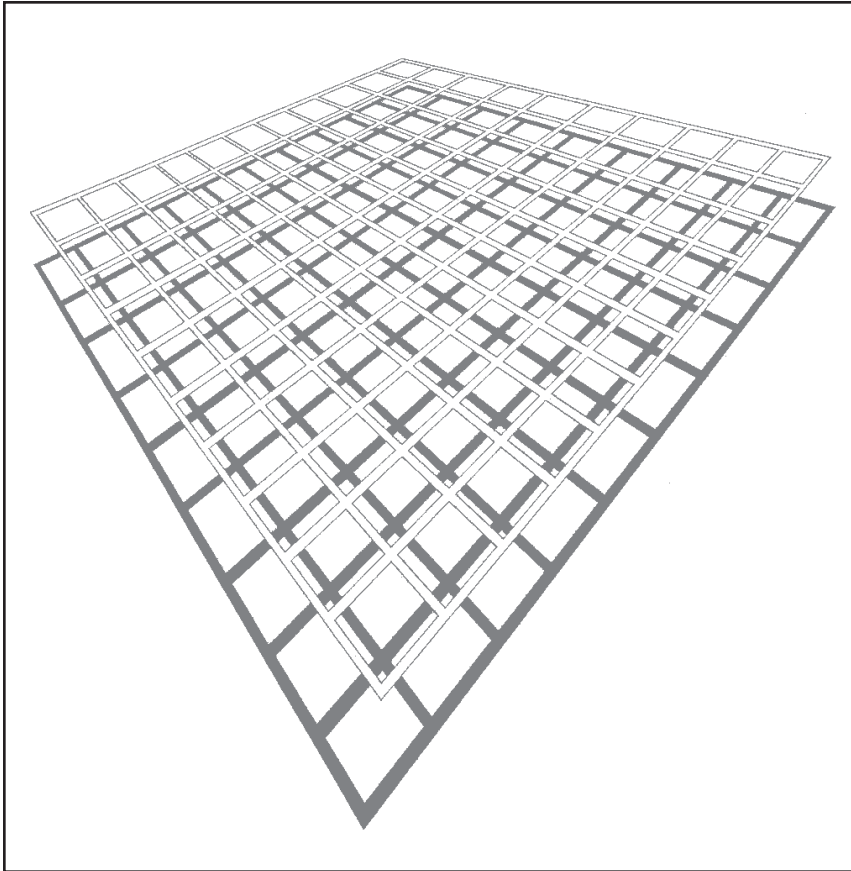


Conductance Data For Commonly Used Chemicals



CONDUCTANCE DATA FOR COMMONLY USED CHEMICALS

From an analytical point of view, little can be done with a conductance reading, however accurate it may be, unless it can be related to chemical concentration via a table or graph. Much data has been generated in the past 100 years in this area, but a comprehensive gathering of the information in a form useful to industry has been lacking¹. It is hoped that the following will provide a ready and reasonably accurate reference of conductance values for the majority of electrolytes encountered in industrial situations.

The information is presented in graphical form to permit rapid evaluation of response patterns and to eliminate the time consuming and often impractical (because of non-linearity) extrapolation required in tables with widely separated concentrations. This method of presentation sacrifices the precision gained by listing actual values, but the accuracy retained is more than sufficient for the great majority of industrial uses. The intent has been to provide a useful working tool more so than a scientific reference.

Most of the data presented is the result of extremely careful and accurate laboratory work conducted by various researchers over the years. It is recognized that older sources of information, notably the extensive International Critical Tables, have been found to be slightly inaccurate due to changes in the definition of basic units in recent times as well as to erroneous alignment procedures and measurement techniques. However, with the previously stated area of application in mind, these minor errors are of little significance and may safely be ignored.

A few curves are based on more casual "field condition" observations, and others are derived from data with a low degree of resolution in the original reference. Both will be marked with a single asterisk (*) in the index that follows.

All conductance values have been referenced to a single temperature of 25°C for convenience (isothermal plots are given for selected chemicals of major importance). Much of the original data was presented at this temperature, and all sources fell in the range of 15° to 25°C. Where possible, the temperature correction factor was calculated from isothermal equivalent conductances listed in the International Critical Tables. An average was taken over as wide a range as possible from .5N to 5N and 0-25°C. When such a calculation was not possible, the widely accepted "average" of 2%/°C was used. Temperature factors, of course, will vary in a non-linear manner with respect to both temperature and concentration for many chemicals, but the small size of the adjustments render this of little importance. As the majority of corrections involved differentials of only 5° or 7°C, errors introduced from this source will be small. With this in mind, the final effect of temperature correction error deserves further comment.

The relative conductance values at various concentrations would not be noticeably affected. The error could be approximately but correctly described as relating to the reference temperature rather than conductance. Too much or too little correction simply means that the curve shown is really that seen at 24° or 26° rather than the indicated 25°. It is not anticipated that errors will exceed the $\pm 1^\circ$ examples given in any except the most unusual cases.

No guarantees of accuracy can be given, but most of the data should easily fall within 5% of the correct absolute value. The choice of curve shape through data points will be a factor in some cases, and it is for this reason that the points were clearly indicated. (Some were omitted in the lower portions of the scale for the sake of clarity.)

¹An earlier and excellent series of curves was published for this purpose by Industrial Instruments Inc. It provided very detailed data for a half-dozen or so commonly used chemicals, and has been included in the list of reference sources.

NOTES:

1. Concentration is expressed as % by Weight of the anhydrous substance.
2. Conductance units are $\mu\text{mhos/cm}$.
3. Plotted data points are indicated by circles.

SOURCES OF CONDUCTANCE DATA

1. *International Critical Tables*, Vol. VI, pp. 230-258; McGraw Hill, 1929.
2. *Handbook of Chemistry and Physics*, 55th Edition: CRC Press, 1976.
3. *Lange's Handbook of Chemistry*, 10th and 11 th Editions.
4. Graphs published by Industrial Instruments, Inc.; Cedar Grove, N.J.
5. Previously unpublished laboratory measurements performed at Uniloc, Inc., Irvine, Calif. 1970-1976.
6. Miscellaneous information regarding single electrolytes obtained from various reliable industrial sources.
7. *Electrolyte Solutions*, Robinson and Stokes: Butterworths, 1959.
8. *Electrochemical Data*, Dobos: Elsevier, 1975.
9. *Electrolytic Conductance and the Conductances of the Halogen Acids in Water*, Hamer and DeWane: National Bureau of Standards Publication NSRDS-NBS 33, 1970.
10. *Handbook of Electrochemical Constants*, Parsons: Butterworths/Academic Press, 1959.

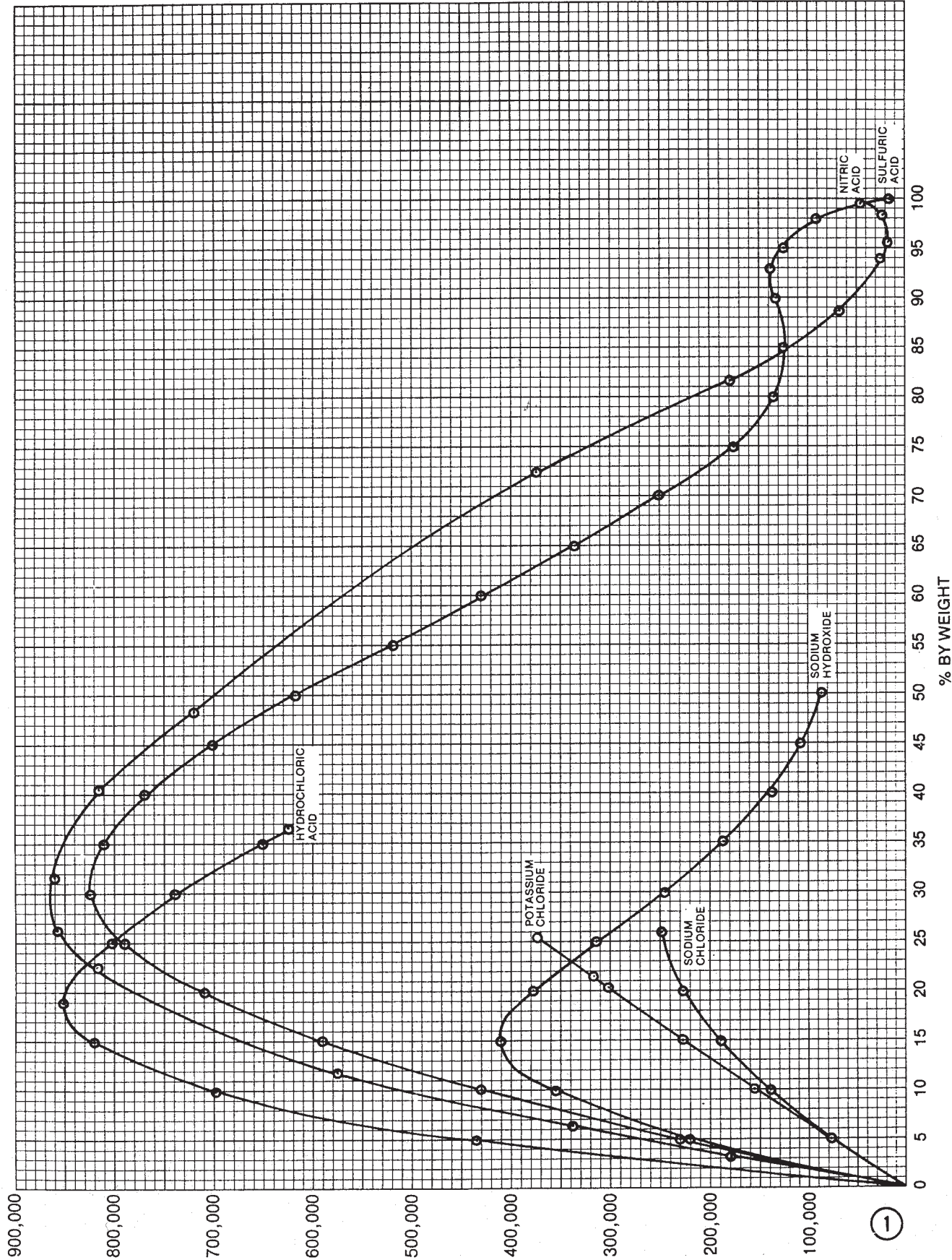
INDEX OF ELECTROLYTES

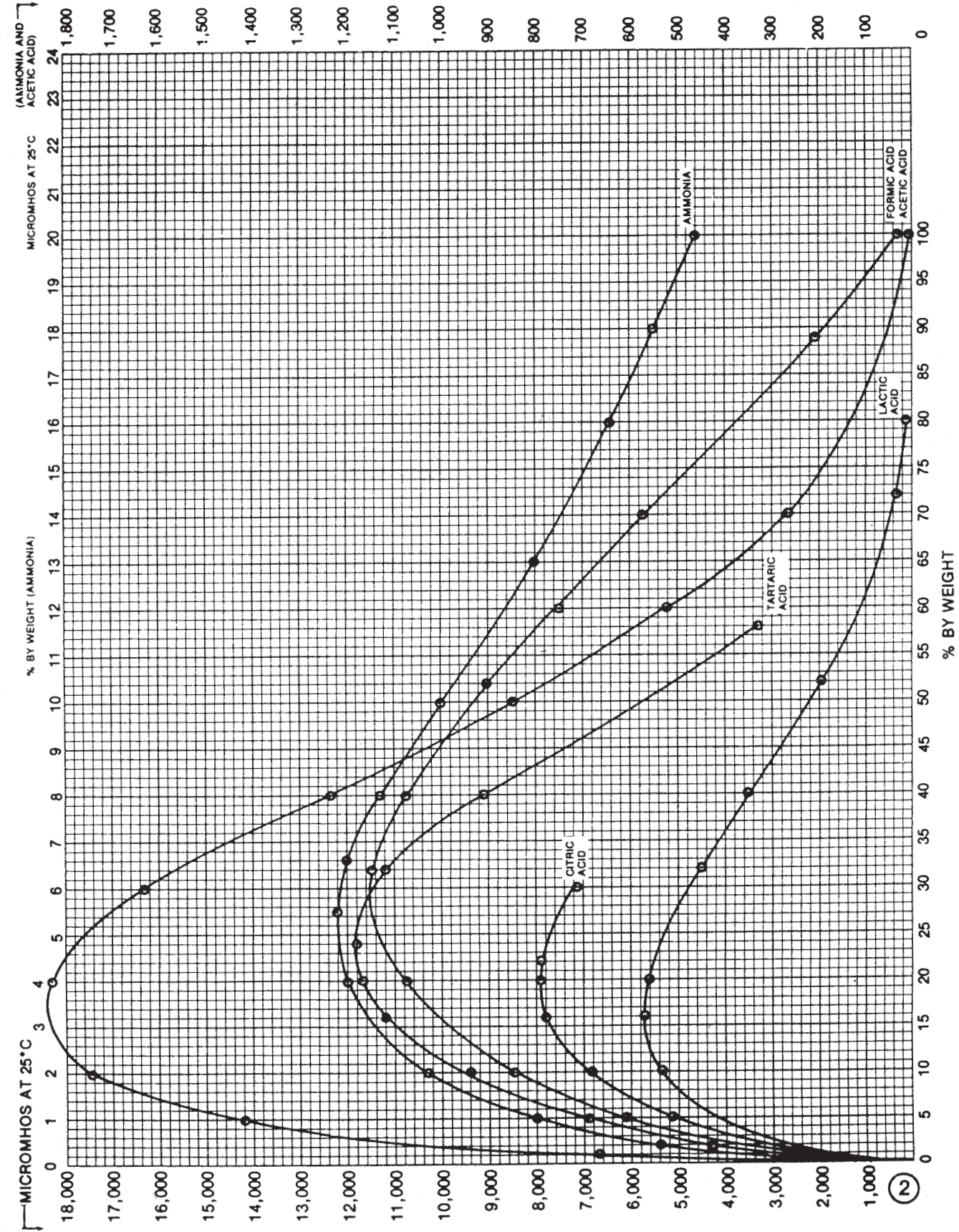
Substance	Chemical Formula	Maximum conductance and point of inflection at 25°C [μ mhos/cm/% by wt.]	Mol. Wt. (Anhydrous)	Graph No.
1. Acetic acid	CH ₃ COOH	1,850/17%	60.05	2
2. Aluminum chloride	AlCl ₃	—	133.34	6
3. *Ammonia/Ammonium Hydroxide	NH ₃ /NH ₄ OH	1,200/5.5%	17.03/35.05	2
4. *Ammonium bifluoride	NH ₄ F•HF	—	57.04	7
5. Ammonium chloride	NH ₄ Cl	—	53.50	13
6. Ammonium fluoride	NH ₄ F	—	37.04	7
7. Ammonium iodide	NH ₄ I	—	144.94	14
8. Ammonium nitrate	NH ₄ NO ₃	—	80.04	13
9. Ammonium sulfate	(NH ₄) ₂ SO ₄	—	132.14	11
10. Ammonium thiocyanate	NH ₄ SCN	—	76.12	10
11. Barium chloride	BaCl ₂	—	208.25	8
12. *Barium hydroxide	Ba(OH) ₂	—	171.39	4
13. *Barium nitrate	Ba(NO ₃) ₂	—	261.38	3
14. Cadmium bromide	CdBr ₂	30,000/32%	272.24	9
15. Cadmium chloride	CdCl ₂	35,000/22%	183.32	5
16. Cadmium iodide	CdI ₂	—	366.25	9
17. Cadmium nitrate	Cd(NO ₃) ₂	108,000/32%	164.10	9
18. Cadmium sulfate	CdSO ₄	51,000/27%	208.48	9
19. Calcium chloride	CaCl ₂	204,000/24%	110.99	11
20. Calcium nitrate	Ca(NO ₃) ₂	122,000/25%	164.10	9
21. Cesium chloride	CsCl	—	168.37	13
22. Chromic acid	CrO ₃	670,000/35%	99.99	14
23. Citric acid	(COOH)CH ₂ C(OH) (COOH)•H ₂ O	7,900/20%	210.14 (Hyd.)	2
24. Cobaltous Chloride	CoCl ₂	—	129.84	6
25. Cupric chloride	CuCl ₂	108,000/23%	134.45	11
26. Cupric nitrate	Cu(NO ₃) ₂	134,000/28%	187.55	8
27. Cupric sulfate	CuSO ₄	—	159.61	6
28. (Ethylenediamine) Tetraacetic acid disodium salt, EDTA sodium	Na ₂ C ₁₀ H ₁₄ O ₈ N ₂ •2H ₂ O	—	372.24(Hyd.)	3
29. Ferric chloride	FeCl ₃	96,000/16%	162.22	9
30. Ferrous sulfate	FeSO ₄	53,000/24%	15.94	6
31. Formic acid	HCOOH	11,500/30%	46.03	2
32. Hydrobromic acid	HBr	—	80.92	14
33. Hydrochloric acid	HCl	850,000/19%	36.47	1
34. Hydrofluoric acid	HF	—	20.01	13
35. Hydroiodic acid	HI	—	127.93	14
36. Iodic acid	HIO ₃	—	175.93	12
37. Lactic acid	CH ₃ CHOH COOH	5,700/15%	90.08	2
38. Lanthanum nitrate	La(NO ₃) ₃	97,000/28%	324.93	8
39. Lead (plumbous) nitrate	Pb(NO ₃) ₂	—	331.23	8
40. Lithium chloride	LiCl	190,000/21%	42.40	11
41. Lithium hydroxide	LiOH	380,000/11%	23.95	13
42. Lithium iodide	LiI	—	133.86	7
43. Lithium sulfate	Li ₂ SO ₄	83,000/18%	109.95	7
44. Magnesium chloride	MgCl ₂	160,000/18%	95.23	11
45. Magnesium nitrate	Mg(NO ₃) ₂	—	148.34	6
46. Magnesium sulfate	MgSO ₄	58,000/17%	120.37	7
47. Manganous chloride	MnCl ₂	130,000/20%	125.84	8
48. Manganous sulfate	MnSO ₄	51,500/22%	151.00	5
49. Nickel sulfate	NiSO ₄	—	154.78	7
50. Nitric acid	HNO ₃	865,000/29%	63.02	1
51. Oxalic acid	HO ₂ CCO ₂ H	—	90.04	4
52. Phosphoric acid	H ₃ PO ₄	230,000/50%	98.00	12
53. Potassium acetate	KCH ₃ CO ₂	150,000/32%	98.14	12
54. Potassium bicarbonate	KHCO ₃	—	100.12	7
55. Potassium biphthalate	KHC ₈ H ₄ O ₄	—	204.23	3

INDEX OF ELECTROLYTES (Continued)

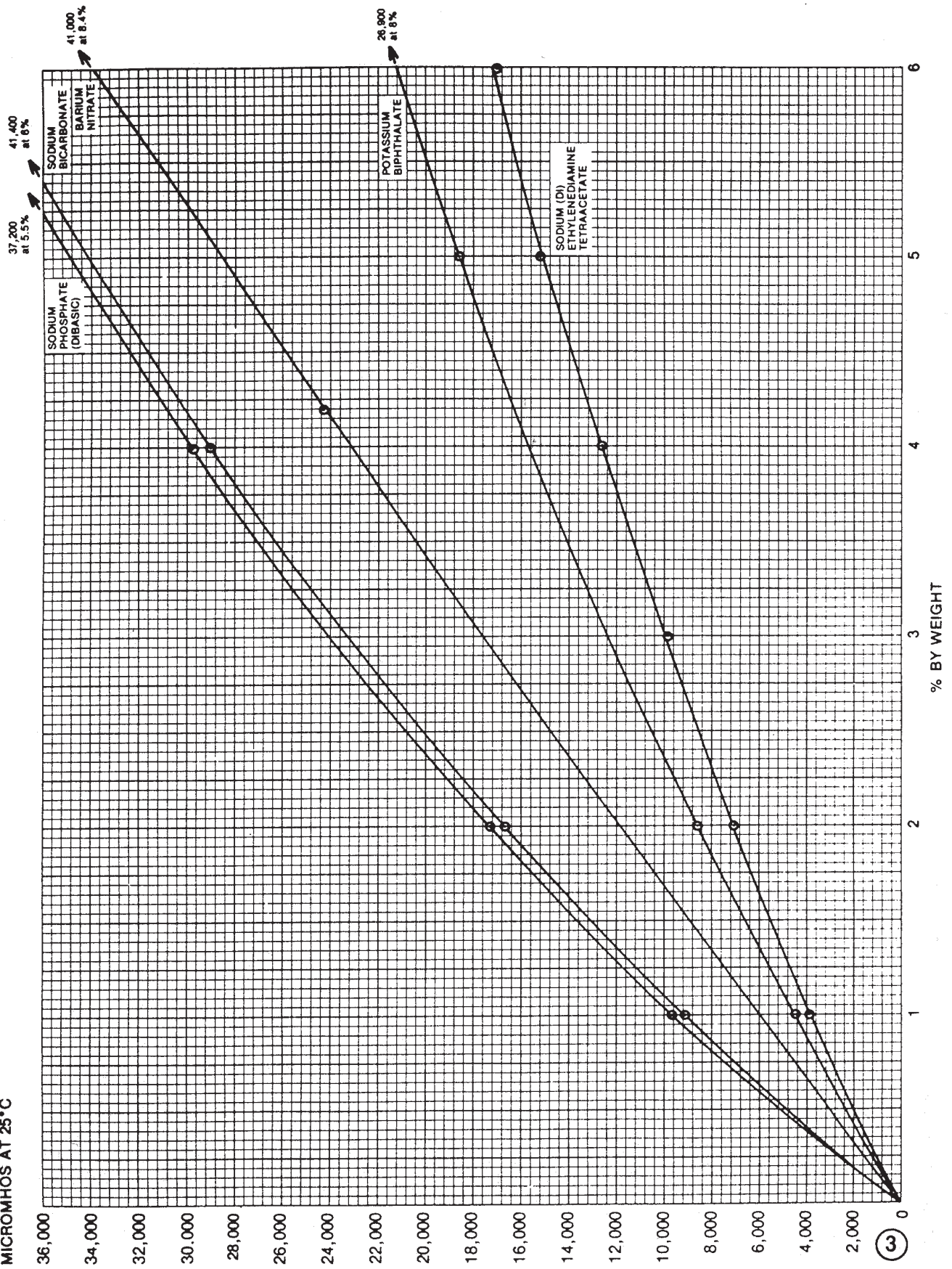
Substance	Chemical Formula	Maximum conductance and point of inflection at 25°C [μ mhos/cm/% by wt.]	Mol. Wt. (Anhydrous)	Graph No.
56. Potassium bromide	KBr	—	119.01	13
57. Potassium carbonate	K ₂ CO ₃	258,000/34%	138.21	12
58. Potassium chloride	KCl	—	74.55	1
59. Potassium chromate	K ₂ CrO ₄	—	194.20	10
60. Potassium cyanide	KCN	—	65.11	6
61. Potassium dichromate	K ₂ Cr ₂ O ₇	—	294.21	6
62. Potassium ferricyanide	K ₃ Fe(CN) ₆	—	329.26	13
63. Potassium ferrocyanide	K ₄ Fe(CN) ₆	—	368.36	6
64. Potassium fluoride	KF	288,000/34%	58.10	12
65. Potassium hydroxide	KOH	625,000/26%	56.11	14
66. Potassium iodide	KI	—	166.03	14
67. Potassium nitrate	KNO ₃	—	101.10	7
68. Potassium oxalate	K ₂ C ₂ O ₄	—	166.22	7
69. Potassium permanganate	KMnO ₄	—	158.04	4
70. Potassium phosphate (monobasic)	KH ₂ PO ₄	—	136.13	4
71. Potassium phosphate (dibasic)	K ₂ HPO ₄	—	174.18	4
72. Potassium sulfate	K ₂ SO ₄	—	174.26	4
73. Potassium sulfide	K ₂ S	535,000/30%	110.26	14
74. Potassium thiocyanate	KSCN	—	97.18	10
75. Procaine hydrochloride	C ₆ H ₄ [COOCH ₂ CH ₂ N(C ₂ H ₅) ₂](NH ₂)•HCl-1,4	34,000/32%	272.78	5
76. Sea water	—	—	—	4
77. *Silver fluoride	AgF	—	126.88	10
78. Silver nitrate	AgNO ₃	—	169.89	12
79. Sodium acetate	NaCH ₃ CO ₂	78,000/22%	82.04	5
80. Sodium bicarbonate	NaHCO ₃	—	84.01	3
81. Sodium bromide	NaBr	—	102.91	10
82. Sodium carbonate	Na ₂ CO ₃	103,000/19%	106.01	6
83. Sodium chloride	NaCl	—	58.44	1
84. Sodium citrate	Na ₃ C ₆ H ₅ O ₇	64,500/23%	258.07	5
85. Sodium diatrizoate (Hypaque)	Na(CH ₃ CONH) ₂ C ₆ I ₃ CO ₂	18,500/40%	635.92	5
86. Sodium dichromate	Na ₂ Cr ₂ O ₇	165,000/40%	261.97	9
87. Sodium ferrocyanide	Na ₄ Fe(CN) ₆	—	303.92	10
88. Sodium hydroxide	NaOH	410,000/15%	40.01	1
89. Sodium molybdate	Na ₂ MoO ₄	—	205.95	4
90. Sodium nitrate	NaNO ₃	—	85.01	11
91. Sodium phosphate (monobasic)	NaH ₂ PO ₄	60,000/28%	119.97	8
92. Sodium phosphate (dibasic)	Na ₂ HPO ₄	—	141.98	3
93. Sodium phosphate (tribasic)	Na ₃ PO ₄	—	163.96	4
94. Sodium sulfate	Na ₂ SO ₄	—	142.07	7
95. Sodium sulfide	Na ₂ S	262,000/15%	78.06	10
96. Sodium tartrate	NaOOC(CHOH) ₂ COONa	68,500/24%	194.07	5
97. Sodium thiocyanate	NaSCN	206,000/34%	81.08	12
98. Sodium thiosulfate	Na ₂ S ₂ O ₃	152,000/29%	158.13	8
99. Sodium tungstate	Na ₂ WO ₄	—	293.92	4
100. Strontium chloride	SrCl ₂	198,000/30%	158.55	11
101. Strontium nitrate	Sr(NO ₃) ₂	113,000/30%	211.65	8
102. Sulfuric acid	H ₂ SO ₄	825,000/30%	98.08	1
103. Tartaric acid	HO ₂ C(CHOH) ₂ CO ₂ H	11,800/24%	150.09	2
104. Tetracaine hydrochloride	C ₁₅ H ₂₄ N ₂ O ₂ •HCl	—	300.84	4
105. Trichloroacetic acid	CCl ₃ COOH	—	163.38	10
106. Zinc chloride	ZnCl ₂	104,000/27%	136.29	12
107. Zinc Sulfate	ZnSO ₄	56,500/4%	161.44	4

MICROMHOS AT 25°C





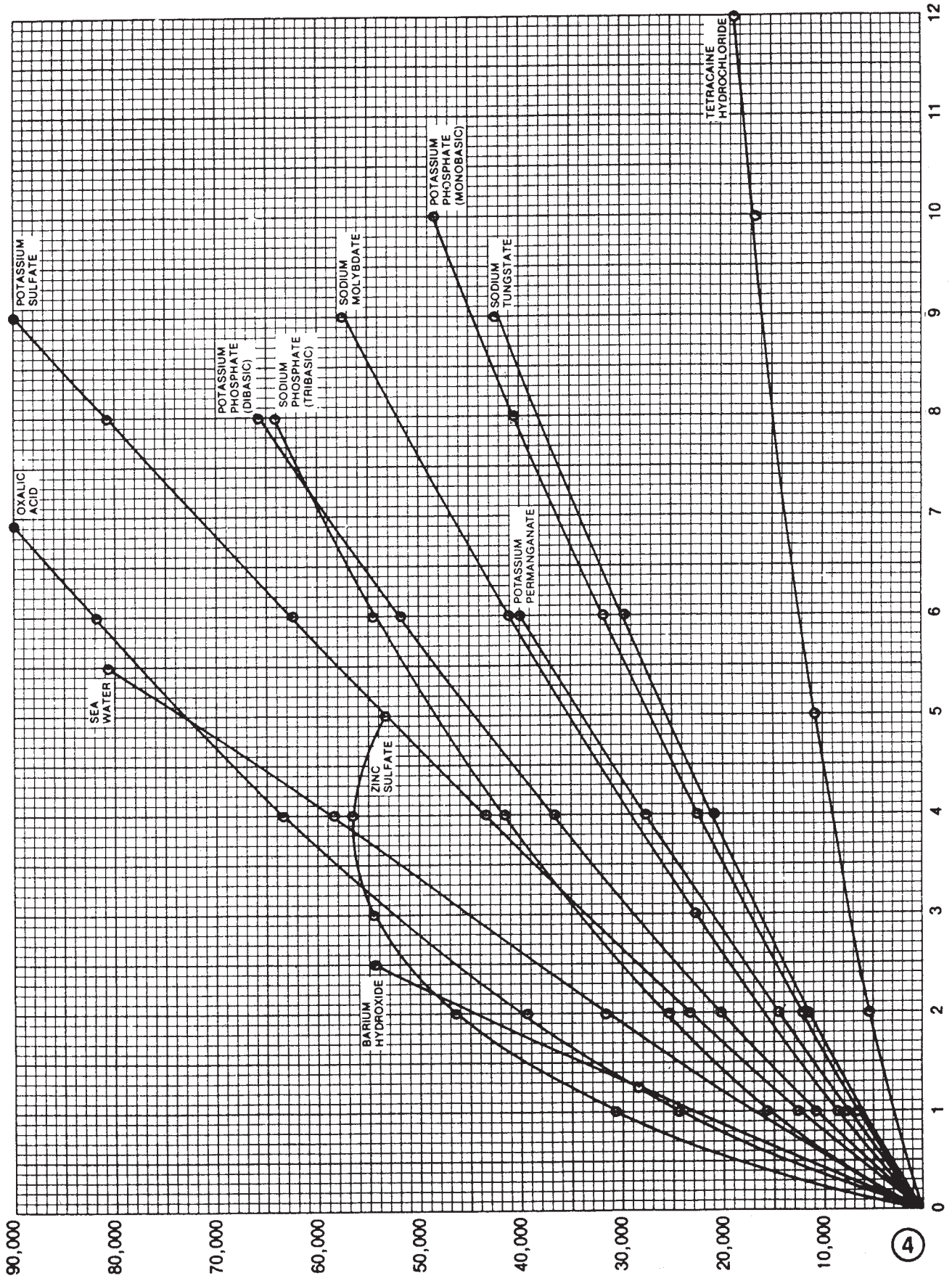
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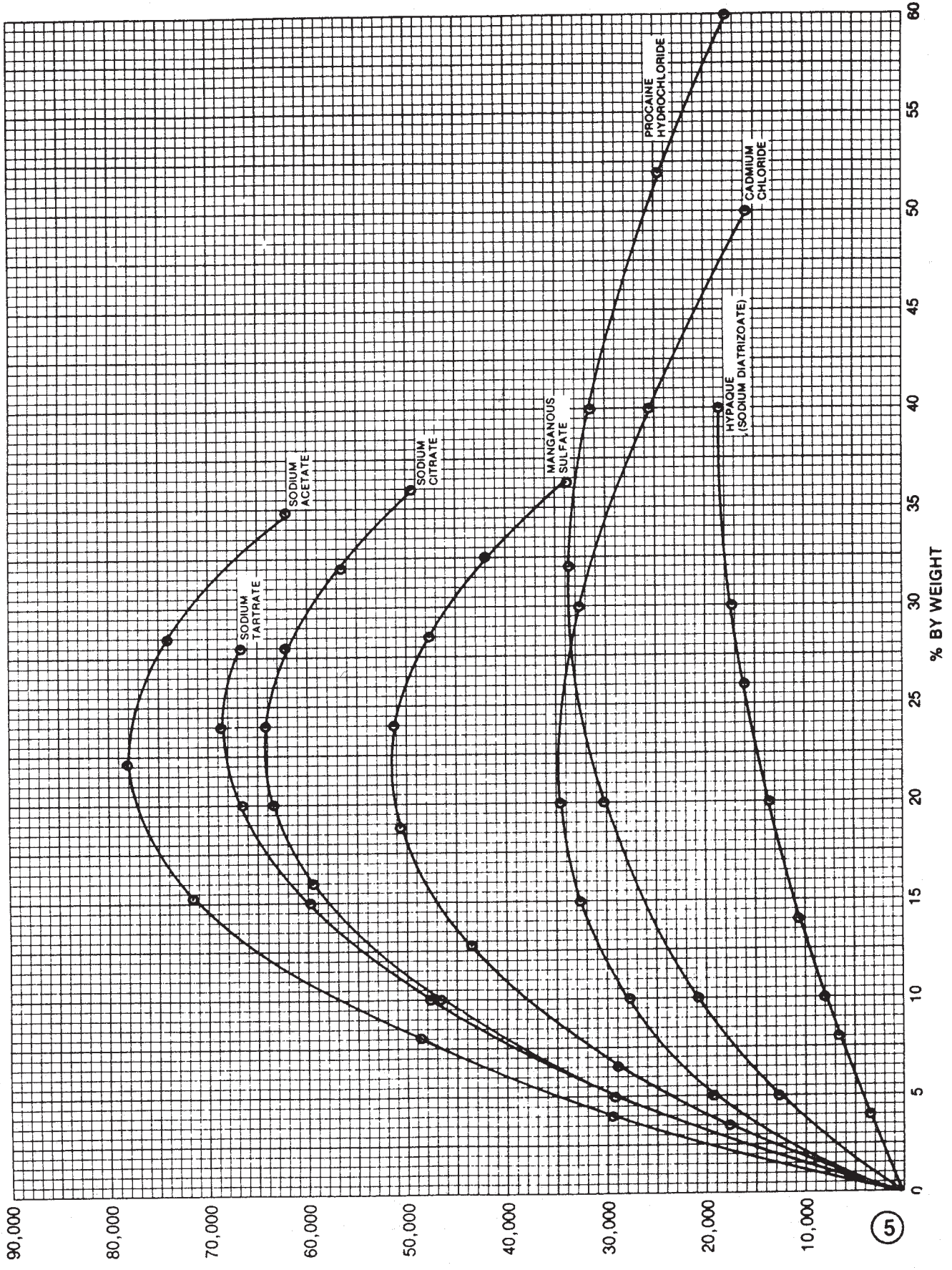


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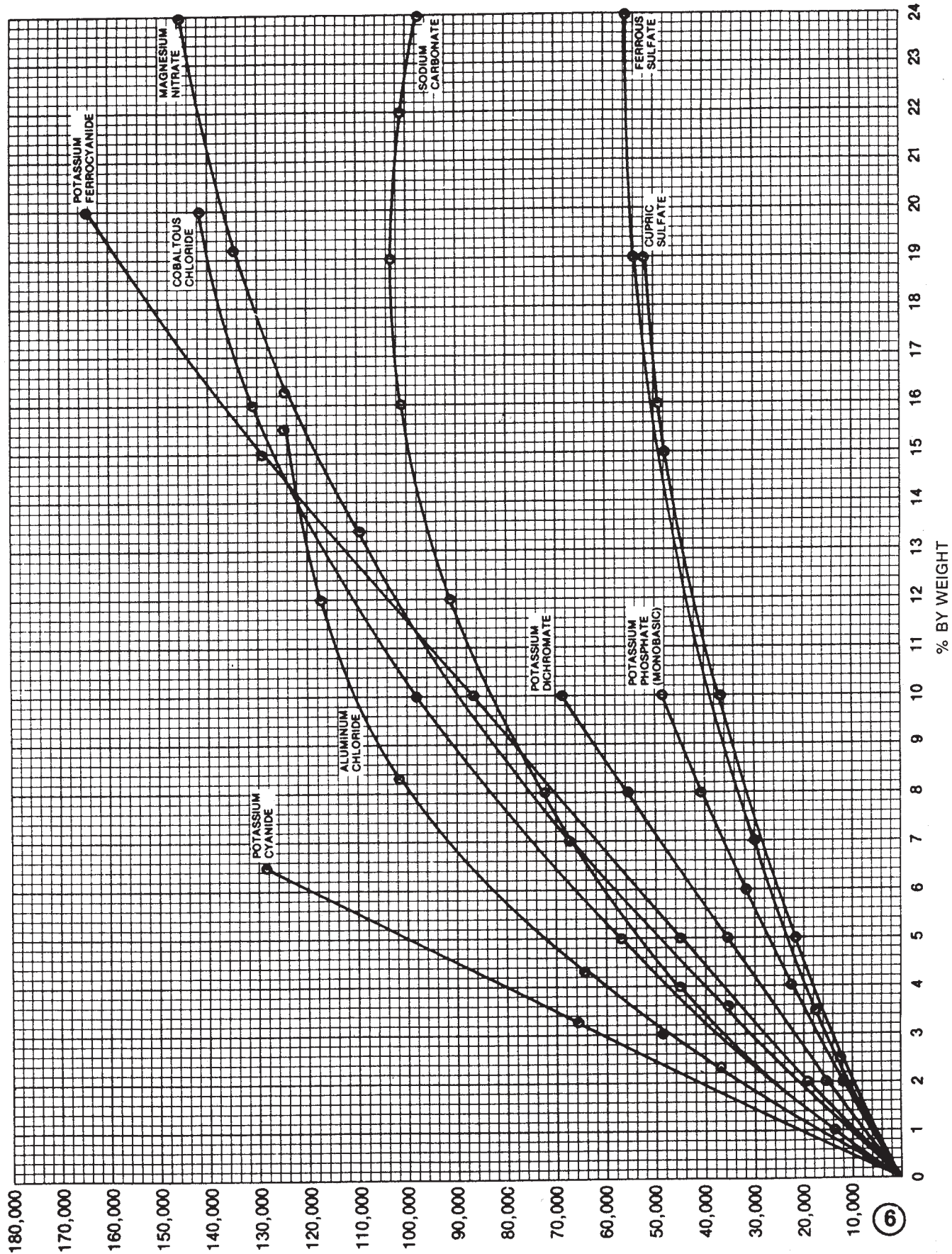
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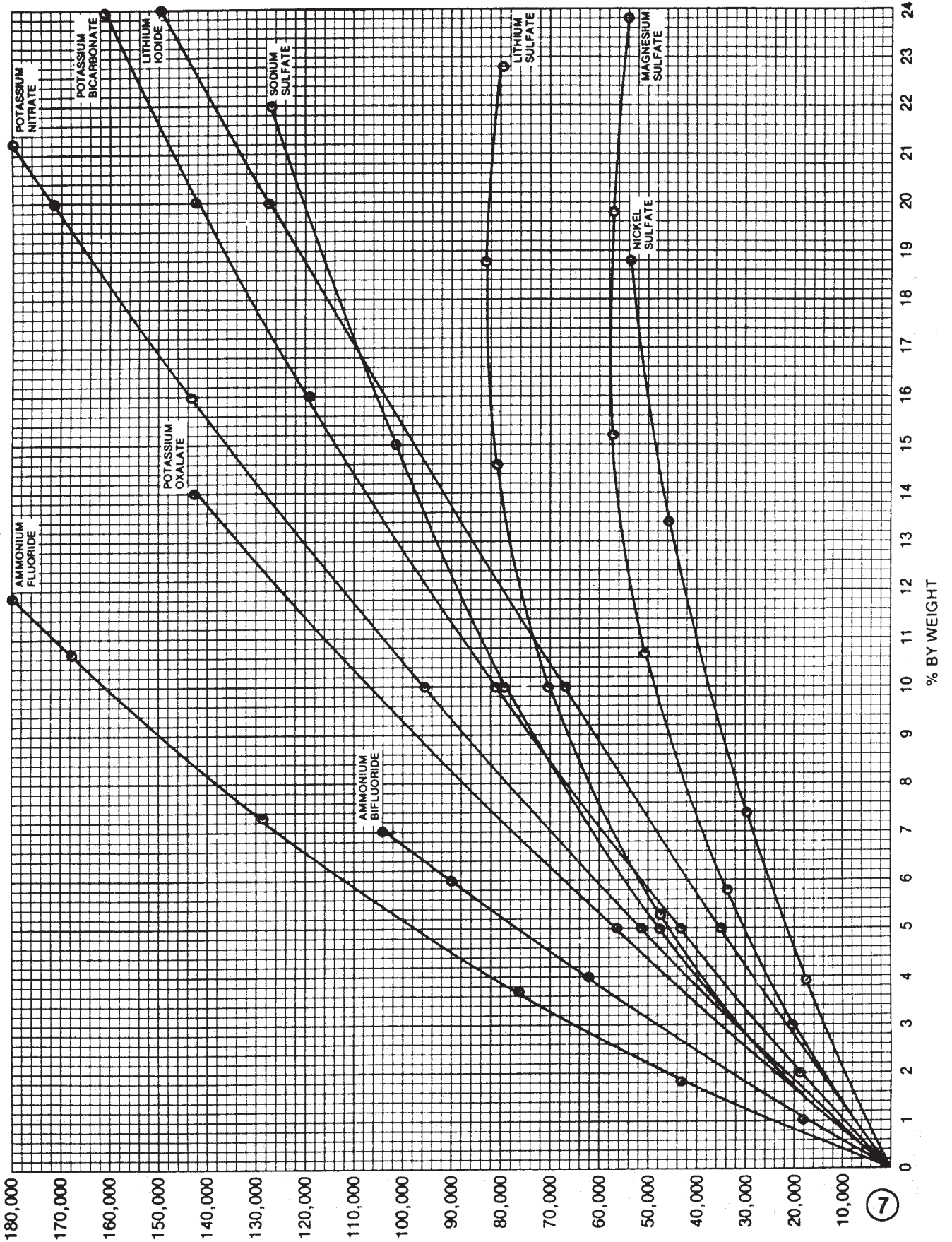


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MICROMHOS AT 25°C



MICROMHOS AT 25°C

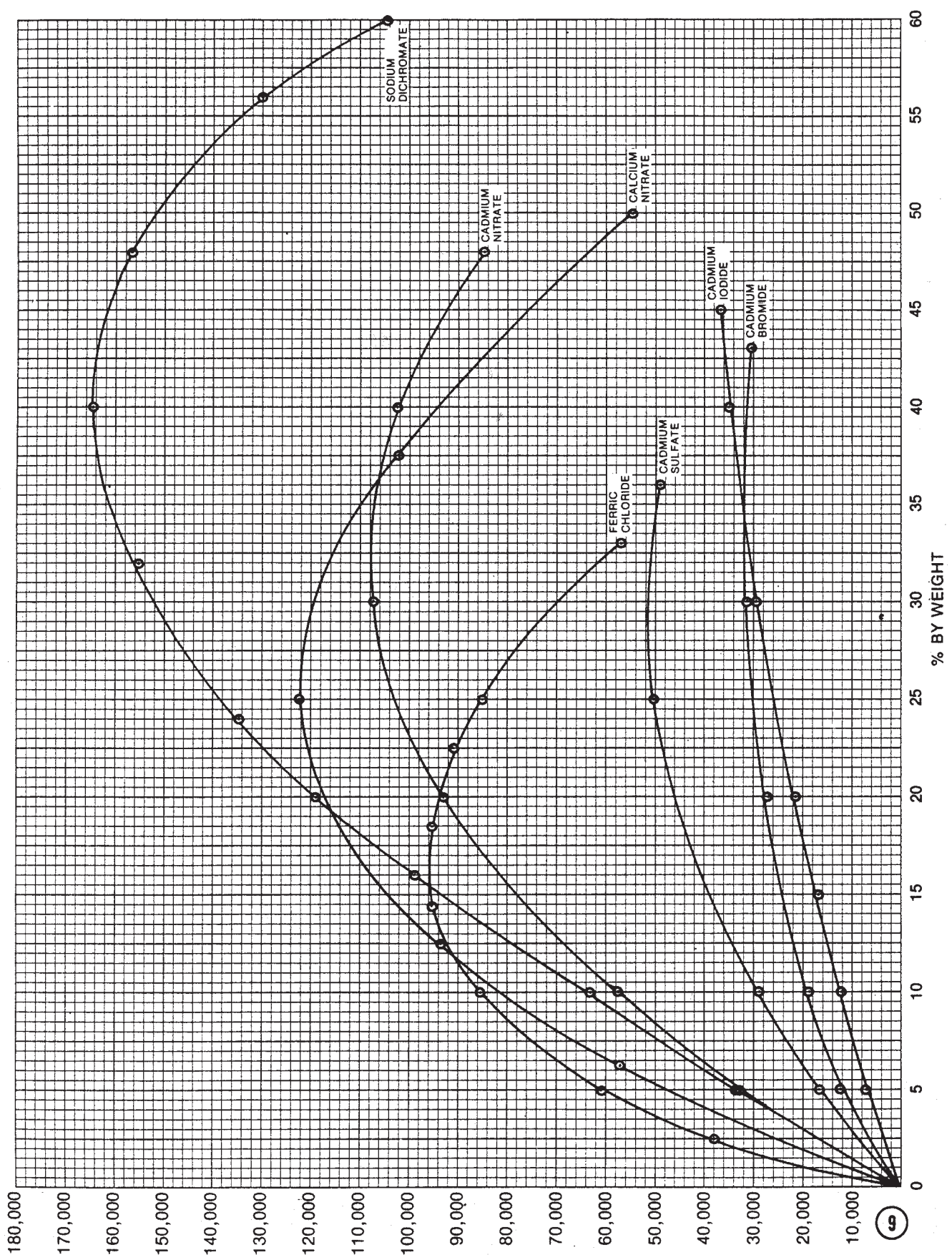


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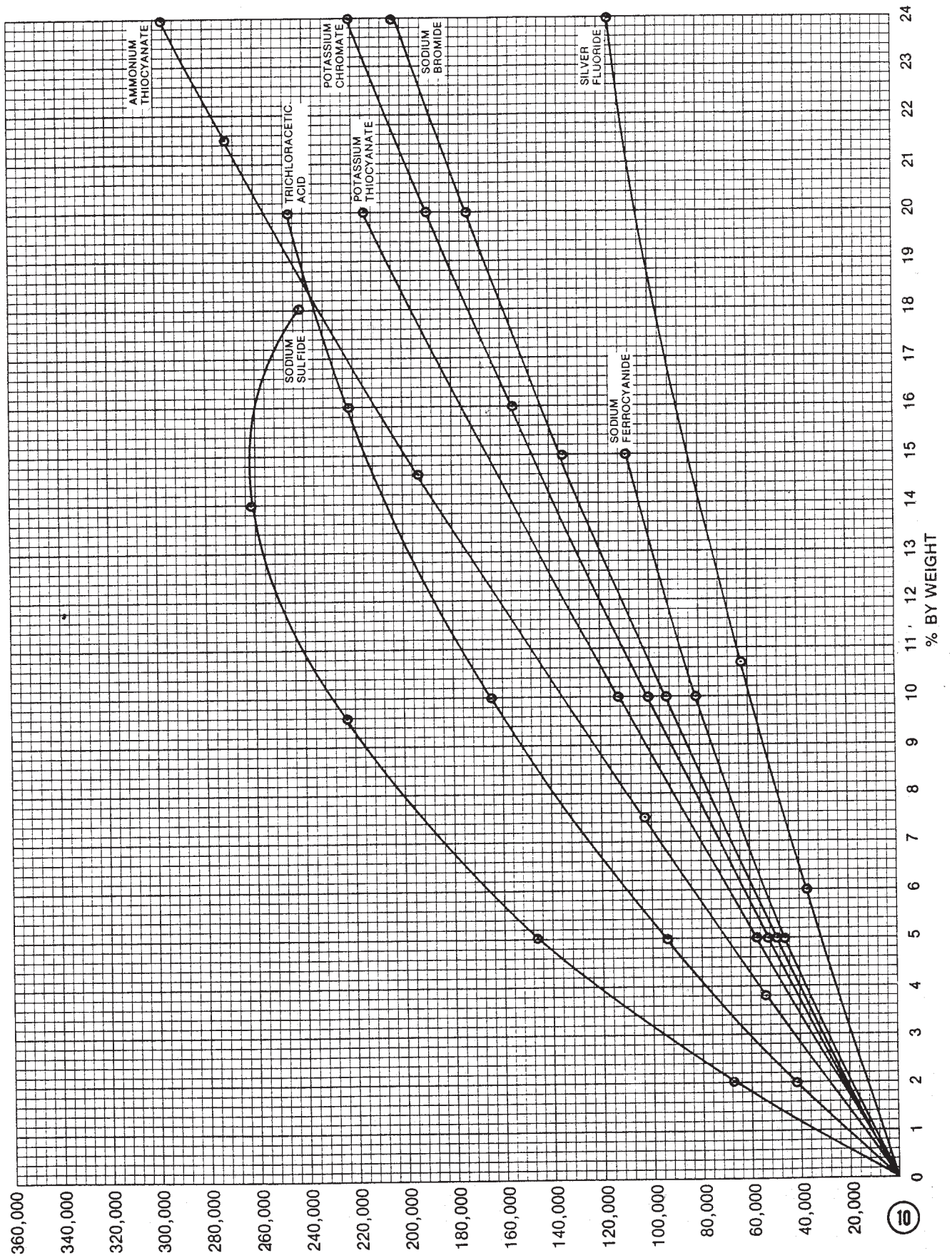
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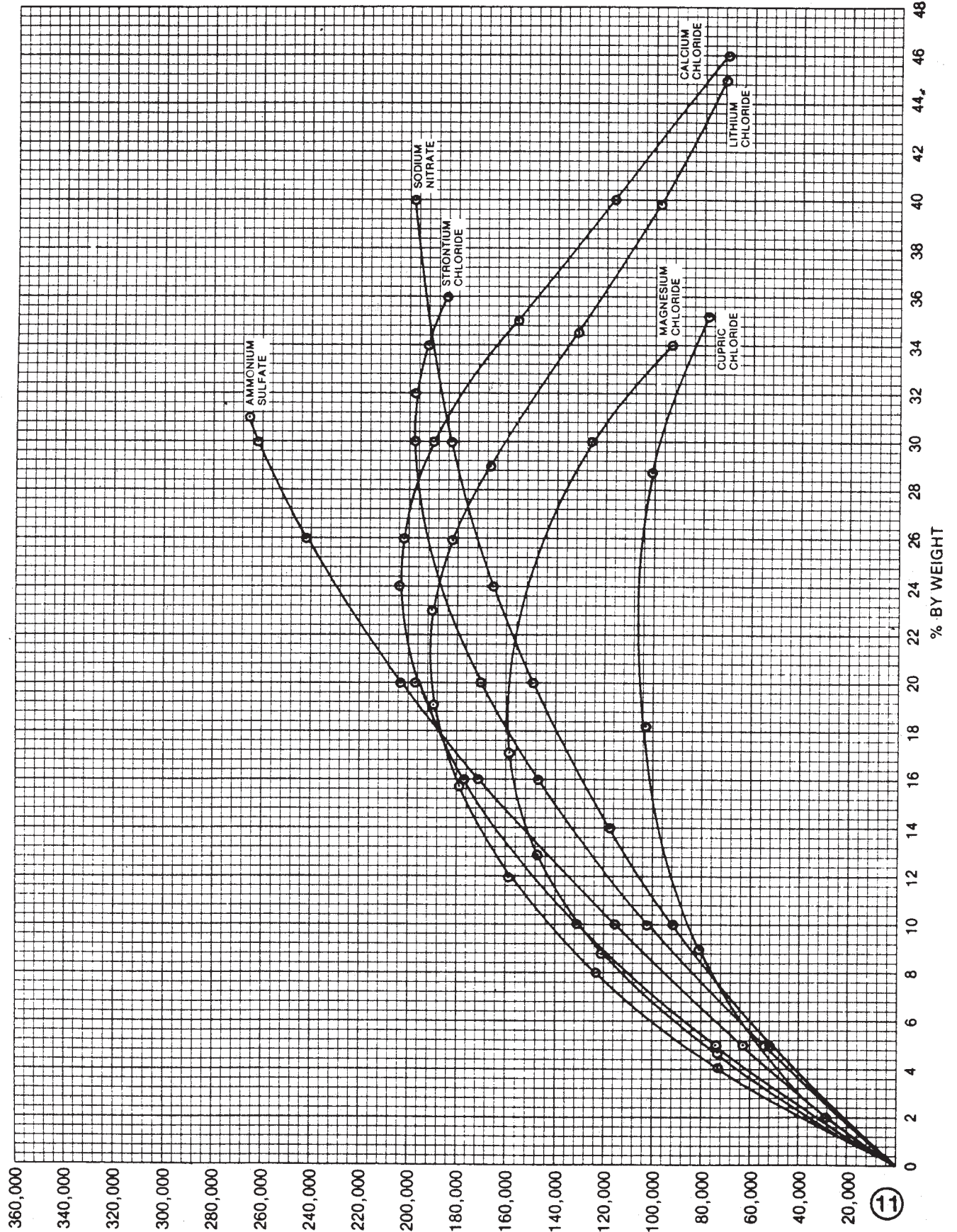
MICROMHOS AT 25°C



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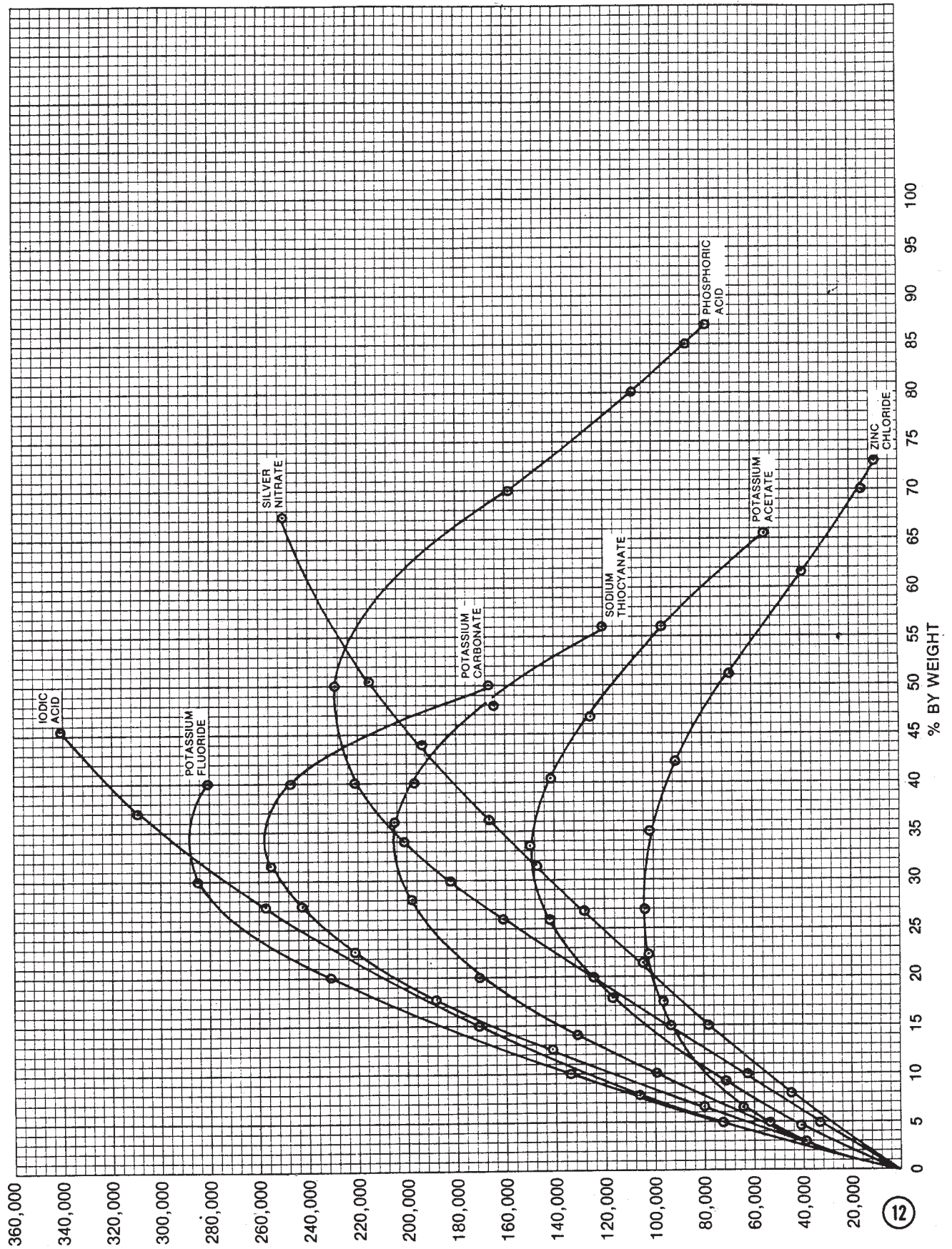


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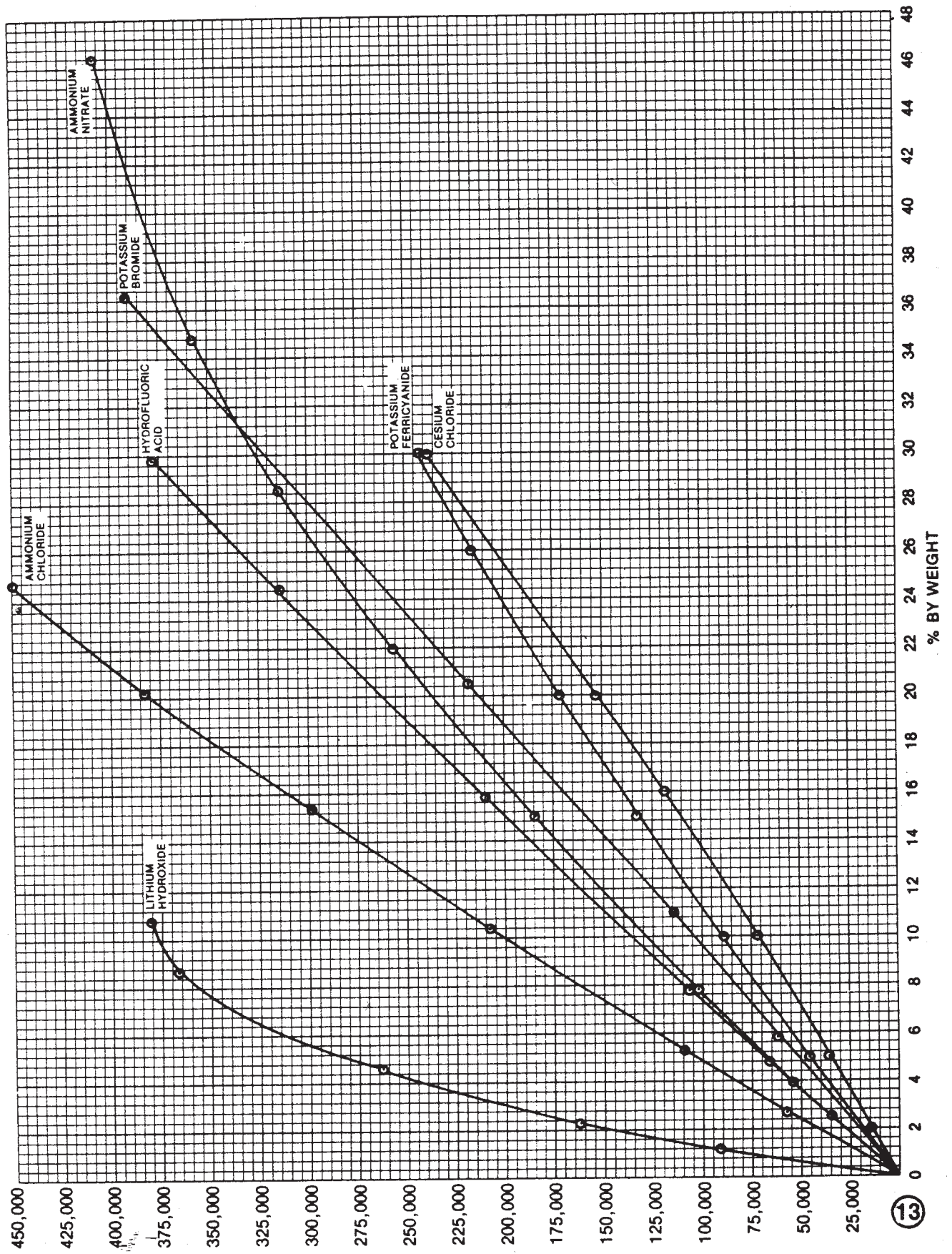
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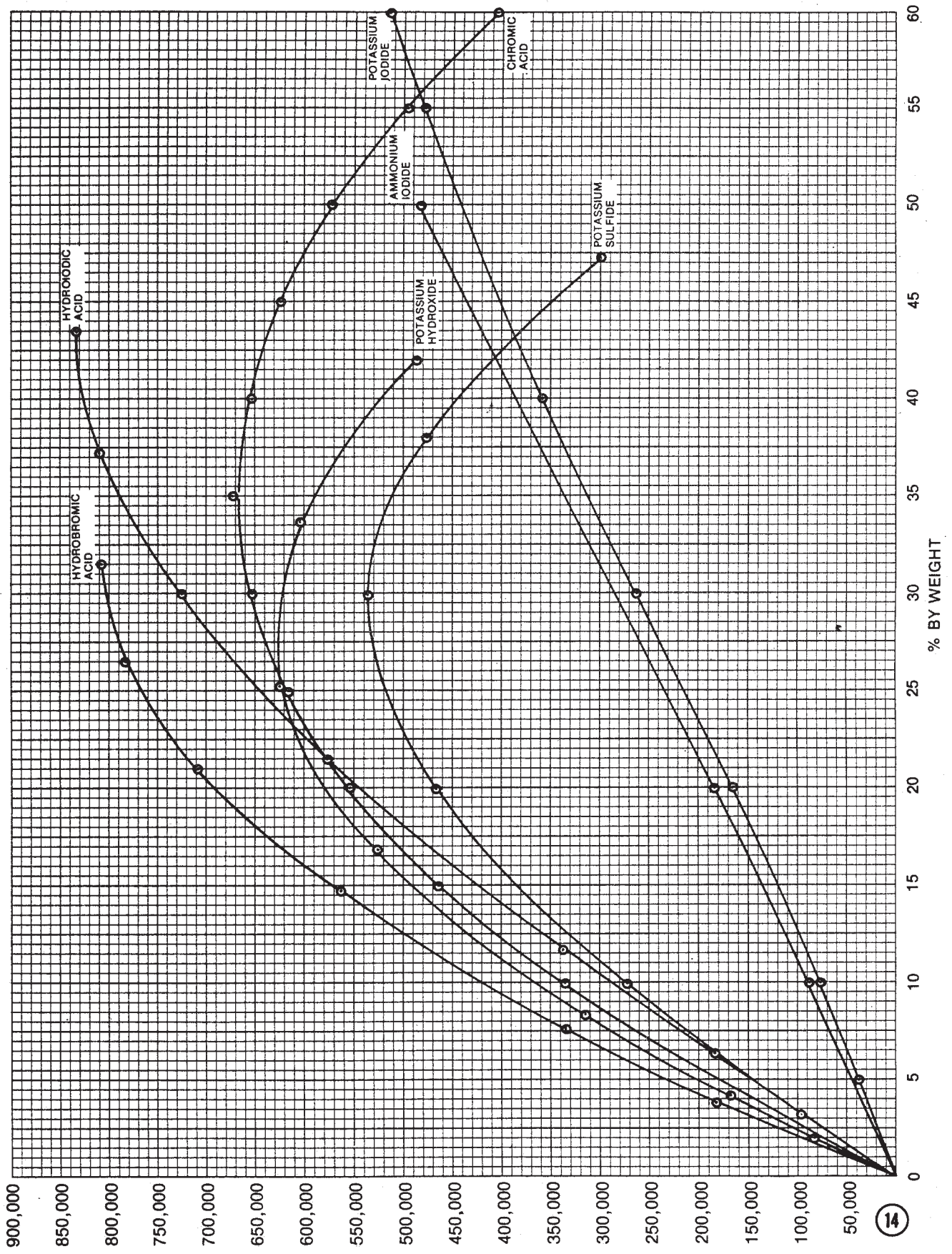
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MICROMHOS AT 25°C



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MICROMHOS AT 25°C



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**ELECTRICAL CONDUCTANCE OF SATURATED SOLUTIONS OF SLIGHTLY SOLUBLE
ELECTROLYTES (SALTS ARE CORRECTED FOR CONDUCTANCE OF WATER)**

(Data from *International Critical Tables*, Vol. VI)

SUBSTANCE	TEMP.°C	SOLUTION μMHOS/CM	SUBSTANCE	TEMP.°C	SOLUTION μMHOS/CM
AgBr	21.1	0.075	HgCl	24.6	2.13
AgBrO ₃	19.9	663.24	HgI ₂	18.0	0.2 (?)
AgCH ₃ COC(CN)CO ₂ C ₂ H ₅	25.0	251.5	La(IO ₃) ₃ •3H ₂ O	25.0	692
AgCl	25.0	1.794	La ₂ (C ₂ O ₄) ₃ •10H ₂ O	25.0	953
AgCN	20.0	19.0	La ₂ (C ₄ H ₄ O ₆) ₃ •3H ₂ O	25.0	58.5
Ag ₂ C ₂ O ₄	25.0	35.97	Li ₂ PO ₃ •3.5H ₂ O	25.0	274
Ag ₂ CrO ₄	25.0	26.61	Li ₃ PO ₄ •0.5H ₂ O	25.0	937
AgI	20.8	0.002	MgC ₂ O ₄	18.0	199.3
AgIO ₃	25.0	101.27	MgCO ₃	25.9	885.1
AgONC(CN)CO ₂ C ₂ H ₅	25.0	234.6	MgF ₂	27.0	270.7
AgONC(CN)CO ₂ CH(CH ₃) ₂	25.0	131.8	Mn(OH) ₂	18.0	9.49
AgOOCCH ₃	25.0	4,975	Nd ₂ (C ₂ O ₄) ₃ •10H ₂ O	25.0	0.764
AgOH	24.9	35.944	PbBr ₂	20.0	3,692
Ag ₃ PO ₄	19.5	6.1	Pb(BrO ₃) ₂	19.9	4,630.4
AgSCN	20.0	0.096	PbCO ₃	20.0	1.39
Agn-Propionate	25.0	1,924	PbC ₂ O ₄	22.0	1.54
Agdl-Tartrate	25.0	583.4	PbCl ₂	20.0	53,540
Ag d-Tartrate	25.0	989	PbF ₂	25.0	514
Ag l-Tartrate	25.0	1009	PbI ₂	20.1	338.4
Ag p-Toluate	25.0	251.7	Pb(IO ₃) ₂	25.0	8.75
Aragonite	25.0	41.0	Pb ₃ (PO ₄) ₂	20.0	0.14
Antipyrine Salicylate	18.0	1,000	Pb(SCN) ₂	20.0	5,346
BaCO ₃	18.0	25.475	PbSO ₄	25.0	40.3
BaCrO ₄	25.0	4.345	Pr ₂ (C ₂ O ₄) ₃ •10H ₂ O	25.0	1.164
BaC ₂ O ₄ •?H ₂ O	25.0	91.62	Sa ₂ (C ₂ O ₄) ₃	25.0	0.82
BaC ₂ O ₄ •2H ₂ O	25.0	108.6	SrF ₂	25.0	204.6
BaC ₂ O ₄ •3.5H ₂ O	18.0	94.91	SrC ₂ O ₄	25.0	70.79
BaSO ₄	25.0	2.923 (avg.)	SrSO ₄	25.0	147.4
Barite	25.0	3.517	TlBr	25.0	293.8
CaCO ₃	25.0	35.97	TlBrO ₃	19.9	1,079.
CaC ₂ O ₄ •H ₂ O	25.0	12.37	TlCl	25.0	2,160.
CaF ₂	26.1	50.55	TlC ₂ O ₄	20.0	5,341.
CaF ₂ (Fluorite)	25.0	45.81	TlI	25.0	36.64
CaSO ₄ •2H ₂ O	25.0	2,210	TlIO ₃	20.0	154.1
CdC ₂ O ₄ •3H ₂ O	25.0	36.22	TlSCN	20.0	1,399
Ce(IO ₃) ₃ •2H ₂ O	25.0	636.8	Tl ₂ S	20.0	216
Ce ₂ (C ₂ O ₄) ₃ •10H ₂ O	25.0	0.651	Y ₂ (C ₂ O ₄) ₃ •9H ₂ O	25.0	1.74
Ce ₂ (C ₄ H ₄ O ₆) ₃ •4.5H ₂ O	25.0	51.66	Yb ₂ (C ₂ O ₄) ₃ •10H ₂ O	25.0	4.849
CuI	24.6	2.128	ZnC ₂ O ₄ •2H ₂ O	25.0	10.21
CuSCN	18.0	0.4			
Calcite	25.0	33.8			
Celestite	25.0	147.4			

ELECTRICAL CONDUCTANCE OF VARIOUS PURE LIQUIDS

(Data from *Lange's Handbook of Chemistry, 12th edition*)

LIQUID	TEMP.°C	μMHOS/CM	LIQUID	TEMP.°C	μMHOS/CM
ACETALDEHYDE	15	1.7	DIETHYL OXALATE	25	.76
ACETAMIDE	100	<43	DIETHYL SULFATE	25	.26
ACETIC ACID	25	.0112	DIETHYLAMINE	-33.5	.0022
ACETIC ANHYDRIDE	25	.48	DIMETHYL SULFATE	0	.16
ACETONE	25	.06	EPICHLOROHYDRIN	25	.034
ACETONITRILE	20	7	ETHYL ACETATE	25	< .001
ACETOPHENONE	25	.006	ETHYL ACETOACETATE	25	.04
ACETYL BROMIDE	25	2.4	ETHYL ALCOHOL	25	.00135
ACETYL CHLORIDE	25	.4	ETHYL BENZOATE	25	<.001
ALIZARIN	233	1.45 (?)	ETHYL BROMIDE	25	< .02
ALLYL ALCOHOL	25	7	ETHYL ETHER	25	< 4x10 ⁻⁷
AMMONIA	-79	.13	ETHYL IODIDE	25	.02
ANILINE	25	.024	ETHYL ISOTHIOCYANATE	25	.126
ANTHRACENE	230	.0003	ETHYL NITRATE	25	.53
ARSENIC TRIBROMIDE	35	1.5	ETHYL THIOCYANATE	25	1.2
ARSENIC TRICHLORIDE	25	1.2	ETHYLAMINE	0	.4
BENZALDEHYDE	25	.15	ETHYLENE BROMIDE	19	<.0002
BENZENE	—	.076	ETHYLENE CHLORIDE	25	.03
BENZOIC ACID	125	.003	ETHYLIDENE CHLORIDE	25	<.17
BENZONITRILE	25	.05	EUGENOL	25	.17
BENZYL ALCOHOL	25	1.8	FORMAMIDE	25	4
BENZYL BENZOATE	25	<.001	FORMIC ACID	25	64
BENZYLAMINE	25	<.017	FURFURAL	25	1.5
BROMINE	17.2	1.3 x 10 ⁻⁷	GALLIUM	30	36,800 mhos
BROMOBENZENE	25	<.00002	GERMANIUM TETRABROMIDE	30	78
BROMOFORM	25	<.02	GLYCEROL	25	.064
CAPRONITRILE	25	3.7	GLYCOL	25	.3
CARBON DISULFIDE	1	7.8 x 10 ⁻¹²	GUAIACOL	25	.28
CARBON TETRACHLORIDE	18	4 x 10 ⁻¹²	HEPTANE	20	<1x10 ⁻⁷
CHLORINE	-70	<1 x 10 ⁻¹⁰	HEXANE	18	<1x10 ⁻¹²
CHLOROACETIC ACID	60	1.4	HYDROGEN BROMIDE	-80	.008
CHLOROFORM	25	<.02	HYDROGEN CHLORIDE	-96	.01
CHLOROHYDRIN	25	.5	HYDROGEN CYANIDE	0	3.3
CYANOGEN	-	<.007	HYDROGEN IODIDE	-35	.2
CYMENE	25	<.02	HYDROGEN SULFIDE	-60	.00001
DICHLOROACETIC ACID	25	.07	IODINE	110	.00013
DICHLOROHYDRIN	25	12	iso-BUTYLALCOHOL	25	.08
DIETHYL CARBONATE	25	.017			

ELECTRICAL CONDUCTANCE OF VARIOUS PURE LIQUIDS

(Data from *Lange's Handbook of Chemistry, 12th edition*)

LIQUID	TEMP.°C	μMHOS/CM	LIQUID	TEMP.°C	μMHOS/CM
KEROSENE	25	<.017	n-PROPYL ALCOHOL	25	.02
m-CHLOROANILINE	25	.05	iso-PROPYL ALCOHOL	25	3.5
m-CRESOL	25	<.017	n-PROPYL BROMIDE	25	< .02
MERCURY	0	10,629.6 mhos	PYRIDINE	18	.053
METHYL ACETATE	25	3.4	QUINOLINE	25	.022
METHYL ALCOHOL	18	.44	SALICYLALDEHYDE	25	.16
METHYL IODIDE	25	<.02	STEARIC ACID	80	< 4x10 ⁻⁷
METHYL NITRATE	25	4.5	SULFONYL CHLORIDE	25	2
METHYL THIOCYANATE	25	1.5	SULFUR	115	1x10 ⁻⁶
METHYLETHYL KETONE	25	.1	SULFUR	130	5x10 ⁻⁵
NAPHTHALENE	82	.0004	SULFUR	440	.12
NITROBENZENE	0	.005	SULFUR DIOXIDE	35	.015
NITROMETHANE	18	.6	SULFURIC ACID	25	10000
NONANE	25	<.017	SULFURYL CHLORIDE	25	.03
o- or m- NITROTOLUENE	25'	<.2	TOLUENE	—	< 1x10 ⁻⁸
OLEIC ACID	15	<.0002	o-TOLUIDINE	25	< 2
PENTANE	19.5	<.0002	p-TOLUIDINE	100	.062
PETROLEUM	—	3 x 10 ⁻⁷	TRICHLOROACETIC ACID	25	.003
PHENETOLE	25	<.017	TRIMETHYLAMINE	-33.5	.00022
PHENOL	25	<.017	TURPENTINE	—	2 x 10 ⁻⁷
PHENYL ISOTHIOCYANATE	25	1.4	iso-VALERIC ACID	80	<4 x 10 ⁻⁷
PHOSGENE	25	.007	WATER	18	.044
PHOSPHORUS	25	.4	XYLENE	—	1.43 x 10 ⁻¹¹
PHOSPHORUS OXYCHLORIDE	25	2.2			
PINENE	23	<.0002			
PIPERIDENE	25	< .2			
PROPIONALDEHYDE	25	.85			
PROPIONIC ACID	25	<.001			
PROPIONITRILE	25	< .1			

SUMMARY OF FORMULAE, CONVERSION DATA AND MISCELLANEOUS INFORMATION

1. To obtain the conductance at temperatures other than reference when the temperature coefficient is known:

$$C_T = C_R [1 + tc (T - T_R)] \text{ for the general case.}$$

$$C_T = C_R [1 + tc (T - 25)] \text{ for } 25^\circ\text{C reference.}$$

T = temperature of interest T_R = reference temperature

tc = temperature coefficient C_T = conductivity at temperature of interest

C_R = conductivity at reference C₂₅ = conductivity at 25°C

2. To obtain the conductance at 25°C when conductance values at two other temperatures are known:

$$C_{25} = [C_{T2}(T_1 - 25) - C_{T1}(T_2 - 25)] / (T_1 - T_2)$$

3. To obtain the temperature coefficient, referenced to 25°C, when the conductance at any two temperatures is known:

$$tc = (C_{T1} - C_{T2}) / [C_{T2}(T_1 - 25) - C_{T1}(T_2 - 25)]$$

4. Centigrade - Fahrenheit conversion:

$$^\circ\text{C} = 5/9(^\circ\text{F} - 32) \quad ^\circ\text{F} = 9/5(^\circ\text{C}) + 32$$

A rule-of-thumb method for making the conversion is to recall the easily remembered values at freezing and

boiling, and that a change of 5°C is matched by a change of 9°F. Thus, 35°C is seven "increments" above freezing. Multiply the seven by the Fahrenheit "increments" of 9 to obtain a Fahrenheit reading that is 63 degrees above freezing, or 95°F.

5. Concentration conversions:

Multiply the original concentration value by the conversion factor shown.

6. Resistance values to simulate contacting (electrode) sensor:

$$\text{Resistance(ohms)} = \frac{\text{Cell Constant} \times 10^6}{\mu\text{mhos of solution at } 25^\circ\text{C}}$$

7. For a 1.0 cell constant:

Conductance, μmhos	Resistance, ohms
1	1,000,000
10	100,000
100	10,000
1,000	1,000
10,000	100
100,000	10
1,000,000	1

Here is an easy way to remember it — there are always a total of six zeros in the conductance/ resistance combination for the even decade values shown. So, 100 umhos, having two, will require a resistance with four, which is 10,000 ohms.

FROM	Weight Conc.	Molarity	Molality	Weight%
TO Weight Conc.	$\frac{\text{Grams Solute}}{\text{Liter solution}}$	Wm	$\frac{10^3 p Wm}{10^3 + C Wm}$	10p
Molarity	$\frac{1}{Wm}$	$\frac{\text{Moles solute}}{\text{Liter Solution}}$	$\frac{10^3 p}{10^3 + C Wm}$	$\frac{10p}{Wm}$
Molality	$\frac{10^3}{Wm(10^3 p - Wc)}$	$\frac{10^3}{10^3 p - M Wm}$	$\frac{\text{Moles Solute}}{1000 \text{ Grams Solvent}}$	$\frac{10^3}{Wm(10^2 - W\%)}$
Weight %	$\frac{1}{10p}$	$\frac{Wm}{10p}$	$\frac{10^2 Wm}{10^3 + C Wm}$	$\frac{\text{Grams Solute}}{100 \text{ Grams Solution}}$
ppm = W% x 10 ⁴		Normality = Molarity x Equivalents per mole		

Wm = Molecular weight of solute (g)

Wc = Weight concentration

M = Molality

p = Solution density (g/cm³)

W% = Weight %

C = Molarity

TABLE OF THE ELEMENTS

NAME	SYMBOL	ATOMIC WEIGHT	NAME	SYMBOL	ATOMIC WEIGHT
Actinium	Ac	(227)	Mercury	Hg	200.59
Aluminum	Al	26.9815	Molybdenum	Mo	95.94
Americium	Am	(243)	Neodymium	Nd	144.24
Antimony	Sb	121.75	Neon	Ne	20.179
Argon	Ar	39.948	Neptunium	Np	237.0482
Arsenic	As	74.9216	Nickel	Ni	58.71
Astatine	At	(210)	Niobium	Nb	92.9064
Barium	Ba	137.34	Nitrogen	N	14.0067
Berkelium	Bk	(245)	Nobelium	No	(254)
Beryllium	Be	9.01218	Osmium	Os	190.2
Bismuth	Bi	208.9806	Oxygen	O	15.9994
Boron	B	10.81	Palladium	Pd	106.4
Bromine	Br	79.904	Phosphorus	P	30.9738
Cadmium	Cd	112.40	Platinum	Pt	195.09
Calcium	Ca	40.08	Plutonium	Pu	239.05
Californium	Cf	(248)	Polonium	Po	210
Carbon	C	12.011	Potassium	K	39.102
Cerium	Ce	140.12	Praseodymium	Pr	140.9077
Cesium	Cs	132.9055	Promethium	Pm	(147)
Chlorine	Cl	35.453	Protactinium	Pa	231.0359
Chromium	Cr	51.996	Radium	Ra	226.0254
Cobalt	Co	58.9332	Radon	Rn	(222)
Copper	Cu	63.546	Rhenium	Re	186.2
Curium	Cm	(247)	Rhodium	Rh	102.9055
Dysprosium	Dy	162.50	Rubidium	Rb	85.4678
Einsteinium	Es	(254)	Ruthenium	Ru	101.07
Erbium	Er	167.26	Samarium	Sm	150.4
Europium	Eu	151.96	Scandium	Sc	44.9559
Fermium	Fm	(253)	Selenium	Se	78.96
Fluorine	F	18.9984	Silicon	Si	28.086
Francium	Fr	(223)	Silver	Ag	107.868
Gadolinium	Gd	157.25	Sodium	Na	22.9898
Gallium	Ga	69.72	Strontium	Sr	87.62
Germanium	Ge	72.59	Sulfur	S	32.06
Gold	Au	196.9665	Tantalum	Ta	180.9479
Hafnium	Hf	178.49	Technetium	Tc	98.9062
Helium	He	4.00260	Tellurium	Te	127.60
Holmium	Ho	164.9303	Terbium	Tb	158.9254
Hydrogen	H	1.0080	Thallium	Tl	204.37
Indium	In	114.82	Thorium	Th	232.0381
Iodine	I	126.9045	Thulium	Tm	168.9342
Iridium	Ir	192.22	Tin	Sn	118.69
Iron	Fe	55.847	Titanium	Ti	47.90
Krypton	Kr	83.80	Tungsten (Wolfram)	W	183.85
Lanthanum	La	138.9055	Uranium	U	238.029
Lawrencium	Lr	(257)	Vanadium	V	50.9414
Lead	Pb	207.2	Xenon	Xe	131.30
Lithium	Li	6.941	Ytterbium	Yb	173.04
Lutetium	Lu	174.97	Yttrium	Y	88.9059
Magnesium	Mg	24.305	Zinc	Zn	65.37
Manganese	Mn	54.9380	Zirconium	Zr	91.22
Mendelevium	Md	(256)			

CONDUCTANCE IN DILUTE AQUEOUS SOLUTIONS

(Data obtained from *Handbook of Electrochemical, Constants*,
Parsons; Academic Press/Butterworths, 1959)

Conductance values at lower concentrations can be approximately determined by use of the following formula:

$$\text{Specific Conductance at } 25^{\circ}\text{C} \approx 1000 C A_0 (1 - a \sqrt{C} + bC)$$

A_0 , a and b are obtained from the tables that follow.

$$C = \text{Normality} \approx \frac{\text{Parts Per million concentration}}{1000 \times \text{Equivalent weight}}$$

The equivalent weight may be obtained from the tables also. The formula is useful for values of C between 0.0001 and 0.1 only. No allowance was made for solution density as it will be near that of pure water at lower concentrations. However, if it is known and greater accuracy is desired, simply multiply the value already calculated for C times the density to obtain a more precise answer. If normality is known, rather than ppm or wt. %, use it directly for C .

Example 1: What is the specific conductance of a 10,000 ppm solution of silver nitrate at 25°C ?

$$C \approx 10,000 / (1000 \times 169.89) = .05886$$

$$\begin{aligned} \text{Specific Conductance} \\ \approx 1000 (.05886) (133.3) [(1 - .68 \sqrt{.05886} + .35(.05886))] \\ \approx 6,713 \text{ mhos/cm} \end{aligned}$$

How much would density correction affect the reading?
The relative density at 10,000 ppm is 1.007 (at 20°C).

$$\begin{aligned} C &= 10,000 (1.007) / (1000 \times 169.89) = \\ &.05927 \text{ Corrected for density} \end{aligned}$$

$$\begin{aligned} \text{Specific conductance} \\ \approx 1000 (.05927) (133.3) [(1 - .68 \sqrt{.05927} + \\ .35(.05886))] \\ \approx 6,757 \text{ mhos} \end{aligned}$$

The error due to no density correction was less than 1%.

Example 2: What is the specific conductance of a 0.01 N solution of KCl at 25°C ?

$$\begin{aligned} \text{Specific Conductance} \approx \\ 1000 (.01) (149.8) [1 - .63 \sqrt{.01} + .64 (0.1)] \\ \approx 1,413 \text{ umhos/cm} \end{aligned}$$

Because C was given as normality, no density correction is necessary. Referring to the table of conductance values for standard KCl solutions, the measured value at 0.01N is 1411 umhos/cm. The calculated value of 1413 is, thus, in error by less than two-tenths of one percent. Not all calculations will be this close, but this approximation will be more than adequate for most industrial applications.

Specific Conductance (25°C) \approx 1000 CAo (1-a \sqrt{C} + bC) where .0001 C .1

C = Normality = ppm concentration/(1000 x equivalent weight)

(Multiply ppm x density for greater accuracy.)

Substance	Equivalent Weight	Ao(25°C)	a	b	Min./Max. ppm for use of Formula
AgMnO ₄	226.81	122	0.72	2.0	20 - 23,000
AgNO ₃	169.87	133.3	0.68	0.35	16 - 17,000
Ag ₂ SO ₄	155.90	142	1.30	-3.5	15 - 16,000
AlBr ₃	88.90	139	1.64	2.2	8 - 9,000
AlCl ₃	44.45	137.6	1.65	2.0	4 - 5,000
All ₃	135.90	137.6	1.66	3.1	13 - 14,000
Al(NO ₃) ₃	71.00	129.5	1.72	2.2	7 - 8,000
BaAc ₂	127.72	104.2	1.59	1.7	12 - 13,000
BaBr ₂	148.58	141.1	1.28	1.78	14 - 15,000
Ba(BrO ₃) ₂	196.57	118	1.44	1.4	19 - 20,000
BaCl ₂	104.13	139.5	1.28	1.74	10 - 11,000
Bal ₂	195.58	141	1.28	2.7	19 - 20,000
Ba(MnO ₄) ₂	187.61	119	1.42	1.4	18 - 19,000
Ba(NO ₃) ₂	130.68	132	1.34	1.2	13 - 14,000
Ba(OH) ₂	85.68	256	0.88	0.0	8 - 9,000
CaBr ₂	99.95	133.0	1.32	2.1	9 - 10,000
CaCl ₂	55.50	135.6	1.3	1.8	5 - 6,000
Ca ₂ Fe(CN) ₆	73.03	118	5.47	11.0	7 - 8,000
Ca ₃ [Fe(CN) ₆] ₂	90.71	138	3.87	7.2	9 - 10,000
Ca(NO ₃) ₂	82.05	130.0	1.35	2.0	8 - 9,000
CaSO ₄	68.07	104	2.9	3.6	6 - 7,000
CdBr ₂	136.11	97	1.73	0.95	13 - 14,000
CdCl ₂	91.66	104	1.65	0.9	9 - 10,000
Cdl ₂	183.11	77	2.02	1.38	18 - 19,000
CdSO ₄	104.23	105	2.89	3.7	10 - 11,000
CoAc ₂	118.04	90.1	1.74	1.4	11 - 12,000
CoBr ₂	109.38	126	1.35	1.9	10 - 11,000
CoCl ₂	64.92	124.5	1.37	1.2	6 - 7,000
Co(NO ₃) ₂	91.47	122.4	1.39	2.0	9 - 10,000
CoSO ₄	77.50	100	2.07	1.65	7 - 8,000
CsCl	168.40	154.6	0.62	-0.7	16 - 17,000
CsOH	74.96	271	0.45	0.5	7 - 8,000
CuAc ₂	90.82	60	2.36	2.2	9 - 10,000
CuBr ₂	71.73	134	1.31	1.6	7 - 8,000
CuCl ₂	67.22	131	1.33	1.5	6 - 7,000
Cu(NO ₃) ₂	93.78	128.8	1.38	1.7	9 - 10,000
CuSO ₄	79.80	113	2.79	3.3	7 - 8,000
FeCl ₂	63.38	137	1.34	1.05	6 - 7,000
FeSO ₄	75.97	99	2.08	1.7	7 - 8,000
GdBr ₃	132.33	139.9	1.63	3.2	13 - 14,000
GdCl ₃	87.87	140	1.63	2.5	8 - 9,000
Gdl ₃	179.32	139	1.64	4.0	17 - 18,000
HBr	80.92	429.4	0.37	0.35	8 - 9,000
HBrO ₃	128.92	408	0.37	-5.0	12 - 13,000
HCNS	59.09	404	0.38	0.37	5 - 6,000
HCl	36.46	426.0	0.37	0.38	3 - 4,000
HClO ₃	84.46	408	0.36	0.4	8 - 9,000
HClO ₄	100.46	417	0.37	0.4	10 - 11,000
H ₂ CrO ₄	59.01	207	0.97	2.2	5 - 6,000
HI	127.91	428	0.37	0.42	12 - 13,000
HIO ₃	175.91	391.2	0.38	-4.7	17 - 18,000
HMnO ₄	119.95	410	0.38	0.2	11 - 12,000
HNO ₃	63.01	420	0.37	0.36	6 - 7,000
KAc	98.15	115.4	0.75	1.3	9 - 10,000

Substance	Equivalent Weight	Ao(25°C)	a	b	Min./Max. ppm for use of Formula
KBr	119.01	151.7	0.62	0.62	11 - 12,000
KBrO ₃	167.01	129.4	0.69	0.48	16 - 17,000
KCNS	97.18	140.0	0.65	0.63	9 - 10,000
KCl	74.56	149.8	0.63	0.64	7 - 8,000
KClO ₃	122.55	138.7	0.66	0.4	12 - 13,000
K ₂ CrO ₄	97.10	156	1.22	1.3	9 - 10,000
KF	58.10	128	0.70	0.5	5 - 6,000
K ₄ Fe(CN) ₆	92.09	169	2.48	3.6	9 - 10,000
K ₃ Fe(CN) ₆	109.75	167.8	1.56	1.8	10 - 11,000
K ₂ Fe(CN) ₅ NO	147.07	136.4	1.32	1.9	14 - 15,000
KI	166.01	150.8	0.63	0.62	16 - 17,000
KIO ₃	214.00	115	0.53	0.4	20 - 22,000
KMnO ₄	158.04	136	0.67	0.5	15 - 16,000
KNO ₃	101.11	144.5	0.64	0.36	10 - 11,000
KOH	56.11	271	0.45	0.4	5 - 6,000
K ₂ SO ₄	87.14	151.4	1.24	1.14	8 - 9,000
LiBr	86.85	121.4	0.72	0.5	8 - 9,000
LiCl	42.39	115	0.75	0.78	4 - 5,000
LiClO ₃	90.39	104.1	0.81	0.3	9 - 10,000
Li ₂ CrO ₄	64.93	123.6	1.46	1.5	6 - 7,000
LiI	133.84	117.7	0.74	0.8	13 - 14,000
LiNO ₃	68.94	111	0.77	0.45	6 - 7,000
LiOH	23.95	236.5	0.48	0.5	2 - 3,000
Li ₂ SO ₄	54.97	119.2	1.48	1.4	5 - 6,000
MgBr ₂	92.07	129	1.34	2.2	9 - 10,000
MgCrO ₄	70.15	125	2.64	3.2	7 - 8,000
Mg ₂ Fe(CN) ₆	65.14	172	4.75	13	6 - 7,000
Mg(NO ₃) ₂	74.16	129.0	1.35	1.8	7 - 8,000
Mg(OH) ₂	29.17	257	0.87	2.1	2 - 3,000
MgSO ₄	60.19	116	2.75	3.7	6 - 6,000
MnBr ₂	107.38	128	1.34	1.7	10 - 11,000
MnCl ₂	62.92	126	1.36	1.6	6 - 7,000
MnSO ₄	75.50	109	2.84	3.8	7 - 8,000
NH ₄ Br	97.95	155	0.62	0.60	9 - 10,000
NH ₄ CNS	76.12	140.8	0.65	0.5	7 - 8,000
NH ₄ Cl	53.49	150.5	0.63	0.49	5 - 6,000
NH ₄ IO ₃	192.94	117	0.74	0	19 - 20,000
NH ₄ Pic	246.14	104.4	0.80	0.9	24 - 25,000
(NH ₄) ₂ SO ₄	66.07	149.9	1.25	1.1	6 - 7,000
NaAc	82.03	91.1	0.89	0.34	8 - 9,000
NaBr	102.90	126.0	0.70	0.5	10 - 11,000
NaBrO ₃	150.90	106.1	0.79	0.60	15 - 16,000
NaCNS	81.07	110.5	0.77	0.75	8 - 9,000
Na ₂ CO ₃	53.00	124.1	1.47	1.6	5 - 6,000
NaCl	58.44	126.5	0.70	0.74	5 - 6,000
NaClO ₃	106.44	115	0.75	0.6	10 - 11,000
NaClO ₄	122.44	110	0.77	0.6	12 - 13,000
NaCrO ₄	161.97	132	1.38	1.5	16 - 17,000
NaF	41.99	106	0.79	0.6	4 - 5,000
Na ₄ Fe(CN) ₆	75.98	155	2.74	4.7	7 - 8,000
NaHCO ₃	84.01	96.0	0.85	0.6	8 - 9,000
NaI	149.89	127.0	0.70	0.80	14 - 15,000
NaNO ₃	84.99	123	0.72	0.36	8 - 9,000
NaOH	40.01	246.5	0.47	0.3	4 - 4,000

Substance	Equivalent Weight	Ao(25°C)	a	b	Min./Max. ppm for use of Formula
NaPic	251.09	81.	0.97	0.7	25 - 26,000
Na ₂ SO ₄	71.02	129.0	1.39	1.50	7 - 8,000
Na ₂ S ₂ O ₃	79.06	135.0	1.36	1.60	7 - 8,000
NiAc ₂	88.40	89.5	1.75	1.3	8 - 9,000
NiBr ₂	109.27	127	1.34	1.6	10 - 11,000
NiCl ₂	64.81	123.3	1.37	1.7	6 - 7,000
Ni(NO ₃) ₂	91.36	124.5	1.37	1.8	9 - 10,000
NiSO ₄	77.39	100	2.7	1.6	7 - 8,000
PbCl ₂	139.05	145.0	1.26	-7.0	13 - 14,000
Pb(NO ₃) ₂	165.60	135.7	1.32	0.89	16 - 17,000
RbBr	165.37	148	0.63	0.2	16 - 17,000
RbCl	120.92	153	0.62	0.7	12 - 13,000
RbI	212.37	145.3	0.64	0.65	21 - 22,000
RbOH	102.48	272	0.45	0.5	10 - 11,000
SnI ₃	130.02	140.2	1.63	2.9	12 - 14,000
SmCl ₃	85.57	139.8	1.64	3.0	8 - 9,000
Sml ₃	177.02	138.5	1.64	3.4	17 - 18,000
SrAc ₂	102.86	101	1.63	2.0	10 - 11,000
SrBr ₂	123.72	136.0	1.30	1.8	12 - 13,000
SrCl ₂	79.27	136.0	1.30	1.74	7 - 9,000
Sr(NO ₃) ₂	105.82	131.8	1.34	1.5	10 - 11,000
TiCl	239.82	150.3	0.63	-1.3	23 - 25,000
TiClO ₃	~87.82	137.6	0.65	0.45	28 - 30,000
TiOH	221.38	276.1	0.45	0.45	22 - 23,000
YBr ₃	137.59	141	1.63	2.8	13 - 14,000
YCl ₃	65.09	136	1.67	3.5	6 - 7,000
YI ₃	156.54	143.8	1.60	2.6	15 - 16,000
ZnAc ₂	91.73	88	1.77	1.2	9 - 10,000
ZnBr ₂	112.60	159	1.23	0.7	11 - 12,000
ZnCl ₂	68.14	130	1.48	2.3	6 - 7,000
Zn(NO ₃) ₂	94.69	125	1.37	2.2	9 - 10,000
ZnSO ₄	80.72	105	2.90	4.2	8 - 8,000
Me ₃ HNCI	95.56	123.6	0.71	0.76	9 - 10,000
Me ₄ NI	201.03	118.6	0.73	0.35	20 - 21,000
Me ₄ NPic	290.22	76	1.02	0.5	29 - 30,000
Et ₄ NI	257.15	108	0.78	-.-	25 - 26,000
Et ₄ NPic	346.34	63	1.18	-.-	34 - 35,000
Pr ₄ NI	313.27	100	0.83	-.-	31 - 32,000

Ac = Acetate
Et = Ethyl
Me = Methyl
Pic = Picrate
Pr = Propyl

CONDUCTANCE IN DILUTE NON-AQUEOUS SOLUTIONS

(Data obtained from *Handbook of Electrochemical Constants*,
Parsons; Academic Press/Butterworths, 1959)

All comments, formulae, etc. regarding aqueous solutions will apply here as well (except as noted regarding limits for C and temperature).

ACETONITRIDE AT 25°C			
Solute	A _o	a	b
AgNO ₃	150.0	2.28	1.4
KI	181.4	2.02	1.5
1/3TIBr ₃	140.5	2.39	5.9
1/3TICl ₃	170.4	2.09	2.1
Pr ₄ NCIO ₄	172.3	2.08	2.4
Pr ₄ NI	169.6	2.10	10.0
Pr ₄ NPic	146.3	2.32	14.0
Am ₄ NI	152.0	2.26	1.0
CPH ₂ (p-C ₆ H ₄ OMe)CIO ₄	160.9	2.18	4.0
C(p-C ₆ H ₄ OMe) ₃ CIO ₄	156.7	2.22	5.0

METHANOL AT 25°C			
Solute	A _o	a	b
HBr	192.0	1.78	2.0
HCl	188.0	1.79	2.0
HI	197.0	1.76	2.5
KCH ₃ (CH ₂)COO	89.0	2.73	4.1
KI	113.3	2.34	5.1
KOH	105.8	2.45	5.5
KOCH ₃	106.8	2.42	1.0
LiCHS	101.5	2.51	5.5
LiCl	94.2	2.53	3.0
LiNO ₃	100.7	2.52	5.0
NaBr	101.8	2.50	4.1
NaCNS	106.9	2.43	6.0
NaCH ₃ (CH ₂) ₃ COO	82.0	2.88	4.1
NaC ₆ HCH ₃ (NO ₂) ₃ O	91.0	2.67	3.9
NaCl	98.4	2.56	4.0
Nal	107.8	2.42	4.8
NaOH	95.7	2.60	5.6
NaOH ₃	98.4	2.55	5.0
NaPic	91.4	2.68	4.6
Et ₄ NI	117.6	2.30	2.0
Me ₃ NCH ₂ PhI	96.8	2-58	5.0
(C ₅ H ₁₁)NI	86.9	2.77	4.0
C ₃ H ₅ H ₂ Pic	102.4	2.49	2.0
i-C ₄ H ₉ H ₃ NCl	97.4	2.57	6.0
C ₅ H ₁₂ NC ₆ HMc(NO ₂) ₃ O	94.4	2.63	2.8
PhH ₃ NC ₆ HMc(NO ₂) ₃ O	82.0	2.88	3.8

FORMAMIDE AT 25°C			
Solute	Ao	a	b
1/2 Ba (NO ₃) ₂	30.3	1.33	1.33
1/2 Ca (NO ₃) ₂	31.6	1.29	1.00
CsCl	29.0	0.74	0.75
CsNO ₃	29.4	0.74	0.61
KCNS	28.7	0.75	1.20
KCl	28.0	0.76	0.90
KI	27.7	0.77	1.04
LiNO ₃	25.0	0.83	1.05
NH ₄ Cl	30.4	0.72	1.60
NH ₄ I	30.5	0.72	1.10
NH ₄ NO ₃	33.6	0.67	0.60
NaBr	25.7	0.81	0.80
1/2Na ₂ CrO ₄	26.0	1.56	1.80
Nal	25.0	0.83	1.18
NaNO ₃	28.3	0.76	0.63
NaHCOO	25.1	0.83	0.65
NaPhCOO	20.0	0.99	0.78
NaSalicylate	20.6	0.97	0.60
NaPhSO ₃	20.7	0.96	0.75
RbBr	28.3	0.76	1.10
RbCl	28.2	0.76	0.60
RbI	28.0	0.76	1.00
RbNO ₃	28.6	0.75	1.00
1/2Sr(NO ₃) ₂	32.0	1.28	1.00
Me ₄ NCl	28.7	0.75	0.65
Me ₄ NI	25.0	0.83	1.10
Et ₄ NCl	28.7	0.75	0.65
Et ₄ NI	25.0	0.83	1.10

HYDROGEN CYANIDE AT 18°C b = 0

Valid to C = 10⁻⁵N.

Solute	Ao	A
CsCl	368.2	200
KBr	363.2	248
KCNS	358.0	243
KCl	363.4	280
KClO ₄	353-3	275
KI	363.3	235
KNO ₃	353.9	253
LiBr	356.9	270
LiCNS	340.6	400
LiCl	345.4	335
LiI	336.9	230
LiI	348.0	258
LiNO ₃	336.6	402
NaBr	343.8	243
NaCNS	337.7	230
NaClO ₄	335.5	235
Nal	344.9	238
NaNO ₃	333.8	250
NaPic	266.9	195
RbCl	363.2	195
Et ₄ NPic	282.3	215

SULPHUR DIOXIDE AT 0°C			
Solute	Ao	a	b
Ph ₃ CClO ₄	153.6	5.03	17.0
Ph ₂ C(C ₆ H ₄ Me)ClO ₄	149.8	4.93	15.0
PhC(C ₆ H ₄ Me) ₂ ClO ₄	141.3	5.06	16.0
C(C ₆ H ₄ Me) ₃ Cl	168.5	4.69	15.0
C(C ₆ H ₄ Me) ₃ ClO ₄	150.0	4.92	15.0
Ph ₂ C(C ₆ H ₄ Ph)Cl	78.3	6.83	16.0
C(C ₆ H ₄ Ph) ₃ Cl	5.0	5.00	12.0
Ph ₂ C(p-C ₆ H ₄ OMe)Cl	169.1	4.68	13.0
Ph ₂ C(p-C ₆ H ₄ OMe)ClO ₄	148.0	4.95	17.0
C(p-C ₆ H ₄ OMe) ₃ ClO ₄	144.4	5.03	16.0
PhC(p-C ₆ H ₄ NO ₂)(p-C ₆ H ₄ OMe)Cl	90.0	5.97	20.0
C(p-C ₆ H ₄ NO ₂) ₂ (p-C ₆ H ₄ OMe)ClO ₄	103.5	5.86	17.0
C(p-C ₆ H ₄ NO ₂)(p-C ₆ H ₄ OMe) ₂ ClO ₄	123.0	5.39	20.0
Me ₄ NCl	160.5	4.80	11.8
Me ₄ NBr	160.8	4.79	11.8
Me ₄ NI	166.0	4.72	12.0
Me ₃ SI	150.2	4.93	12.0

ACETONE AT 25°C			
Solute	Ao	a	b
NaI	161.0	3.71	6.0
Pr ₄ NI	152.0	3.83	6.0
C ₅ Hl ₂ NPic	89.1	5.34	9.0
CPh ₂ (p-C ₆ H ₄ OMe)ClO ₄	160.0	3.72	5.0
C(p-C ₆ H ₄ OMe) ₃ ClO ₄	160.2	3.72	8.0

HYDRAZINE AT 0°C				
Solute	Ao	a	b	
1/2 CdI ₂	76.0	1.97	2.2	
HCl	103.0	0.858	0.7	
HPhCOO	85.9	0.950	0.0	
HPh ₃ CCOO	74.8	1.03	-4.0	
HCH ₂ NO ₃	87.0	0.94	-3.0	
Hm-C ₆ H ₄ (NO ₂)O	86.4	0.95	-5.0	
KCl	85.0	0.96	1.0	
Nam-C ₆ H ₄ (NO ₂)O	58.1	1.21	4.0	
Et ₄ Nl	66.6	0.87	-1.0	
25°C	HCl	153.9	0.90	0.6
	KClO ₄	128.2	0.90	0.6
	KI	130.0	0.99	1.3
	NaClO ₄	110.0	1.09	1.4
	Nal	112.5	1.07	0.8
	Et ₄ NCl	99.7	1.16	1.6

AMMONIA AT -33°C			
Solute	Ao	a	b
AgNO ₃	241.7	3.92	8.0
HCl	183.8	4.48	9.0
HNO ₃	245.5	3.89	7.3
KI	295.7	3.59	6.0
KNH ₂	108.7	6.55	13.0
KPh ₂ N	230.0	4.01	8.0
KPh ₃ BNH ₂	155.0	5.14	10.5
LiNO ₃	225.7	4.05	8.5
NaBr	240.2	3.92	7.0
NaCl	206.9	4.22	8.0
Nal	265.1	3.76	7.2
NaNO ₃	224.8	4.05	8.0
NaEtS	201.8	4.27	9.0
NaPhS	219.6	4.32	10.0
NaPh ₂ N	198.7	4.3	10.0
NaMe ₃ Sn	249.0	3.86	10.0
NaPh ₃ BNH ₂	202.5	4.26	9.8
Et ₂ HNCI	183.0	4.43	8.0
Me ₃ Sl	210.0	4.19	6.9

ETHANOL AT 25°C			
Solute	Ao	a	b
HBr	77.3	2.62	4.1
HCl	70.5	2.74	3.6
HI	81.4	2.57	4.5
KI	46.5	3.42	6.4
KOH	42.0	3.63	6.0
LiCl	37.0	3.90	7.0
LiNO ₃	40.7	3.70	6.8
NH ₄ CCl ₃ COO	37.0	3.93	6.2
NH ₄ Cl	39.7	3.75	6.2
NH ₄ Pic	40.8	3.70	6.0
NaBr	39.0	3.80	10.0
NaCCl ₃ COO	34.3	4.12	6.6
Nal	46.0	3.44	7.0
NaOH	38.0	3.86	6.8
Me ₃ NCH ₂ Phl	43.4	3.56	5.8
C ₅ Hl ₂ NCl	37.0	3.92	6.0
C ₅ Hl ₂ NPic	37.5	3.90	5.6
CPh ₂ (p-C ₆ H ₄ OMe)ClO ₄	61.4	3.02	6.0
CPh(p-C ₆ H ₄ OMe) ₂ ClO ₄	60.3	2.97	7.0

FORMIC ACID AT 25°C			
Solute	Ao	a	b
CsHCOO	75.2	1.06	1.4
KHCOO	79.6	1.03	1.5
LiHCOO	75.7	1.06	0.7
NH ₄ HCOO	82.4	1.01	1.2
NaHCOO	75.7	1.06	1.4
RbHCOO	81.1	1.02	1.0
PhNH ₃ HCOO	75.8	1.06	1.2
8.50°C { KCl	35.82	1.12	0.94
Me ₄ NCl	35.70	1.12	0.94

DIMETHYL-FORMAMIDE AT 25°C b = o		
Solute	Ao	A
KBr	84.1	154
KCNS	90.2	151
KClO ₄	82.7	137
KI	82.6	137
KNO ₃	88.5	214
NaBr	83.4	165
NaCNS	89.5	171
Nal	81.9	138
NaNO ₃	87.9	263

SPECIFIC CONDUCTANCE OF STANDARD KCl SOLUTIONS

(Data obtained from *Handbook of Electrochemical Constants*,
Parsons; Academic Press/Butterworths, 1959)

Concentration	Conductance, $\mu\text{mhos/cm}$			
	0°C	18°C	20°C	25°C
1N KCl 71.3828 g KCl per kg solution	65,430	98,201	102,024	111,733
0.1N KCl 7.43344 g KCl per kg solution	7,154.3	11,191.9	11,667.6	12,886.2
0.01N KCl 0.746558 g KCl per kg solution	775.12	1,222.69	1,275.72	1,411.45



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