NAME:- MUKESH MEEL

CLASS:- M.Sc. (Previous)

SUBJECT:- PHYSICAL CHEMISTRY

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ROLL.No:- 1285828

Sl No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission	F
(1.)	determine the solubility and solubility product of spriangly soluble salt $BaSO_4$				
(2.)	Determine the strength of given strong acid conductonitrically using standered strong base solution.				
(3)	Determine the strength of a given strong acid (HCl) conductometrically using standered base NH_4OH				
(4.)	Determine the strength at given weak acid s conductometrically using strong base NaOH.				
(5.)	calculate the rate constant for the reaction of ethyl acetate				
(6.)	Determine the triangular phase diagram of CH_3COOH HCl, H_2O				

S. No.	Name of the Experiment	Page No.	Date of Experiment	Date of Submission
(7.)	determine the strength of acid from given acidic mixture of two acid.			
(8.)	calibration of volumetric glass ware.			

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Date ....

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object:- Determine the solubility and solubility product of Sharingly soluble salt $BaSO_4$.

principal:-

Conductance mesurement may be employed in determination or solubility or a sharingly soluble salt lipe barium sulphate. since the saturated solution as a springly soluble salt is very dilute clie < 10^{-3}N so it may be regarded as completely ionised in soluble state it's equivatent conductance is that inginite dilution obtained by assumation of ionic conductance of the constitaents ions.

In the present case

$$\lambda_\infty = \lambda^+_\infty + \lambda^-_\infty$$

As the specific conductance of water must be taken in to account.

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Calculation:-

Correct the specific conduction of the solution of a sparingly salide salt by substracting the specific conductanic of water.

$K = K_{solution} - K_{water}$

$= 0.375 - 0.372$

$= 0.003 \times 10^{-3} S$

The solubility of a sparingly soluble salt is.

$$S = \frac{1000 \times K}{\lambda_\infty} \times \text{equilent weight}$$

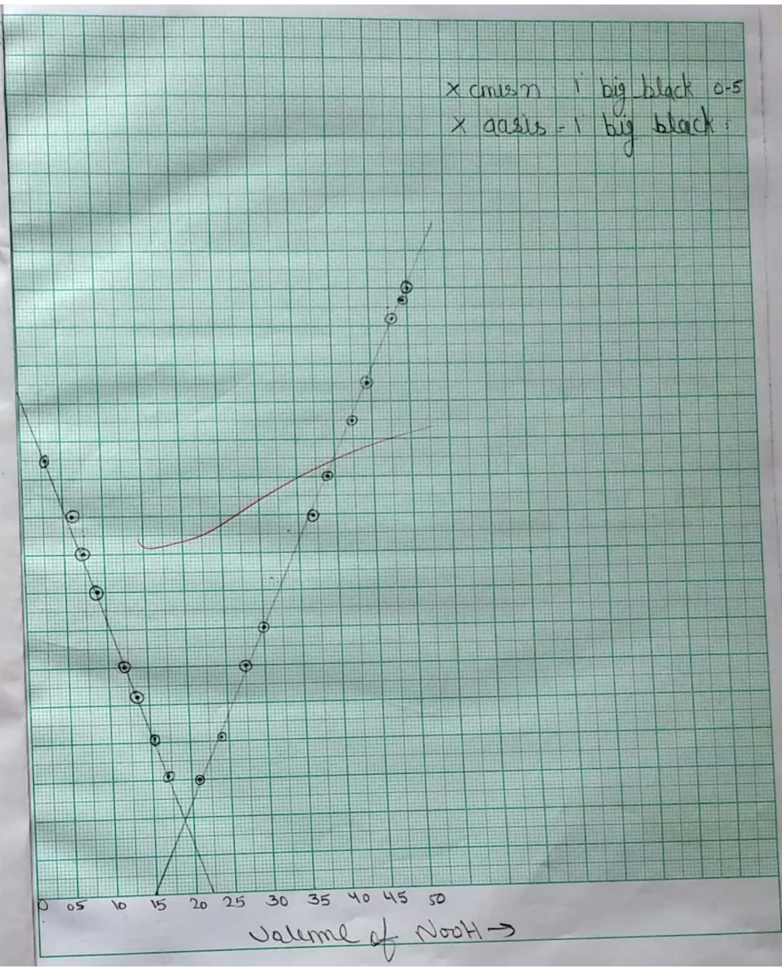
$$= \frac{0.003 \times 10^{-3} \times 1000}{146.16}$$

$= 0.0024$ gm litter

solubility product of $BaSO_4 = S^2$

$= 0.0024 \times 0.0024$

$= 0.00000484$



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$K = K_{solution} - K_{water}$

$s = K_{solution}$

$\frac{K \times 1000}{\lambda_\infty}$ gm equivalent/litter

Procedure :- (1.) Determine the cell constant of conductivity cell at 25°C.

(1.) measures the conductance of water used in proparation of solution.

2.) prepare flash barium sulphate solution with hydroxide acid wash the precipitate throughly with conductivity water for several times to remove soluble and adhered impurities present if any.

place the solution well washed salt in a thermo state at 30°C stire it well after half an hour pipette out the clear solution in the breaker and measured the conductance are obtained.

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observation:-

Temprature = 30°c

S.N.	observed conducatance of water (milli's)	observed conductance of $BaSO_4$ (milli's)
1.	0.371	0.374
2.	0.375	0.370
3.	0.370	0.381
	Average = 0.372	0.375

Result:-

solubility of the sparingly solide salt $BaSO_4$ is 0.0024 gm/litter and solubility product is 0.00000484

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Expt. No. (2.)   Page No.

object :-

Determine the strength of given strong acid Conductomitrically using standerd strong base solution.

principal :-

Titration of strong acid like hydrochloric acid with a strong base like sodium hydraxide intially the value due to chloride and hydrogen ions as NaOH solutions is gradually added to it. The hydrogen ions are replaced by ions thus decrased.

$$(H^+ + Cl^-) + (Na^+ + OH^-) \longrightarrow Na^+ + Cl^- + H_2O$$

It goes on drasing untill Hcl is completilly neutralised i.e the equivalance point reached. Now after this paint any subsequent addition of sodium hydride.

solution result in increase of unductatance due to Na^+ solution result in increase of conductance dup to Na^+ ions and OH^- ions A plot of conductance due to Na^+ ions and OH^- ions four volume of titrent gives two staignt lines the point of intersection of entroploted lines will be the end point of titration and gives the value of alkali required for the neuration of the acid

Requirement:-

Conductivity meter conductivity cell microbus the pipette braker.

chemicals:- N/10 NaoH and unknown Hcl

procedure:- (i) N/10 NaoH standerd solution is prepared and filled in microburettle.

(ii.) 20ml given hydrochloride acid is taken in braker (100ml)

(iii.) set the canductometer at cell constant and tope conductance of given solution of Hcl.

(iv.) Now 0.5 ml NaoH added from microburettic and conductance is measured this process is repeated after each succes in addition of alkali.

(v.) Now graph is ploted and point found it

observation:-

strength of NaoH = N/10

volume of acid = 20ml

Calculation:-

Strong acid and strong base.

$N_1V_1 = N_2V_2$

$N_1 = \frac{N_2V_2}{1}$

N_1 = Normality of acid

V_1 = Volume of acid

N_2 = Normality of base $= \frac{1}{1} = 1$

V_2 = Volume of base = 1.8

$N_1 = \frac{1}{10} \times \frac{1.8}{20}$ N

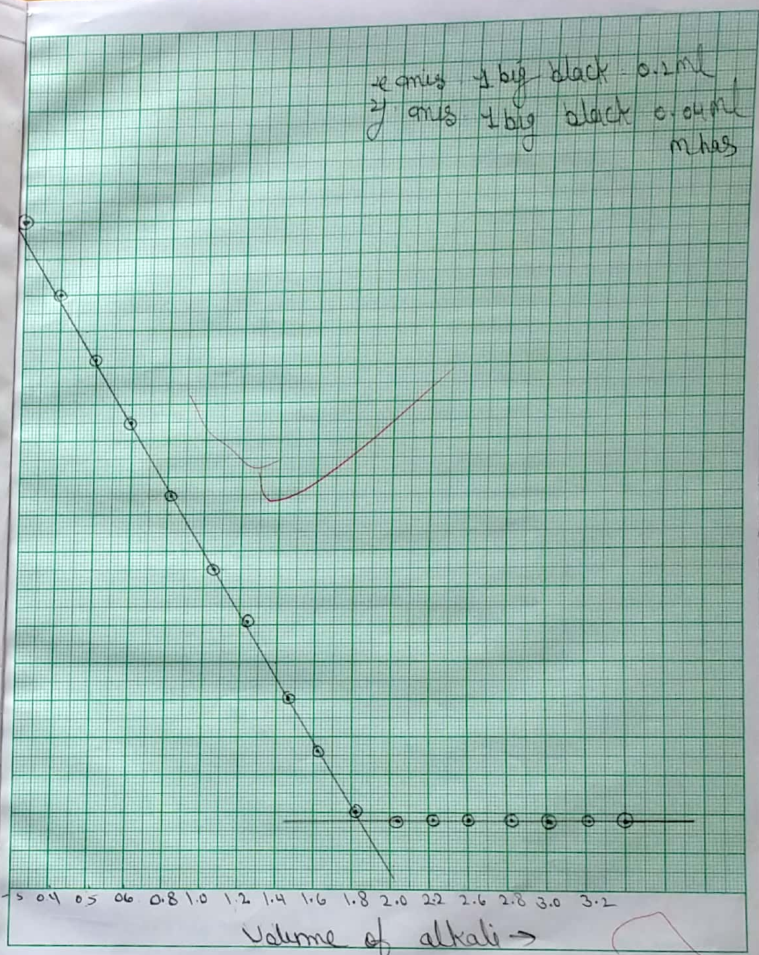
= 0.009 N

Concentration of given hydrochloride acid

= N_1 × equivalent weight

= 0.009 × 36.5 g/l

= 0.3285 g/l



S.No.	Volume of alkalic NaOH added (in ml)	Conductance of the solution.
1.	0.0	1.452
2.	0.2	1.321
3.	0.4	1.223
4.	0.8	1.084
5.	1.0	0.998
6.	1.2	0.592
7.	1.4	0.523
8.	1.6	0.385
9.	1.8	0.486
10.	2.0	0.608
11.	2.2	0.662
12	2.4	0.753
13	2.6	0.825
14	2.8	0.926
15	3.0	1.002
16	3.2	1.099
17	3.4	1.86
18	3.6	1.239
19	3.8	1.357
20	4.0	1.442
21	4.2	1.573
22	4.4	1.697
23	4.6	1.680
24	4.8	1.756
25	5.0	1.827

Result:- The strenght of given hydrochloric acid is 0.3285 gm/litter.

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object:-

Determine the stringht given strong acid (HCl) conductromitrically using standared base (NH_4OH).

principal:-

When a titration is corried out between strong acid and weak base lipe Hill and NH_4OH repectiely the conductance decrease due to the replacement of H^+ ions by slow moving of NH_4^+ ions until the equivlance paint is reached afthr the end point and futher

addition of NH_4OH does not case any operacible change in conductivity. The graph becomes haligonted prallel to volume axis since the excess of equens ammino is not appecially ionised in the prence of ammonia chloride.

$$H^+ + Cl^- + NH_4OH \longrightarrow NH_4^+ + Cl^- + H_2O$$

Requirements - conductivity meter microburette
piphate, braker

Chemicals -
N/10 NH_4OH (standard solution)

and Known HCl

Conclulation :-

weak base and strong acid

$N_1V_1 = N_2V_2$

$N_1 = \frac{N_2V_2}{1}$

N_1 = Normality of acid = ?

V_1 = volume of acid = 20

N_2 = Normality of base - W.

V_2 = volume of base = 1·8

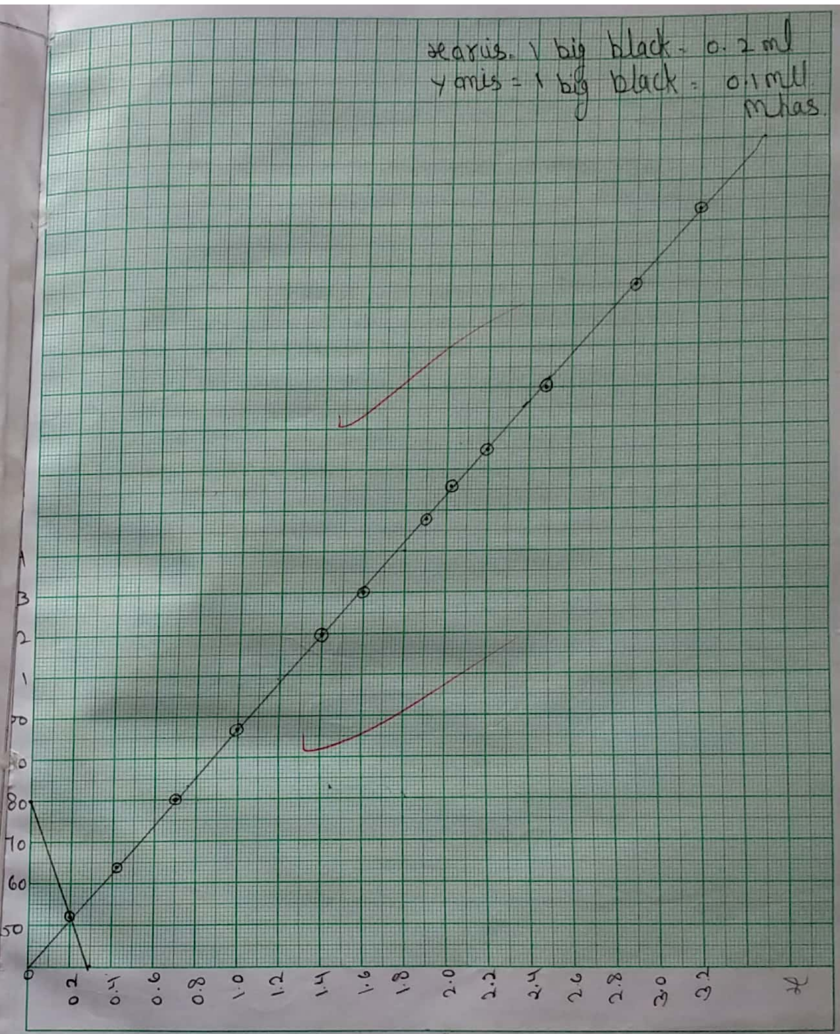
$N_1 = \frac{1}{10} \times \frac{1.8}{20}$ N

Concitration of hydrochloric acid

= N_1 X equivalent Water

= 0·009 X 36·5

= 0·3285 gm/litter



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Procdure:- (1) N/10 NH_4OH standerd solution is pypoused.

(ii.) 20 mL HCl and is topen in the broker.

(iii.) sit the Conductometer on cell constant.

(iv.) Take the conductance of well.

(v.) Now add 0.2 mL NH_4OH and conductance is measured addition of alkalic.

(vi.) Now graph is plotted and end point is found out.

Observation:-

strenght of NaOH = 0.1N
volume of acid = 20 mL

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S.No.	Volume alkali NH_4OH (added in mL)	
1.	0.0	0.688
2.	0.2	0.673
3.	0.4	0.652
4.	0.6	0.633
5.	0.8	0.614
6.	1.0	0.592
7.	2.0	0.576
8.	2.2	0.557
9.	2.4	0.537
10.	2.6	0.517
11.	2.8	0.517
12.	3.0	0.518
13.	3.2	0.517
14.	3.4	0.516
15.	3.6	0.519
16.	3.8	0.520
17.	4.8	0.517

Result:-

The strenght of given hydrochloric acid is 0.3285 gm/litter.

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Expt. No. (4.) Page No. ....

object:-

Determine the strenght of given weak acid and CH_3COOH and conductrometrically using standard strong base (NaOH).

principal:-

If titration is carried out between a weak like acetic acid and strong base ex:- sodium hydroxide solution the conductance due to acid is very low an account of it's poor dissciation. It first decrease using to the feronation of weak acid but soom after the in a increase in conductance after complete neturatization of the acid the conductance & rapidely due to increase in OH^- ions.

$$CH_3COOH + Na^+ + OH^- \longrightarrow CH_3COO^- + H_2O$$

Requirement:-

conductivity meter, microburete pipette, braker.

chemicals:-

N/10 NaOH (standard solution and

Unknow. CH_3COOH (acetic acid)

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calculation :-

Strong acid and weak base

$N_1V_1 = N_2V_2$

$N_1 = \frac{N_2V_2}{1}$

N_1 = Normality of acid = ?

V_1 = volume of acid = 20

N_2 = Normality of base = 1

V_2 = Volume of base = 1.1

$N_1 = \frac{1}{10} \times \frac{1.1}{2.0}$

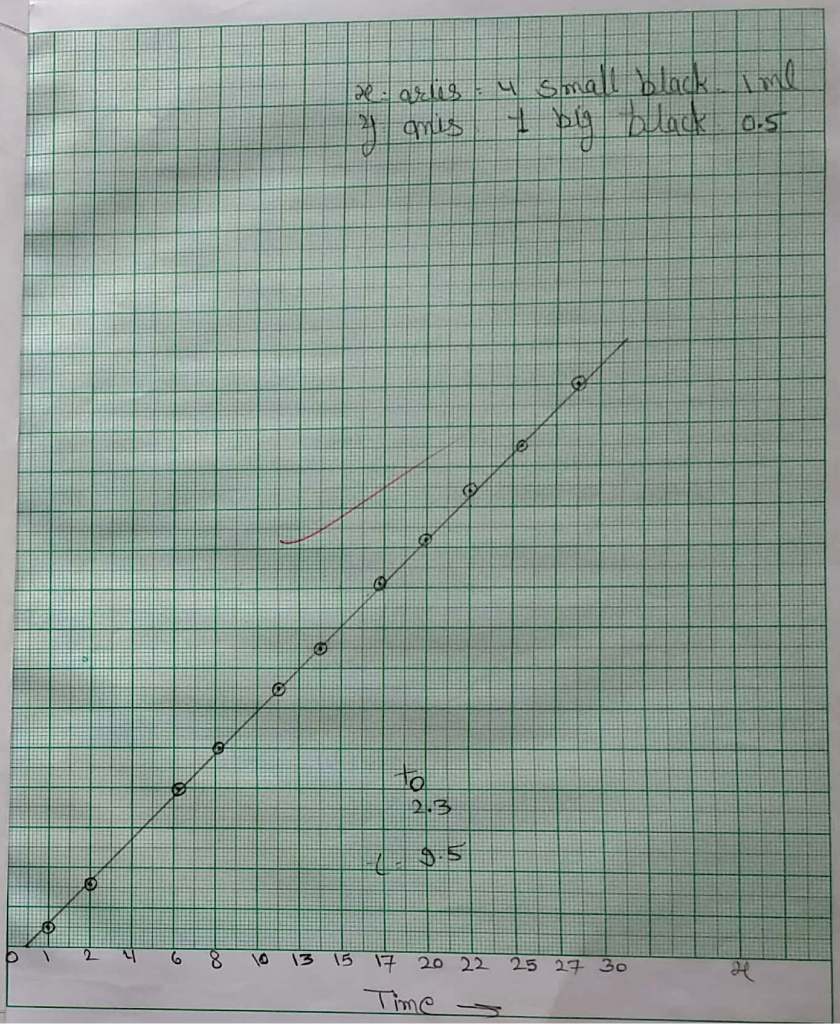
= 0.0055N

Concentration of given acetic acid

= N X equivalent Water

= 0.0055 X 60

= 0.33 gm/l



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procedure:-

(i) N/10 NaOH solution is pupored and filled in microburenter.

(ii.) 20ml CH_3COOH acid is topen in beaker.

(iii.) sit the cell constant of conductivity meter take the conductance of CH_3COOH.

(iv.) Now add 0.2ml NaOH and conductance is measured.

(v.) This process is repeated after each successive addition of alkali.

observation:-

Normality of NaOH = N/10

Volume of acid = 20ml

S.N.	Volume alkali (NaOH) add (in ml)	conductance of solution (ml)
1.	0.0	0.642
2.	0.2	0.610
3.	0.4	0.516
4.	0.6	0.623
5.	0.8	0.752
6.	1.0	0.871
7.	1.2	0.990
8.	1.4	

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9.	1·6	1·123
10.	1·8	1·267
11.	2·0	1·367
12.	2·2	1·491
13.	2·4	1·600
14.	2·6	1·738
15.	2·8	1·851
16.	3·0	1·951
17.	3·2	2·050

Result:-

The strenght of given acid is 0·33 gm/litter.

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hydroxide

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Expt. No. (5.)

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object:-

Calculate the rate constant for the reaction of sapolfication of ethyl acetate by sodium hydroxide solution conductometrically. Hydroxide

principal:-

When during a reaction ions are produced and used of as replaced by some other ions then the conductance of the solution under goes charge as the seponification of the acetate by sodium hydroxide the stericonestry as repesented as.

$CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + C_2H_5OH$

In the seporification reaction the fast moving of OH^- ions are replaced by slow moving CH_3COO^- ions Intially the NaOH solution and finally at will be due to ions formed by an equivalent amount of sodium are produced as the reaction process the conductance of reaction mixture thus decreased If the reaction

conductance ~~of reaction~~

is carried out with same intial connectrations The reactions then the rate constant can be calculated using integrated rate low for the second order reaction.

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$$K = \frac{1}{t} \frac{x}{a(a-x)}$$

(K = second order rate constant)

Requirement :-

(a) conductivity meter conductivity cell stop watch volumtric beaker buratte pipe Hc etc.

(b.) 0.05 NaOH Phenajphalern ethyl acilate - aritic acid.

Procedure :-

(i.) 0.05 NaOH is prepared and standaried.

(ii.) solution A :- 20ml 0.05 NaOH and mape itemp 10ml Now this is the 0.01N solution A.

(iii.) solution. B :- (-

(a.) first 0.05N NaOH is taken in a beaker and add 50ml water Now it in 10ml.

(b.) 5ml ethyl acetate in other beaker and add 25ml water now in 30ml now both (a) and (b) solution to make solution 100ml co- value is taken by a solution with the help of conductometer.

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Calculation:-

$$K_1 = \frac{1}{0.01} \times \frac{C_0 - C_t}{C_t - C_\infty} = \frac{1}{0.01} \times \frac{1.412 - 1.167}{1.167 - 0.210} = \frac{0.245}{0.957}$$

$$K_2 = \frac{1}{0.02} \times \frac{1.412 - 1.010}{1.010 - 0.210} = \frac{0.402}{0.800} \times \frac{1}{0.02} = 25.12$$

$$K_4 = \frac{1}{0.04} \times \frac{1.412 - 0.817}{0.817 - 0.210} = \frac{1}{0.04} \times \frac{0.592}{0.607} = 24.0$$

$$K_6 = \frac{1}{0.06} \times \frac{1.412 - 0.781}{0.701 - 0.210} = \frac{1}{0.06} \times \frac{0.711}{0.491} = 24.1$$

$$K_8 = \frac{1}{0.08} \times \frac{1.412 - 0.551}{0.551 - 0.210} = \frac{1}{0.08} \times \frac{0.799}{0.403} = 24$$

$$K_{10} = \frac{1}{0.10} \times \frac{1.412 - 0.551}{0.551 - 0.210} = \frac{1}{0.10} \times \frac{0.861}{0.341} = 2.521$$

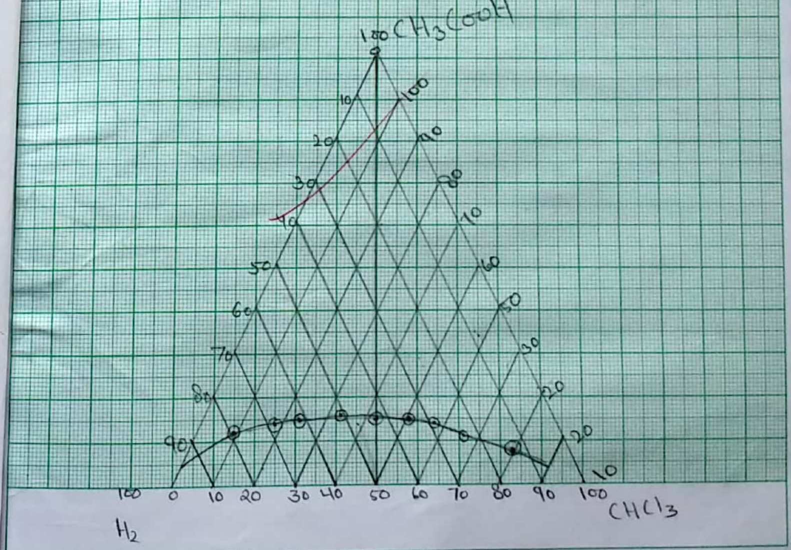
$$K_{13} = \frac{1}{0.13} \times \frac{1.412 - 0.498}{0.498 - 0.210} = \frac{1}{0.13} \times \frac{0.914}{0.288} = 24.41$$

$$K_{15} = \frac{1}{0.15} \times \frac{1.412 - 0.461}{0.461 - 0.210} = \frac{1}{0.15} \times \frac{0.951}{0.251} = 25.25$$

$$K_{17} = \frac{1}{0.17} \times \frac{1.412 - 0.443}{0.443 - 0.210} = \frac{1}{0.17} \times \frac{0.969}{0.233} = 24.46$$

$$K_{20} = \frac{1}{0.2} \times \frac{1.412 - 0.417}{0.417 - 0.210} = \frac{1}{0.2} \times \frac{0.995}{0.207} = 24.6$$

$$K_{22} = \frac{1}{0.22} \times \frac{1.412 - 0.401}{0.401 - 0.210} = \frac{1}{0.22} \times \frac{1.011}{1.191} = 24.0$$



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(iv.) Ct value is taken from the R-solution after one minute two minute or gap of minute till 30 minute by the help stop watch and conductometer.

(v.) to taken by the C-value.

observation table:-

time	conductance milli mhos	Co - Ct millimhos	Ct - C∞	$\frac{C_0 - C_t}{C_t - C_\infty}$	K
Initial	1.412				
1.	1.617	0.245	0.957	0.256	25.60
2.	1.010	0.402	0.800	0.502	25.12
4.	0.817	0.592	0.607	0.980	24.20
6.	0.701	0.711	0.491	0.448	24.13
8.	0.613	0.799	0.403	1.982	24.78
10	0.551	0.861	0.341	2.521	25.24
13.	0.498	0.914	0.288	3.172	24.41
15.	0.461	0.951	0.251	3.791	25.25
17.	0.443	0.969	0.233	4.163	24.46
20.	0.417	0.995	0.207	4.811	24.03
22.	0.407	1.011	0.191	5.291	25.31

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$K_{25} = \frac{1}{0.25} \times \frac{1.412 - 0.374}{0.374 - 0.210} = \frac{1}{0.25} \times \frac{1.038}{0.164} = 25.3$

$K_{27} = \frac{1}{0.27} \times \frac{1.412 - 0.369}{0.369 - 0.210} = \frac{1}{0.27} \times \frac{1.043}{0.519} = 24$

K_{avg} -

25.6 + 25.12 + 24.5 + 24.13 + 24.78 + 25.24 + 24.41 + 25.25 + 24.46 + 24.03 + 24.05 + 25.31 + 24.29 + 25

= 346.87

$K_{avg} = \frac{346.87}{14} = 24.77 \ mol^{-1} min^{-1}$

$K \text{ from graph} = \frac{1}{0.01} \times \frac{C_0 - C_t}{C_t - C_\infty}$

$= \frac{2.3}{9.5 \times 0.1} = 24.21 \ mol^{-1} min^{-1}$

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25.	0.374	1.038	0.164	6.333	25.31
27.	0.369	1.048	0.159	6.562	24.29
30.	0.348	1.064	0.238	7.711	25.70
∞	0.210				

Result :-

The rate constant for saponification reaction of ethyl acetate is obtained 24.77 mol^{-1} min and by graph 24.21 mol^{-1} min^{-1}

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object :-

Determine the triangular phase diagram of acetic acid, chloroform, & water.

Principal :-

Chloroform & water are the Practically misible liquides only one bimodal when crossponding to this pair of liquids will be of appear in the phase diagram.

But chloroform is misible in acetic acid sureal mixture of these misible component are ~~[struck out]~~ pyporeol and to each as the mixture a known ammount of third component H_2O is added attentively known amount of two component are mixed and qaantities of the thired are added untill the system to mgentous the quantities of the three component for which this occuress give one point on the biomodal curve this complete binodal never is obtained.

Requirements :-

Small glass stoppered bottles brenlte acetic acid thought form.

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procedure :-

(1) frist mixture of chloroform in acetic acid in stopped bottle with the precentage of 10%. 20%, 30%, 40%, 50%, 60%. 70%. 80%. & 90% are prepared.

Now take 20ml $CHCl_3$ (10%) in a flack and take with H_2O which in m bat He and reecond the amount of water added when tubidity just appened.

Above process in done in similar manner the other minutes.

- calculate the precentage by weight at each component when turbidity fast opperans.

observation table:-

Amount $CHCl_3$ (ml)	Amount CH_3COOH	Volume of H_2	Total	H_2O	$CHCl_3$	CH_3COOH
1	9	1·8	11·8	15·25	8·471	76·27
2	8	2·3	12·3	18·69	16·26	65·04
3	7	2·7	12·7	21·25	23·62	55·11
4	6	3·0	13·0	23·07	30·76	46·15
5	5	3·5	13·0	25·92	37·06	37·03
6	4	3·1	13·5	23·66	45·88	30·54
7	3	2·8	12·8	21·87	54·08	23·43

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Calculation:-

(1) for 10% $CHCl_3$ -

(a) $\% H_2O = \frac{1.8}{11.8} \times 100 = 15.25$

(b) $\% CHCl_3 = \frac{1}{11.8} \times 100 = 8.471$

(c) $\% CH_3COOH = \frac{9}{11.8} \times 100 = 76.27$

(2) for 20% $CHCl_3$ -

(a) $\% H_2O = \frac{2.3}{12.3} \times 100 = 18.69$

(b) $\% CHCl_3 = \frac{2}{12.3} \times 100 = 16.26$

(c) $\% CH_3COOH = \frac{8}{12.3} \times 100 = 65.04$

(3) for 30% $CHCl_3$ -

(a) $\% H_2O = \frac{2.7}{12.7} \times 100 = 21.25$

(b) $\% CHCl_3 = \frac{3}{12.7} \times 100 = 23.62$

(c) $\% CH_3COOH = \frac{7}{12.7} \times 100 = 55.11$

(4) for 40% $CHCl_3$ -

(a) $\% H_2O = \frac{3}{13.0} \times 100 = 23.07$

(b) $\% CHCl_3 = \frac{4}{13} \times 100 = 30.76$

(c) $\% CH_3COOH = \frac{6}{13} \times 100 = 46.15$

(5) for 50% $CHCl_3$:-

(a) $\% H_2O = \frac{3.5}{13.5} \times 100 = 29$

(b) $\% CHCl_3 = \frac{5}{13.5} \times 100 = 37$

(c) $\% CH_3COOH = \frac{5}{13.5} \times 100 = 37$

(6) for 60% $CHCl_3$:-

(a) $\% H_2O = \frac{3.1}{13.1} \times 100 = 23$

(b) $\% CHCl_3 = \frac{6}{13.1} \times 100 = 45$

(c) $\% CH_3COOH = \frac{4}{13.1} \times 100 = 30$

(7) for 70% $CHCl_3$:-

(a) $\% H_2O = \frac{2.8}{12.8} \times 100 = 21.8$

(b) $\% CHCl_3 = 7/12.8 \times 100 = 54$

(c) $\% CH_3COOH = 3/12.8 \times 100 = 23$

(8) for 80% $CHCl_3$:-

(a) $\% H_2O = \frac{2.2}{12.2} \times 100 = 18$

(b) $\% CHCl_3 = \frac{8}{12.2} \times 100 = 65$

(c) $\% CH_3COOH = \frac{2}{12.2} \times 100 = 16$

(9) for 90% $CHCl_3$:-

(a) $\% H_2O = \frac{1.7}{11.7} \times 100 = 14.5$

(b) $\% CHCl_3 = \frac{9}{11.7} \times 100 = 76$

(c) $\% CH_3COOH = \frac{1}{11.7} \times 100 = 8$

80	8	2	2.2	12.2	18.03	65.57	16.39
90	9	1	1.7	11.7	14.52	76.92	8.54

Result:-

Triangular phase diagram for are acid chloroform and water is formed an bimodal arue is formed.

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object :-

To determine the strenght of acids from given acidic mixture of two acide using NaOH solution by conductometrically.

Principal :-

When a mintene containing acetic acid and hydrochoric acid is titrated with an alkalic strong acid (HCl) will be heatinalized first the Neuttralization of weak acid conductance titration casue will be marked by two points the first and second beaker respectively then

V_1 cm^3 of NaOH = Nil

$(V_2 - V_1)$ cm^3 of NaOH = CH_3COOH

Requirement :-

conductivity meter microbuttle pipette breaker.

chemicals :-

N/10 NaOH standerd solution and unknow

CH_3COOH unknown HCl

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procedure:-

(i) burette is fill with the standerd $N/10$ NaOH.

(ii.) 10ml HCl and 20ml CH_3COOH is taken in 100ml beaker.

(iii.) Now set the conductometer on check.

(iv.) conductometer is set on cell constant.

(v.) after the conductivity of acid to be checked.

(vi.) Now 0.5ml NaOH from the burette is added to this solution and check the conductivity this process is repeated till retisfication result is come and each successive addition of NaOH.

observation:-

strenght of standard NaOH solution $N/10$

volume of acid 10ml HCl, 20ml CH_3COOH

Volume of NaOH for H, solution $v_1 = 5ml$

Volume of NaOH for CH_3COOH solution $= v_2 = 1$

$= 9.9 - 5 = 4.9ml$

Calculation:- for HCl:-

$N_1V_1 = N_2V_2$

N_1 = Normality of HCl = ?

V_1 = Volume of HCl = 30 ml

N_2 = Normality of NaOH = $\frac{1}{10}$ N

V_2 = Volume of NaOH = 5 ml

$N_1 = \frac{N_2V_2}{V_1}$

$= \frac{1}{10} \times \frac{5}{30}$

$= 0.0167N$

Concentration of HCl in given mixture

$= N_1 \times$ equivalent weight

$= 0.0167 \times 36.5$

$= 0.06095$ gm/l

for CH_3COOH:-

$N_3V_3 = N_4V_4$

$N_3 = \frac{N_4V_4}{V_3}$

$= \frac{1}{10} \times \frac{4.9}{30}$ N

$= 0.1633N$

Concentration of CH_3COOH in given mixture

$= 0.01633 \times 60$

$= 0.9800$ gm/l.

observation table:-

S.No.	Volume of alkali (NaOH) addition (ml)	conductance of the solution (mil mole)
1.	0.0	2.12
2.	0.5	2.01
3.	1.0	1.821
4.	1.5	1.812
5.	2.0	1.725
6.	2.5	1.592
7.	3.0	1.426
8.	3.5	1.351
9.	4.0	1.296
10.	5.0	1.027
11	6.0	1.101
12.	7.0	1.151
13.	8.0	1.223
14.	9.0	1.251
15.	10.0	1.313
16.	10.5	1.648
17.	11.0	2.012
18.	11.5	2.398
19	12.0	2.653
20	12.5	3.025
21	13.0	3.412

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Result:-

The strenght of hydrochloric acid is 0.6095 gm/litter and acetic acid is 0.9800 gm/litter in given acidic mixture.

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object :-

calibration of volumetric glass ware.

Introduction:-

calibration is the process by which a stater measure such as the volume of container is checked for accuracy.

- In general, measument of mass can be determine more precisely and accurately the measurment of volume.

- There for the mass of liquid contained or dispersed by the glass ware will be measured and the crossponding volume calalated using the density of liquid.

- How ever a relatively small change in tem. causas a change in the liquid's volume and thus it's density.

Theory :-

The result of volumetric analysis are based and accured measurment of volumes of the solution the react with one another. To achiere accuring one mixture employ accurate measuring tools. burettes, pipettsids range and variety are used in normal volumatric analysis.

- Therefore pipettes, burettes and measuring cylindr show be propery calibrated to achieve accurated result.

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- calibration of pipettes, burettes and measuring cylinder be done by measuring weight of water delivered. particular glassware.

- Then with the density of water of the volume of 1gm of water at a measured temp. the correct volume is calculated.

- If W is the weight water delivered then

volume water delivered = W x V (ml)

where v is the volume of 1gm of water in ml at t°c.

Basic principle of Glassware caliburation :-

- small amount of error in calibration inevitable.

- Tolerarce -
  - How much error is allowed in the calibration of a volume meaturing item.
- most accuratly calibration glass ware termed volumatric
- Has narrowest to lerance allowed.

- Two effect of temp. to consider in high accuring measurment.
- Expand or contact with change in temp.
- Affects accuracy.

- Volume of the solution change as the temp. changes.
- Devices calibrated at 20°c with water.

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calibration of volumetric flask :-

- weight accurately a throughly cleaned and dried flask on a robuit bulaned.
- Fill the flask with are free distilled water, so that the lower edge of the meniscus stands at the fixed mark of the neck. Remove any drop of water above the mark by a piece of filter paper.
- Dry the outer surface and weight the flask again. After having determined the weight of water contained in the flask upto the mark, obtain the true volume of the vessed from the table → In case the error is considered etch a new ring on the neck.

Temperature °C	Apparent wt of 1cm³ of water (g)	vol. crosspoding to an apparent wt of 1g water (cm³)	Temp. (°C)	Apparent wt of cm³ of water(g)	volume on apparent wt of 1g water (cm³)
10	0.9986	1.0013	18	0.9976	1.0024
11	0.9985	1.0014	19	0.9974	1.0026
12	0.9984	1.0015	20	0.9972	1.0028
13	0.9983	1.0017	21	0.9970	1.0030
14	0.9982	1.0018	22	0.9967	1.0033
15	0.9981	1.0019	23	0.9965	1.0035
16	0.9979	1.0021	24	0.9963	1.0037
17	0.9977	1.0023	25	0.9960	1.0040

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