CHAPTER 3

SYSTEM : LITHIUM SULPHATE

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Robert A. Robinson and others (1937) have studied the conductivity of univalent electrolyte in water. The change of conductivity with concentration for Li, Na, K and H chlorides at 25°c follows Omsager's equation upto 1×10^{-3}N.

M.A.Klochko and others (1958) studied electro conductivity and viscosity for the system lithium nitrate - methyl alcohol. In this investigation the concentration of $LiNO_3$ was 0 to 24.89 mole% and the temperature 0, 25 and 50°c. The conductivity curves had maxima which shifted towards higher concentration with the rise in temperature. Thus at 0°C, the maxima coincided with 8 mole % and at 50°c with 8.5 mole %. The viscosity curves rose gently at first and then sharply. Generally the property curves of $LiNO_3$ in methanol resembled closely analogous curves in water except for the numerical values of the respective points. At 25°c the conductivity maxima in water coincided with 10.3 mole % $LiNO_3$ and in methanol with 8.3 mole %. The observed values of conductivity at 25°c and 50°c in water were 5.3 - 5.9 times the corresponding values in methanol, whereas the viscosity in methanol was only 1.34 - 1.35 times the mcorresponding values in water. Apparently the interaction of components in the two systems is quite different.

E.K.Kartzmark and co-workers (1955) have studied the conductance of aqueous lithium nitrate solutions at 25°c and 110°c. The electrical conductivity, density and viscosity of aqueous $LiNO_3$ upto concentration of 14M were measured at 25°c and 110°c. Good agreement with conductivity results calculated from the Robinson stokes equation was obtained upto concentration of 7.0M. At the highest concentration studied the calculated values were about half as good as the measured results. The disagreement was attributed to the breakdown of the R.S. equation in the presence of the strongly hydrated Li ions and of ion-pair formation.

A.N.Campbell and others (1956) have studied the conductance of lithium nitrate solutions in ethanol and ethanol water mixtures at 25^{o}c in 30, 70 and 100 wt% ethanol conductance was determined at concentrations ranging from 0.01M upto saturation at 25^{o}c. The densities and viscosities of these solutions were also determined. The data was compared with the calculated conductivities obtained from the Wishaw-Stokes equation. The agreement is fairly good upto approximately 2M for all solvents except absolute alcohol. They have concluded that the nitrate ion as well as the Li ion is solvated to some extent at least in alcohol.

Philip W. Brewster and others (1959) reported conductance measurements in the halides, nitrates and nitrites of the alkali metals in anhydrous ethanolamine at 25^{o}c including LiCl. Linear plots of λ vs $\sqrt{C}$ approach the Onsager tangent from below. The limiting conductivity data confirm the Kohlrausch law of independent ion migration in ethanolamine. The usual trend is observed in the limiting equivalent conductivity of salts of given anion i.e. Li $<$ Na $<$ K. But for a given cation the conductivity increases in the order I $<$ Br $<$ Cl opposite to that in methyl formaide and substitute acetamides.

G.D.Parfitt and others (1963) have observed the conductance of silver, potassium and lithium nitrates in ethanol water mixtures.

The reproducibility of the conductivity measurements at 25°c $\pm$ 0.005°c was 0.05%. The limiting equivalent conductivity, the association constant and ion-size parameter 'a' were found graphically. All three salts showed an increase in 'a' found from the conductivity equation at high ethanol content accompanied by an increase in "stokes radius" calculated from mobilities. Association was in the order Li $<$ Ag $<$ K.

Kozlowski and others (1972) studied the electrical conductivity of lithium chloride in N-N dimethyl formamide water mixture. Decrease in the dielectric constant was observed with increase of dimethyl formamide in dimethyl formamide water mixtures. Increasing dimethyl formamide has some effect on the conductivity.

Shkodin A.M. and co-workers (1975) studied 1-1 valence electrolyte dissociation ina aliphatic alcohols of solutions LiCl, NaI, KI from CH_3OH to $C_9H_{19}OH$. The results have been discussed in terms of H-bonding of lower alcohols and association due to the dispersion forces with the higher alcohols and the balance between these forces and ionic solvation.

Aleshko - Ozherskil and others (1979) have determined the temperature and cation radii effect of ion-solvation. The result showed that in case of alkali metal chloride solutions, the increase in temperature aff affect water int the region of remote (outer-sphere) hydration while an increase in ionic radius effects the immediate vicinity of the ions.

Vasin S.K. and the others (1979) have studied the ion association in aqueous solution of alkali metal sulphate (II) in

M_2SO_4- H_2SO_4- water system. The study showed that Li^+ occurs as simple hydrated ions while Na^+, K^+, Rb^+, Cs^+ form solvent separated ion pairs of $M^+ - H_2O - HSO_4^-$ type.

Daniel and others (1982) have investigated the formation of complex between sulphate ion and the alkali metal ions ($M^+ = Li^+$, K^+, Na^+, Rb^+ or Cs^+) at 37^oc. The result showed that the order of stability for $[M(SO_4)]^-$ complex is $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$.

Abraham Michael H and others (1982) have studied structure making and structure breaking effect of alkali halides ions from electrostatic entropies of solvation. Entropy data indicate that in water the ions Li^+, Na^+, Ag^+ and F^- are structure makers, K is on border line and in non aqueous solvents like methyl alcohol, formamide, dimethyl formamide all the above ions are structure breakers.

Ivanovo and others (1985) have studied the density, viscosity and x-ray data for $LiHSO_4$, $NaHSO_4$, and $KHSO_4$ solution in H_2SO_4 at 298.15^oK. The result showed that ion solvating capacities are in the order $K^+ < Na^+ < Li^+$.

Helmy, Fathia M and others (1987) have studied the triple ion formation (MOAC where $M = Li^+$, Na^+, K^+) in glacial acetic acid at different temperatures by conductometric measurments. The graph of $\ln\lambda$ vs $\ln C$ gives a straigh line with slope = $-\frac{1}{2}$ according to equation $\ln = \ln A - 0.51 \ln C$ where (C = total alkali cation concentration) indicating that there is a triple ion formation. The graph of $\lambda\sqrt{C}$ vs C confirming the result $\lambda\sqrt{C} = A + Bc$, where A is intercept and B is slope. The equation was derived in presence of triple-ion formation.

Hyodo, Shaki and others (1989) have investigated the local structure of the solvated Li^+ in ethylene carbonate (EC) solutions by using Raman spectroscopy. The splitting of Raman line occurs at approximate 900 per cm. The splitting indicates that, there exist two types of EC molecules. One is solvated to Li^+ and the other not solvated. The resulted intensity data were applied to anology of the " Li^+ - EC " solution.

The possibilities of the determination of Li^+ in a contact ion pair were also discussed.

In the present chapter molar conductance of Lithiam sulphate in mixed solvents have been determined by the author to study the effect of composition of ethanol, methanol and acetone in mixed solvents in the following systems at 5, 10, 15, 20, 25, 30°c.

1) 1×10^{-2}M Li_2SO_4 + X % ethanol
2) 5×10^{-3}M Li_2SO_4 + X % ethanol
3) 1×10^{-3}M Li_2SO_4 + X % ethanol
4) 1×10^{-4}M Li_2SO_4 + X% ethanol
5) 5×10^{-5}M Li_2SO_4 + X% ethanol
6) 1×10^{-2}M Li_2SO_4 + X% methanol
7) 5×10^{-3}M Li_2SO_4 + X% methanol
8) 1×10^{-3}M Li_2SO_4 + X% methanol
9) 1×10^{-3}M Li_2SO_4 + X% acetone
10) 5×10^{-4}M Li_2SO_4 + X% acetone
11) 1×10^{-4}M Li_2SO_4 + X% acetone
12) 5×10^{-5}M Li_2SO_4 + X% acetone

Turbidity was obtained for the preparation of following solutions :

1) 1×10^{-2}M Li_2SO_4 + X% acetone

2) 5×10^{-3}M Li_2SO_4 + X% acetone

and hence the above concentrations could not be studied.

System	: Li_2SO_4
Concentration	: $1x10^{-2}M$
Solvent	: Ethanol-water
Temperature	: 5, 10, 15, 20, 25 & 30°C

TABLE 3.1

% Ethanol	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	100.0	116.0	130.5	153.5	175.0	185.8
10	71.7	81.0	110.3	119.3	131.8	145.2
20	53.8	69.0	80.9	88.8	100.4	111.7
30	42.8	48.8	60.5	69.4	78.8	88.2
40	31.9	35.0	47.1	55.1	63.7	74.6
50	30.3	31.8	42.4	43.9	53.5	62.9
60	23.2	26.1	30.9	36.4	43.8	51.9
70	18.8	21.7	23.1	30.2	35.1	42.8
80	15.8	17.7	21.4	23.8	27.0	34.5
90						

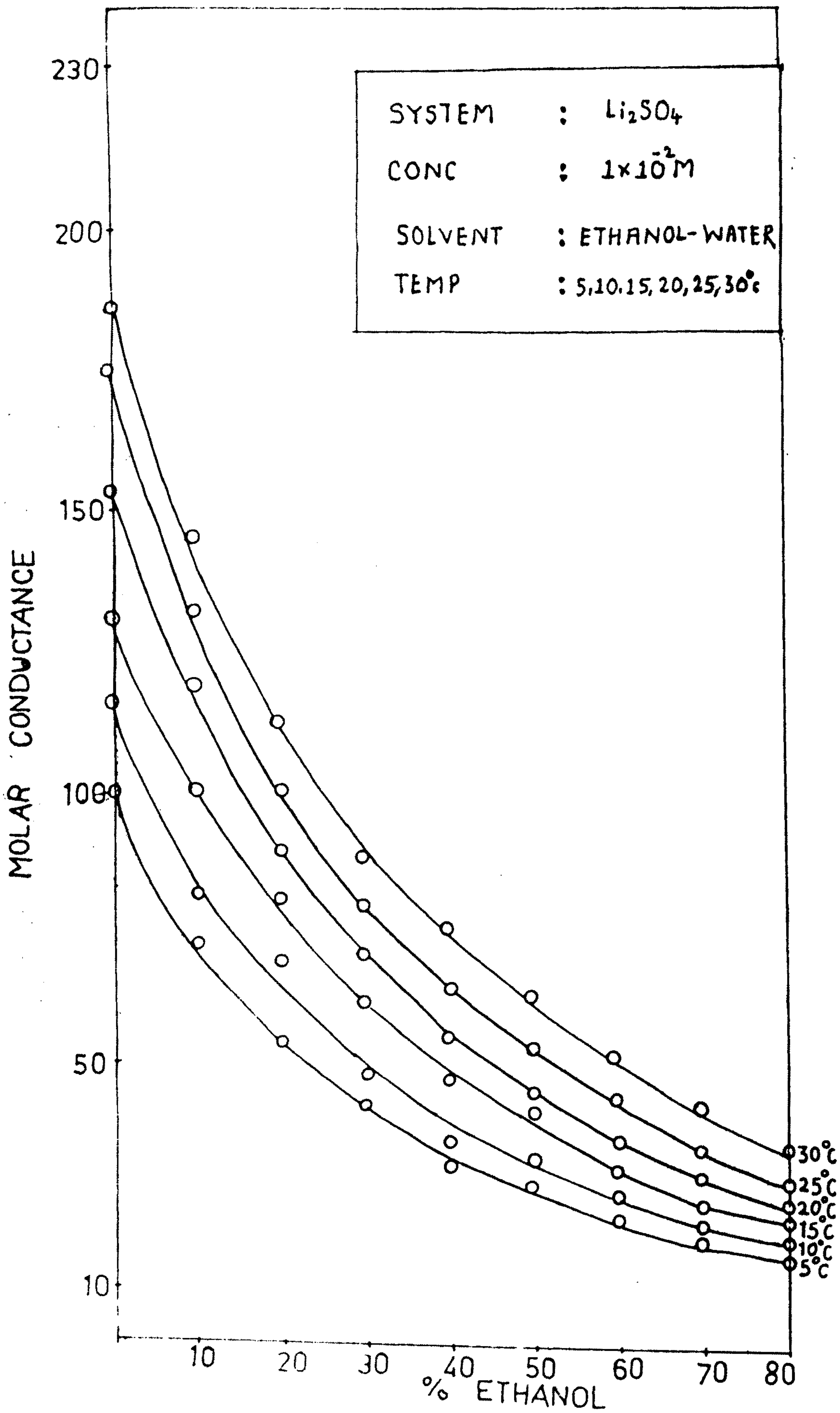
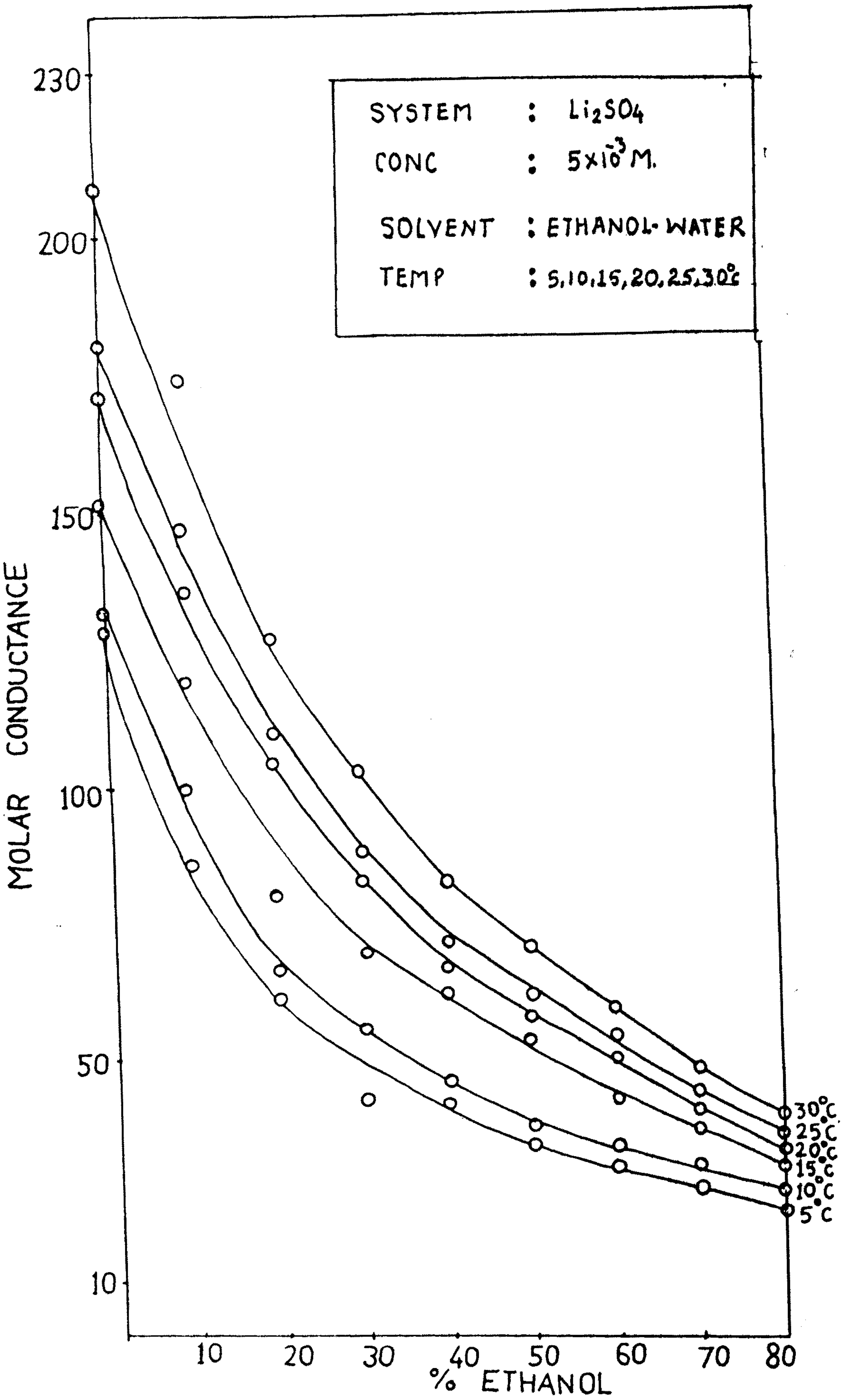

SYSTEM : Li_2SO_4
CONC : 1×10^{-2}M
SOLVENT : ETHANOL-WATER
TEMP : 5,10,15,20,25,30°c
MOLAR CONDUCTANCE
230
200
150
100
50
10
10
20
30
40
50
60
70
80
% ETHANOL
30°C
25°C
20°C
15°C
10°C
5°C

FIG - 3.1

System	:	Li_2SO_4
Concentration	:	5×10^{-3}M
Solvent	:	Ethanol-water
Temperature	:	5, 10, 15, 20, 25 & 30°C

TABLE 3.2

% Ethanol	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	129.6	131.6	152.0	171.4	179.8	208.6
10	87.4	100.8	120.6	137.0	147.4	173.6
20	61.6	66.6	81.4	106.2	110.2	127.8
30	42.8	56.0	70.2	82.4	88.0	102.6
40	36.0	46.2	62.6	66.2	71.4	83.2
50	34.8	37.2	53.4	57.6	61.6	70.6
60	30.4	33.2	43.0	50.8	50.8	59.0
70	27.4	30.4	37.4	39.4	43.0	48.4
80	22.4	24.2	29.6	31.8	34.0	37.8
90						



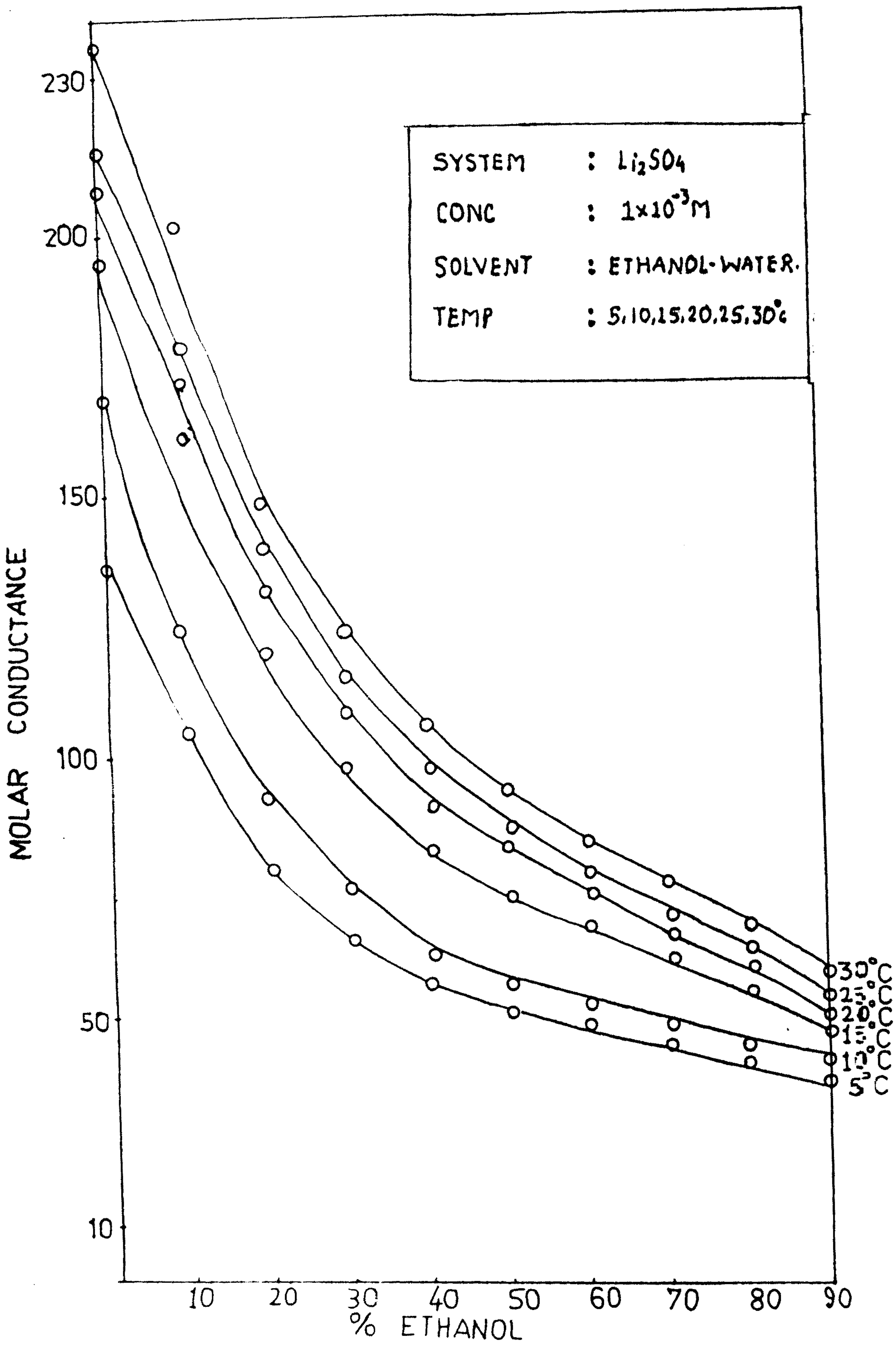
SYSTEM : Li_2SO_4
CONC : 5×10^{-3} M.
SOLVENT : ETHANOL-WATER
TEMP : 5,10,15,20,25,30°C
230
200
150
100
50
10
MOLAR CONDUCTANCE
10
20
30
40
50
60
70
80
% ETHANOL
30°C
25°C
20°C
15°C
10°C
5°C

FIG - 3.2

System	:	Li_2SO_4
Concentration	:	$1x10^{-3}M$
Solvent	:	Ethanol- water
Temperature	:	5, 10, 15, 20, 25 & 30°C

TABLE 3.3

% Ethanol	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	137.0	149.0	175.0	189.0	210.0	236.0
10	105.0	125.0	142.0	172.0	178.0	194.0
20	79.0	93.0	120.0	131.0	140.0	149.0
30	65.0	75.0	99.0	109.0	115.0	124.0
40	61.0	62.0	83.0	91.0	98.0	106.0
50	51.0	57.0	74.0	84.0	86.0	94.0
60	49.0	52.0	68.0	74.0	77.0	84.0
70	45.0	48.0	61.0	66.0	69.0	76.0
80	41.0	43.0	55.0	59.0	63.0	68.0
90	37.0	39.0	46.0	47.0	52.0	56.0



SYSTEM : Li_2SO_4
CONC : 1×10^{-3}M
SOLVENT : ETHANOL-WATER.
TEMP : 5,10,15,20,25,30°c
MOLAR CONDUCTANCE
230
200
150
100
50
10
10
20
30
40
50
60
70
80
90
% ETHANOL
30°C
25°C
20°C
15°C
10°C
5°C

FIG - 3·3

System	: Li_2SO_4
Concentration	: $1x10^{-4}M$
Solvent	: Ethanol-water
Temperature	: 5, 10, 15, 20, 25 & 30°C

TABLE 3.4

% Ethanol	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	168.0	193.0	216.0	228.0	246.0	318.0
10	123.0	137.0	168.0	190.0	203.0	230.0
20	105.0	118.0	137.0	143.0	154.0	182.0
30	83.0	89.0	112.0	115.0	127.0	137.0
40	69.0	73.0	94.0	96.0	104.0	115.0
50	62.0	67.0	86.0	92.0	96.0	101.0
60	51.0	54.0	73.0	76.0	84.0	90.7
70	48.0	50.0	67.0	72.0	77.0	82.0
80	50.0	51.0	61.0	65.0	68.0	78.5
90	51.0	52.0	56.0	59.0	64.0	70.0

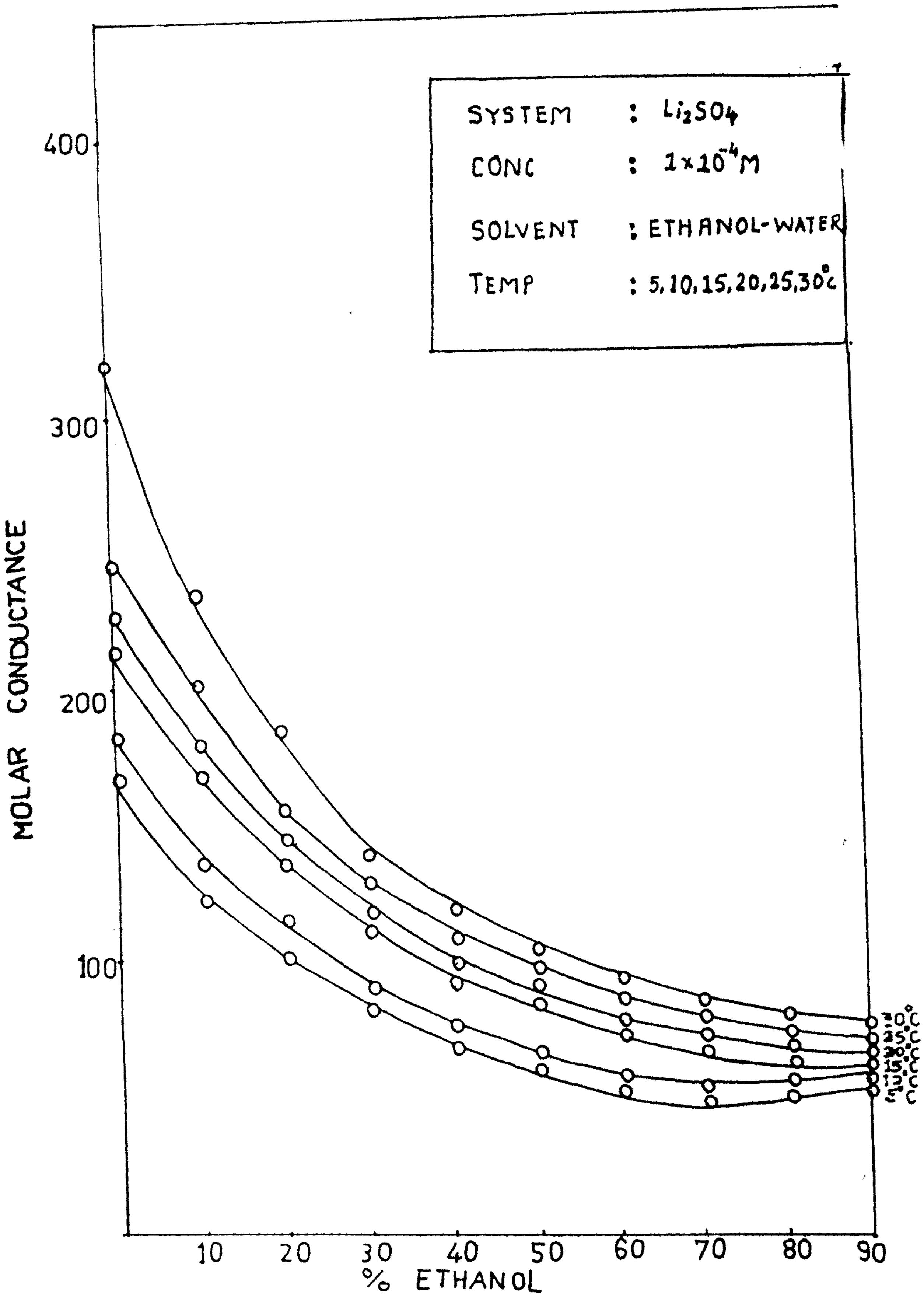

SYSTEM : Li_2SO_4
CONC : 1×10^{-4}M
SOLVENT : ETHANOL-WATER
TEMP : 5,10,15,20,25,30°C
400
300
200
100
MOLAR CONDUCTANCE
30°C
25°C
20°C
15°C
10°C
5°C
10
20
30
40
50
60
70
80
90
% ETHANOL

FIG-3.4

System	:	Li_2SO_4
Concentration	:	$5x10^{-5}M$
Solvent	:	Ethanol-water
Temperature	:	5, 10, 15, 20, 25 & 30°C

TABLE 3.5

% Ethanol	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	197.6	217.8	244.4	245.4	273.6	388.4
10	147.4	174.0	190.0	213.0	224.0	250.0
20	131.0	136.2	141.0	160.0	172.0	200.0
30	100.8	105.6	121.8	132.0	150.4	176.0
40	83.4	87.4	99.6	103.8	124.0	125.6
50	68.6	75.0	93.8	100.0	103.0	118.0
60	42.4	56.0	78.2	81.0	89.6	106.0
70	41.6	55.0	77.4	80.2	84.6	88.8
80	42.0	55.8	66.6	69.2	77.4	84.6
90	42.2	56.2	60.2	61.0	75.0	74.8

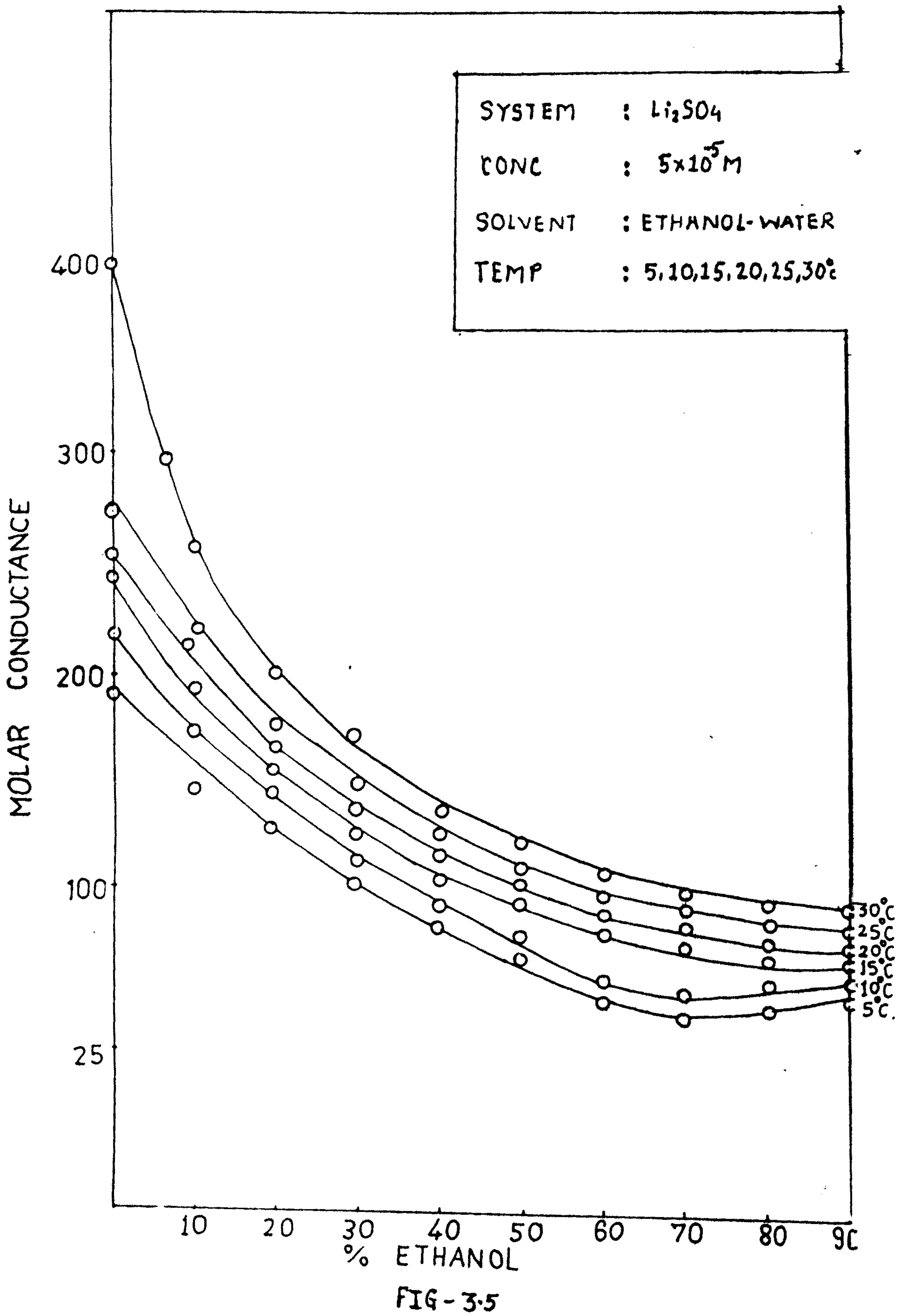

SYSTEM : Li_2SO_4
CONC : 5×10^{-5} M
SOLVENT : ETHANOL-WATER
TEMP : 5,10,15,20,25,30°C
MOLAR CONDUCTANCE
400
300
200
100
25
10
20
30
40
50
60
70
80
90
% ETHANOL
30°C
25°C
20°C
15°C
10°C
5°C

FIG-3.5

System	:	Li_2SO_4
Concentration	:	$1x10^{-2}M$
Solvent	:	Methanol-water
Temperature	:	5, 10, 15, 20, 25 & 30°C

TABLE 3.6

% Methanol	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	116.3	136.6	147.0	161.1	173.2	190.1
10	95.9	106.2	119.6	127.7	134.0	158.4
20	75.5	89.0	98.2	106.3	118.0	131.8
30	58.2	72.7	84.3	90.6	98.4	112.9
40	47.2	53.9	72.4	78.2	86.7	99.0
50	45.3	56.5	63.9	71.0	79.4	88.0
60	43.1	55.3	62.0	66.1	72.0	82.6
70	42.2	53.2	56.3	62.3	70.5	80.1
80	45.3	53.9	57.1	62.8	67.9	73.0
90	49.3	55.2	59.6	63.4	66.1	70.7

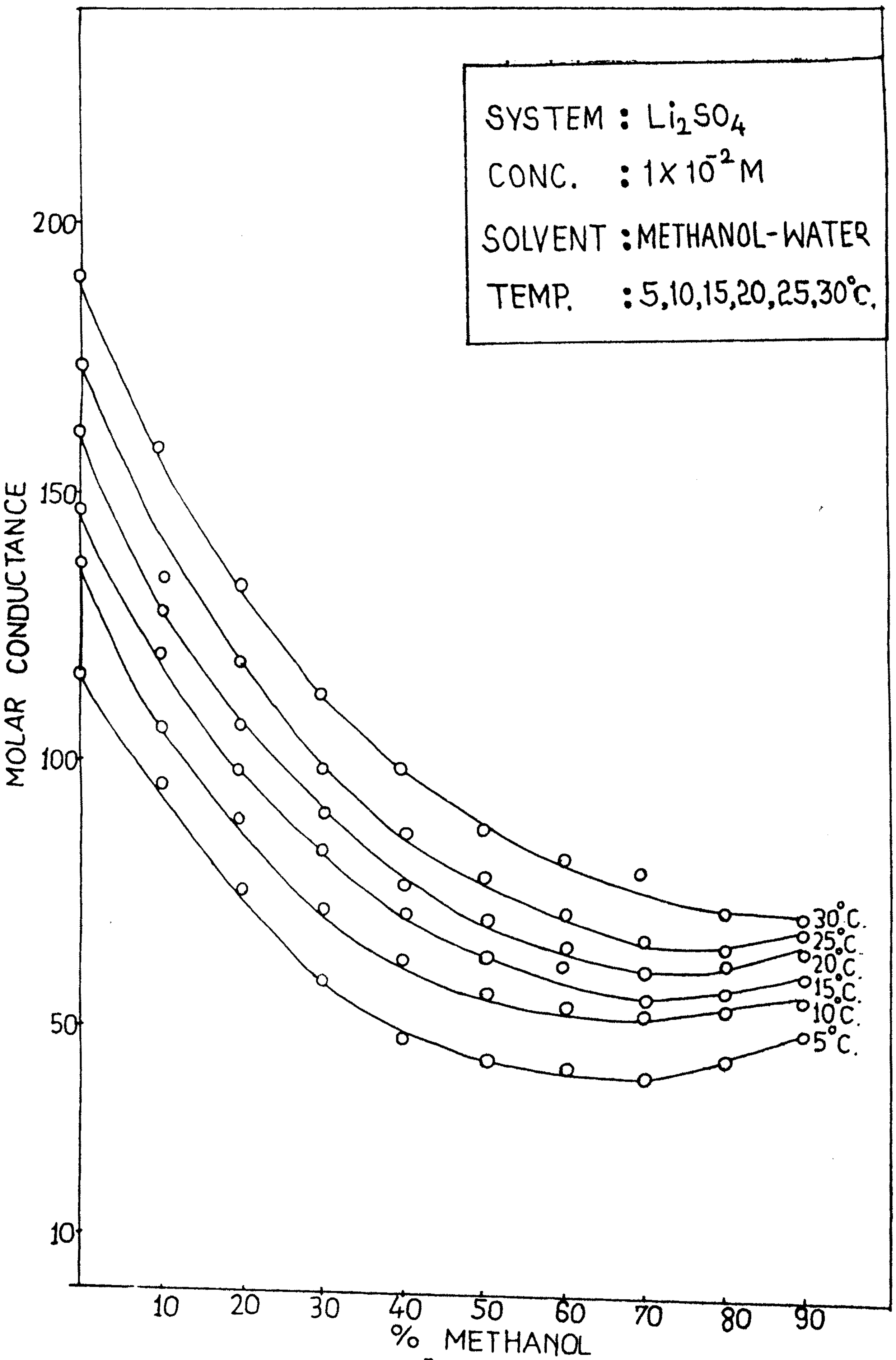

SYSTEM : Li_2SO_4
CONC. : 1×10^{-2} M
SOLVENT : METHANOL-WATER
TEMP. : 5,10,15,20,25,30°C.
MOLAR CONDUCTANCE
200
150
100
50
10
10
20
30
40
50
60
70
80
90
% METHANOL
30°C.
25°C.
20°C.
15°C.
10°C.
5°C.

FIG-3.6

System	:	Li_2SO_4
Concentration	:	$5x10^{-3}$ M
Solvent	:	Methanol-water
Temperature	:	5, 10, 15, 20, 25 & 30°C

TABLE 3.7

% Methanol	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	125.8	145.6	152.0	174.4	184.6	226.8
10	94.6	111.6	116.0	131.4	138.4	167.2
20	80.4	92.6	99.8	110.4	122.0	139.8
30	63.8	73.8	82.4	92.2	108.4	120.8
40	58.6	69.4	72.0	78.8	95.6	107.2
50	55.4	62.0	67.6	74.0	88,0	98.0
60	53.0	59.8	64.8	70.2	83.2	92.4
70	52.2	59.2	64.0	69.8	81.0	88.8
80	54.4	61.6	65.8	69.4	78.8	84.8
90	60.4	65.0	66.6	72.4	79.4	84.0

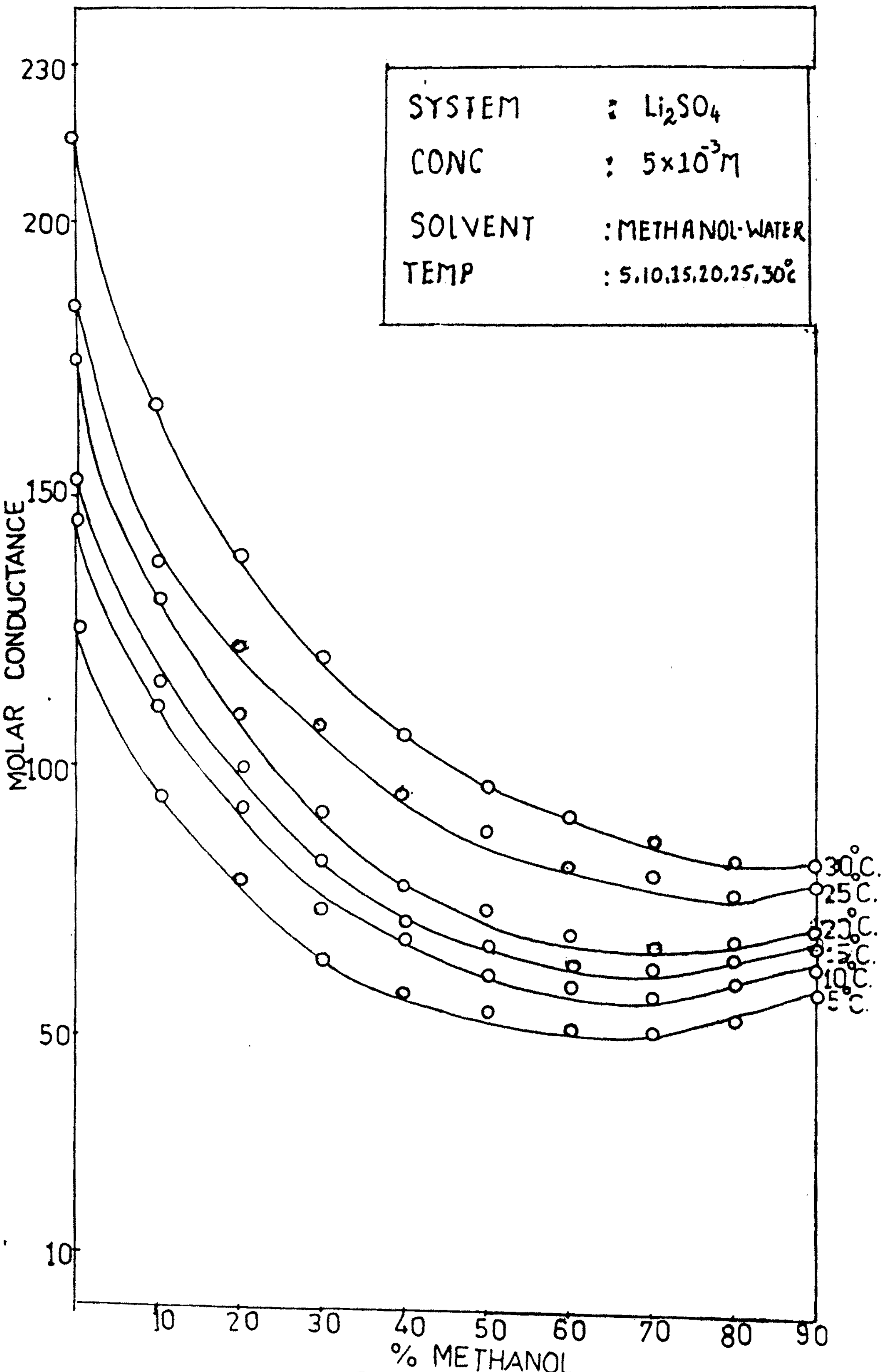

SYSTEM : Li_2SO_4
CONC : 5×10^{-3}M
SOLVENT : METHANOL-WATER
TEMP : 5,10,15,20,25,30°C
230
200
150
100
50
10
MOLAR CONDUCTANCE
10
20
30
40
50
60
70
80
90
% METHANOL
30°C.
25°C.
5°C.

FIG - 3.7

System	:	Li_2SO_4
Concentration	:	$1x10^{-3}$ M
Solvent	:	Methanol-water
Temperature	:	5, 10, 15, 20, 25 & 30°C

TABLE 3.8

% Methanol	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	138.0	151.0	174.0	191.0	213.0	232.0
10	111.0	120.0	149.0	158.0	178.0	197.0
20	97.0	105.0	117.0	141.0	146.0	169.0
30	87.0	92.0	102.0	116.0	132.0	148.0
40	79.0	83.0	92.0	104.0	120.0	134.0
50	74.0	79.0	85.0	99.0	115.0	126.0
60	73.0	76.0	80.0	96.0	110.0	122.0
70	75.0	77.0	79.0	98.0	108.0	119.0
80	81.0	85.0	91.0	102.0	112.0	122.0
90	90.0	94.0	102.0	109.0	116.0	126.0

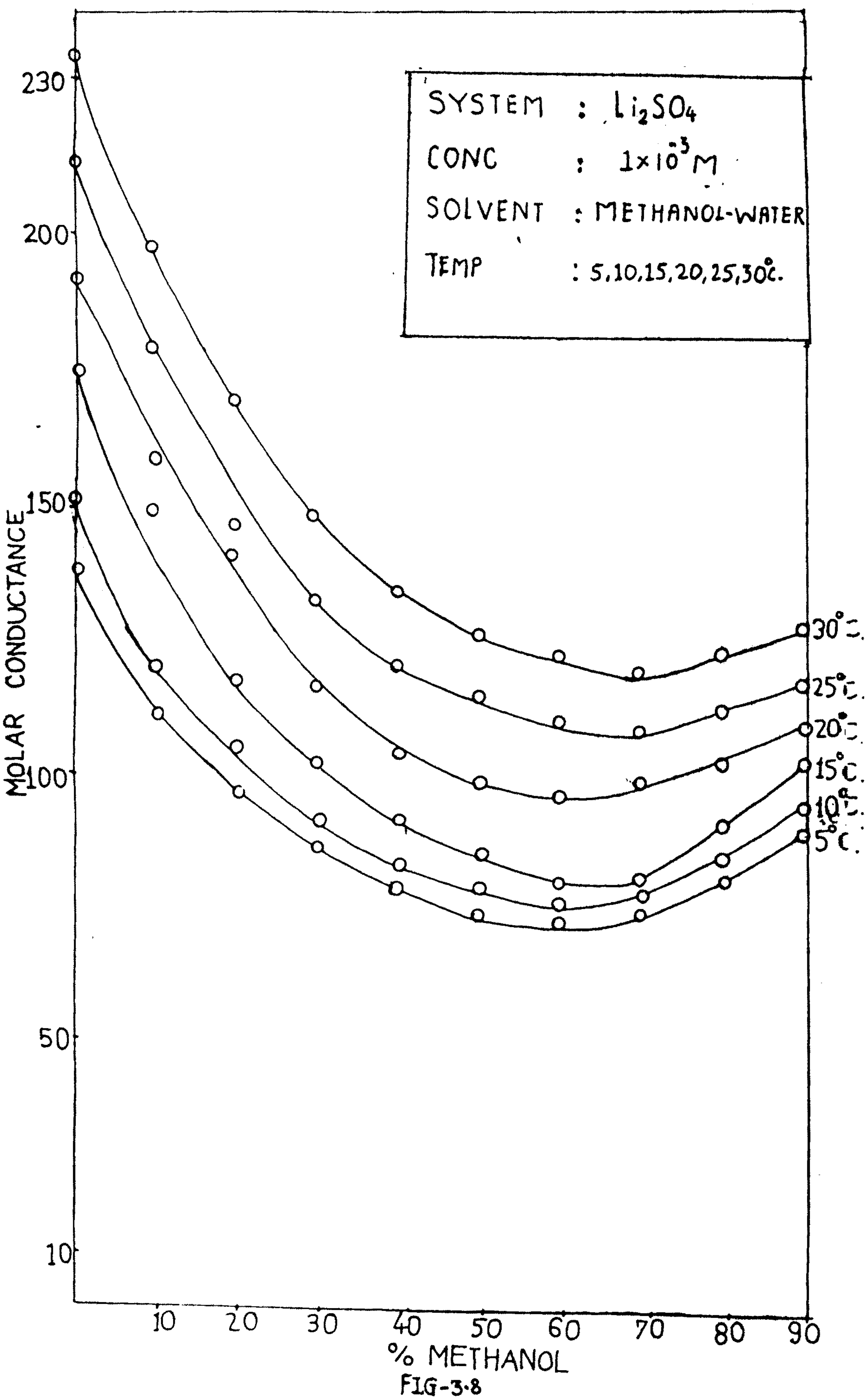
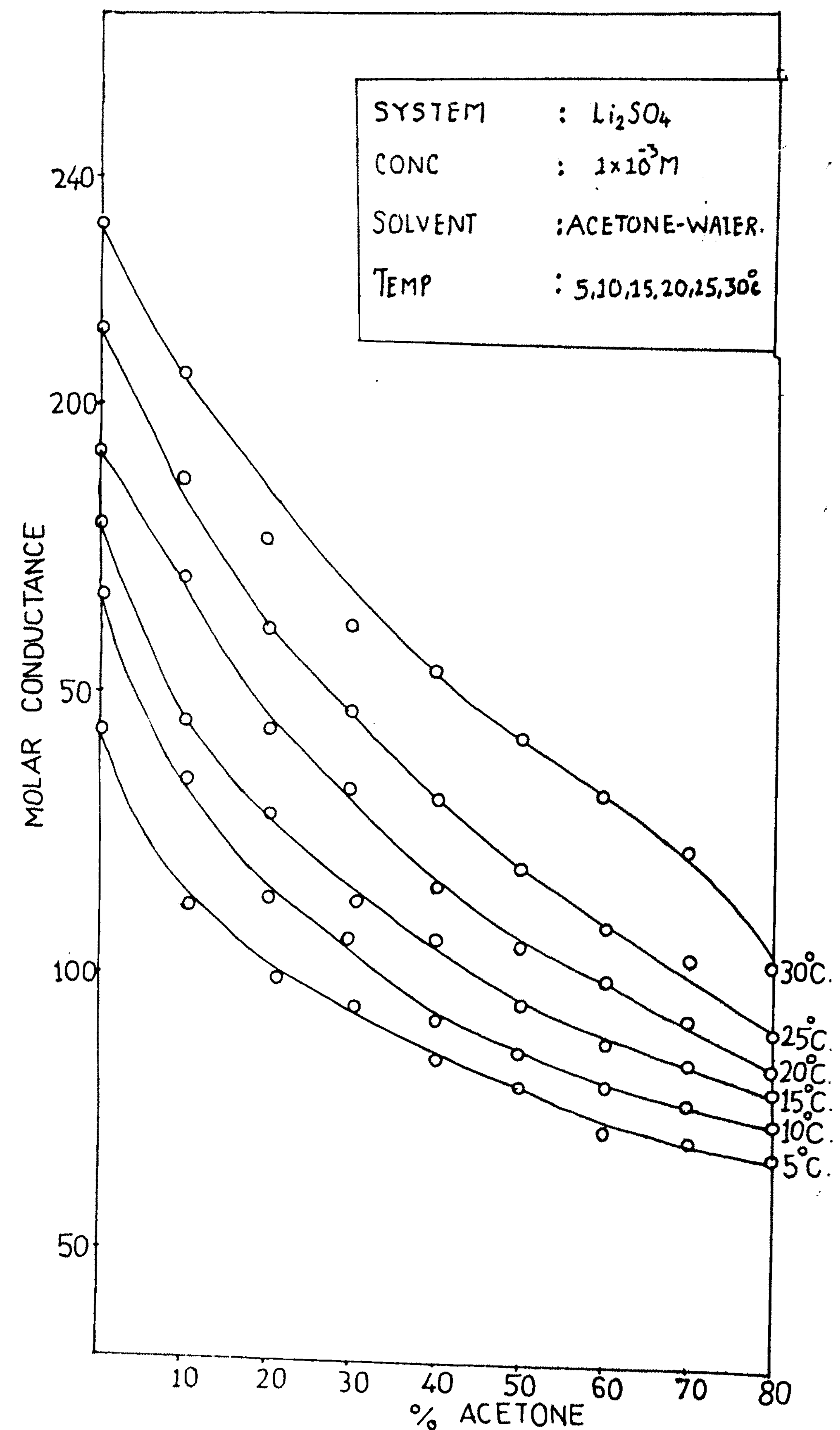

SYSTEM : Li_2SO_4
CONC : 1×10^{-3} M
SOLVENT : METHANOL-WATER
TEMP : 5,10,15,20,25,30°C.
230
200
150
100
50
10
MOLAR CONDUCTANCE
10
20
30
40
50
60
70
80
90
% METHANOL
30°C
25°C
20°C
15°C
10°C
5°C

FIG-3.8

System	: Li_2SO_4
Concentration	: $1x10^{-3}$
Solvent	: Acetone-water
Temperature	: 5, 10, 15, 20, 25 & 30 °C

TABLE 3.9

% Methanol Acetone	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	144.0	168.0	180.0	192.0	214.0	235.0
10	112.0	135.0	155.0	170.0	187.0	205.0
20	98.0	114.0	129.0	144.0	161.0	177.0
30	95.0	107.0	112.0	134.0	147.0	162.0
40	85.0	92.0	107.0	126.0	132.0	154.0
50	80.0	86.0	95.0	105.0	119.0	142.0
60	78.0	80.0	88.0	99.0	109.0	133.0
70	77.0	77.0	85.0	92.0	103.0	123.0
80	67.0	73.0	78.0	80.0	90.0	102.0
90						



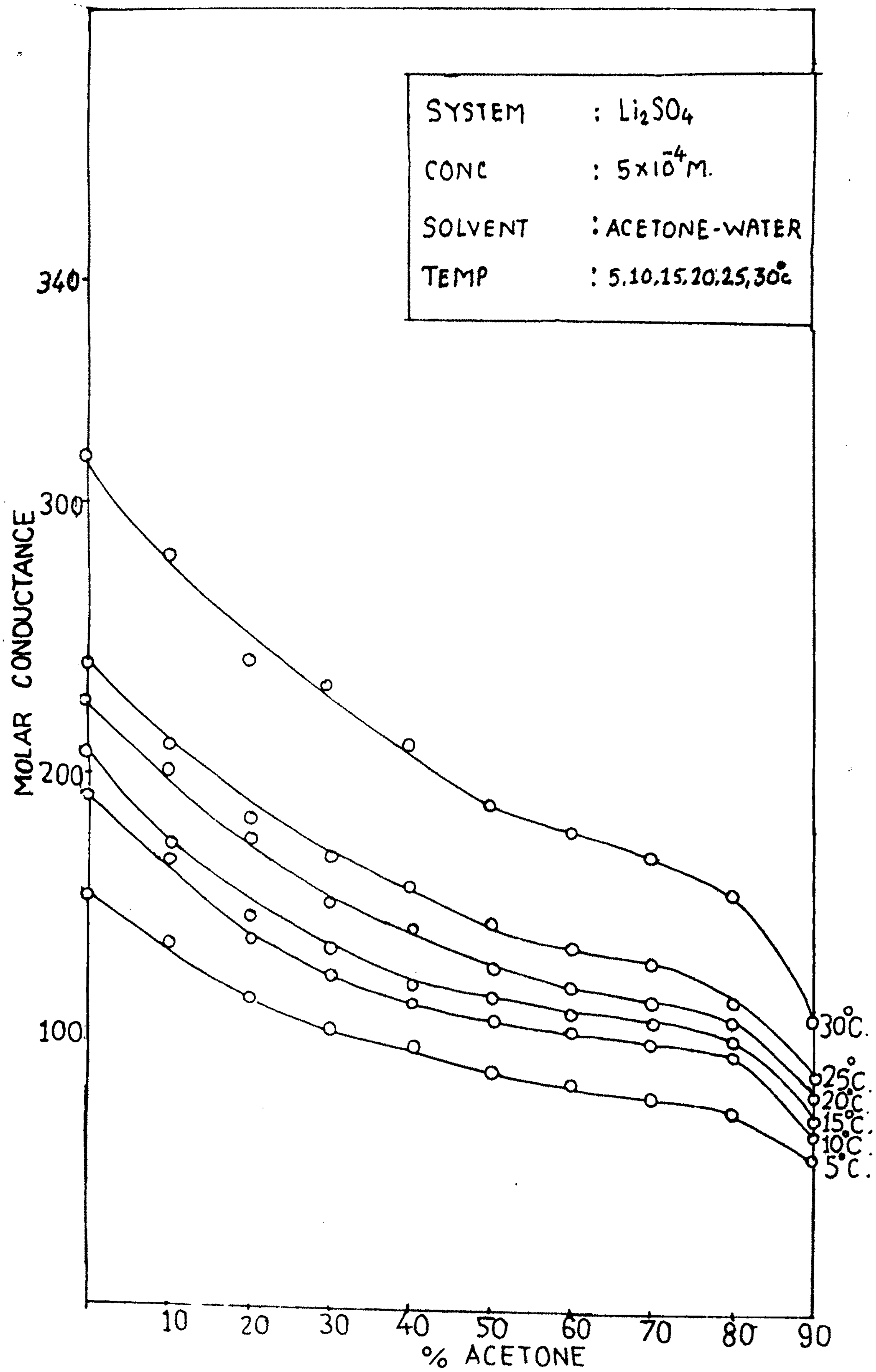
SYSTEM : Li_2SO_4
CONC : 1×10^{-3} M
SOLVENT : ACETONE-WATER.
TEMP : 5,10,15,20,25,30°C
MOLAR CONDUCTANCE
240
200
50
100
50
10
20
30
40
50
60
70
80
% ACETONE
30°C.
25°C.
20°C.
15°C.
10°C.
5°C.

FIG-3·9

System	:	Li_2SO_4
Concentration	:	$5x10^{-4}M$
Solvent	:	Acetone-water
Temperature	:	5, 10, 15, 20, 25 & 30°C

TABLE 3.10

% Acetone	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	152.0	190.0	208.0	228.0	240.0	316.0
10	134.0	166.0	170.0	200.0	210.0	280.0
20	114.0	138.0	144.0	174.0	182.0	242.0
30	102.0	122.0	134.0	150.0	168.0	232.0
40	96.0	112.0	118.0	140.0	156.0	210.0
50	88.0	106.0	112.0	126.0	142.0	188.0
60	82.0	102.0	104.0	118.0	134.0	178.0
70	78.0	98.0	92.0	112.0	128.0	168.0
80	74.0	92.0	86.0	106.0	114.0	154.0
90	56.0	62.0	64.0	68.0	72.0	106.0



SYSTEM : Li_2SO_4
CONC : 5×10^{-4} M.
SOLVENT : ACETONE-WATER
TEMP : 5,10,15,20,25,30°C
340
300
200
100
MOLAR CONDUCTANCE
10
20
30
40
50
60
70
80
90
% ACETONE
30°C.
25°C.
20°C.
15°C.
10°C.
5°C.

FIG-3.10

System	:	Li_2SO_4
Concentration	:	$1x10^{-4}$
Solvent	:	Acetone-water
Temperature	:	5, 10, 15, 20, 25 & 30 °C

TABLE 3.11

% Acetone	MOLAR CONDUCTANCE					
	5 °C	10 °C	15 °C	20 °C	25 °C	30 °C
00	232.0	240.0	248.0	282.0	294.0	308.0
10	204.0	223.0	234.0	251.0	259.0	276.0
20	174.0	186.0	195.0	217.0	225.0	235.0
30	155.0	164.0	176.0	186.0	200.0	210.0
40	136.0	148.0	153.0	168.0	177.0	188.0
50	123.0	132.0	146.0	157.0	166.0	176.0
60	114.0	127.0	142.0	149.0	161.0	164.0
70	116.0	128.0	134.0	144.0	152.0	160.0
80	119.0	131.0	129.0	136.0	150.0	155.0
90	122.0	133.0	118,0	124.0	135.0	140.0

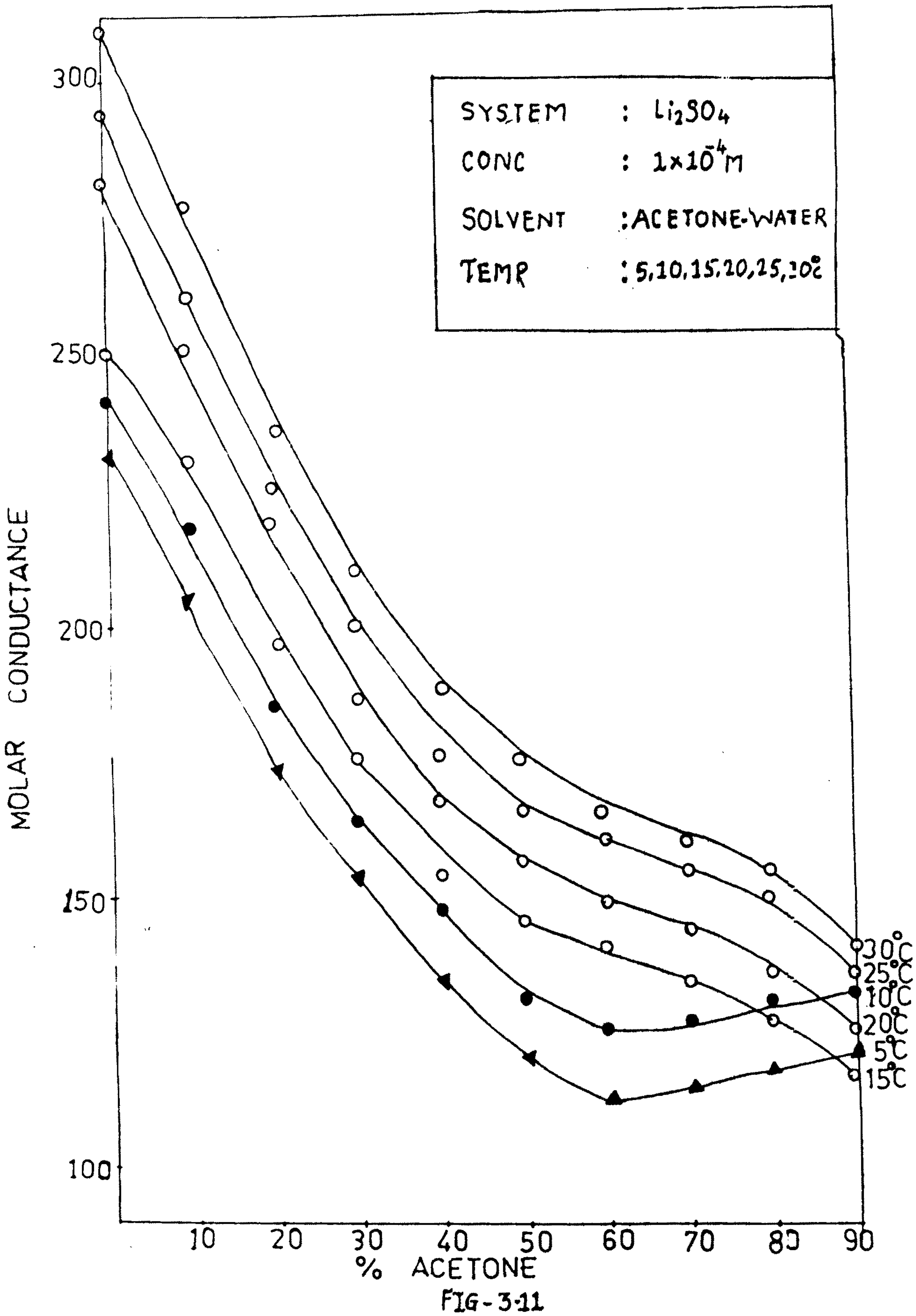

SYSTEM : Li_2SO_4
CONC : 1×10^{-4} M
SOLVENT : ACETONE-WATER
TEMP : 5, 10, 15, 20, 25, 30°
MOLAR CONDUCTANCE
300
250
200
150
100
10
20
30
40
50
60
70
80
90
% ACETONE
30°C
25°C
10°C
20°C
5°C
15°C

FIG-3.11

System	:	Li_2SO_4
Concentration	:	$5x10^{-5}M$
Solvent	:	Acetone-water
Temperature	:	5, 10, 15, 20, 25 & 30°C

TABLE 3.12

% Acetone	MOLAR CONDUCTANCE					
	5°C	10°C	15°C	20°C	25°C	30°C
00	213.0	231.6	244.0	276.4	308.8	348.4
10	200.0	224.6	230.0	243.0	274.6	295.4
20	183.6	189.0	203.4	209.8	230.0	241.0
30	174.2	185.4	189.6	203.6	213.6	225.2
40	162.0	165.8	171.4	181.6	194.4	202.6
50	142.8	146.0	158.4	161.4	171.8	182.2
60	133.8	145.6	146.2	149.6	163.0	175.8
70	119.6	138.4	140.0	148.0	160.0	170.0
80	122.4	143.8	137.8	146.0	158.0	164.0
90	122.6	144.2	132.0	140.0	152.0	150.0

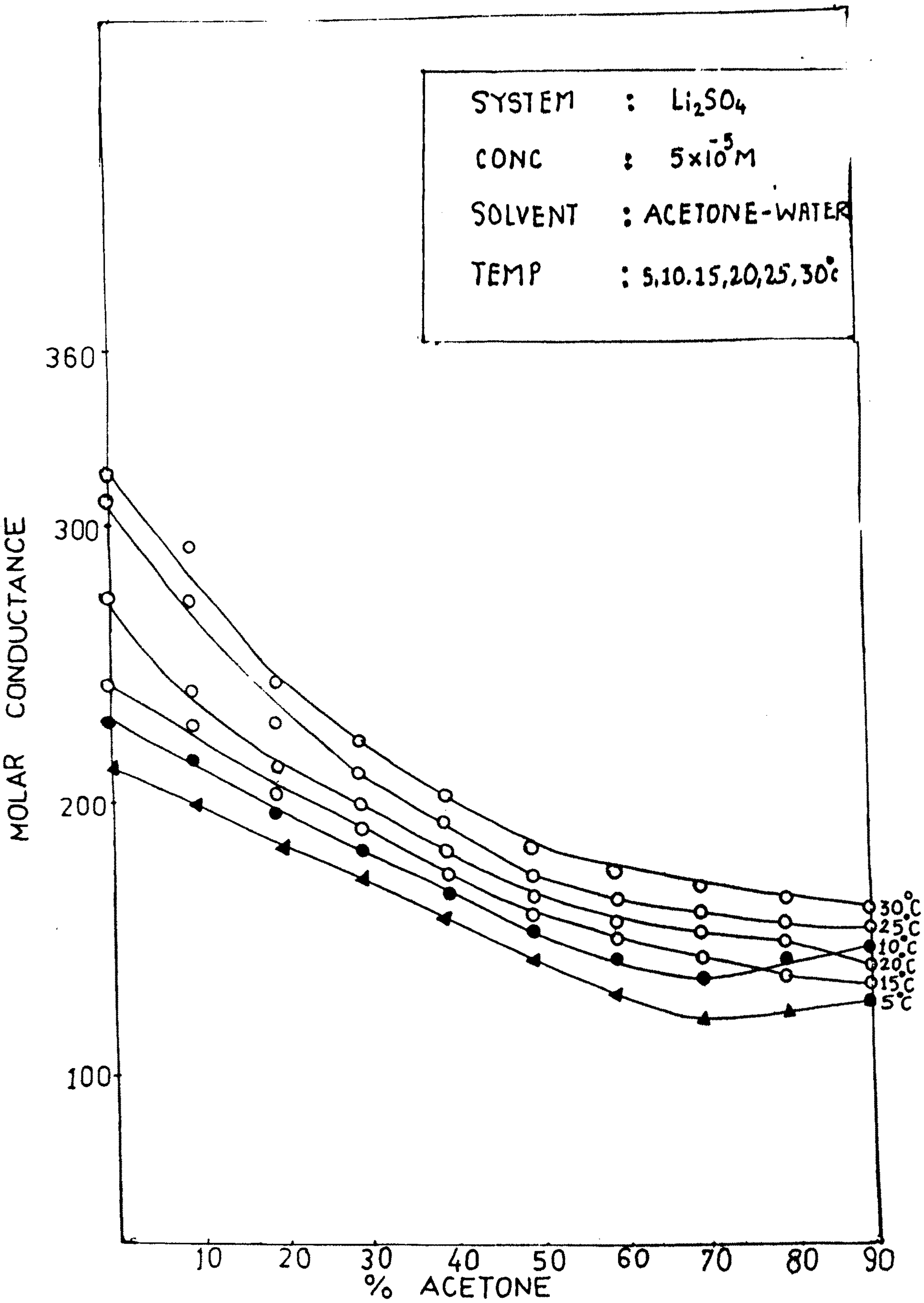

SYSTEM : Li_2SO_4
CONC : 5×10^{-5}M
SOLVENT : ACETONE-WATER
TEMP : 5,10.15,20,25,30°c
MOLAR CONDUCTANCE
360
300
200
100
10
20
30
40
50
60
70
80
90
% ACETONE
30°C
25°C
10°C
20°C
15°C
5°C

FIG-3.12

DISCUSSION

It has been found that molar conductance decreases continuously in the ethanol mixed solvents for the concentrations 1×10^{-2}M, 5×10^{-3}M, 1×10^{-3}M and for the tmperature 5^{o}c, 10^{o}c, 15^{o}c, 20^{o}c, 25^{o}c, 30^{o}c.

A minimum in molar conductance at 70% ethanol in ethanol-water mixture has been observed at 5 and 10^{o}c and for the concentration of 1×10^{-4}M and 5×10^{-5}M of Li_2SO_4.

A minimum in molar conductance is observed for 70% methanol for the concentrations 1×10^{-2}M and 5×10^{-3}M at the temperature 5, 10, 15, 20, 25^{o}c. For the concentration 1×10^{-3}M, the minimum in molar conductance is observed at 60% methanol and for all the above temperatures. No minimum is observed at 30^{o}c for all the three concentrations studied.

The molar conductance decreases continuously in the acetone mixed solvents for the concentrations, viz. 1×10^{-3}M and 5×10^{-4}M and for all the tmperatures studied. It is also observed that for above concentrations the conductance decreases abruptly beyond 80%.

A minimum in molar conductance is observed for 60% acetone and for the concentration 1×10^{-4}M and 70% acetone for the concentration 5×10^{-5}M at 5 and 10^{o}c.

The minimum in molar conductance is more pronounced at lower temperature and at lower concentrations.

When an electrolyte is dissolved in mixed solvents, ions get themselves attached to the molecules of both solvents. In ethanol-water system molar conductance is mainly due to the ions attached to the water molecules. Hence as the percentage of ethanol increases, decreases in molar conductance is expected.

Similarly, in acetone-water and methanol-water systems, molar conductance is mainly due to the ions attached to water molecules. Hence as the percentage of acetone or methanol increases, decrease in molar conductance is expected.

Molar conductance is dependent on the nature and velocity of the ions. Hence the diminution in fluidity of the solvent, which would bring about a corresponding decrease in ionic mobility is an important factor in causing the minimum in conductivity. The change in the ionic atmosphere which surrounds the ion is also an important factor in causing the minimum in conductivity.

An explanation that can be offered to account for the minimum in conductivity is that in these associated solvents, each solvent diminishes the association of the other. Since the dissociating power is a function of the association in the solvent anything that will diminish the association will diminish the dissociating power. The effect of mixing two associating solvents would thus to be diminished the association of both and consequently the dissociating power of each of the solvent. A mixture of such two solvents would then dissociate less than that in the individual solvents and the conductivity curve if plotted against the percentage of non aqueous solvent would pass through a minimum.

Decrease in conductivity with the increase in the organic solvent may be due to the increase in viscosity and partly due to less ionisation of the electrolyte in the mixed solvent.

The conductivity values of Li_2SO_4 in water mixed solvents have been found to be in the order acetone-water $>$ methanol-water $>$ ethanol-water upto 70% of non-aqueous solvent. Beyond 70%, the order changes as methanol-water $>$ acetone-water $>$ ethanol-water. This is observed for concentration 1×10^{-3}M. This can be clearly seen from the following tables.

Comparison of molar Conductances of lithium sulphatein mixed

solvents at $5^{o}C$ and at $1x10^{-5}M$ concentration

TABLE 3.13

% Non aqueous solvent	Ethanol-water	Methanol-water	Acetone-water
00	137.0	138.0	144.0
10	105.0	111.0	112.0
20	79.0	97.0	98.0
30	65.0	87.0	95.0
40	61.0	79.0	85.0
50	51.0	74.0	80.0
60	49.0	73.0	78.0
70	45.0	75.0	77.0
80	41.0	81.0	67.0
90	37.0	90.0	-

Comparison of molar Conductances of lithium sulphate in mixed

solvents at $10^{o}C$ and at $1x10^{-3}M$ concentration

TABLE 3.14

% Non aqueous solvent	$1x10^{-3}M$		
	Ethanol-water	Methanol-water	Acetone-water
00	149.0	151.0	168.0
10	125.0	120.0	135.0
20	93.0	105.0	114.0
30	75.0	92.0	107.0
40	62.0	83.0	92.0
50	57.0	79.0	86.0
60	52.0	76.0	78.0
70	48.0	77.0	78.0
80	43.0	85.0	73.0
90	39.0	94.0	-

Comparison of molar Conductances of lithium sulphate in mixed solvents at $15^{o}C$ and at $1x10^{-3}M$ concentration

TABLE 3.15

% Non aqueous solvent	$1x10^{-3}M$		
	Ethanol-water	Methanol-water	Acetone-water
00	175.0	174.0	180.0
10	142.0	149.0	155.0
20	120.0	127.0	129.0
30	99.0	102.0	112.0
40	83.0	92.0	107.0
50	74.0	85.0	95.0
60	68.0	80.0	88.0
70	61.0	79.0	85.0
80	55.0	91.0	75.0
90	46.0	102.0	-

Comparison of molar Conductances of lthium sulphate in mixed solvents at $20^{o}C$ and at $1x10^{-3}M$ concentration.

TABLE 3.16

% Non aqueous solvent	$1x10^{-3}M$ Ethanol-water	Methanol-water	Acetone-water
00	189.0	191.0	192.0
10	158.0	170.0	172.0
20	131.0	141.0	144.0
30	109.0	116.0	134.0
40	91.0	104.0	116.0
50	84.0	99.0	105.0
60	74.0	96.0	99.0
70	66.0	92.0	98.0
80	59.0	82.0	80.0
90	47.0	109.0	-

Comparison of molar Conductances of lithium sulphate in mixed solvents at 25°C and at 1×10^{-3} M concentration

TABLE 3.17

% Non aqueous solvent	1×10^{-3} M		
	Ethanol-water	Methanol-water	Acetone-water
00	210.0	213.0	214.0
10	178.0	179.0	187.0
20	140.0	140.0	161.0
30	115.0	132.0	147.0
40	98.0	120.0	132.0
50	86.0	115.0	119.0
60	77.0	109.0	110.0
70	69.0	103.0	108.0
80	63.0	112.0	90.0
90	52.0	116.0	-

Comparison of molar Conductances of lithium sulphate in mixed solvents at $30^{o}C$ and at $1x10^{-3}$ M concentration

TABLE 3.18

% Non aqueous solvent	$1x10^{-3}$ M		
	Ethanol-water	Methanol-water	Acetone-water
00	230.0	232.0	235.0
10	194.0	197.0	205.0
20	149.0	169.0	177.0
30	124.0	148.0	162.0
40	106.0	134.0	154.0
50	94.0	126.0	142.0
60	84.0	122.0	133.0
70	76.0	119.0	122.0
80	68.0	122.0	120.0
90	56.0	120.0	-

SYSTEM : Li_2SO_4 (0·01 M) [1×10⁻²M], SOLVENT : ETHANOL - WATER

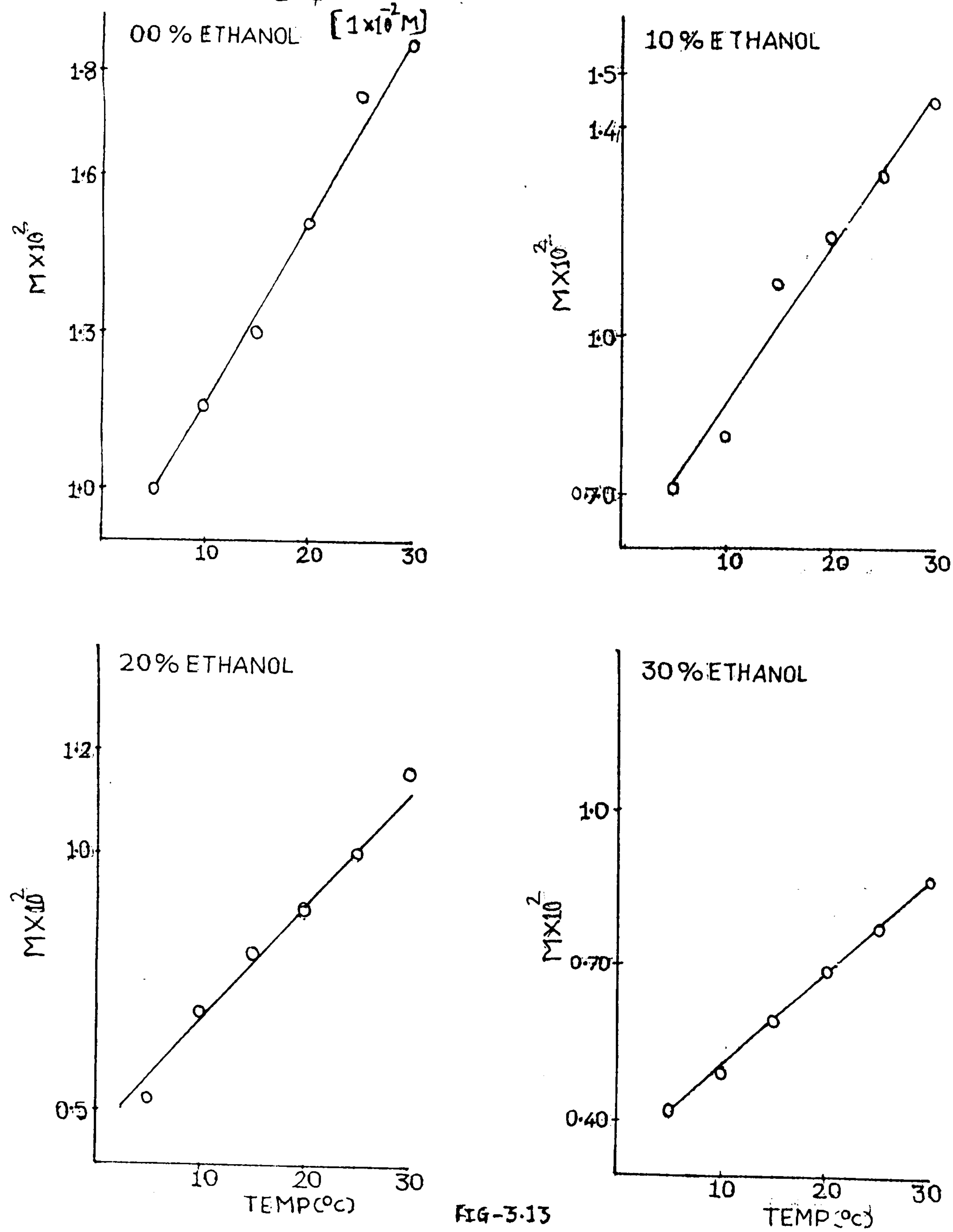


FIG-3.13

SYSTEM: Li_2SO_4 (0·01M), SOLVENT: ETHANOL - WATER

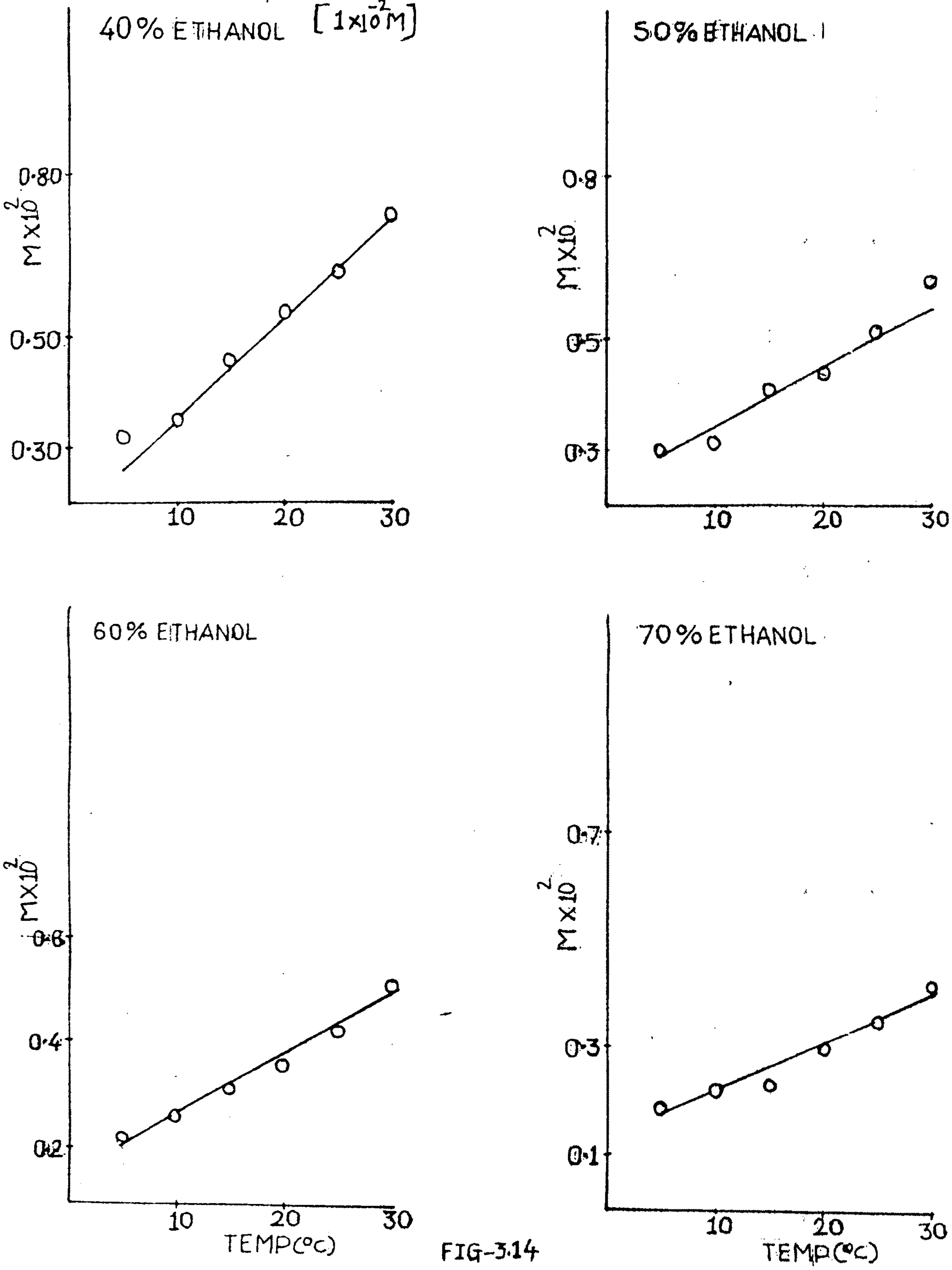


FIG-3.14

SYSTEM : Li_2SO_4 (0·01M) , SOLVENT : ETHANOL - WATER

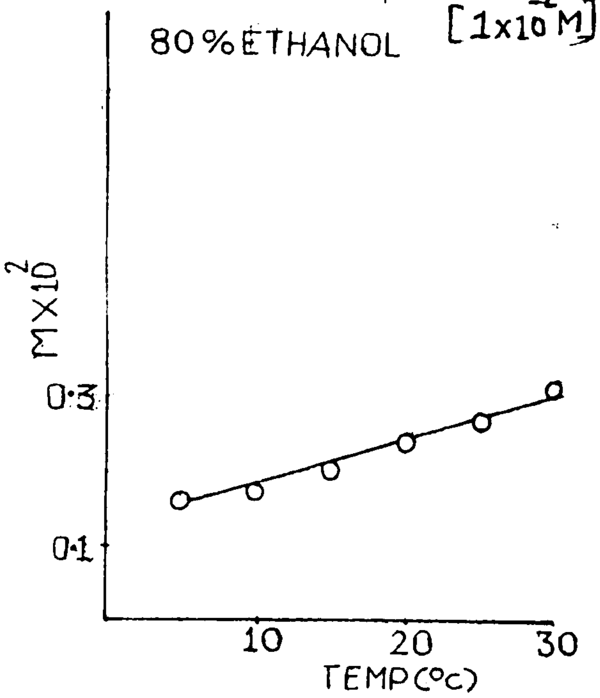


FIG-3.15

SYSTEM: Li_2SO_4 (0.005 M)   SOLVENT: ETHANOL-WATER

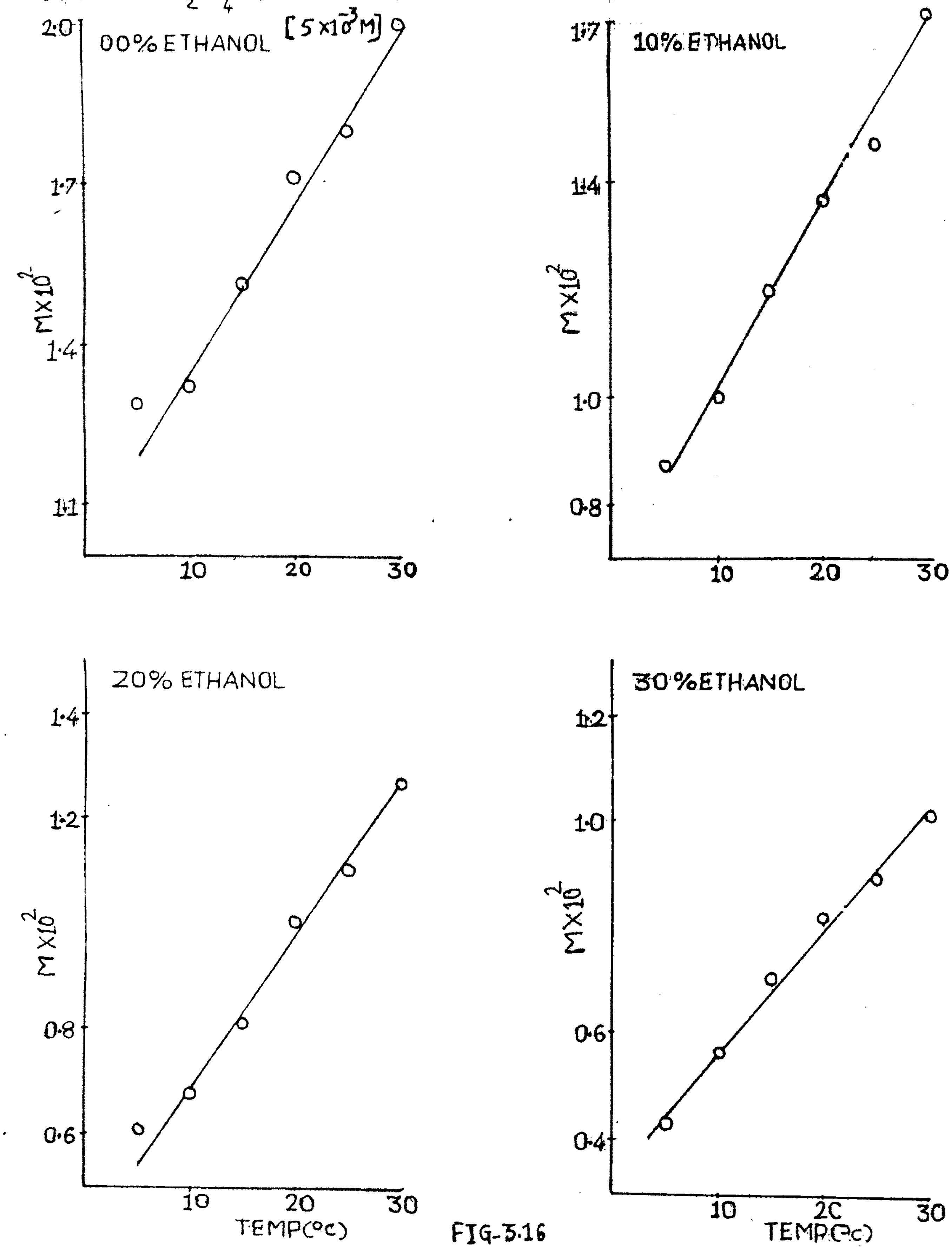


FIG-3.16

SYSTEM: Li_2SO_4 (0.005 M), SOLVENT: ETHANOL- WATER

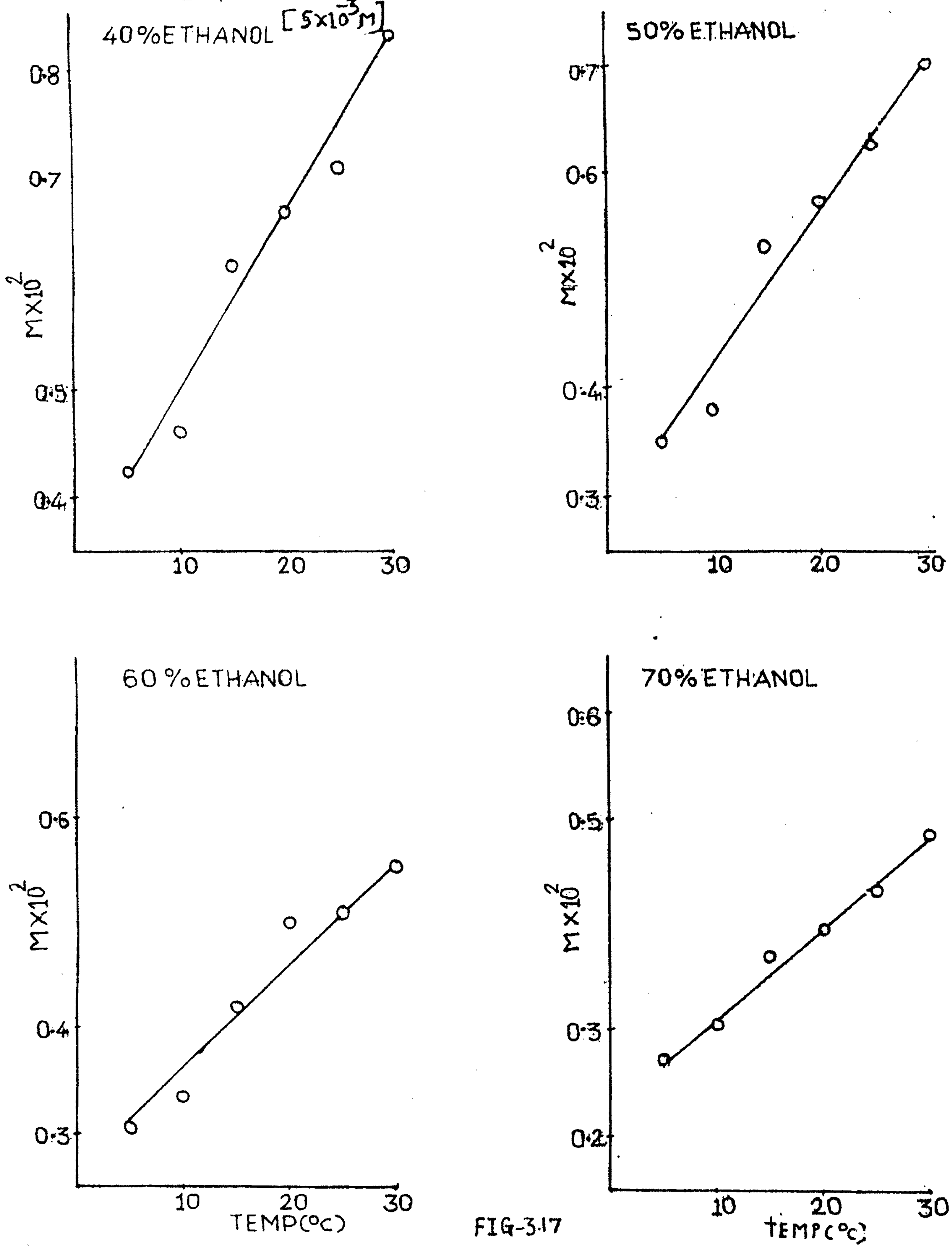


FIG-3.17

SYSTEM : Li_2SO_4 (0.005 M) , SOLVENT : ETHANOL - WATER

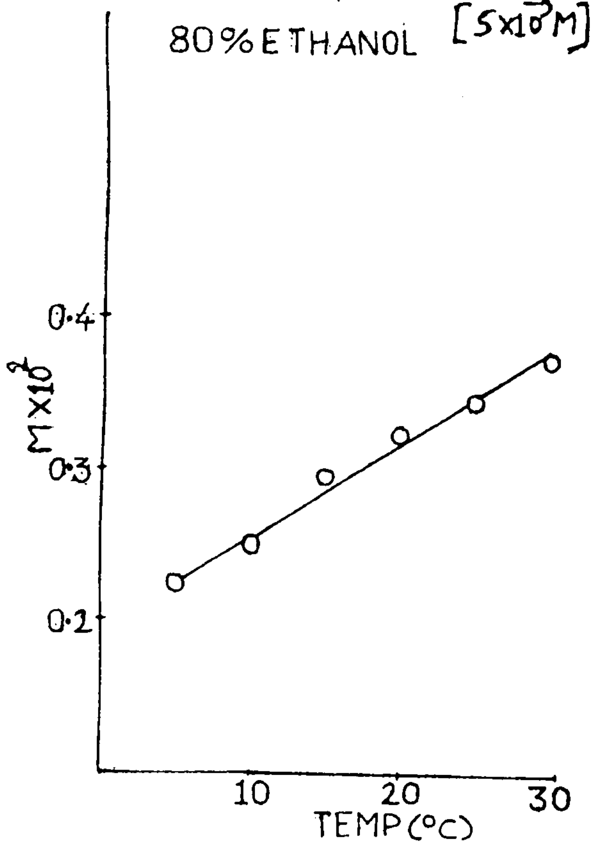


FIG- 3.18

SYSTEM: Li_2SO_4 (0·001M) [1×10^{-3}M], SOLVENT: ETHANOL · WATER

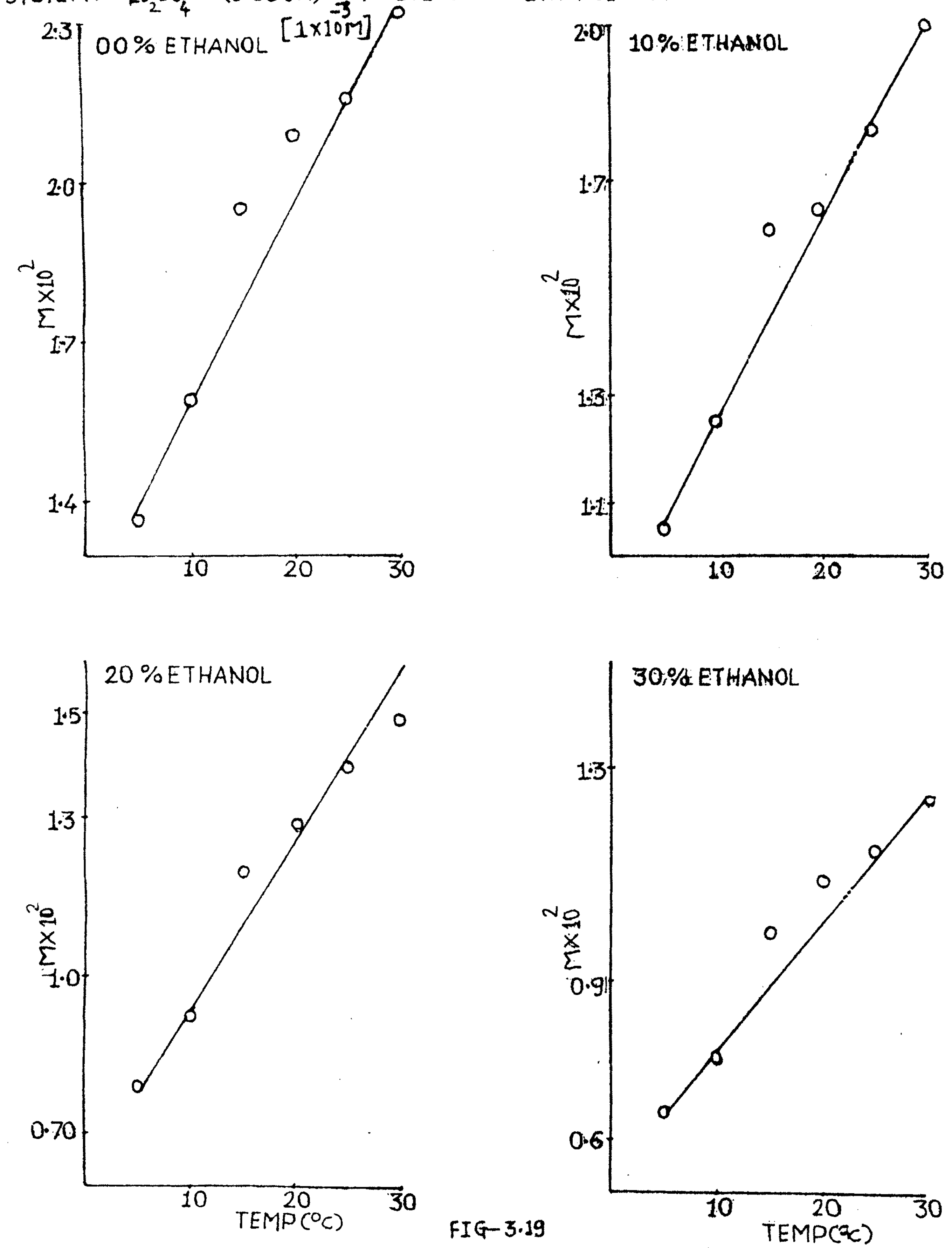


FIG-3.19

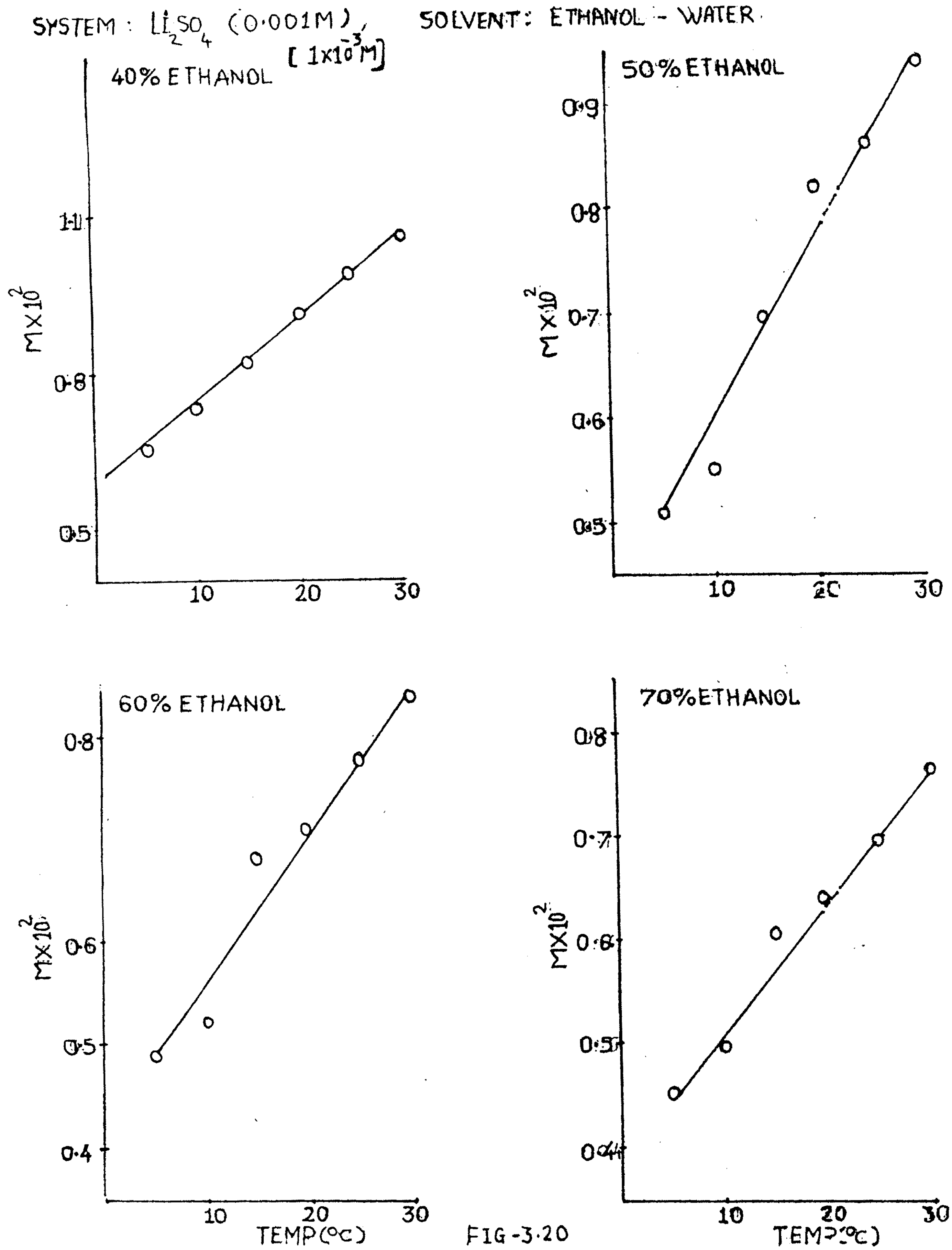

SYSTEM : Li_2SO_4 (0·001M), [1x10^{-3}M]
SOLVENT: ETHANOL - WATER
40% ETHANOL
50% ETHANOL
60% ETHANOL
70% ETHANOL
M x 10^2
TEMP(°C)

FIG-3·20

SYSTEM : Li_2SO_4 (0·001M) , SOLVENT : ETHANOL – WATER

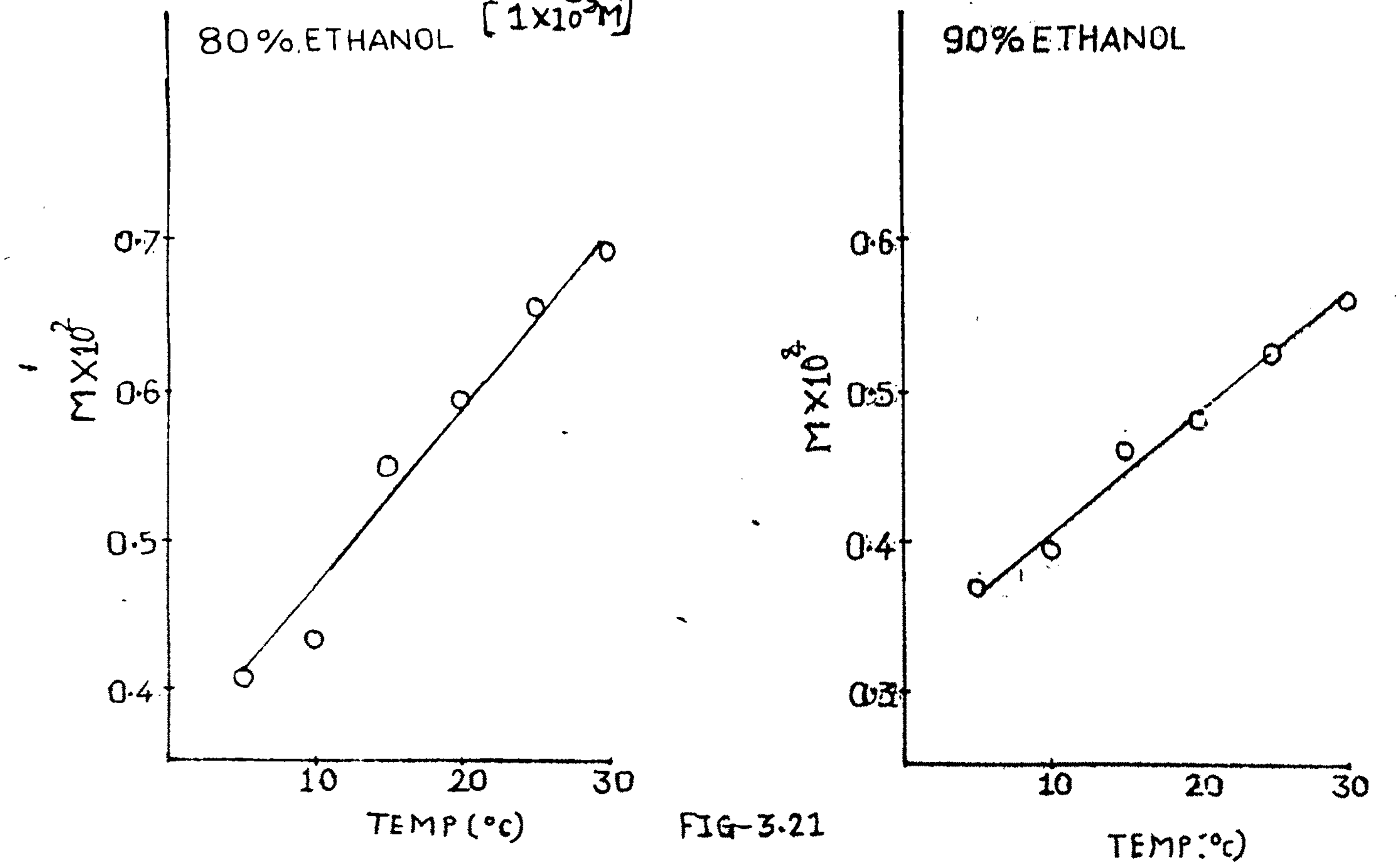


FIG-3.21

SYSTEM: Li_2SO_4 (0·0001M), [1×10^{-4}M] SOLVENT: ETHANOL-WATER

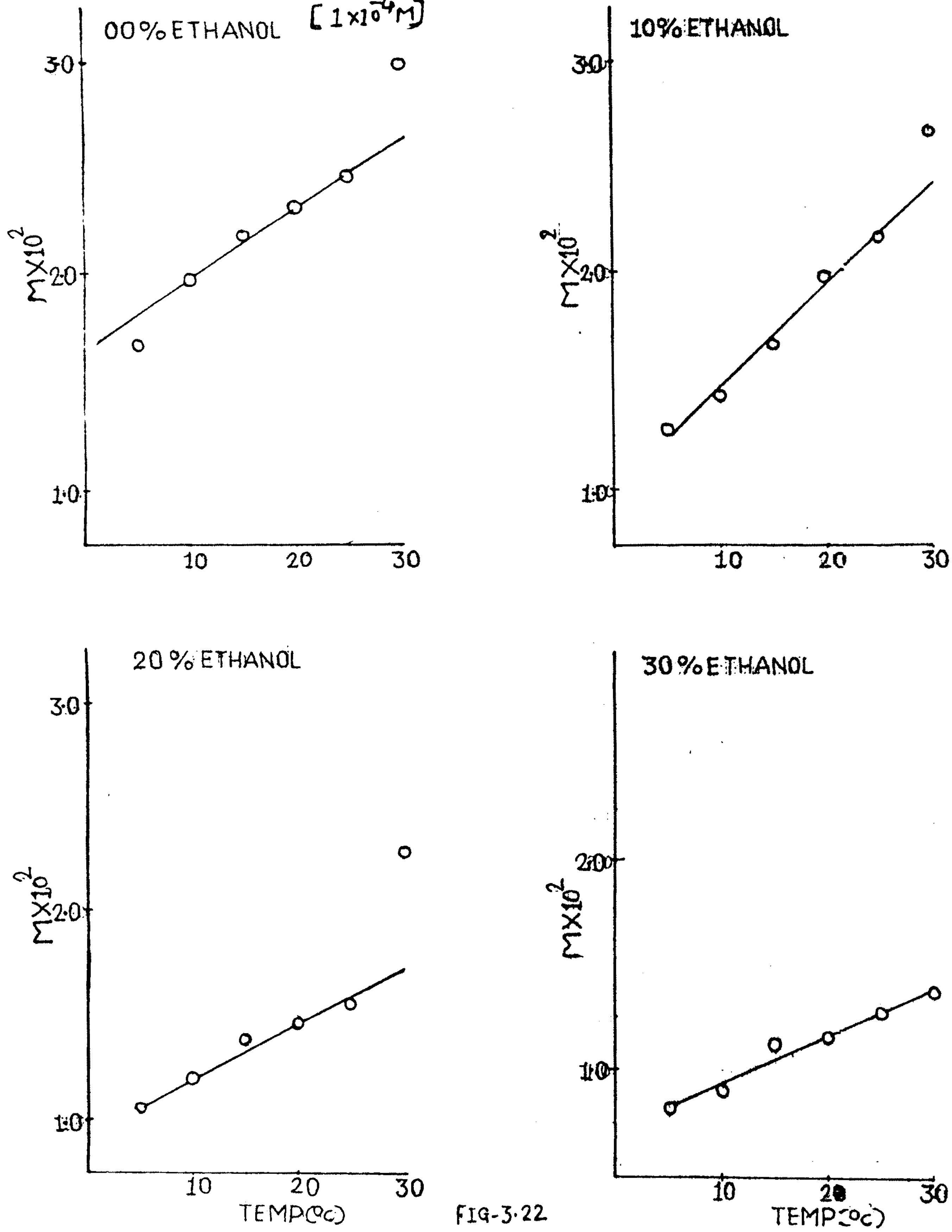


FIG-3·22

SYSTEM: Li_2SO_4 (0·0001M), [1×10⁻⁴M]   SOLVENT: ETHANOL-WATER

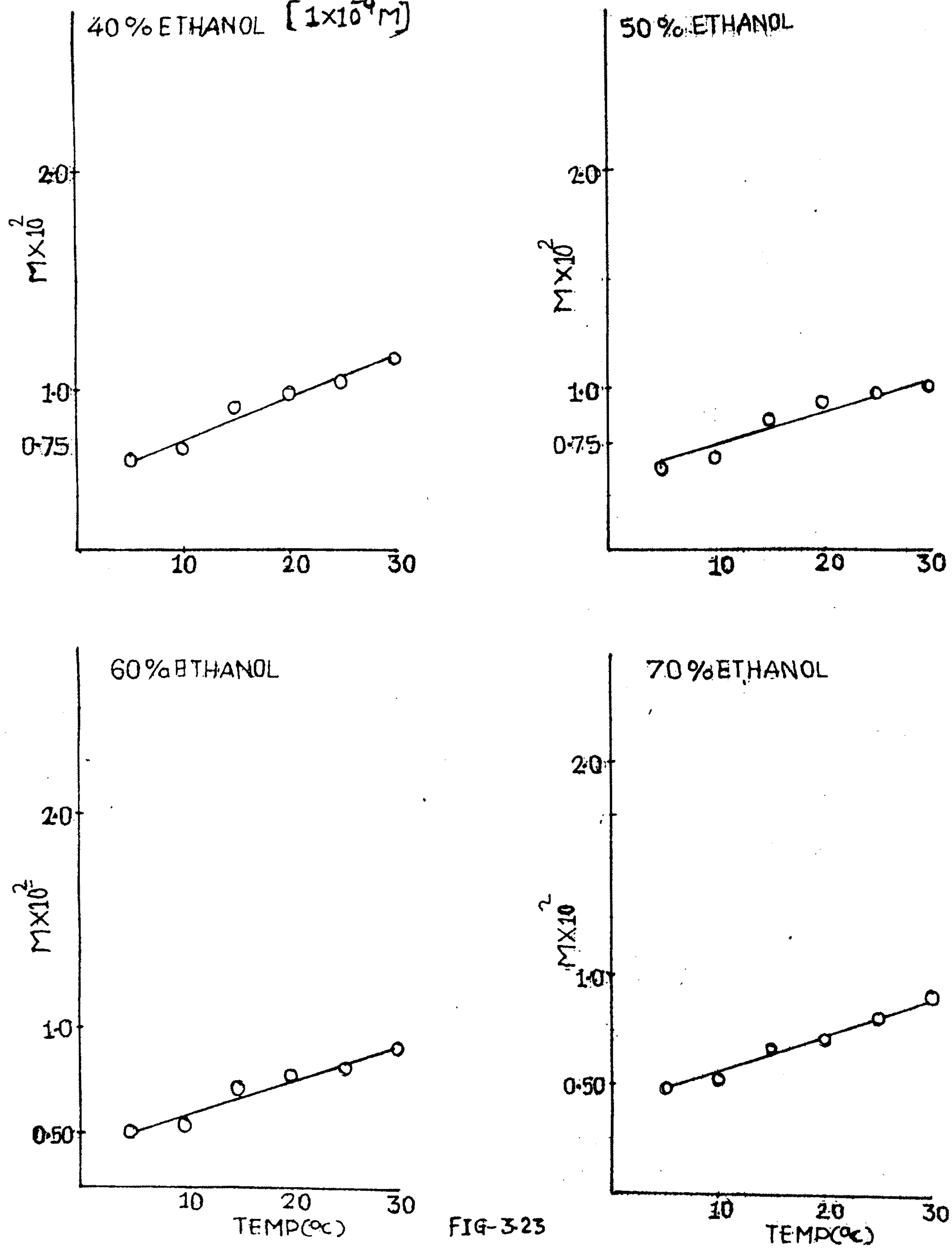


FIG-3.23

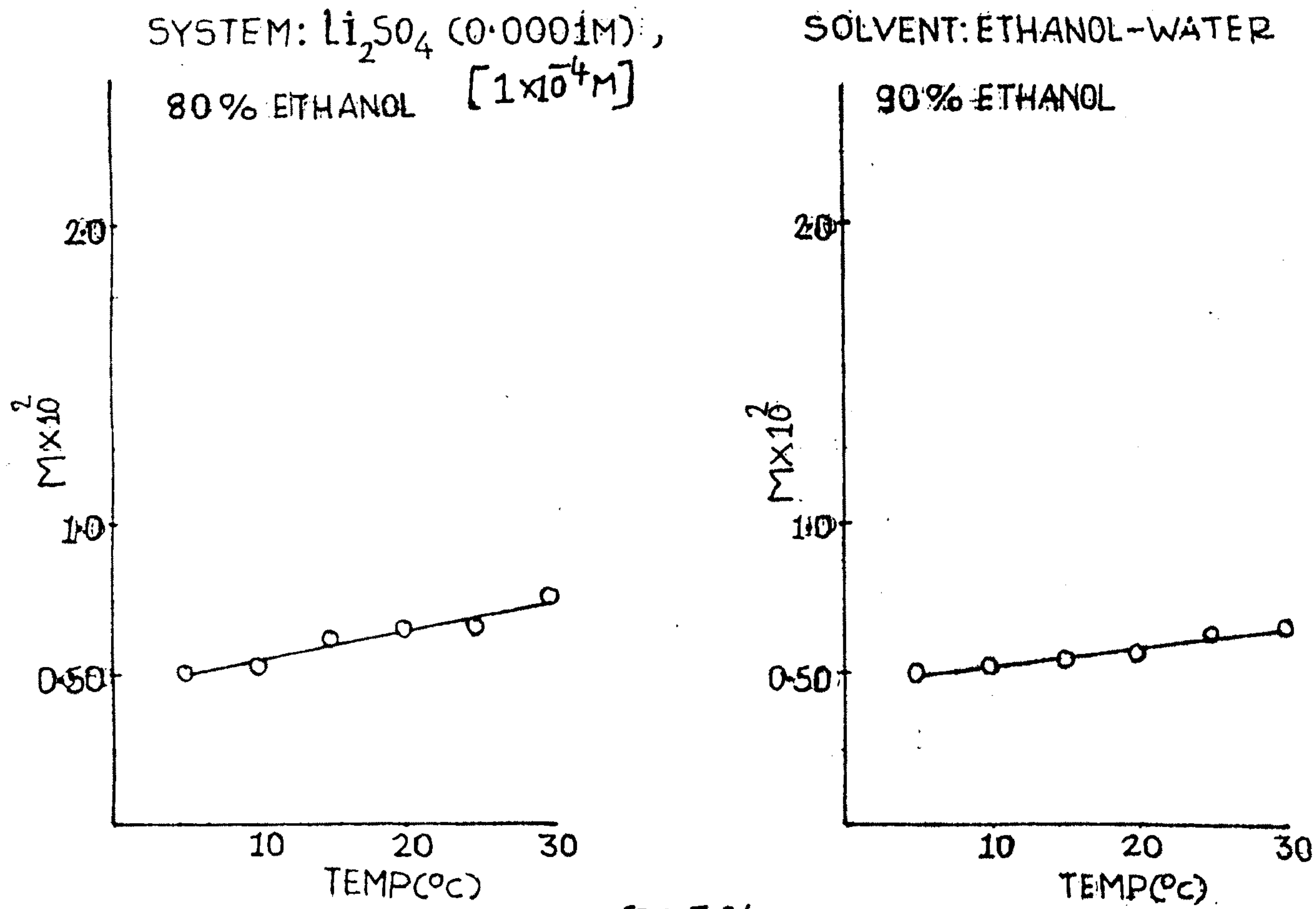

SYSTEM: Li_2SO_4 (0·0001M), [1×10^{-4}M]
SOLVENT: ETHANOL-WATER
80% ETHANOL
90% ETHANOL
$M\times10^{-2}$
2·0
1·0
0·50
10
20
30
TEMP(°C)

FIG-3.24

SYSTEM: Li_2SO_4 (0·00005M) , SOLVENT: ETHANOL-WATER
[5×10^{-5}M]

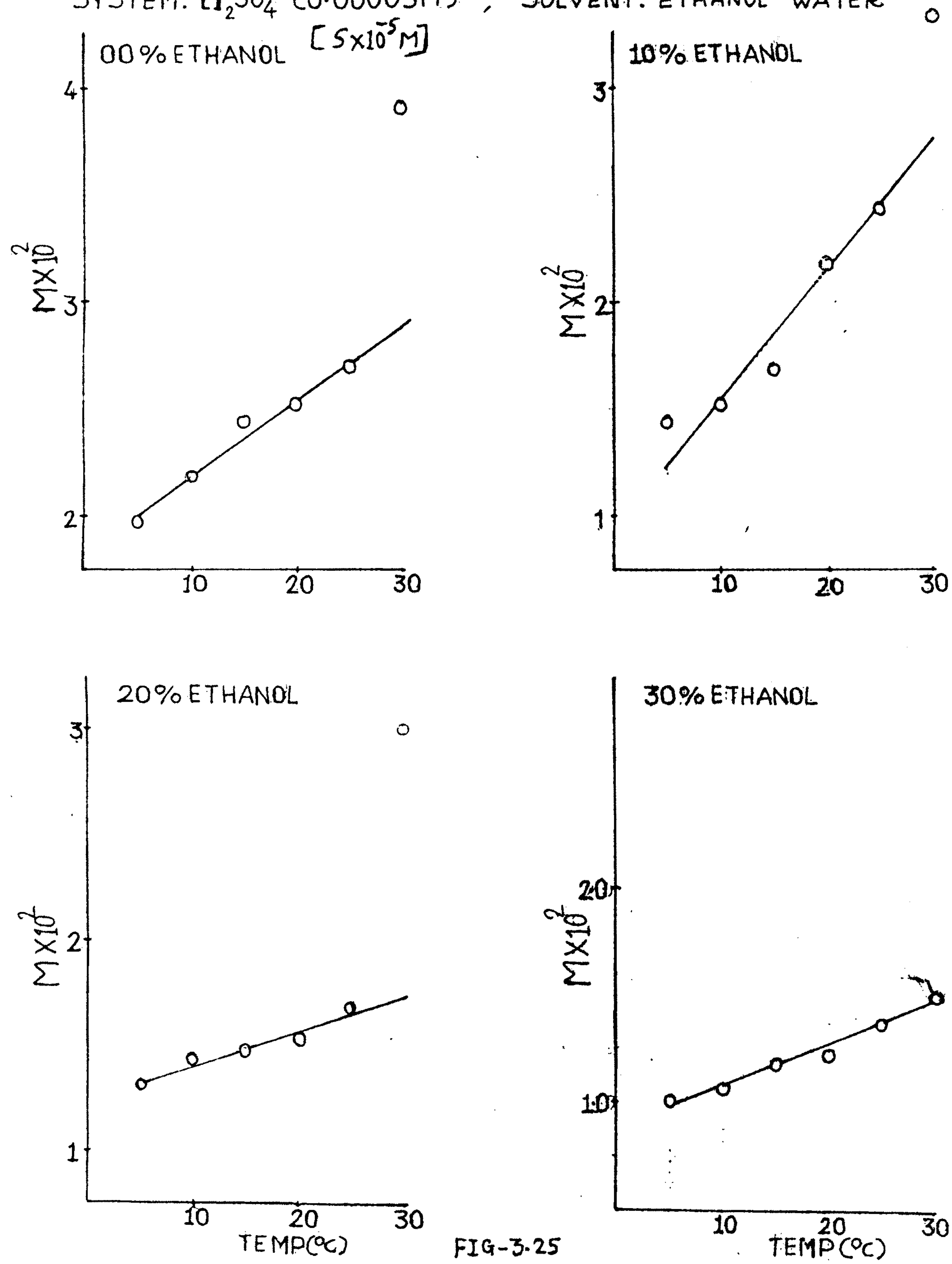


FIG-3.25

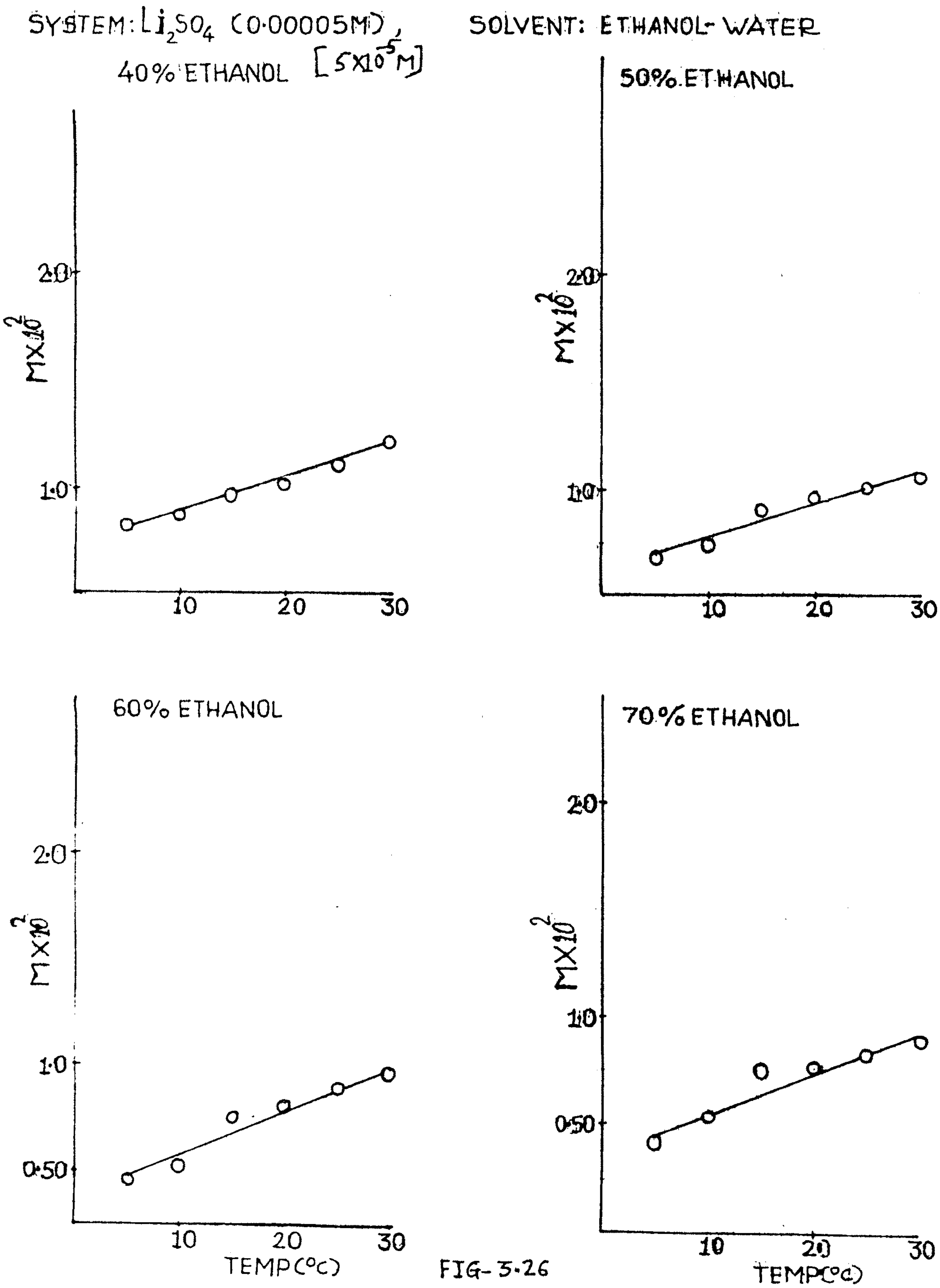

SYSTEM: Li_2SO_4 (0·00005M), [5×10^{-5}M]
SOLVENT: ETHANOL-WATER
40% ETHANOL
50% ETHANOL
60% ETHANOL
70% ETHANOL
$M\times10^{2}$
2·0
1·0
0·50
10
20
30
TEMP(°C)

FIG-3.26

SYSTEM: Li_2SO_4 (0·00005M), SOLVENT: ETHANOL-WATER

[5×10^{-5} M]

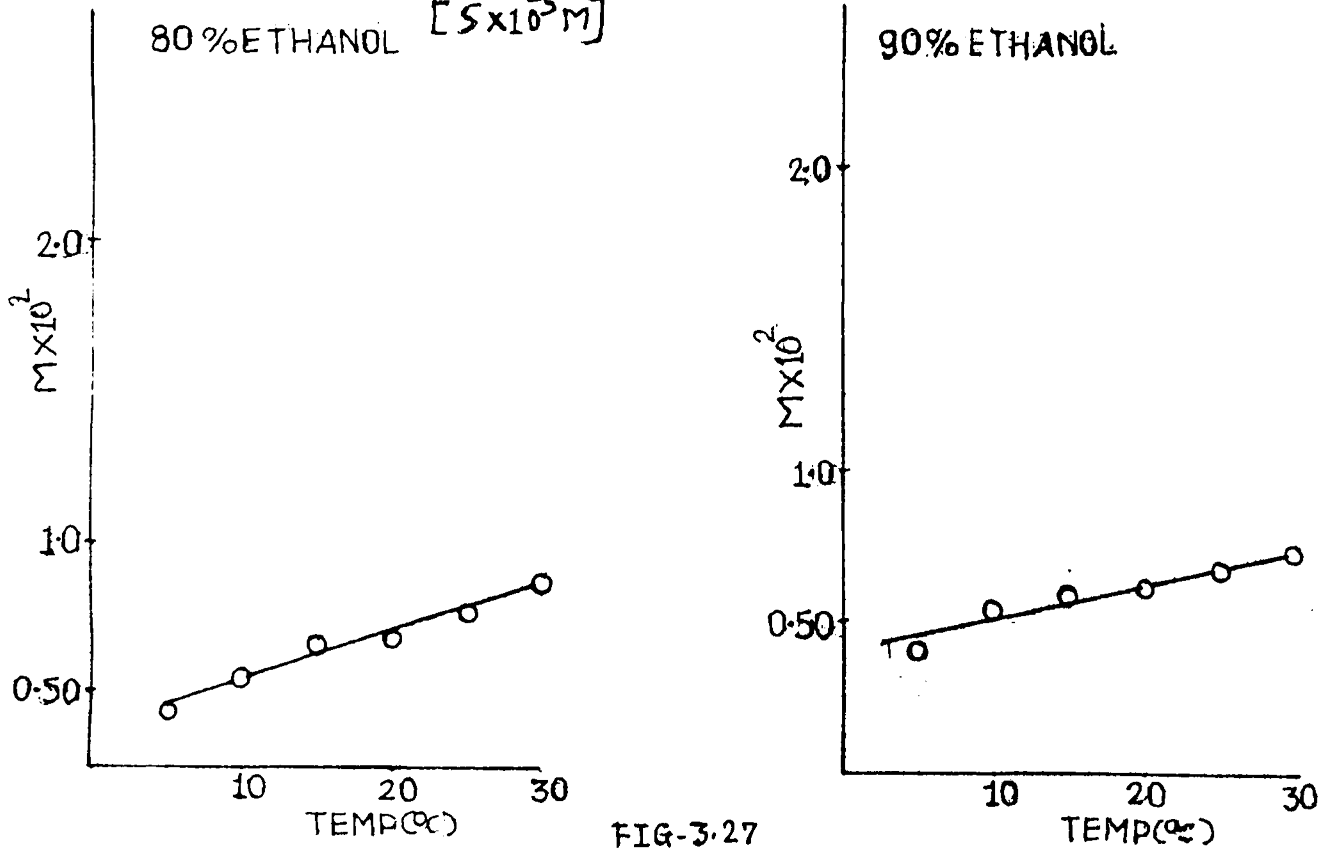


FIG-3.27

SYSTEM : Li_2SO_4 (0·01M), SOLVENT: METHANOL - WATER

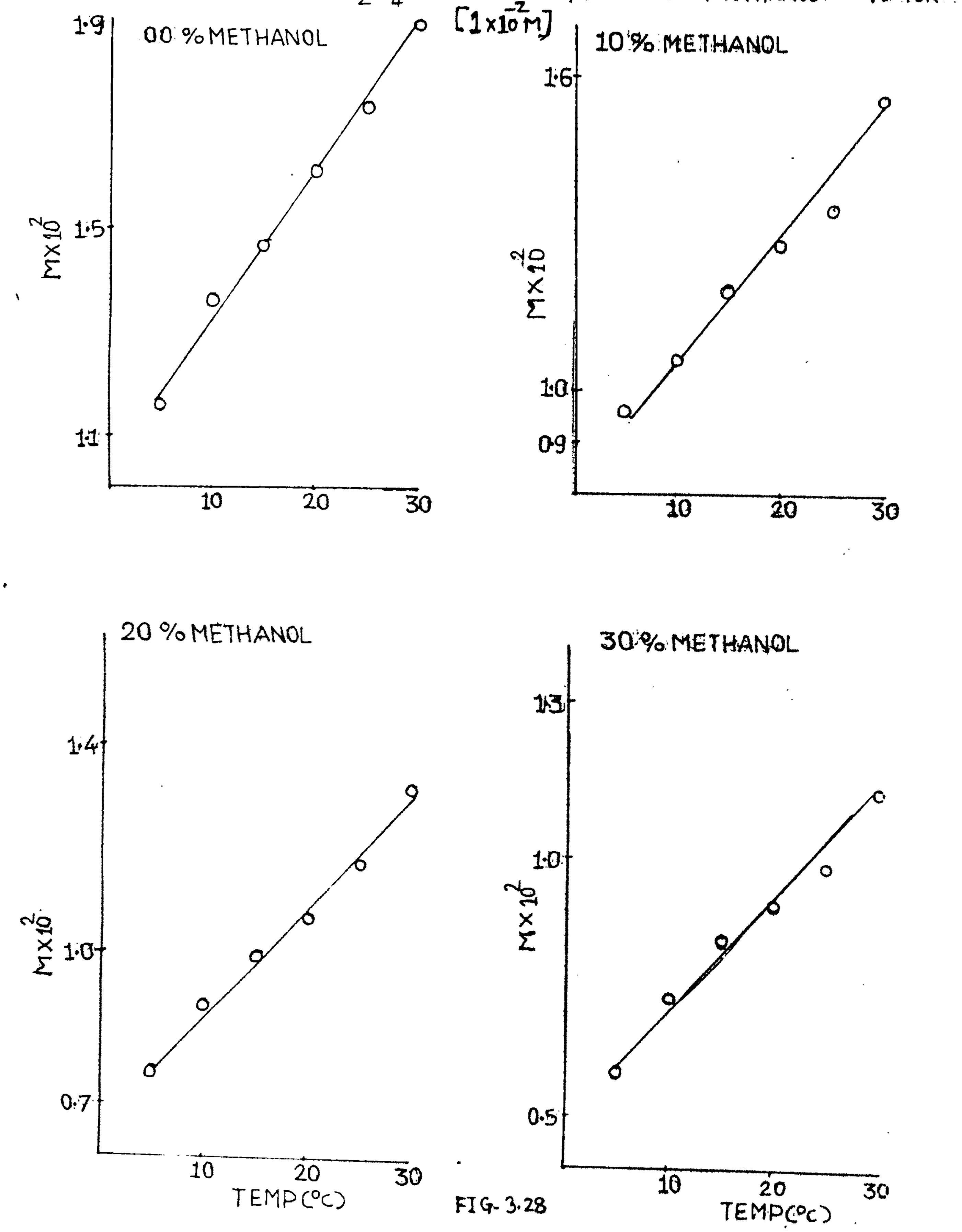


FIG- 3.28

SYSTEM : Li_2SO_4 (0·01M), SOLVENT : METHANOL - WATER.
[1x10^{-7}M]

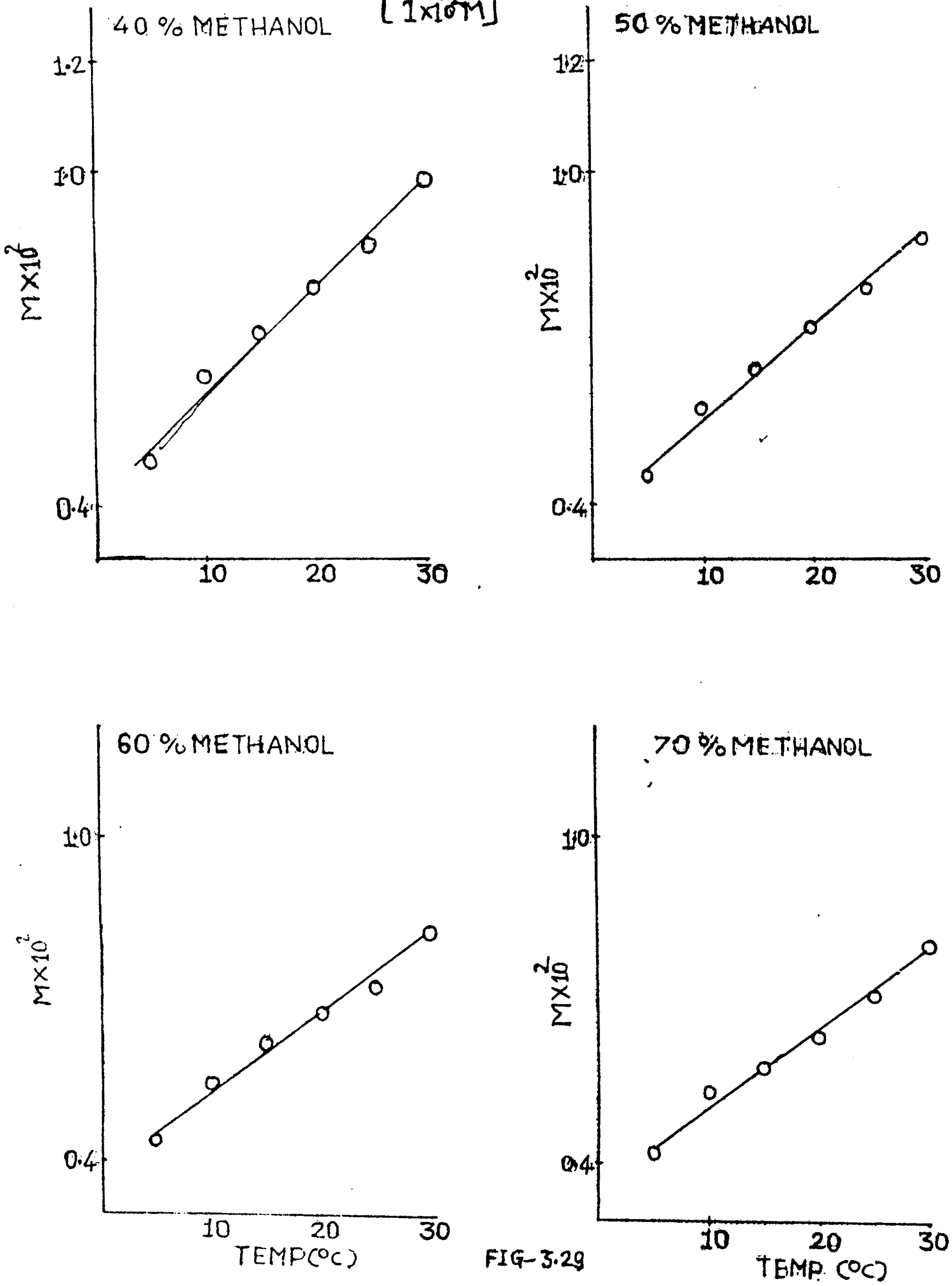


FIG-3.29

SYSTEM : Li_2SO_4 (0·01M), SOLVENT: METHANOL - WATER
[1×10^{-2}M]

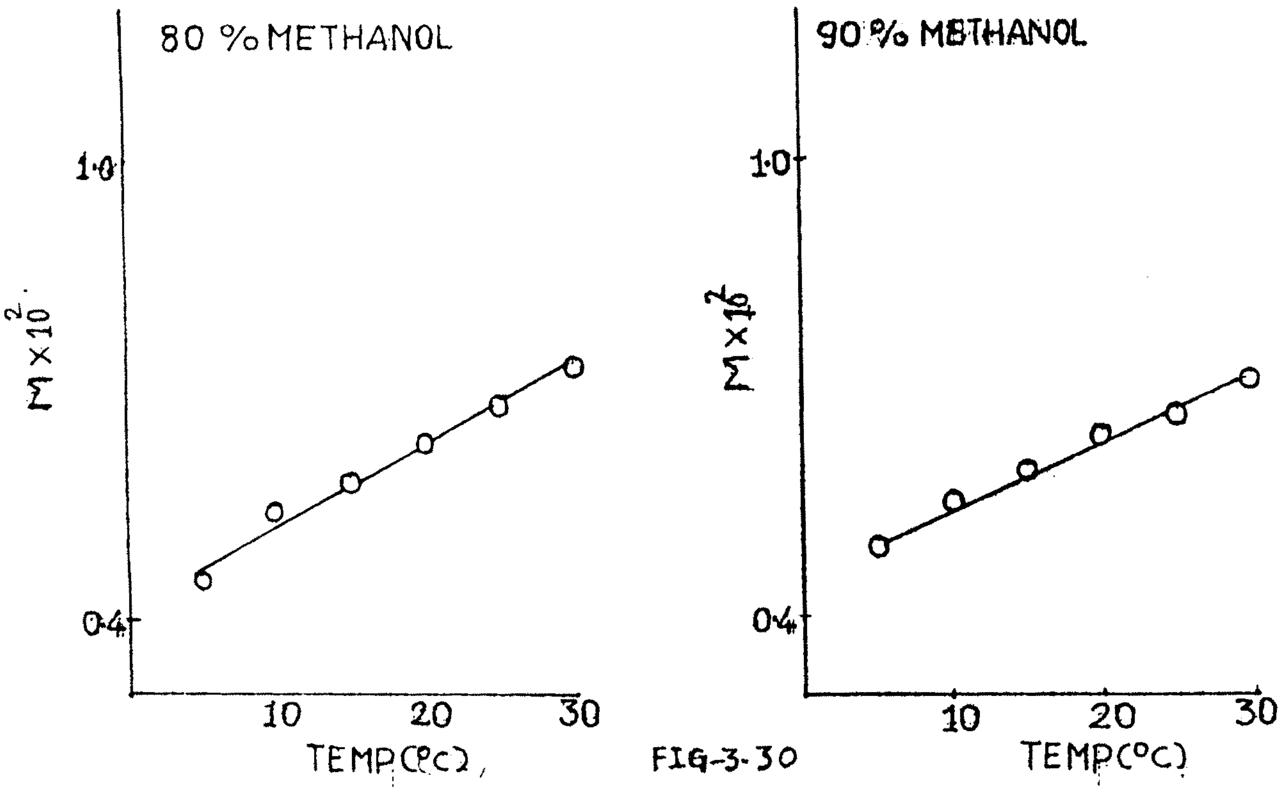


FIG-3-30

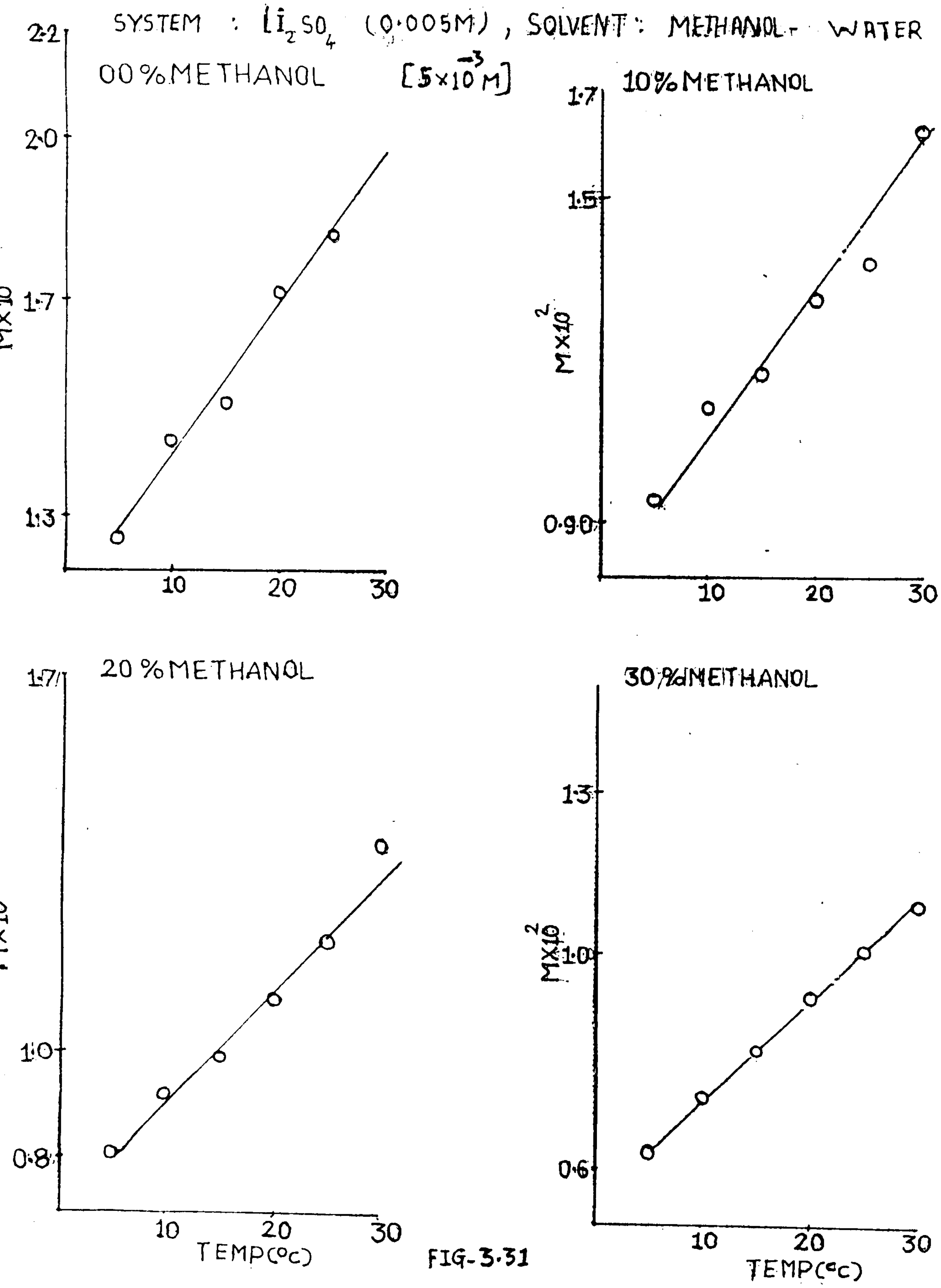

SYSTEM : Li_2SO_4 (0·005M), SOLVENT : METHANOL - WATER
[5×10^{-3}M]
00% METHANOL
10% METHANOL
20% METHANOL
30% METHANOL
$M\times10^{2}$
TEMP(°c)
2·2
2·0
1·7
1·3
1·5
0·90
1·0
0·8
0·6
10
20
30

FIG-3·31

SYSTEM : Li_2SO_4 (0·005 M), SOLVENT: METHANOL – WATER

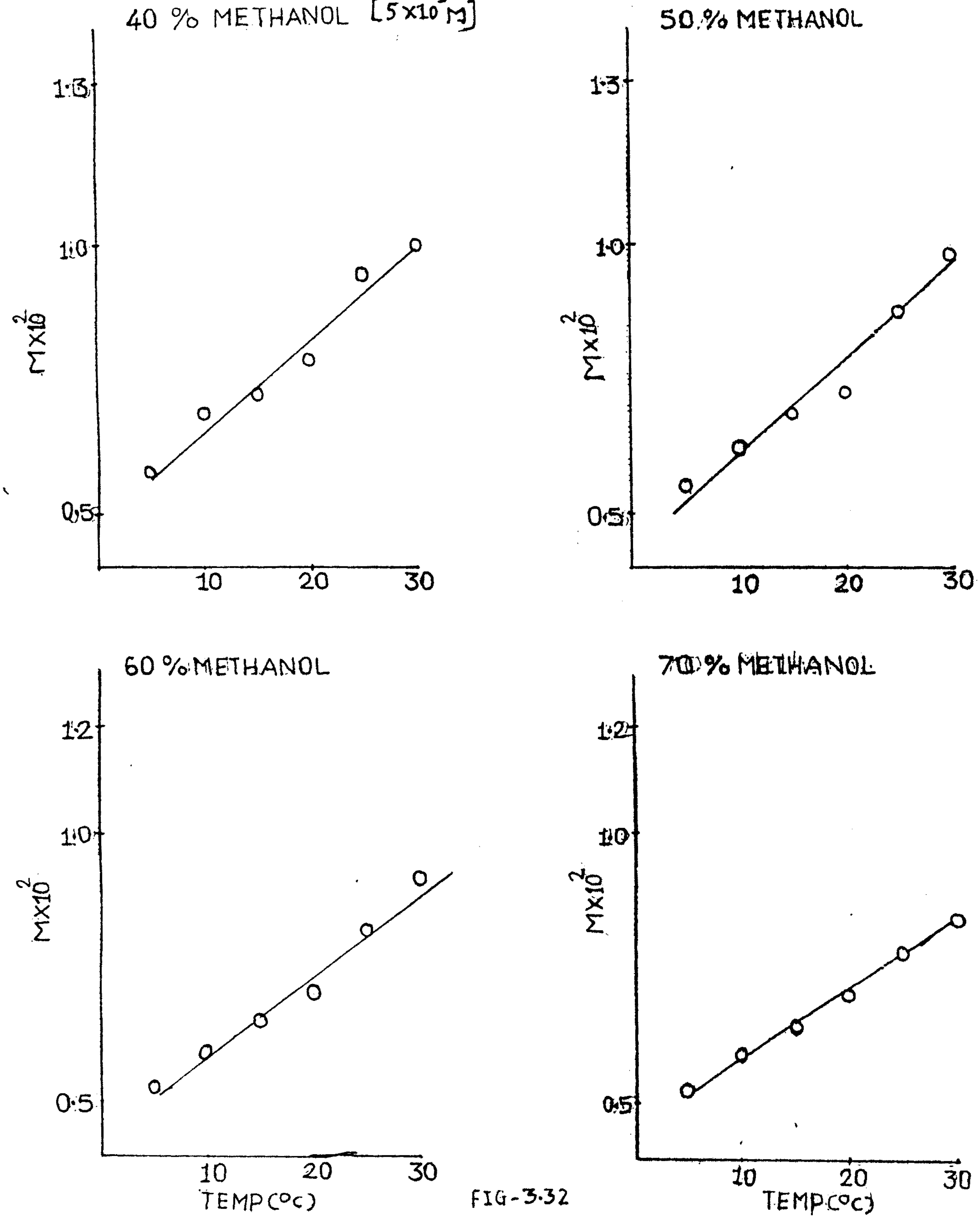


FIG-3.32

SYSTEM : Li_2SO_4 (0·005 M), [5×10^{-3} M] SOLVENT: METHANOL - WATER.

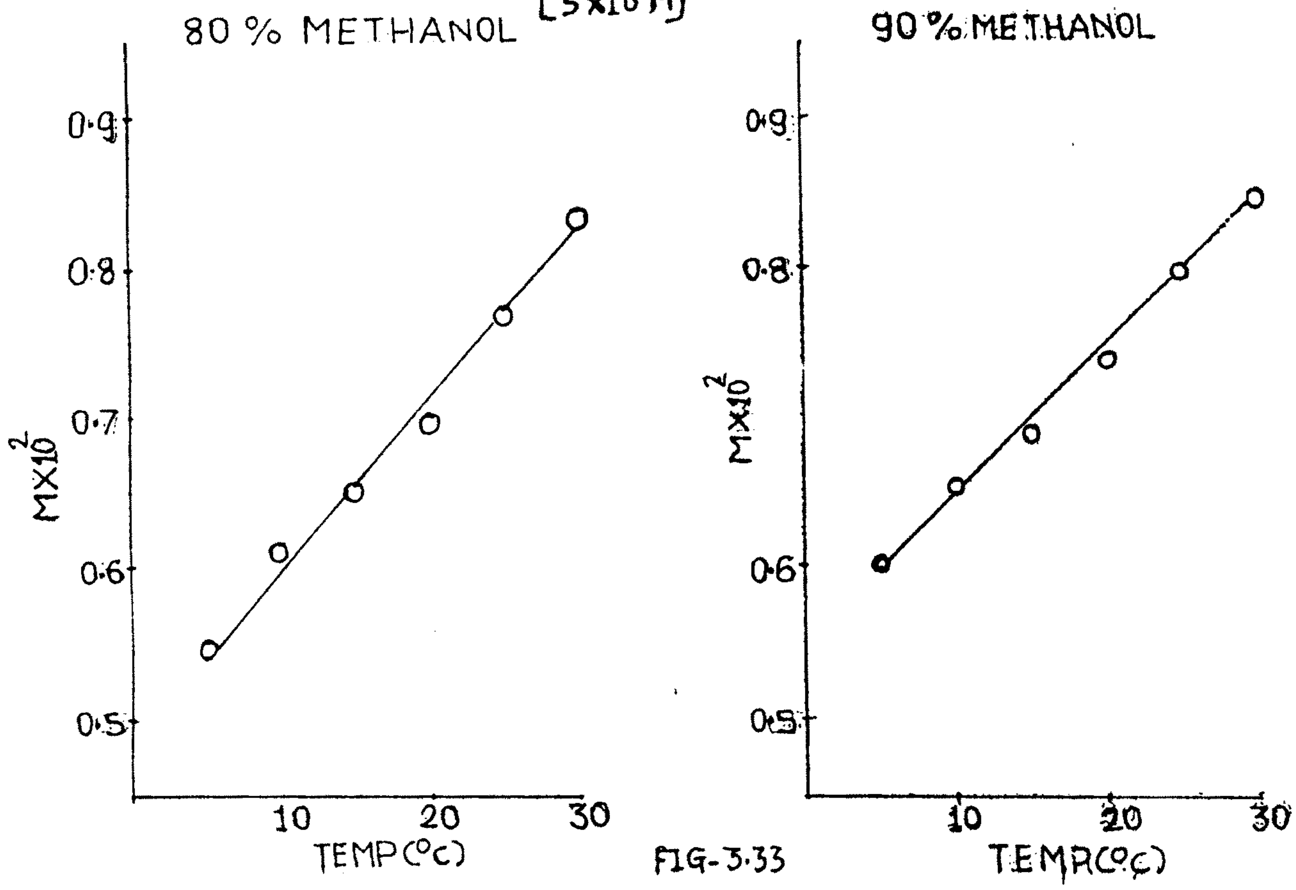


FIG-3.33

SYSTEM : Li_2SO_4 (0·001 M) , SOLVENT : METHANOL - WATER

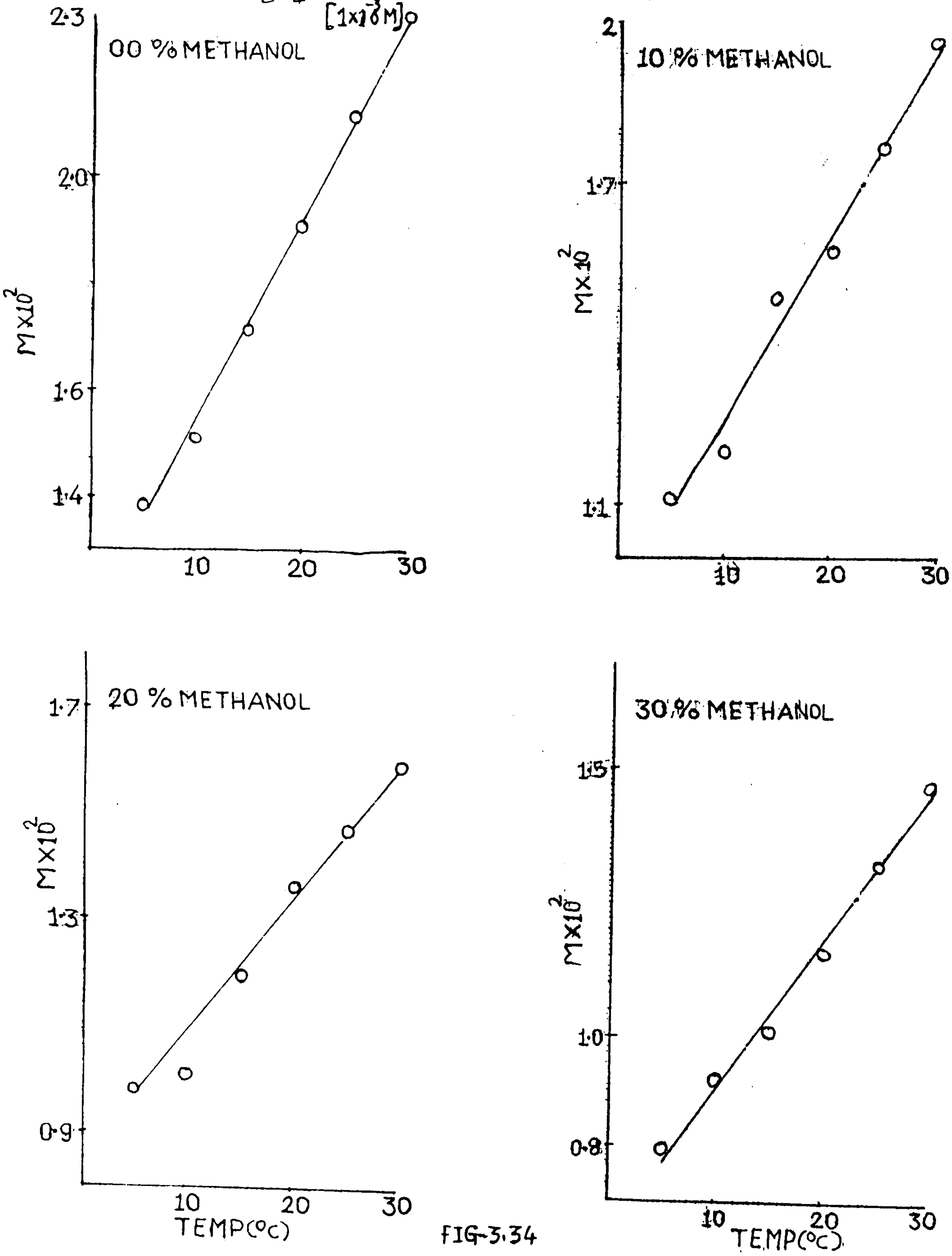


FIG-3.34

SYSTEM : Li_2SO_4 (0·001M) , SOLVENT : METHANOL-WATER
[1×10^{-3} M]

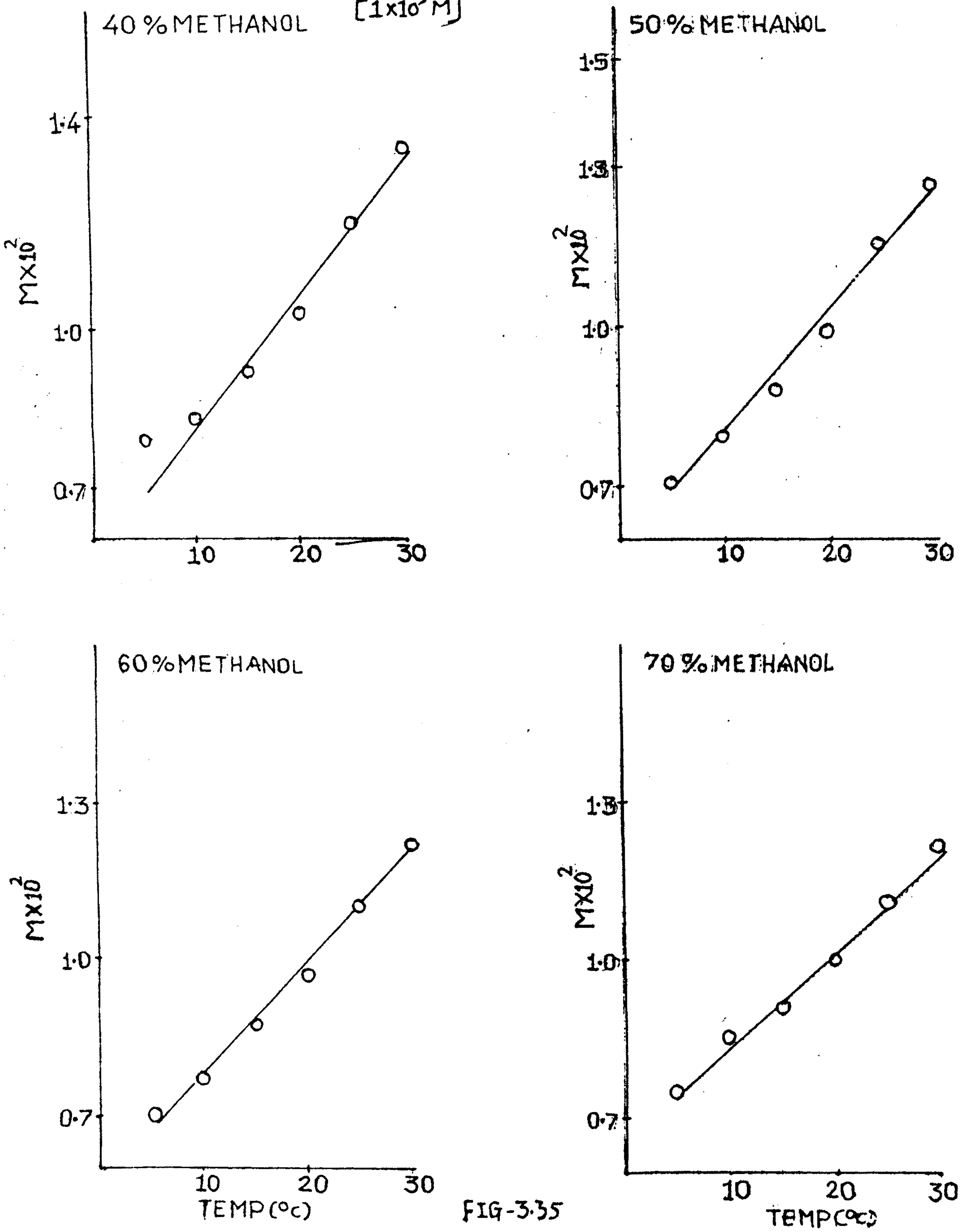


FIG-3.35

SYSTEM : Li_2SO_4 (0·001M), [1×10^{-3}M] SOLVENT : METHANOL - WATER

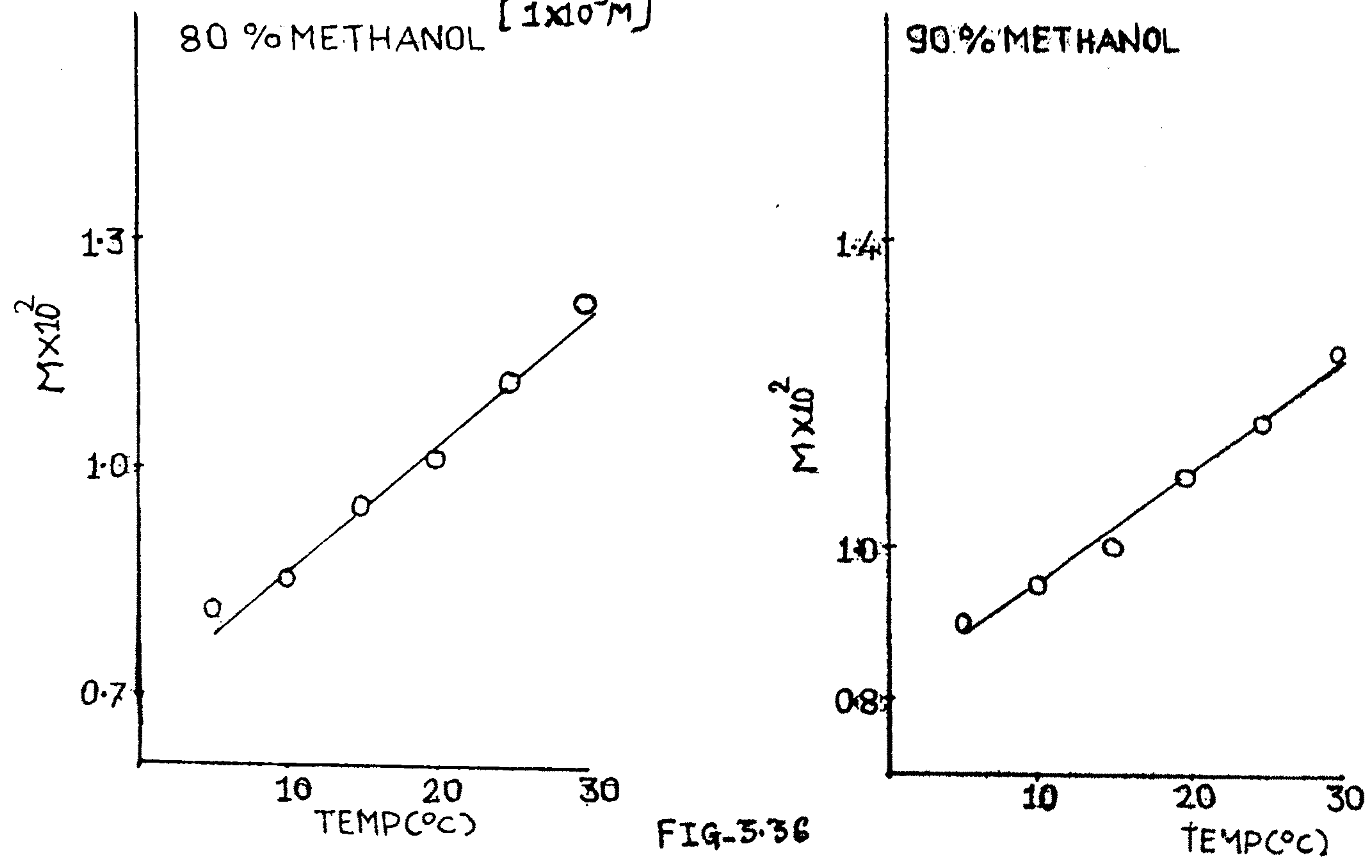


FIG-3·36

SYSTEM : Li_2SO_4 (0·001M) [1x10⁻³M] , SOLVENT: ACETONE - WATER

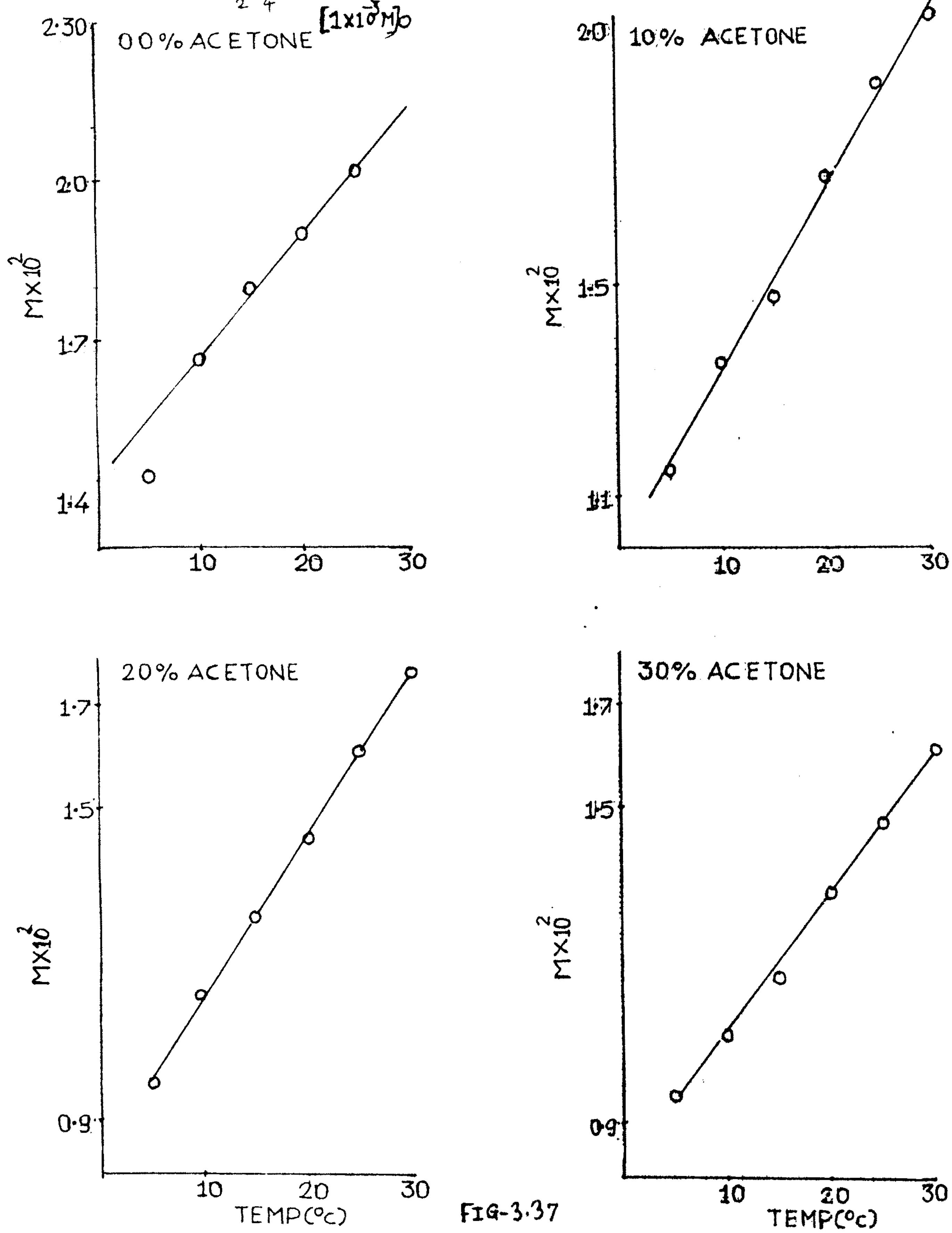


FIG-3.37

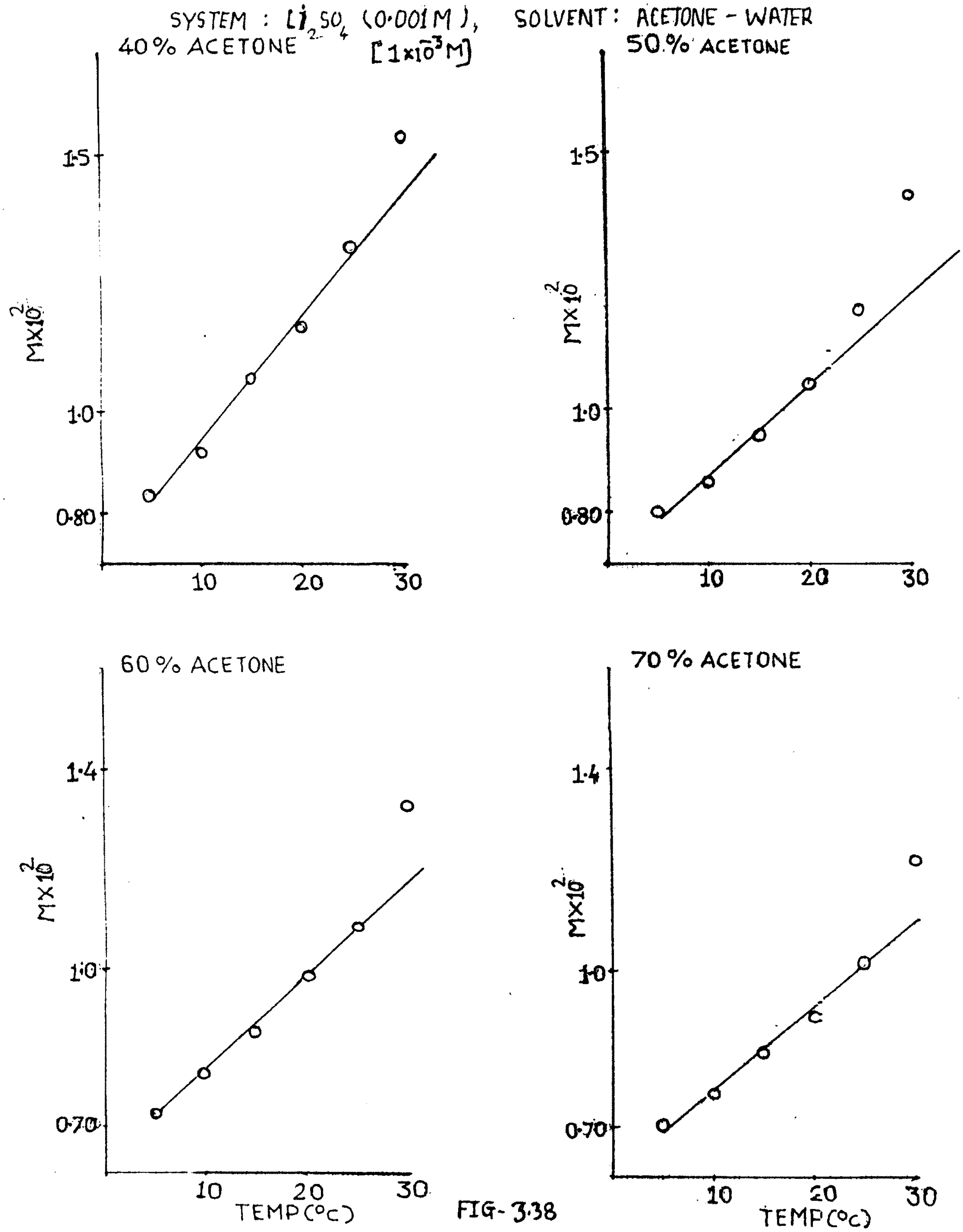
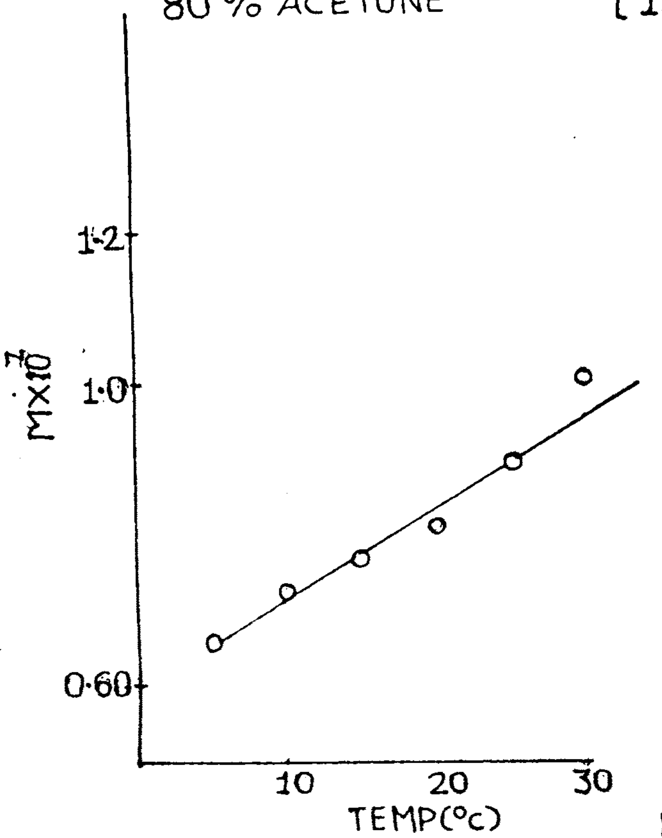

SYSTEM : Li_2SO_4 (0.001 M), [1×10⁻³M]
SOLVENT : ACETONE - WATER
40% ACETONE
50% ACETONE
60% ACETONE
70% ACETONE
M×10²
TEMP (°C)

FIG- 3.38

SYSTEM : Li_2SO_4 (0·001 M), SOLVENT : ACETONE – WATER

80 % ACETONE [1×10^{-3}M]



FIG–3·39

SYSTEM : Li_2SO_4 (0·0005M) [5×10^{-4}M] , SOLVENT: ACETONE - WATER

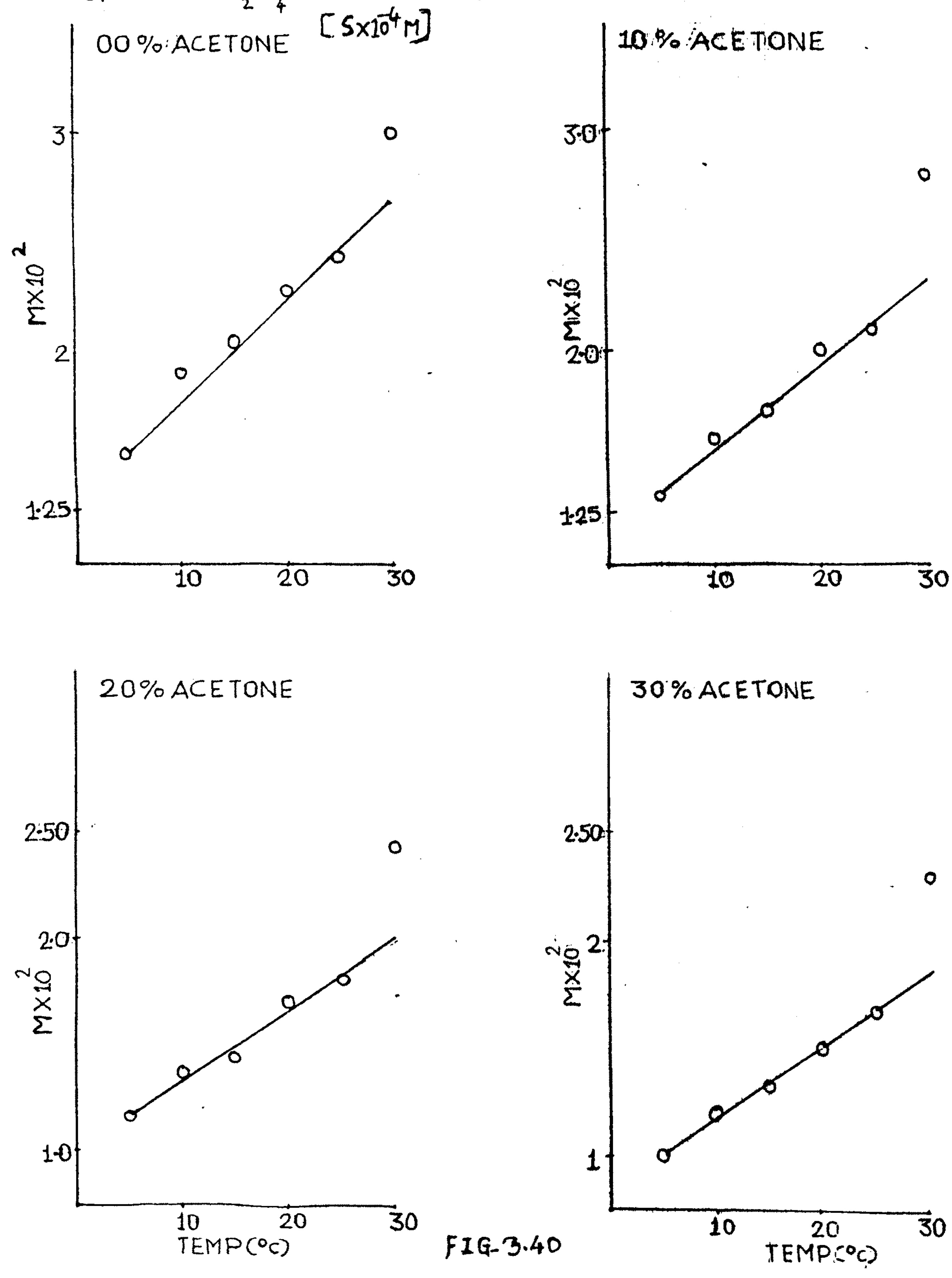


FIG-3.40

SYSTEM : Li_2SO_4 (0·0005 M) , SOLVENT : ACETONE - WATER
[5×10^{-4} M]

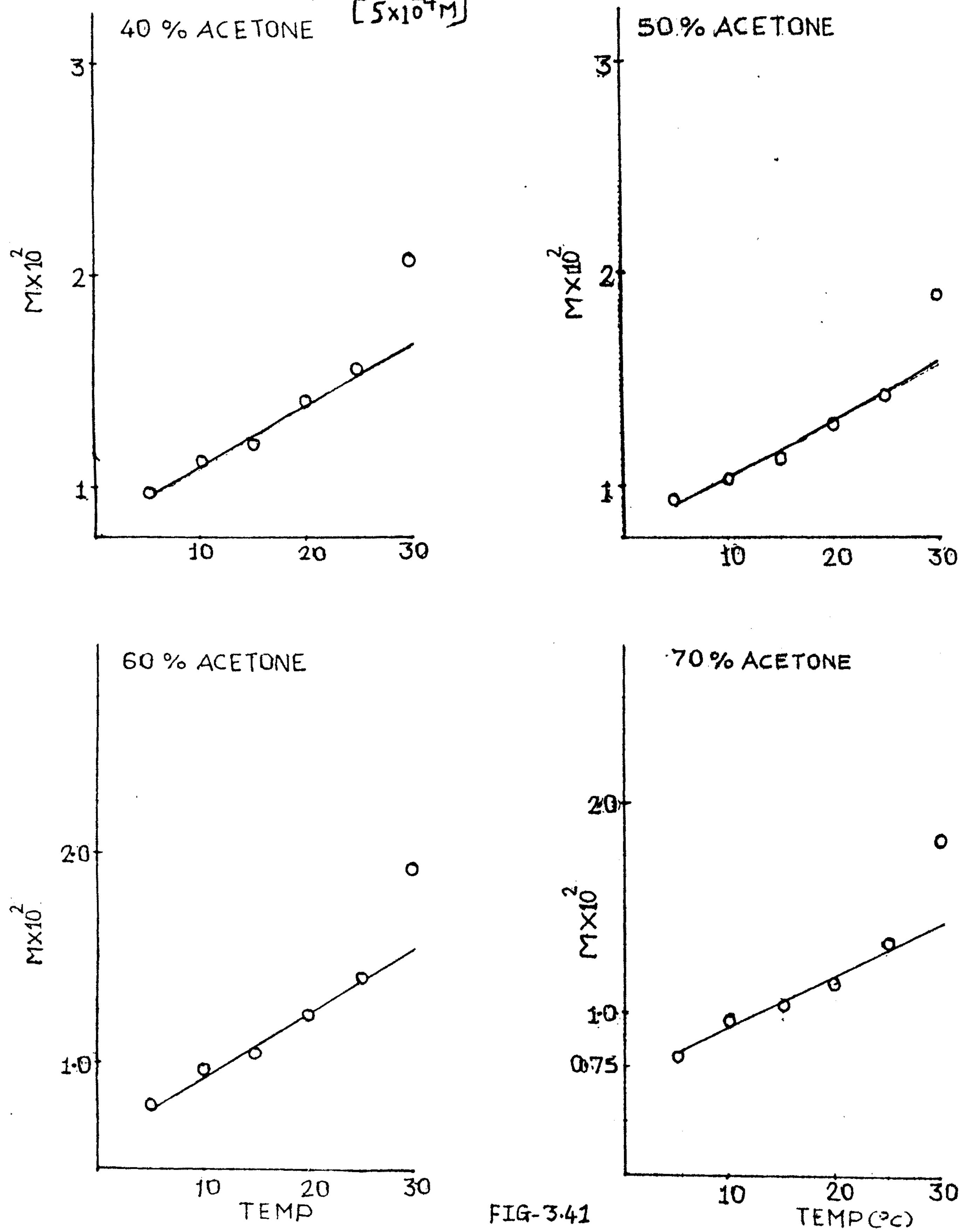


FIG-3.41

SYSTEM : Li_2SO_4 (0·0005M), [5×10^{-4}M] SOLVENT : ACETONE - WATER

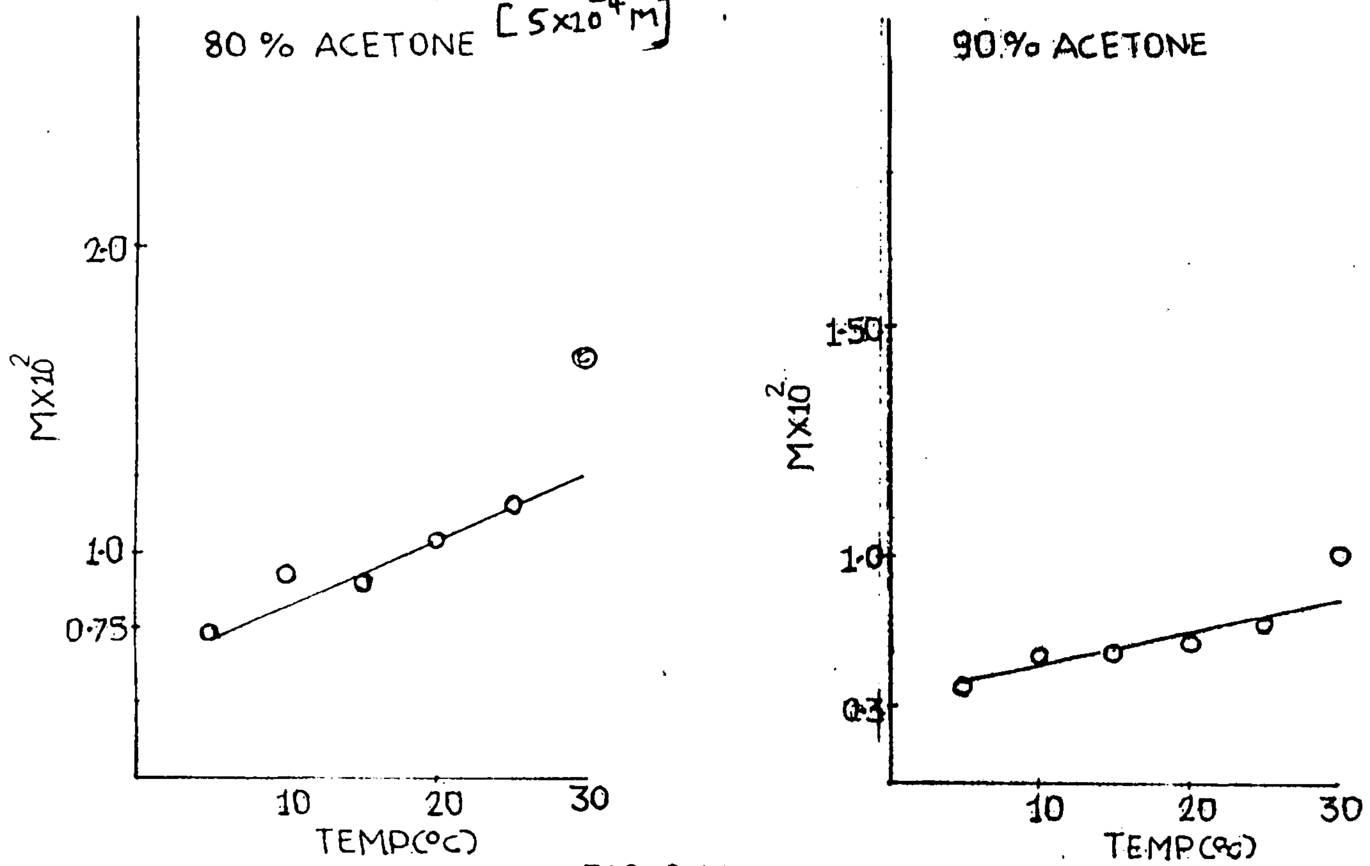


FIG-3·42

SYSTEM: Li_2SO_4 (0·0001M); SOLVENT: ACETONE-WATER

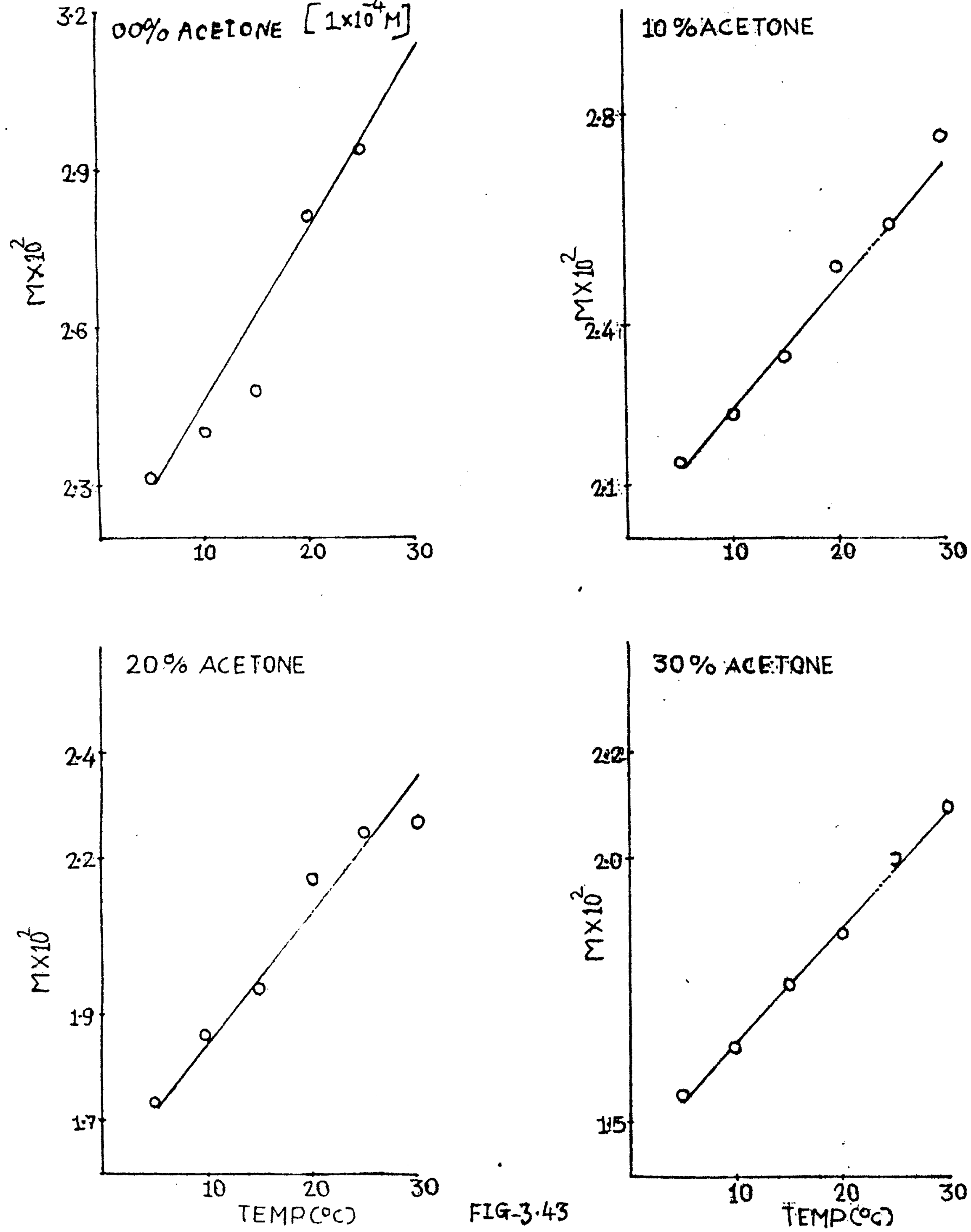


FIG-3·43

SYSTEM : Li_2SO_4 (0.0001M) [1×10^{-4}M], SOLVENT: ACETONE-WATER

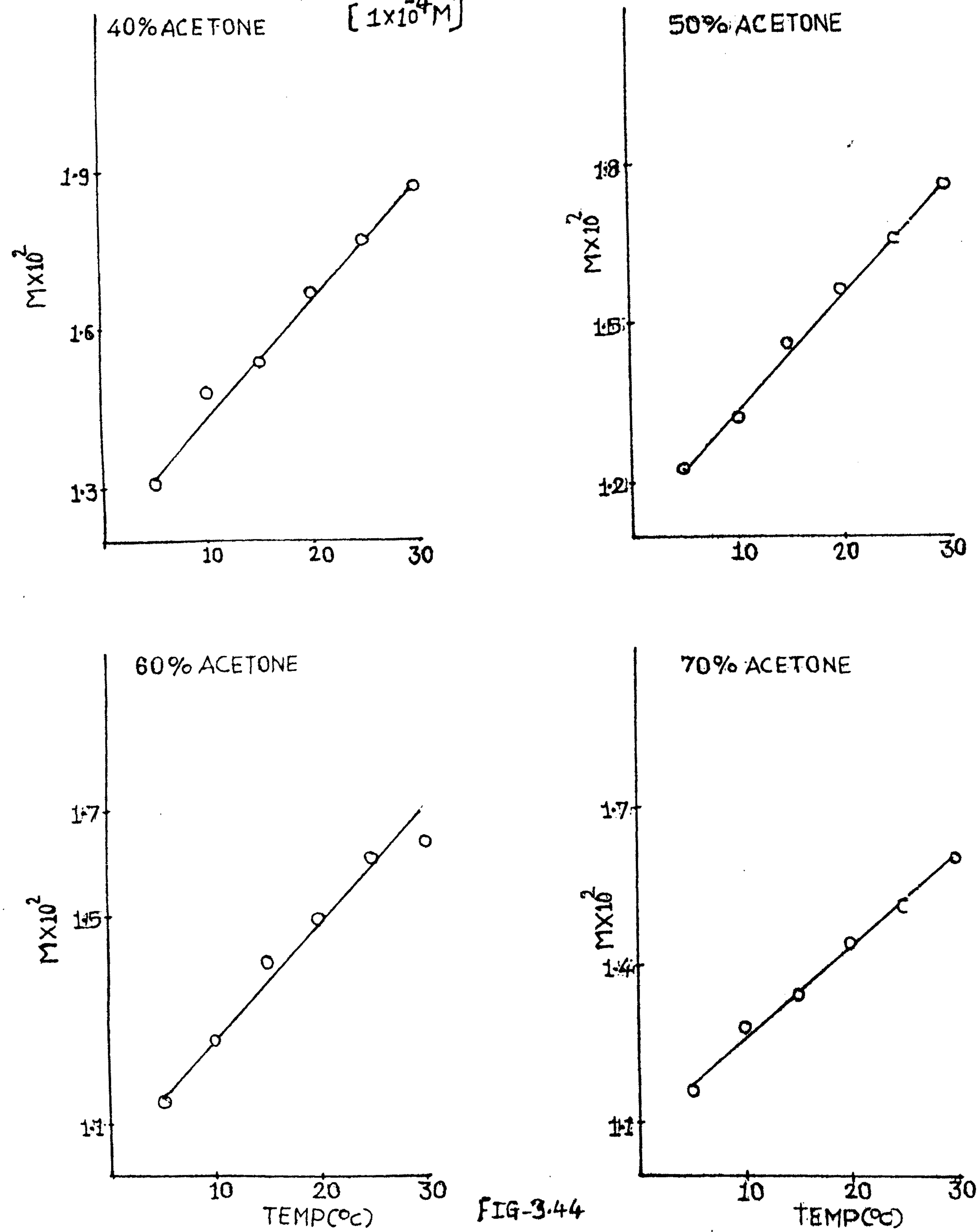


FIG-3.44

SYSTEM : Li_2SO_4 (0·0001M), SOLVENT : ACETONE - WATER

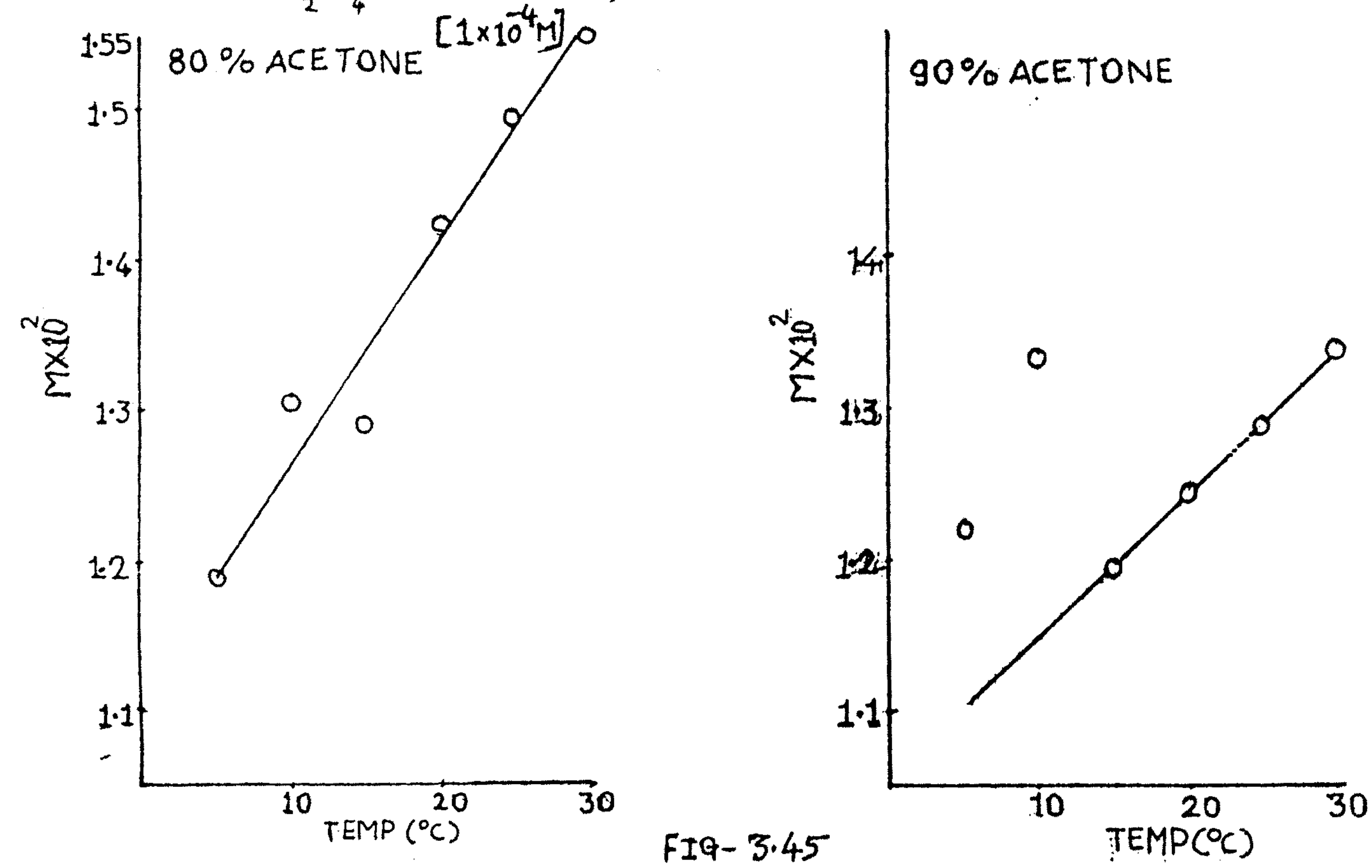


FIG- 3·45

SYSTEM : Li_2SO_4 (0·00005M) , SOLVENT : ACETONE - WATER

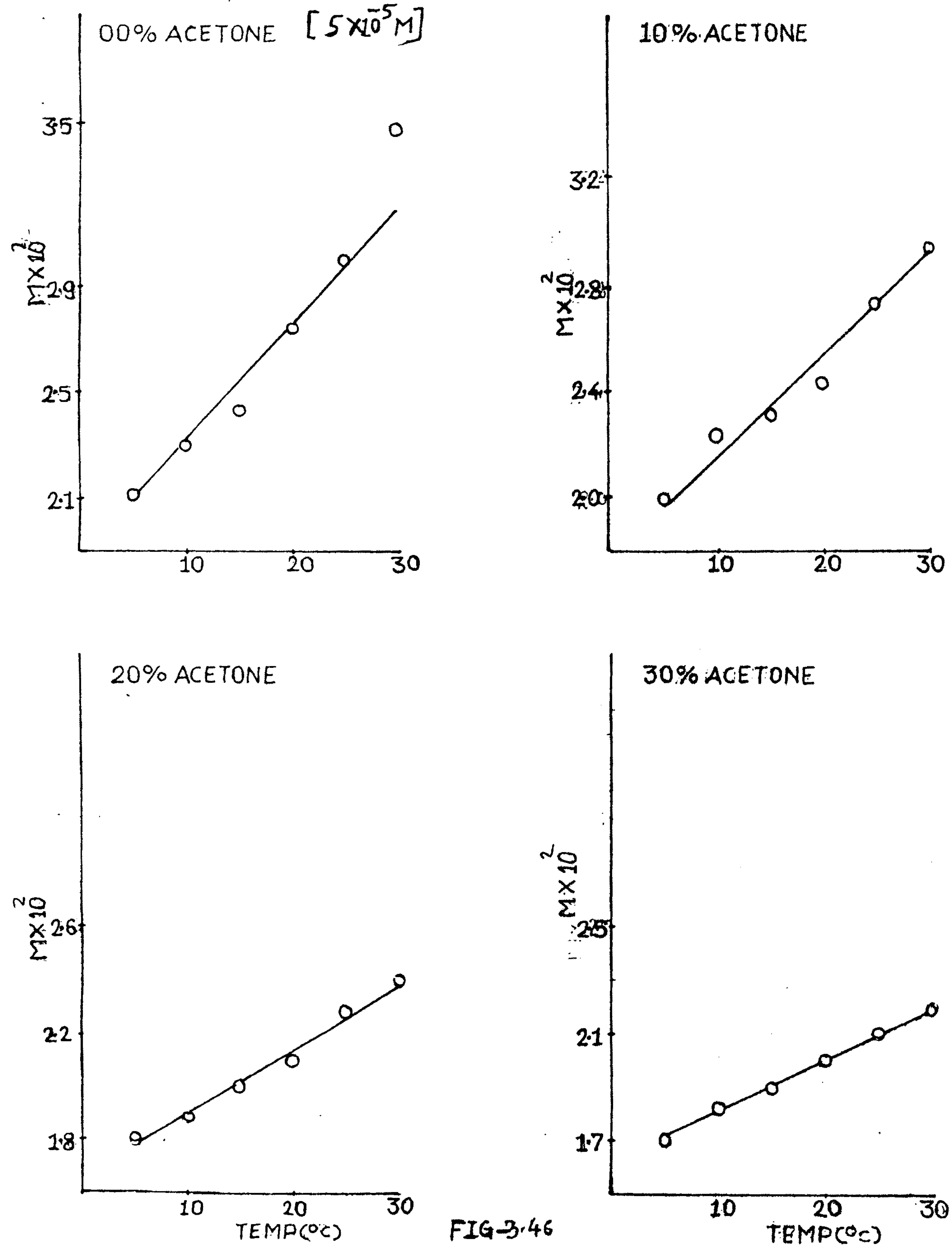


FIG-3.46

SYSTEM : Li_2SO_4 (0.00005 M) , SOLVENT :: ACETONE - WATER

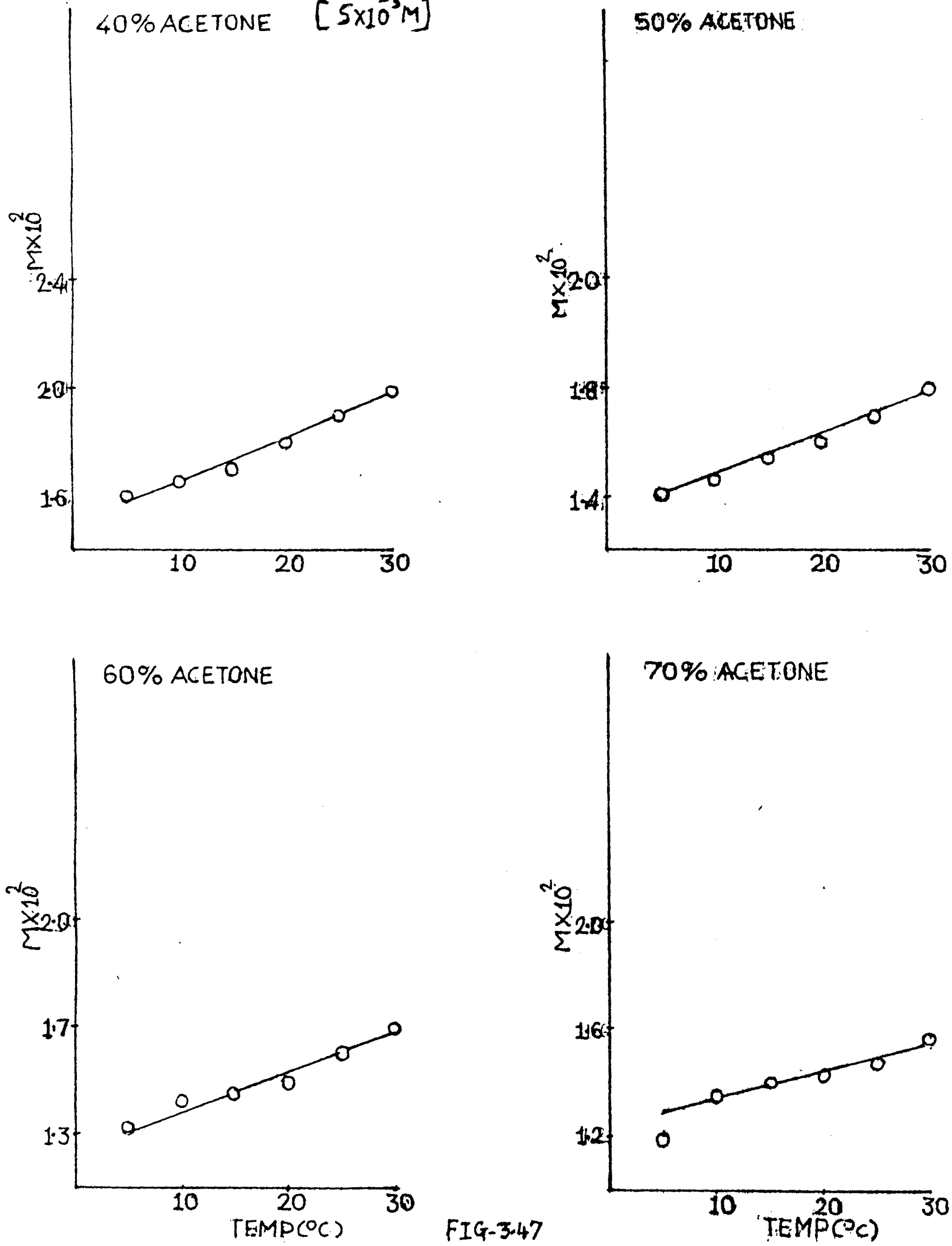


FIG-3.47

SYSTEM : Li_2SO_4 (0·00005M), SOLVENT : ACETONE WATER
[5×10^{-5} M]

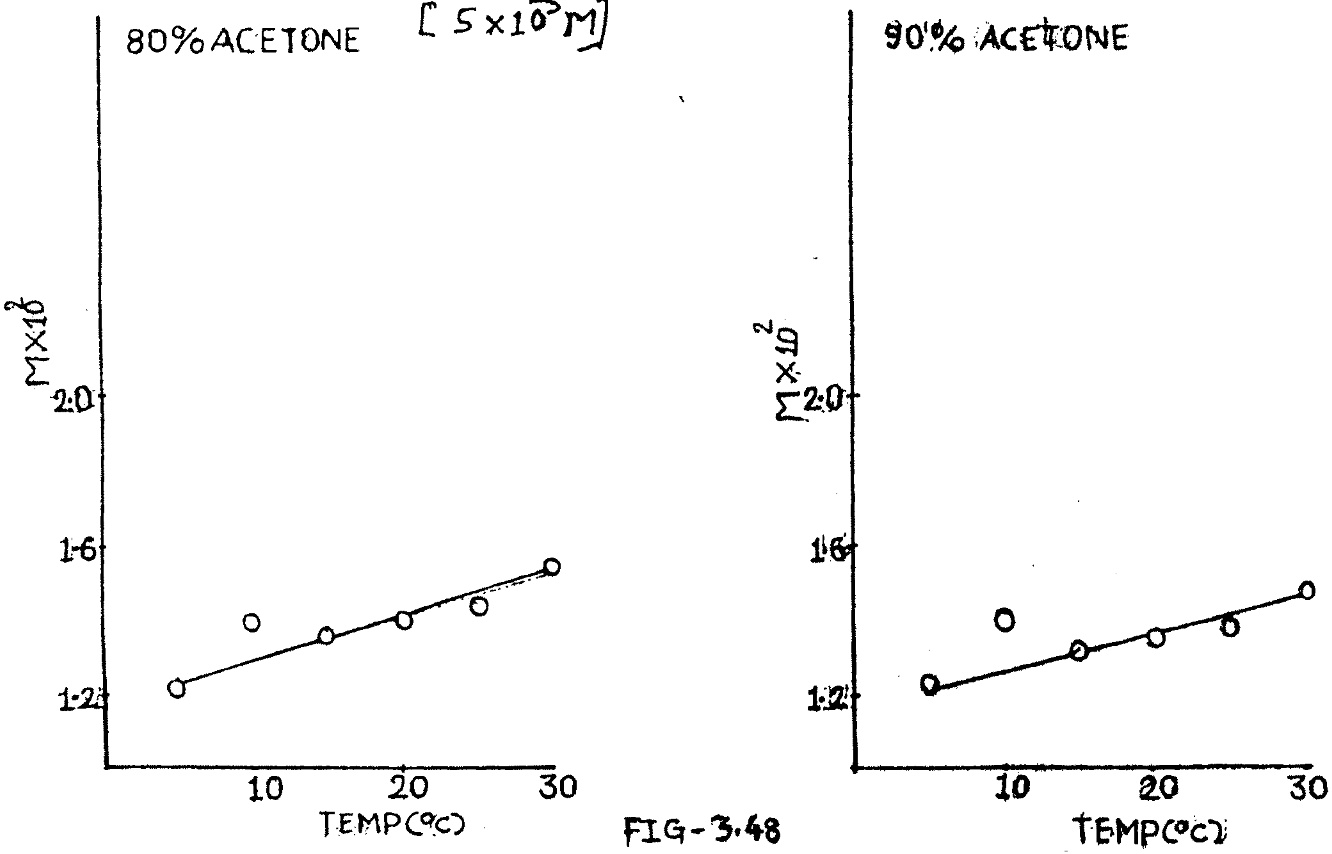


FIG-3.48