOR METAL-LIGAND SYSTEMS



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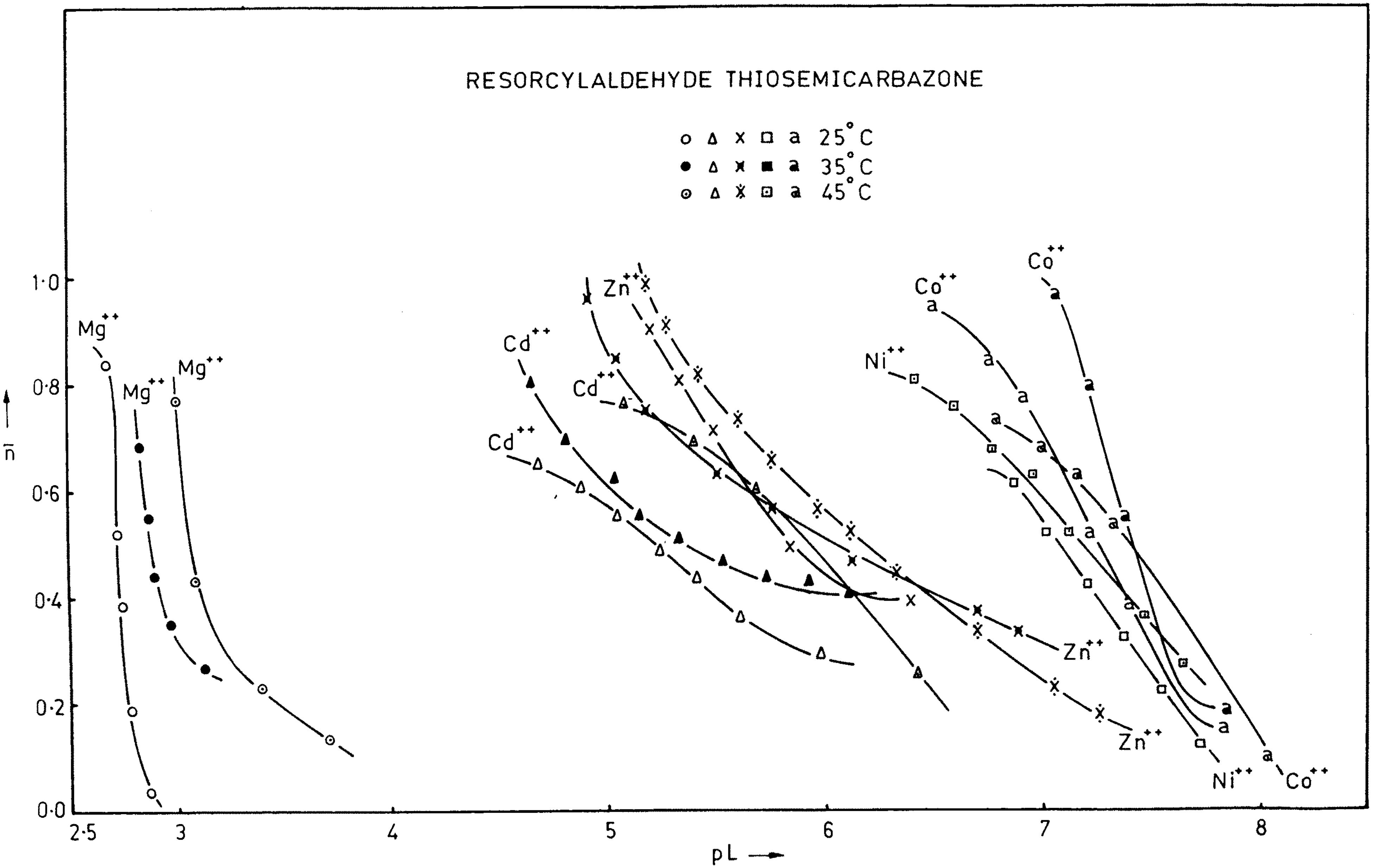

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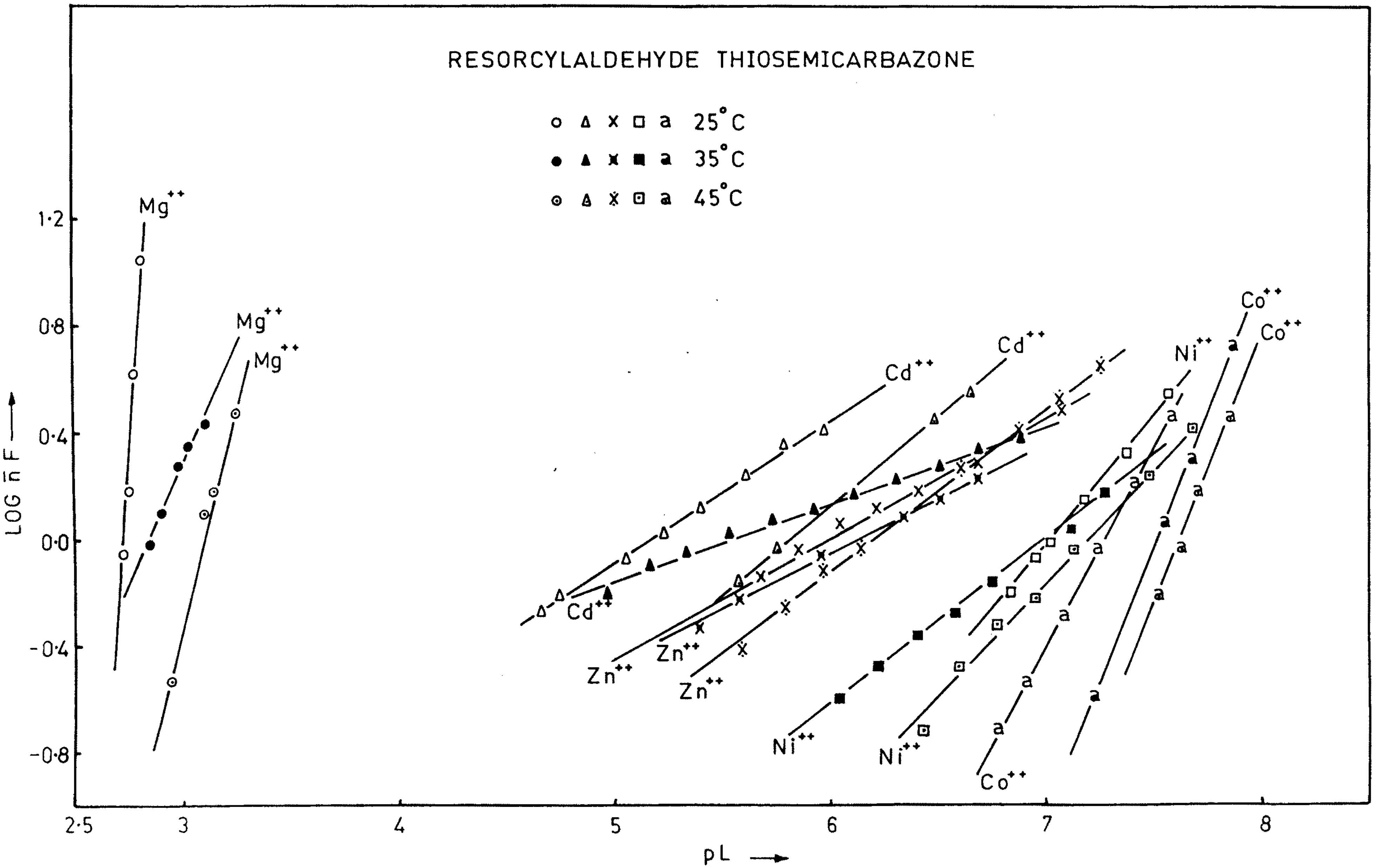

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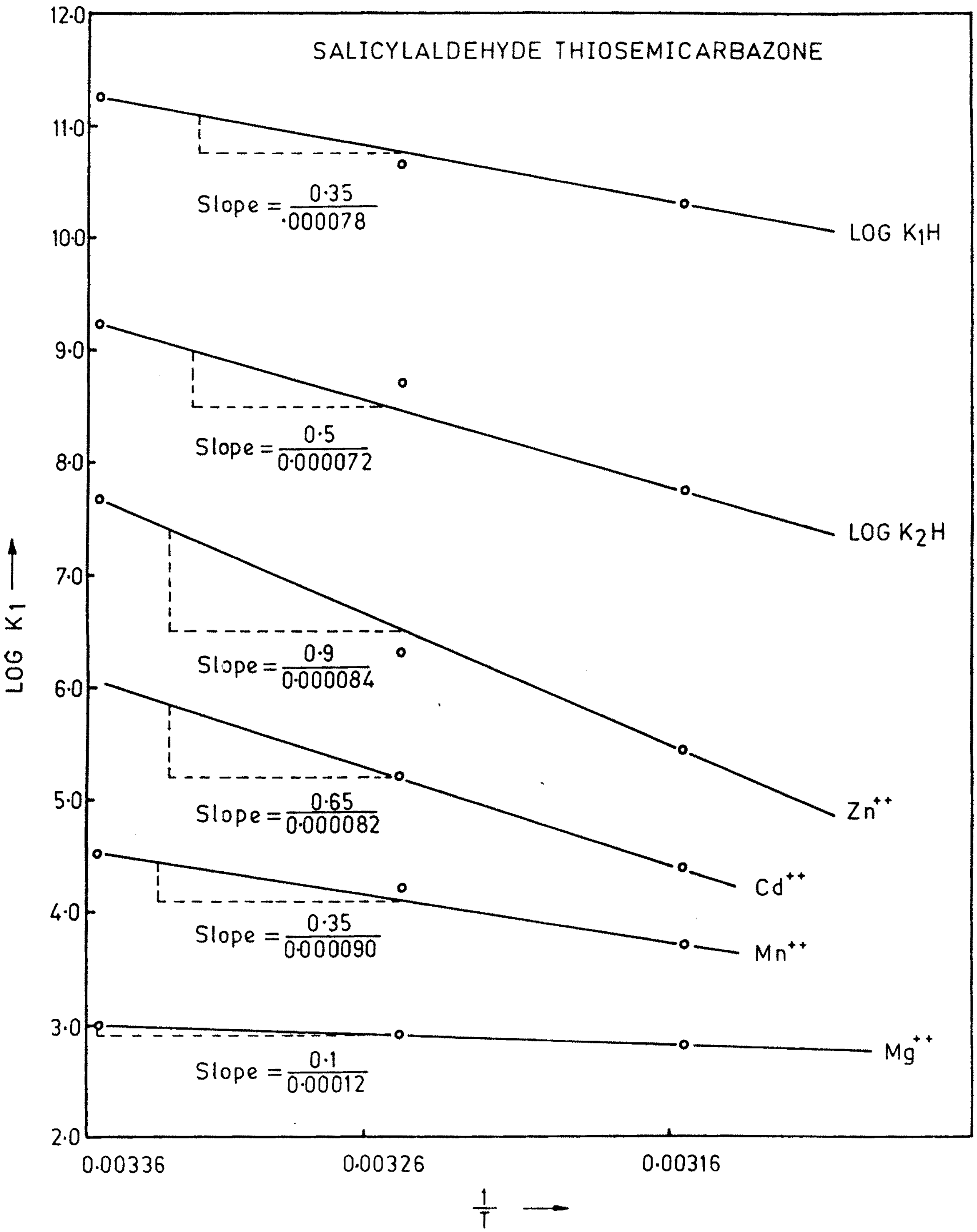
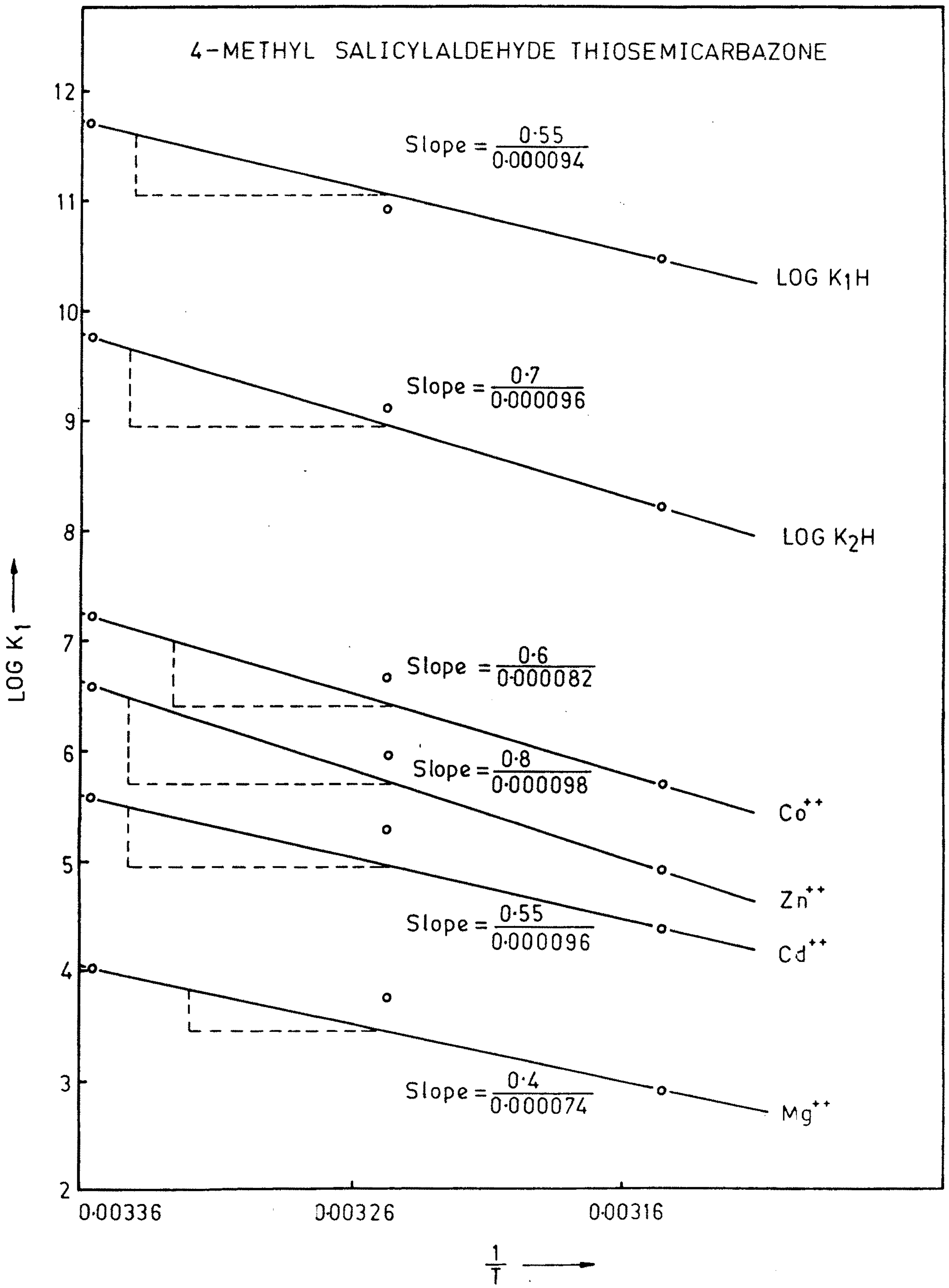


Fig. 5·1·6 : ΔH BY ISOBAR EQUATION



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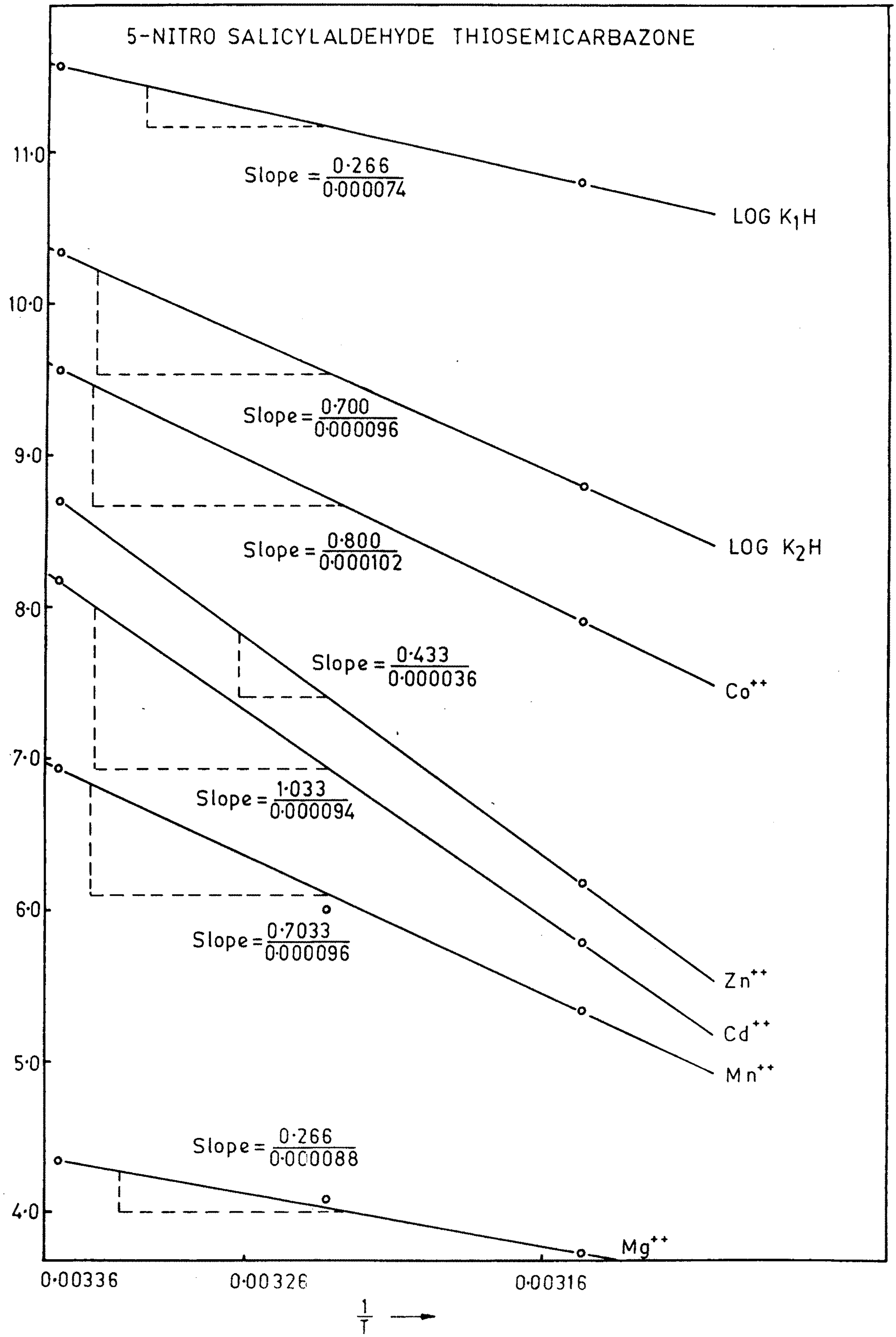

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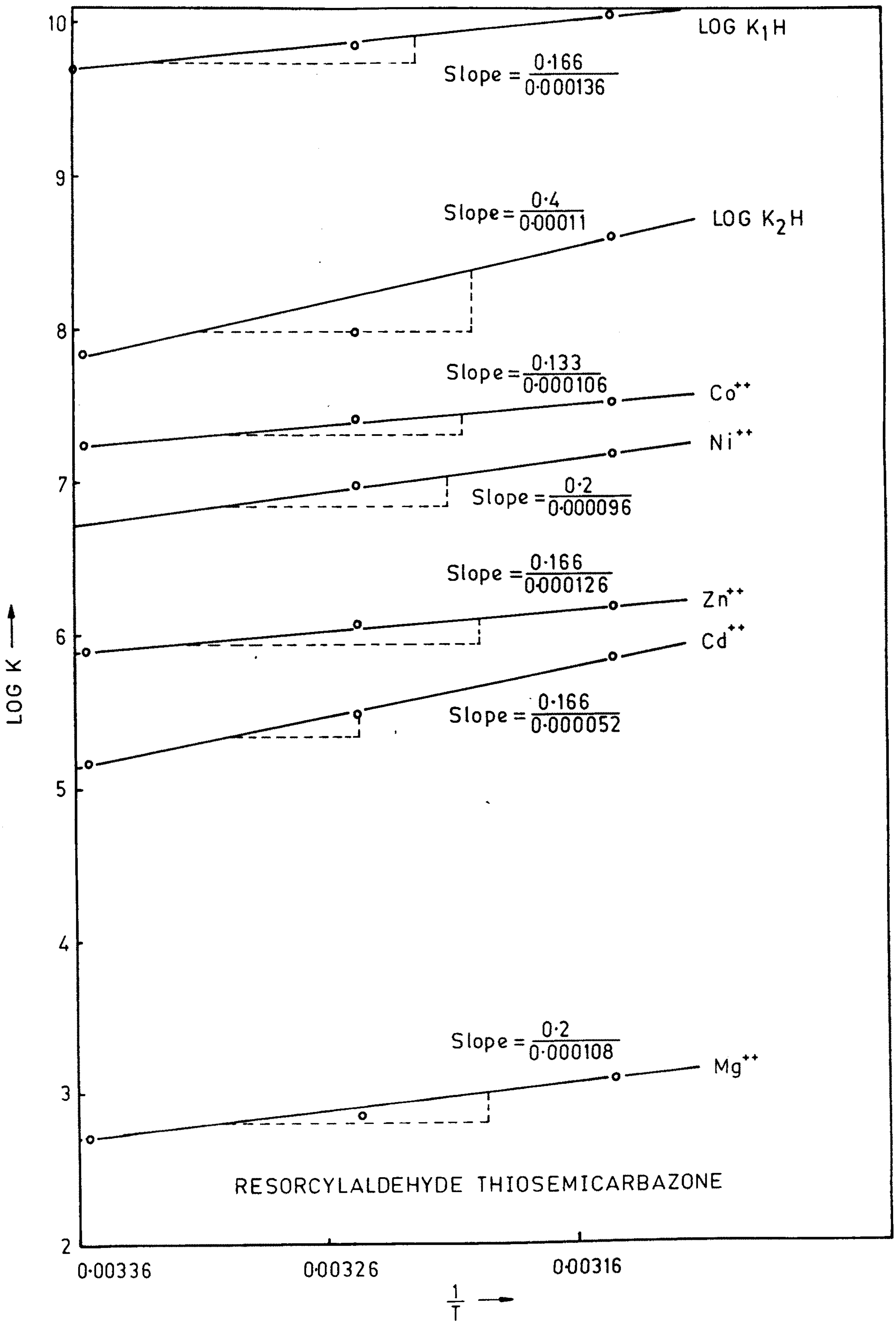

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