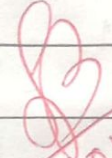
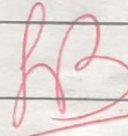


## Particulars of The Experiments Performed

Date	Serial No.	Experiment No.	Subject/Experiment	Page No.	Signature	Remarks
12/11/22	1	1	Conductometric titration for determination of strength of a given HCl solution	1 to 6	SPD 15/11/22	
15/11/22	2	3	Determination of $Cl^-$ ion in a given water sample	7 to 10	SPD 22/11/22	
22/11/22	3	4	Removal and elimination of hardness of water by complexometric titration	11 to 15	SB 29.11.22	
29/11/22	4	5(A)	Determination of viscosity of sugar sol	16 to 20	SB 13.12.22	
13/12/22	5	7	Determination of partition coefficient of acetic acid between n-butanol & water	21 to 26	SPD 20/12/22	



## Particulars of The Experiments Performed

Date	Serial No.	Experiment No.	Subject/Experiment	Page No.	Signature	Remarks
20/12/2022	6	9	Determination of dissolved oxygen in the given sample of water	27 to 31	 <del>16.01.23</del>	
10/1/2023	7	8	To study the adsorption of acetic acid on activated charcoal and to verify the Freundlich isotherm	32 to 39	 <del>17.01.23</del>	



Experiment No:-1

Title:- Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.

A) Chemicals Required :-

- 1) Oxalic Acid
- 2) NaOH Solution
- 3) HCl Solution
- 4) Phenolphthalein Indicator

B) Apparatus Required :-

- 1) Conductivity Meter
- 2) Burette
- 3) Pipette
- 4) Glass Rod

C) Theory :- The conductometric method of titration can be used to determine the end point of ionic titration since the specific conductance of a solution is proportional to the concentration of the ions present in it. This method can be applied to acidimetric titrations.

When HCl is titrated with NaOH solution, the highly mobile  $H^+$  ions [ $\lambda_0(H^+) \approx 350 \text{ ohm}^{-1} \text{ cm}^{-1}$ ] are progressively replaced by slower moving  $Na^+$  ions [ $\lambda_0(Na^+) \approx 50 \text{ ohm}^{-1} \text{ cm}^{-1}$ ] and the conductance of the solution decreases. After the end point, the conductance rises sharply as there is now an excess of  $OH^-$  which are also highly mobile [ $\lambda_0 \approx 198 \text{ ohm}^{-1} \text{ cm}^{-1}$ ].



Hence the neutralisation of a strong acid by the addition of a strong base leads to a minimum conductance at the end-point. When, the conductance of the solution is plotted against the volume of titrant a curve of the form shown in the adjoining figure is obtained.

### D) Procedure:-

#### Part I: Standardisation of NaOH solution

Approximately 0.1(N) NaOH solution is taken in to a burette. This being a secondary standard solution must be standardised with the help of a primary standard. Here a known strength exactly 0.1(N) oxalic acid solution should be used (Supplied).

10 ml of the oxalic acid solution is taken into a 250-ml conical flask with the help of a pipette and 2-3 drops of phenolphthalein indicator is added. NaOH solution is run in from burette till the pink colour appears. The process is repeated thrice to get concordant readings. The readings are to be reported in table 1.

#### Part II:- Conductance measurement using conductivity meter

10 ml of unknown HCl solution is pipetted out in the 150 ml beaker and 50-60 ml water is added. The conductivity cell is immersed in the beaker, then the instrument is switched on and the value is noted. Standardized ~0.1(N) NaOH solution is taken into the Burette and 0.5 ml is added to the

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beaker at a time. The solution is stirred by stirrer and allowed to attain equilibrium after each addition from the burette. The conductance after each addition is noted. The conductance first decreases, reaches minimum conductance value. The reading are to be repeated in table  $\uparrow$

### E) Results & Discussions:-

Room Temperature: \_\_\_\_\_

#### Table - $\uparrow$ Standardisation of NaOH Solution

Sl. No	Vol of oxalic acid ( $V_1$ ml)	Burette Reading		Vol of NaOH consumed (ml)	concordant / Mean Volume ( $V_2$ ml)	St. oxalic acid ( $S_1$ )	St of NaOH ( $S_2$ )
		Initial	Final				
1	10	0	8.7	8.7			
2	10	8.7	16.1	7.4	7.7	0.1 N	0.13 N
3	10	16.5	23.8	7.3			

Calculation:-  $V_1 S_1 = V_2 S_2$

$$\Rightarrow S_2 = \frac{V_1 S_1}{S_2}$$

$$= \frac{10 \times 0.1}{7.7} = 0.13 N$$

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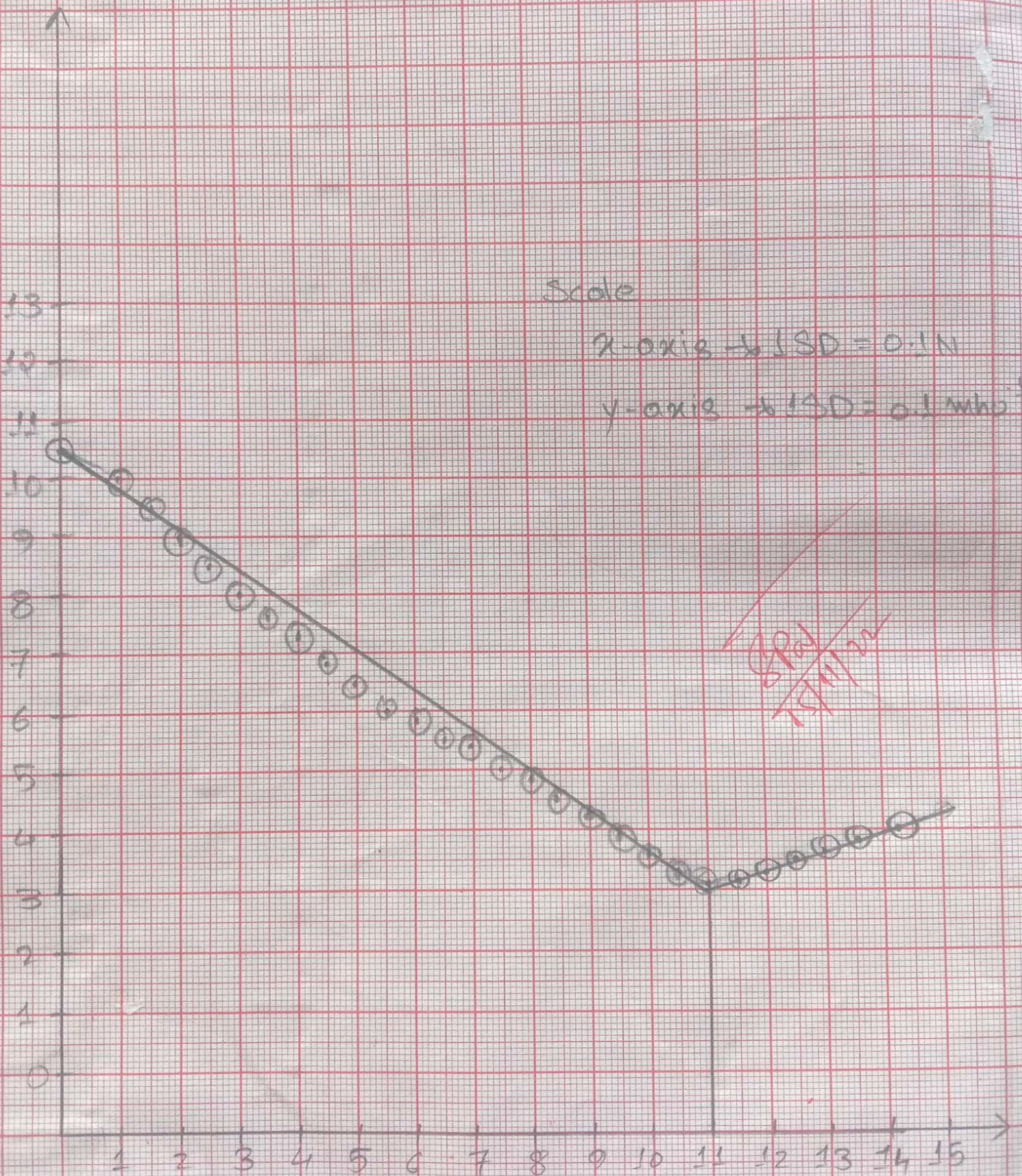




Table-1 → Conductance Measurement using conductivity meter

Sr.No	Vol of unknown HCl in which cell is dipped ( $V_3$ ml)	Vol of NaOH added to the cell from burette(ml)	Observed Conductance [ $\text{mho cm}^{-2}$ ]	Vol of NaOH consumed at End point [From Graph $V_4$ ml]	Strength of NaOH Solution ( $S_2$ )	Strength of HCl solution ( $S_1$ ) $S_1 = (V_4 S_2) / V_3$
1		0.0	10.5			
2		0.5	10			
3		1.0	9.5			
4		1.5	9.2			
5		2.0	8.8			
6		2.5	8.4			
7		3.0	8.0			
8		3.5	7.7			
9		4.0	7.3			
10		4.5	6.9			
11		5.0	6.5			
12		5.5	6.2			
13		6.0	5.9			
14		6.5	5.7			
15		7.0	5.4	<del>11.0</del>	0.13N	0.14N
16		7.5	5.2			
17		8.0	4.9			

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18		8.5	4.5		
19		9.0	4.2		
20		9.5	3.9		
21		10.0	3.6		
22		10.5	3.3		
23		11.0	3.1		
24		11.5	3.2		
25		12.0	3.3		
26		12.5	3.4		
27		13.0	3.6		
28		13.5	3.7		
29		14.0	3.9		
30		14.5	4.1		
31		15.0	4.2		

When the conductance of the solution in cell is plotted against volume of NaOH added a 'V' shaped curve is obtained and from the point of intersection we get the volume of NaOH required to neutralise the unknown acid solution

Calculation:-

$$V_3 S_3 = V_4 S_2$$

$$\Rightarrow 10 \times S_3 = 10.9 \times 0.15$$

$$\Rightarrow S_3 = \frac{10.9 \times 0.15}{10} = 0.16 \text{ N}$$

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F) Conclusion :-

1) Instrumental methods of titration is more accurate than titration using indicators which involve colour change during end point

2) End point of the titration of coloured solutions can be determined by sharp change in conductance value.

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SPD  
15/11/22



## Experiment NO-2

Title: pH-metric titration for determination of the strength of a given HCl solution against a standard NaOH solution.

### A] Chemical Required:

1. Oxalic Acid
2. NaOH solution
3. HCl solution
4. Phenolphthalein indicator.

### B] Apparatus Required:

1. pH-meter.
2. Magnetic stirrer
3. Burette.
4. pipette.

### C] Theory:

The pH-meter titration is basically a potentiometric titration. The acid-base titration goes through a variation in pH over a range. The instrument used to measure such pH variations generally consists of a glass electrode. Glass electrode: Glass electrode is based on the principle that a potential difference is set up at the interface between glass and a solution in contact and it is dependent upon

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Experiment No-3

Title :- Determination of  $\text{Cl}^-$  ions in a given water sample by Argentometric method (Mohr's method)

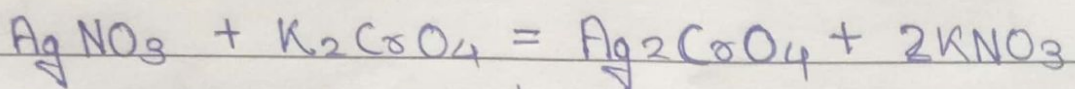
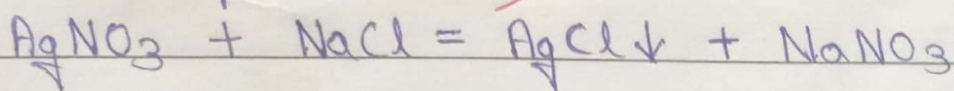
## A) Chemical Required.

1. N/50  $\text{AgNO}_3$  solution
2.  $\text{K}_2\text{CrO}_4$  indicator

## B) Apparatus Required.

1. Burette (50ml)
2. Conical flask (250ml)

C) Theory :- Chlorides ions can be determined by titration of the water sample against a standard solution of  $\text{AgNO}_3$  using potassium chromate as indicator in a neutral or faintly alkaline medium. When  $\text{AgNO}_3$  solution is added to the water sample in presence of  $\text{K}_2\text{CrO}_4$ , the alkaline medium, when  $\text{AgNO}_3$  solution is added, the chlorides present in it are precipitated as  $\text{AgCl}$ . As soon as all the chlorides are precipitated out the extra drop of  $\text{AgNO}_3$  added in excess give a red precipitate of silver chromate ( $\text{Ag}_2\text{CrO}_4$ ). This indicates the end point.



The Ph of the solution should be between 7 to 8 because of at higher ph  $\text{Ag}^+$  ion is precipitated as  $\text{Ag}_2\text{O}$ . If the Ph is lower than 7 to 8 then the chromate ion is converted to dichromate ion. The required pH



## Experiment NO-4

## A] Chemicals Required

1. 100 ml tap water
2. pH = 10 buffer solution
3. 1N NaOH solution
4. EBT indicator solution
5. Murexide indicator.
6. 0.01M di-sodium salt of EDTA

## B] Apparatus Required

1. Conical flask (250 ml)
2. Burette (50 ml)

## C] Theory

The hardness of water is the measure of the capacity of the water to react with soap. Calcium and magnesium are the principal cations that impart hardness. The degree of hardness of hardness of drinking water has been classified in term of equivalent  $\text{CaCO}_3$  concentration as follows:-

Soft	Medium	Hard	Very hard
0.60 mg/l	60-120 mg/l	120-180 mg/l	> 180 mg/l

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## Experiment No-5 (A)

Title :- Determination of viscosity of a Sugar Solution

## A) Apparatus Required:

1. Ostwald Viscometer
2. Specific Gravity Bottle.
3. Digital Stop watch.

## B) Chemicals Required:

→ Specific Concentration (2% or 3%) Sugar Solution

C) Theory - Let us consider a column of liquid in a capillary glass tube. The liquid column flows downwards due to pressure difference. The liquid column in the test tube may be considered as being composed of a large number of concentric cylindrical layers, which slide over one another and move downwards due to pressure gradient. As the liquid layer in contact with the glass wall tends to move, a shearing effect is produced by the glass wall that destroys the relative motion of the moving layers. In this way each of the moving liquid layers experiences a shearing effect by its preceding liquid layer. Thus the velocity of the different liquid layers is not on the same, but changes uniformly according to their distance from the glass wall. The velocity becomes maximum at the center and minimum at the surface of the wall. The shearing

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## Experiment No. 5(B)

Title: Determination of surface tension by drop count  
Method

## A] Chemicals Required:

- Specific concentration (2% or 3%)  
Sugar solution

## B] Apparatus Required:

1. Stalagmometer
2. Specific Gravity Bottle
3. Beaker

## C] Theory:

When a liquid is allowed to flow through a capillary tube is formed at its lower end. It increases to a certain size and falls off. The size of the drop depends on the radius of the capillary and the surface tension of the liquid. The surface tension acting along the circumference of the capillary tube supports the drop in the upward direction. The measurement of surface tension of liquid is based on the fact that the drop of the liquid in the upward direction. The measurement of surface tension the lower end of capillary falls down when weight of drop becomes just equal to the surface tension. liquid at the lower end of the lower end of capillary falls down when weight of drop become just equal to the surface tension.

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Experiment No-7

Title: Determination of 'partition coefficient' of acetic acid between  $n$ -butanol & water.

A] Chemicals Required

1. Acetic Acid
2.  $n$ -butanol
3. Oxalic Acid
4. phenolphthalein indicator
5. NaOH Solution

B] Apparatus Required

1. 250-ml reagent bottles (2)
2. 100 ml measuring cylinder
3. 50 ml burette
4. Electro-mechanical shaker
5. 250 ml conical flask
6. 10 ml pipette

C] Theory:

When a solute is shaken with two immiscible solvents, it will distribute itself between the two solvents in accordance with 'Nernst Distribution Law' if it is soluble in each of them. If the solute has normal molecular weight in both the solvents (i.e. neither associated nor dissociated), the partition will take place according to the following equation:

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## Experiment No - 9

Title : Determination of dissolved oxygen in given sample of water.

## A] Chemicals Required :

1.  $\text{Na}_2\text{SO}_4$  (M/10)
2.  $\text{MnSO}_4$  solution
3. KI
4. Starch
5. conc.  $\text{H}_2\text{SO}_4$

## B] Apparatus Required :

1. Burette
2. pipette (10ml)
3. Conical flask
4. Beakers (250ml)

## C] Theory :

Oxygen itself is not a pollutant in water but its deficiency is an indicator of several types of pollution in water.

Dissolved oxygen (DO) is determined by Winkler's method or iodometric titration. The dissolved oxygen in water oxidizes KI and an equivalent amount of iodine is liberated. The iodine is titrated against a standard hypo solution. However since dissolved oxygen in carrier such as manganese hydroxide is used.

The method involves introducing a conc. solution of  $\text{MnSO}_4$ ,

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## Experiment NO-8

Title: To study the adsorption of acetic acid on active charcoal and to verify the Freundlich isotherms.

### A] Chemicals Required:

1. Activated charcoal
2. 0.5 M acetic acid
3. 0.1 M NaOH solution

### B] Apparatus Required:

1. Conical flask (250 ml)
2. Burette (50 ml)
3. Filter paper
4. Stirrer

### C] Theory:

Adsorption is the adhesion of atoms, ions or molecules from a gas, liquid or dissolved solid to a surface. This process creates a film of the adsorbent. This process differs from absorption, in which a fluid (the adsorbate) is dissolved by or permeates a liquid or solid (the absorbent) respectively.

The term sorption encompasses both processes; while desorption is the reverse of it. The process of adsorption is usually studied through graphs known as adsorption isotherm. It is the graph between the amounts of adsorbate ( $x$ ) adsorbed on the surface of