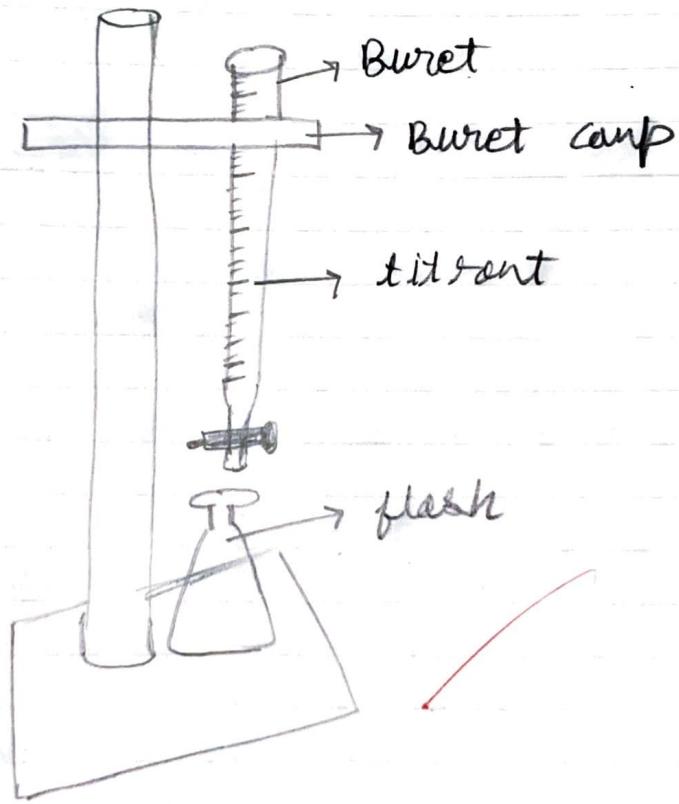


INDEX



S. No.	Date	Name of Experiment	Experiment No.	Page No.	Signature / Remarks
1.	21/11/22	Percentage composition of a given NaCl and NaOH	1.	1	✓ 22/11
2.	29/11/22	To determine the surface tension of a given liquid	2.	7	✓ 29/12
3.	6/12/22	Proportion of urea formaldehyde resin	3.	13	✓ 13/12
4.	13/12/22	Determination of the strength given chloride ion in given sample using titration.	4.	18	✓ 27/12
5.	20/12/22	Determination of coefficient of viscosity of given liq. by Ostwald's viscometer method.	5.	22	✓ 27/12
6.	27/12/22	To determine the amt. of oxalic acid & sulphuric acid in 1L sol. given NaOH sol ⁿ & KMnO ₄ sol	6.	27	✓
7.	17/1/23	To standardize EDTA sol ⁿ and determine total hardness	7.	32	✓ 17/02
8.	24/1/23	Determination of alkalinity in given sample of water	8.	38	✓ 17/02





Experiment - 1

Aim :- To determine the percentage composition of a given mixture of Nael and NaOTT, 1g of which is dissolved per liter of the solⁿ.

Requirement :- 0.1 N HCl, phenolphthalein solution.

Apparatus :- Burette, pipette, 2 breakers, titration flask, stand

Theory :- For the titration of a solⁿ of NaOH and NaCl the other solⁿ needed is HCl solⁿ. NaOTT will react with acid solⁿ whereas NaCl will remain as such.



The mixture solⁿ will be titrated with the acid solⁿ and in this way we can determine the normality of NaOTT and hence its strength. By subtracting the strength of NaOTT from the total strength of solⁿ we can find out the strength of Nael and hence find percentage composition.

Indicator :- Phenolphthalein (as strong acid is reacting with a strong base) Volumetric Analysis.

Observations

Normality of the HCl soln = 0.1 N
Volume of mixture taken for each titration = 10 ml

S.NO	Vol of the solution take in titration flask (ml)	Burette		Vol. of titration used
		initial	final	
1.	10	0.018	10.7	10.7
2.	10	10.7	21.4	10.7
3.	10	21.4	32.1	10.7

Calculation

Acid

$$\frac{N_1 V_1}{10} = \frac{N_2 V_2}{N_2 \times 10}$$

$$\frac{10.7}{10} = \frac{10.7}{N_2 \times 1000} \Rightarrow N_2 = \frac{10.7 \times 1000}{10.7} = 0.107 \text{ N}$$

$$\text{Strength (y)} = 0.107 \times 40 \text{ g (e.g. weight of NaOH)}$$

$$(\text{NaOH}) \text{ by } y = 4.280$$

$$\% \text{ of NaOH} = \frac{y}{10} \times 100 = \frac{4.28}{10} \times 100 = 42.8 \%$$

$$\% \text{ of NaCl} = \frac{2}{19} \times 100 = \frac{5.72}{10} \times 100 = 52.2 \%$$



Procedure :-

1. Rinse the burette with the given HCl solⁿ (N/10 HCl)
2. Take HCl in the burette and note initial reading.
3. Pipette out 10ml. of solⁿ in the titration flask.
4. Add a drop of phenolphthalein to the solⁿ.
5. Run the acid solⁿ into the mixture from the burette till the solⁿ change colour from pink to colourless.
6. Repeat to get three concordant readings.

End point : Pink to colourless

Result :-

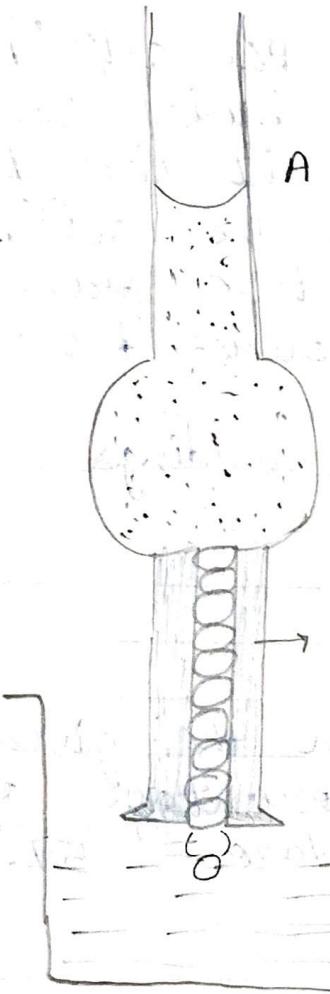
The percentage of NaOH present in the given mixture = ~~42.8%~~ and the percentage of NaCl present in the given mixture = ~~57.2%~~

Precautions :-

1. Wash the apparatus first with water and then with detergent followed by plenty of water.
2. Rinse the burette and pipette with the respective solutions to be taken in.
3. Do not rinse the conical flask the solⁿ to be taken in it.
4. Use anti parallax card to avoid error in burette reading.

A diagram showing a vertical test tube containing a small amount of red liquid (blood). A horizontal glass tube, labeled "capillary tube" at its right end, is shown being lowered into the blood. The tube has a small bulb at its left end.

capillary tube



epillary

→ capillary

A hand-drawn sketch of a circular base with a central hole, labeled "Base" and "Surf Base".

 surface tension

\downarrow acts along the circumference
Weight of Drop

stalagmometer



EXPERIMENT - 2

OBJECTIVE :

To determine the surface tension of a given liquid (ethyl alcohol) by drop method.

APPARATUS : Stalagmometer, beaker, pinch cock
Stalagmometer is essentially a pipette with a capillary at the lower end and a bulb in the middle. The end is flattened and ground carefully so that there is a large droppin surface. There are two marks A and B, above and below the bulb respectively. These marks define the volume to be delivered for counting the drops. In case the rate of flow of liquid leading to rapid drop formation, a piece of rubber tubing with a pinch cock is attached to the top of the stalagmometer and the rate of flow is adjusted to not more than 15 drops per minute.

THEORY : When a liquid is allowed to flow through a capillary tube, a drop 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.

OBSERVATION : Sept 19, 2017

S.N.	Water		Liquid A		Liquid B	
	No. of drops	Mean	No. of drops	Mean	No. of drops	Mean
1	55	55	68	68	43	43
2	58	58	65	65	45	45
3	60	57	65	65	42	42
4	56	56	62	62	41	41

Water has more surface tension than liquid A and liquid B. Surface tension decreases with increasing temperature.

Temperature	5	10	15	20	25	30	35	40
	Surface Tension	75.04	74.36	73.62	72.86	72.14	71.17	70.33

The surface tension of water decreases with increasing temperature. It is due to the decrease in the number of molecules per unit area. As the temperature increases, the kinetic energy of the molecules increases, causing them to move faster and spread out more. This results in a decrease in the density of the liquid, which in turn leads to a decrease in surface tension. The decrease in surface tension with increasing temperature is known as thermal hysteresis.



The measurement of surface tension of liquid is based on the fact that the drop of the liquid at the lower end of capillary falls down when weight of drop becomes just equal to the surface tension.

1. Now the force of gravity exerted on the drop, is given by $V.d.g$. where V is the volume of the drop, d its density and g its gravity. The force of gravity will pull down the drop.
2. The force tending to uphold the drop is given by ~~$2\pi\gamma$~~ $2\pi\gamma$ where $2\pi\gamma$ is circumference of the capillary of radius γ .

$$2\pi\gamma = V.d.g \quad - \textcircled{1}$$

If n is the number of drops in volumes V of the liq. then volume of each drop, will $V = \frac{V}{n}$ from eq. ~~①~~ we have $2\pi\gamma = \frac{(V.d.g)}{n} \quad - \textcircled{2}$

$$2\pi\gamma_1 = \left(\frac{V}{n_1}\right) d_1 g \text{ for 1st liq.} - \textcircled{3}$$

$$2\pi\gamma_2 = \left(\frac{V}{n_2}\right) d_2 g \text{ for 2nd liq.} - \textcircled{4}$$

Dividing eqⁿ $\textcircled{3}$ by $\textcircled{4}$, we have

$$\frac{\gamma_1}{\gamma_2} = \frac{n_2}{n_1} \times \frac{d_1}{d_2}$$

CALCULATION : Find a value for the tension of liquid air at 20°C. Given that density of sample 'A' = 1.2 gm/cm³, surface tension of water = 72 dyne/cm.

v_{L_1} = surface tension of 'A'

v_w = surface tension of water = 72 dyne/cm

d_{L_1} = density of sample 'A' = 1.2 gm/cm³

$$v_{C_1} = \frac{d_{L_1} \times v_w \times v_w}{d_w \cdot m_{L_1}} \text{ (for sample A)}$$

v_{L_2} = surface tension of sample 'B'

d_{L_2} = density of sample 'B' = 1.3 gm/cm³

~~$v_{L_1} = v_w \times \frac{d_{L_1} \times v_w \times v_w}{d_w \cdot m_{L_1}}$~~ (for sample A)

~~$v_{L_2} = v_w \times \frac{d_{L_2} \times v_w \times v_w}{d_w \cdot m_{L_2}}$~~ (for sample B)

$$v_{L_2} = \frac{1.3 \times 57 \times 72}{1.0 \times 93} = 129.07 \text{ dyne/cm}$$

~~$v_{L_2} = \frac{1.3 \times 57 \times 72}{1.0 \times 93} = 129.07 \text{ dyne/cm}$~~

Principle of float (V) = $\frac{\rho_A V}{\rho_B V}$

$$\left(\frac{\rho_A}{\rho_B}\right) \times \left(\frac{V}{V}\right) = \frac{1.2}{1.3}$$



PROCEDURE

1. Immerse the lower end of the stalagmometer in a beaker containing distilled water. Suck the water until it rises above the mark A.
2. Now ~~do~~ let the water flow out and start counting the number of drops when the water meniscus just reaches the mark A, and counting is stopped when the water meniscus passes the lower mark B. Let the number of drops be n_w .
3. Repeat to get three readings.
4. Clean the stalagmometer and dry it. Fill it with ~~lq.~~ until it rises above the mark A and count the number of drops when a fixed volume of liquid flows below the mark A and mark B, as before. Let the number of drops be n_r .
5. Weigh the relative density bottle and note down its weight.
6. Fill it with water and weight it again.
7. Remove water dry the relative density bottle. Now fill it with the given liquid and weight.



~~(A)~~ RESULT : The surface tension of the given liquid is ~~75.76 dyne/cm~~ of sol A & ~~124.07 dyne/cm~~ of sol B

~~(B)~~ PRECAUTIONS :

1. Stalagmometer should be thoroughly cleaned.
2. It should be in vertical position throughout the counting process.
3. Drop formation should be adjusted to a slower rate and should not exceed 15 drops per minute.

IMPLICATIONS

1. Applications of surface tension in soap solⁿ
Surface tension of soap solution is less it can spread over large areas and wash clothes more effectively.
2. Application in soldering
in soldering addition of flux reduce the surface tension of molten liquid.
3. Mosquito eggs can float on water because of surface tension.
4. A needle place on water can be made to float due to the surface tension of water.
5. Tooth paste contains soaps, which reduces the surface tensions and helps it spread



freely in mouth.

- b. Antiseptics like Dettol have low surface tension so that they can spread faster.

Viva Questions

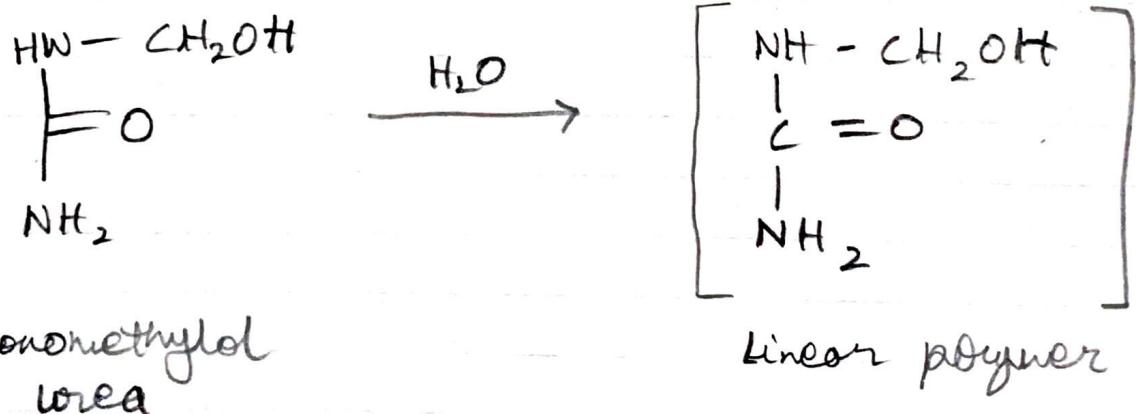
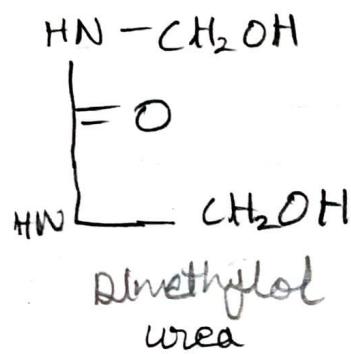
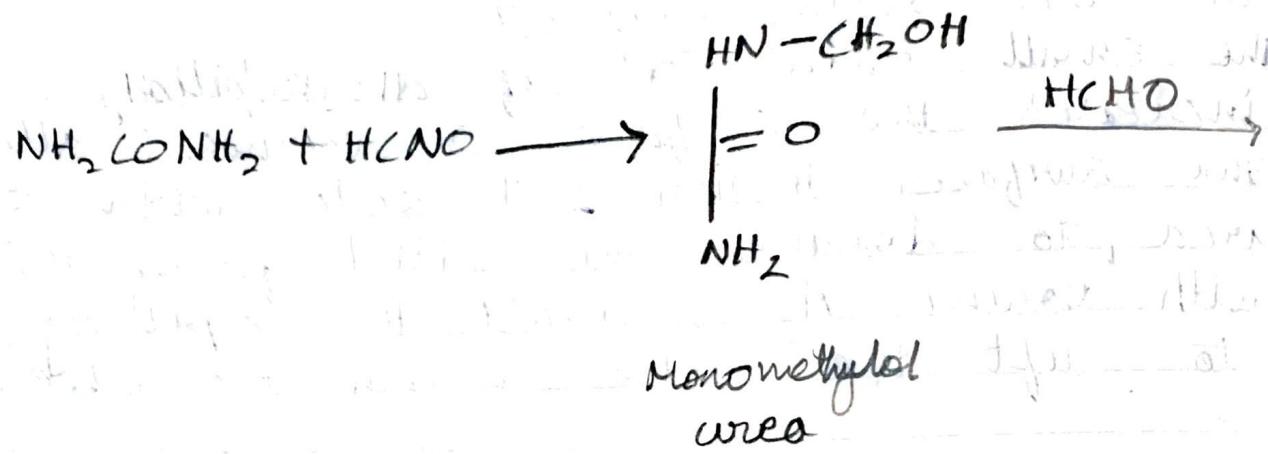
1. What are the effect of surface tension?
When the object is on the surface of a fluid, the surface under tension behaves like an elastic membrane. It is also responsible for the spherical shape of water droplets
2. Define surface energy?
Surface energy quantifies the disruption of intermolecular bonds that occurs when a surface is created
3. Give some applications of surface energy?
A needle placed on water can be made to a surface tension water.
Mosquito eggs can float on water because of its surface tension.
Antiseptics like dettol have low surface tension so that they can spread faster



4. Why do we use a narrow capillary tube in the stalagmometer?

The small radius 'r' of a capillary tube increases the surface to volume allowing the surface tension that scale with surface area, to dominate the initial forces that scale with volume. As a result the capillary rise to lift the water within the tube.

Q6



EXPERIMENT - 3

AIM

Preparation of urea formaldehyde resin.

Apparatus Required

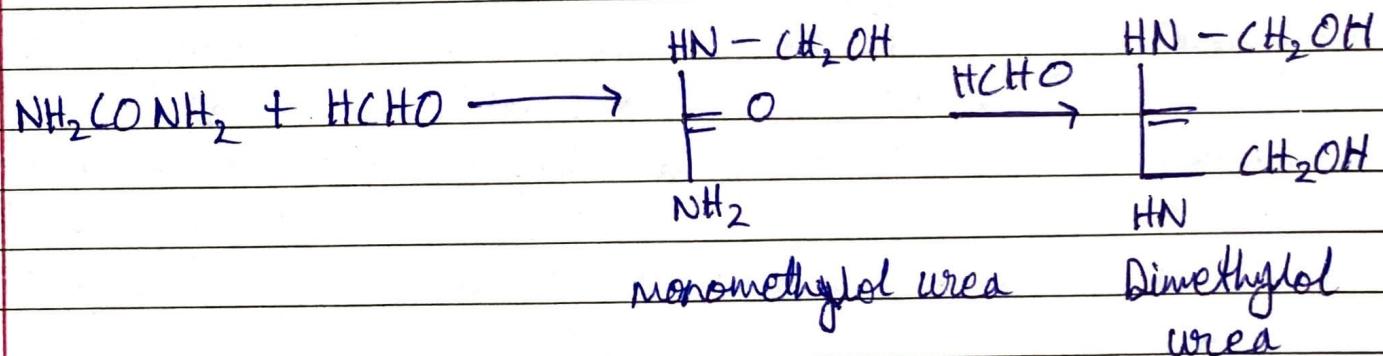
Beakers, glass rod, funnel, filter paper.

Chemicals

Formaldehyde (40%), Urea, conc. H_2SO_4 , distilled water.

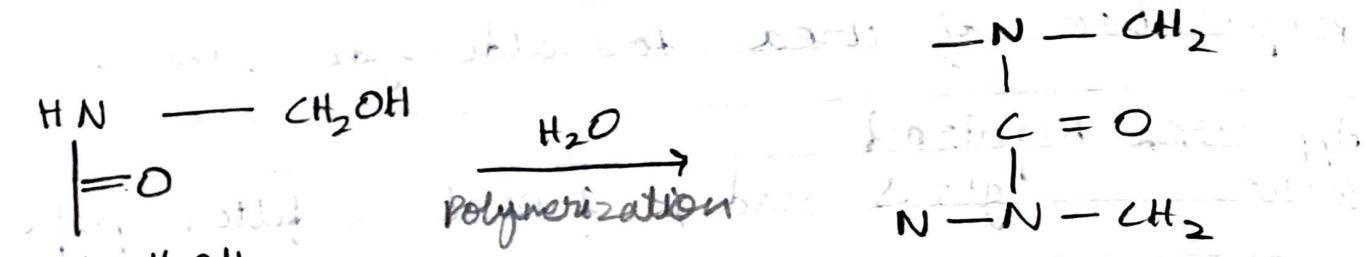
Theory

Urea formaldehyde resin is prepared by the condensation reaction b/w urea and Formaldehyde in neutral or alkaline conditions. The first products formed during the formation of resin are monomethylol and dimethylol urea.

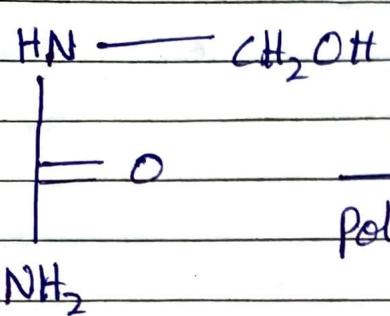


Polymerization can take place from mono or dimethyl urea, or possibly through both with the formation of long chain.

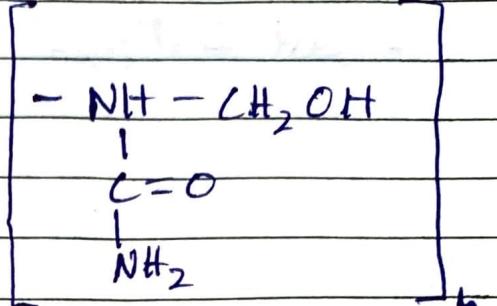
卷之三



Dimethylol wrea cross linked Polymer

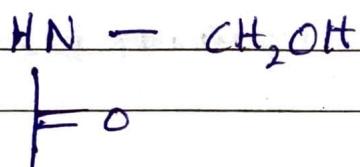


$\xrightarrow[\text{Polymerization}]{\text{H}_2\text{O}}$



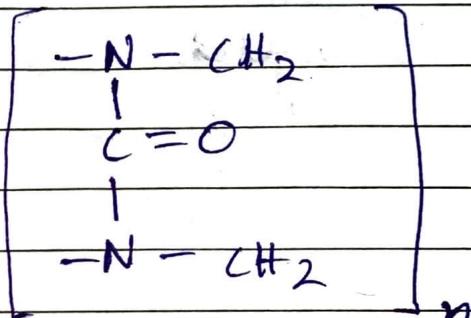
linear Polymer

Monomethylol urea



Dimethylol urea

$\xrightarrow[\text{Polymerization}]{\text{H}_2\text{O}}$



cross linked
Polymer

~~Procedure~~

- ① Place about 7ml of 40% formaldehyde solution in 100 ml beaker.
- ② Add about 5g of urea with constant stirring till saturated solution is obtained.
- ③ Add a few drops of conc. H_2SO_4 with constant stirring.
- ④ A voluminous white solid mass appears in the beaker.
- ⑤ Wash the white solid with water and dry it in folds of filter paper.
- ⑥ calculate the yield of the product.



Result

The yield of urea formaldehyde resin is
6.30g

~~Q13~~ Precautions

- ① While adding conc. H_2SO_4 , it is better to stay little away from the beaker since the reaction sometimes becomes vigorous.
- ② The reaction mixture should be stirred continuously.



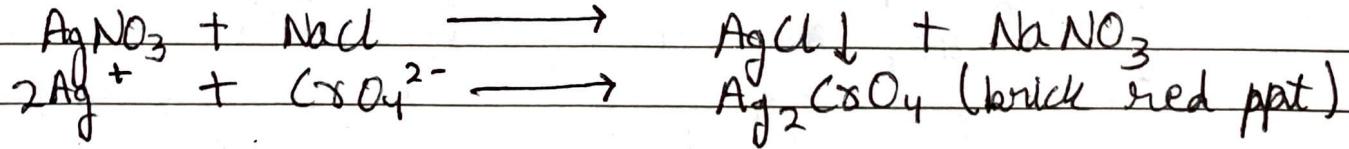
Experiment - 4

AIM :- Determination of strength of given chloride ion in given sample using titration.

Apparatus :- Burette , pipette , beakers , titration flask stand.

Theory :- While silver nitrate solution is added to a solution chloride containing few drops of potassium chromate , white silver chloride is precipitated initially . As soon as all the chloride ions have been precipitated out , even a drop of silver nitrate added in excess gives a red precipitate of silver chromate this indicates the end point .

The solubility product of silver chloride is lower than that of silver chromate . Hence as long as the chloride ions have been precipitated out , even a slight excess of Ag^+ produces insoluble silver chromate which is red in colour .



Observations

H₂-gas evolved

S.NO	Volume of the acid solution taken in ml for the titration	Burette reading		volume of the AgNO ₃ added (final - initial) ml
		Initial reading ml	Final reading ml	
1	10.0	0.0	4.5	4.5
2	10.0	4.5	7.0	2.5
3	10.0	9.0	13.5	4.5

Calculation

Strength of AgNO₃ = ~~Strength of NaCl soln.~~ $\frac{N_1 V_1}{V_2} \times 100$

$$N_1 = \frac{1}{100} N, \quad V_1 = 4.9 \text{ ml}; \quad V_2 = 10 \text{ ml}$$

$$N_2 = \frac{1}{100} (4.9) = 4.9 \times 10^{-3} N$$

$$\text{Strength} = N \times \text{eq. wt}$$

$$= 4.9 \times 10^{-3} \times 35.5$$

$$\text{Strength} = 1.74 \times 10^{-1} \text{ g/L}$$



Procedure :-

1. Rinse and fill the burette with given AgNO_3 solⁿ
2. Pipette out 10ml of NaCl solⁿ in the titration flask.
3. Add 0.5ml of K_2CrO_4 indicator
4. Add AgNO_3 from the burette, shaking the flask constantly. A white ppt of AgCl is obtained. After the addition of few ml of AgNO_3 a red colour appears in the flask but disappear quickly upon shaking.
5. Continue the addition drop by drop till a permanent reddish brown is obtained. Take three concordant readings.

Result :-

The strength of given chloride ion is given
solⁿ is ~~0.1775 g/L~~ ~~0.174 g/L~~

Precautions :-

1. Store AgNO_3 in a coloured bottle
2. The whole apparatus must be washed with distilled water
3. same amt. of indicator must be added each time.
4. The reaction must be added each time. briskly shaken during the titration.



EXPERIMENT - 5

AIM :- Determination of coefficient of viscosity of given liquid by Ostwald's viscometer method.

Theory :- The Ostwald's viscometer method is based on Poiseuille's eq. This relates the rate of flow of liquid through a capillary tube with the coefficient of viscosity and is expressed by the eq.

$$\eta = \frac{(\pi \delta^4 t p)}{8 V I} \quad \text{--- (1)}$$

where V = volume of liquid of viscosity η flowing in time t , through a capillary tube of radius δ and length I .

p = Hydrostatic pressure of liquid.

If t_1 & t_2 are the flow time required to flow for equal volumes of two liquids through the same length of a capillary tube then from eq.

(1) we have

$$\eta_1 = \frac{\pi P_1 \delta^4 t_1}{8 V_1}$$

$$\eta_2 = \frac{\pi P_2 \delta^4 t_2}{8 V_2}$$

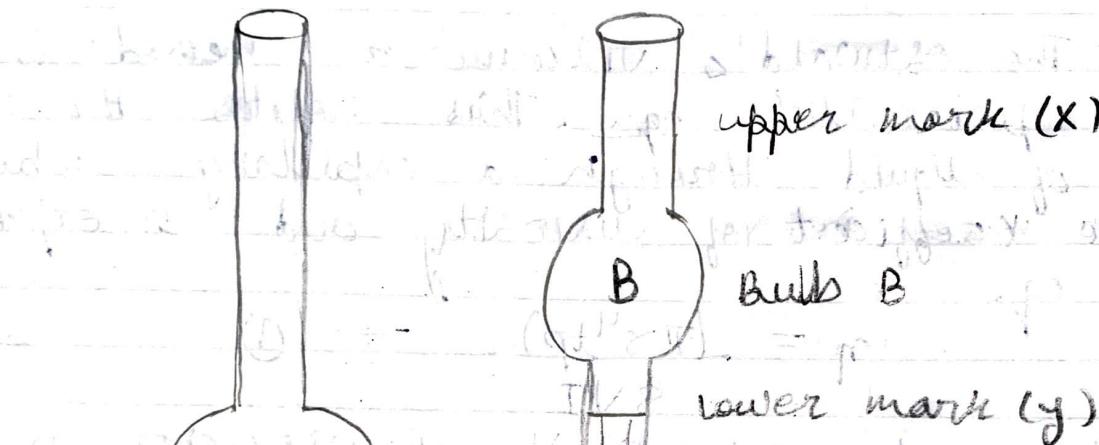
$$\frac{\eta_1}{\eta_2} = \frac{P_1 t_1}{P_2 t_2} \quad \text{--- (2)}$$

$$\frac{\eta_1}{\eta_2} = \frac{d_1 t_1}{d_2 t_2}$$

2. TURBIDIMETRY

Measuring turbidity by light scattering method
Apparatus and methods and applications

Arm 1 Arm 2



Bulb A

A

Bulb B

B

lower mark (y)

Viscometer

Viscometer

Viscometer

(a)

(b)

(c)

(d)



This will give us the relative viscosity of the given liquid. Relative viscosity has no units. The absolute viscosity $\eta = \frac{d_1}{d_2} \cdot \frac{t_1}{t_2} \cdot \eta_2$

Apparatus :- Ostwald's viscometer, stop watch, specific gravity bottle, 10ml pipette, distilled water rubber tubing.

Description : Ostwald's viscometer: It consists of capillary tube connected at its upper end with a bulb A and its lower end with a U-tube provided with bulb B. Bulb B is of large size than A. Marks X and Y are etched on the capillary tube and below the bulb A. The bulbs are necessary to maintain the hydrostatic pressure during flow of liquid. Through the capillary, the liquid flows with a measurable speed.

Procedure :-

1. Clean the viscometer with chromic acid and then wash it several times with distilled water. It is finally washed with alcohol and ether and then dried.
2. Attach a piece of clean rubber to the end of arm 2 and clamp with viscometer vertically in air.

Observations :-

Room temp. $\approx 30^\circ\text{C}$

S.No	Given liquid A Time of flow (sec)	Given liq. B Mean time (t ₂₁)	Time of flow (sec)	Mean time (t ₁₂)	Time of flow (sec)	Water Mean (t _w)
1.	35.53	35.50	39.73	39.77	35.00	34.50
2.	35.97	35.50	39.77	39.76	34.50	34.50
3.	35.00		39.80	X	34.00	

Density of water, $d_w = 1 \text{ gm/cc}$

Density of liquid A, $d_{11} = 1.2 \text{ gm/cc}$

Density of liquid B, $d_{12} = 1.3 \text{ gm/cc}$

Viscosity of water, $n_w = 10 \text{ millipoise}$



3. Now introduce a sufficient volume of the given liquid with the help of a pipette in bulb A so that the bend portion of the U-tube and more than half of the bulb A are filled up.
4. Through the rubber tube, suck up the liquid until it rises above the mark C. Make sure that there is no air bubble inside the liquid.
5. Now, allow the liquid to fall freely through the capillary up to the mark C. Start the stop watch and ~~note~~ note the time t_1 for the flow of the liquid from mark C to mark D.
6. Repeat the liquid and clean and dry the viscometer again.
7. Repeat the experiment thrice. The value should be concordant.
8. Repeat the experiment by taking the same volume of the distilled water and note the time taken t_2 for the flow of water from mark C to D. Repeat thrice.
9. Weight the relative density bottle and note down its weight.
10. Fill it with the given liquid and weight it again.
11. Remove the liquid. Wash it with chromic acid and then distilled water. Dry in the oven. Now fill it with the distilled water and weigh it.

and used for further calculations, we
can find the difference of height after the bath
was removed are for reduced bath salt bath.

calculations

A solid salt is placed inside the
bath salt dish which reduces the specific re-

specific viscosity of sample 'A' at this point
of time and thickness obtained in dw & tw both to be
calculated along with this will be written as

i) Viscosity of sample 'A' at the previous
time of salt bath salt dish obtained

$$\text{Viscosity } \eta_{21} = \frac{\eta_{21}}{\eta_{21}} = \frac{d_2 \times t_2}{d_w \times t_w} \times 34.50 \times 10$$

$$\text{Viscosity } \eta_{21} = \frac{42.16}{34.5} = 12.34 \text{ times salt to salt}$$

ii) Viscosity of sample 'B' at the previous
time of salt bath salt dish obtained

$$\text{Viscosity } \eta_{12} = \frac{\eta_{12}}{\eta_{12}} = \frac{d_{12} \times t_{12} \times n_w}{d_w \times t_w} \times 34.50 \times 10$$

$$\text{Viscosity } \eta_{12} = \frac{516.88}{34.5} = 14.98 \text{ times salt to salt}$$



Result :-

The viscosity of the given solⁿA at $30^{\circ}C$
is $1.234 \text{ m}^2/\text{sec}$.

~~(A) 1)~~

The viscosity of the given solⁿB is $1.498 \text{ m}^2/\text{sec}$

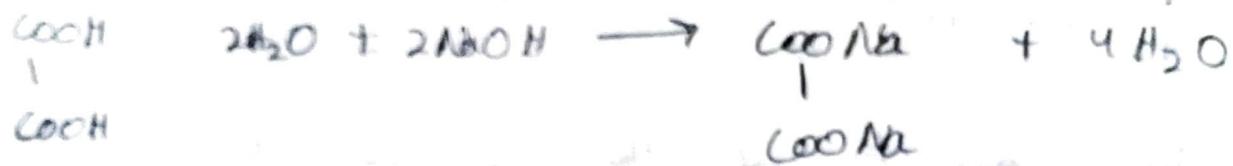
Precautions :-

1. Rinse and dry the apparatus properly.
2. Always take same volume for all liquids.

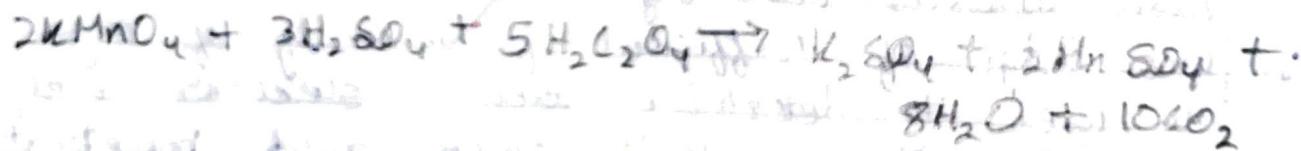
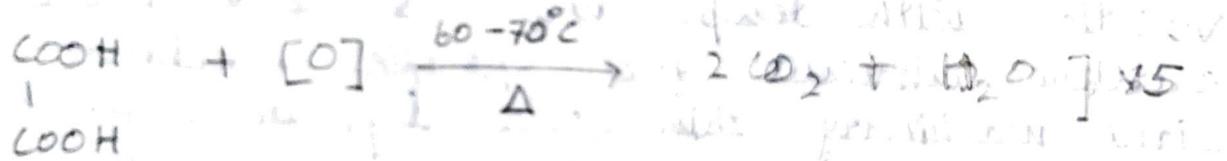
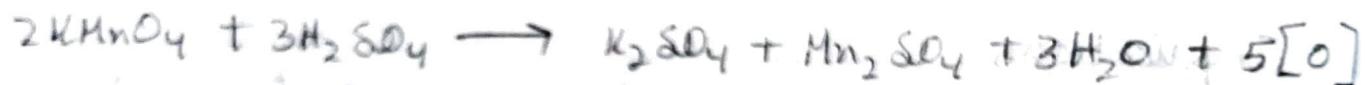
Implications :-

1. The knowledge of coefficient of viscosity and its variation with temp. helps us to choose a suitable lubricant for specific machine. In light machinery thin oils (e.g., lubricant oil) with low viscosity is used. In heavy machinery high viscous oil (e.g., grease) are used.
2. Knowledge of coefficient of viscosity of organic lig. is used to determine their molecular weight.
3. Low viscosity of fluid gives good penetration to reach the spot that needs lubrication or loosening. Thus, it penetrates into bicycle chains.
4. A general increase in viscosity of oil, lubricant at high temp. which is lower oil consumption and less wear.

1st Titration



2nd Titration





Experiment - 6

AIM :- To determine the amount of oxalic acid and sulphuric acid in 1 L solution. Given NaOH solution and KMnO_4 solution.

Chemical required :-

NaOH solⁿ, KMnO_4 solⁿ, oxalic acid solⁿ sulphuric acid solⁿ, phenolphthalein.

Apparatus :-

Burette, pipette, 2 beakers, titration flask stand

Theory :-

This involves double titration.

1st titration : NaOH reacts with oxalic acid as well as H_2SO_4 according to the following equations.

By titrating NaOH against the given mixture of oxalic acid and sulphuric acid, the total normality of oxalic acid and H_2SO_4 can be found.

2nd titration : The mixture solⁿ is titrated with KMnO_4 solⁿ which will react with oxalic acid (redox titration) in the presence of H_2SO_4 . This, from second titration, normality of oxalic acid alone can be found out and hence its

⇒ Observation Table :-

NaOH versus mixture (initial vol = 10 ml)

S.No	Vol. of the sol ⁿ taken in titration flask (ml)	Burette reading		Volume of the titrant used (Final - Initial) (ml)
		Initial reading	Final reading	
1.	10	0.0	21.0	21.0
2.	10	6.0	27.0	21.0
3.	10	27.0	48.0	21.0

concentrated reading = 21 ml

KMnO₄ Verses mixture (only oxalic acid reacts)

S.No	Vol. of the sol ⁿ taken in the titration flask (ml)	Burette Reading		Volume of the titrant used (Final - Initial) (ml)
		Initial reading	Final reading	
1.	10	3.0	13.0	10.0
		13.0	23.0	10.0
		23.0		10.0



strength is determine. From the normality of the solⁿ obtained in the first titration, the normality of H₂SO₄ & its strength can be found out.

The reaction of oxalic acid with KMnO₄ is very slow, therefore, the oxalic acid solⁿ is heated to 60-70°C initially once the reaction has started, its rate automatically increases due to the formation of Mn²⁺ ions which catalyze the reaction (act catalyst)

⇒ Indicator used :

phenolphthaleine (1st titration)

KMnO₄ is self - indicator (2nd titration)

⇒ End point

colourless to pink (1st titration)

colourless to pink (2nd titration)

Procedure

1st titration

1. Rinse the apparatus thoroughly. Take NaOH in the burette and pipette out 10ml mixture in the titration flask.
2. Add a drop of phenolphthaleine and run NaOH from the burette.



3. Titrate till end pt. is achieved and note down the volume of NaOH used.
4. Repeat to get 3 concordant reading.

2nd titration

- ① Rinse the apparatus thoroughly. Take KMnO₄ in the burette. Since it is a colourless solⁿ we note the upper meniscus for taking the initial reading.
- ② Pipette out 10 ml of the mixture in the titration flask. Add half a test tube (almost 10 ml) of H₂SO₄ and then, Heat the conical flask slowly until the moisture appears on the neck of the flask on it is unbreakable to touch (60 - 70°C)
- ③ Titrate to achieve the end pt. and note value of KMnO₄ used.
- ④ Repeat to get the 3 concordant reading.

Result :

Amount of oxalic acid in the given mixture
= 6.3 g/L

✓ Amount of H₂SO₄ present in the given mixture = 5.34 g/L



Precautions :

- ① All the apparatus should be washed before use.
- ② Rinse the burette with $KMnO_4$ & pipette with given solⁿ.
- ③ Never use a pinch lock burette & $KMnO_4$ attacks rubber.
- ④ Always use freshly prepared $KMnO_4$ solⁿ
- ⑤ A sulphuric acid should be added in excess otherwise a brown precipitate of MnO_2 may form.



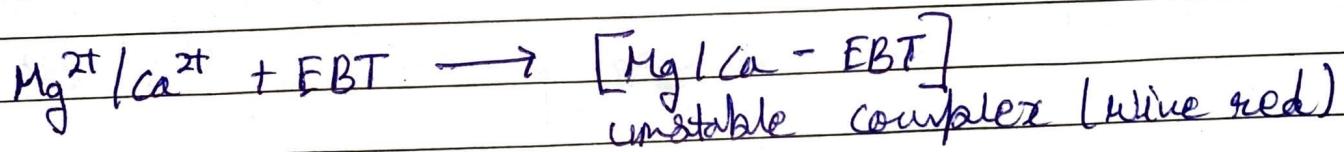
EXPERIMENT - 7

AIM :- To standardize EDTA solution and to determine total hardness (temporary + permanent) of the given water sample by complexometric titration

Apparatus :- Burette, pipette, beakers, titration, flask stand

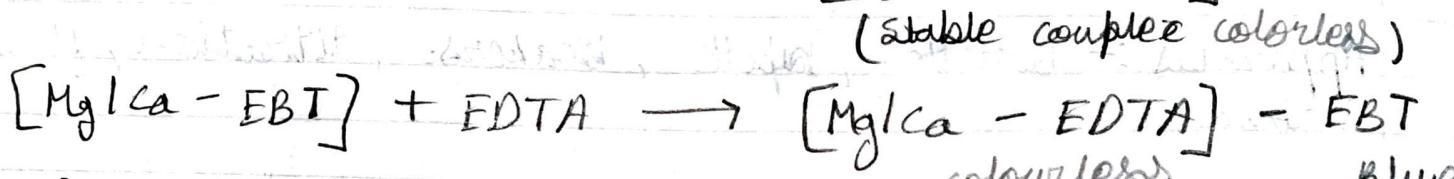
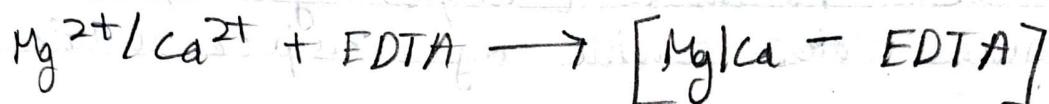
Theory :- The hardness of water can be determined by complexometric titration. EDTA is used as a complexing agent. In the form of its disodium salt it is used to estimate Ca^{2+} & Mg^{2+} ions, using Eriochrome black-T as an indicator. Estimation of Ca^{2+} or Mg^{2+} by EDTA method is based on the following principal.

- First, the indicator Eriochrome Black T, which is a blue coloured dye, forms an unstable complex with Ca^{2+} or Mg^{2+} ions of hard water at a pH of 9 to 10. The complex is wine red in colour.



- As this solution is titrated against EDTA.

Chemical Reaction :- एक रसायनिक प्रक्रिया।



Observation Table ~~for the elements of the first group~~

Determination of total hardness;

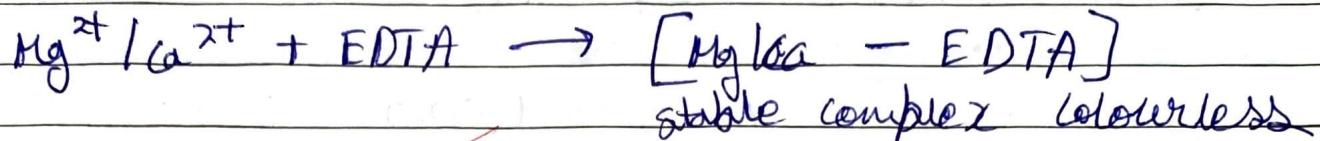
S.No	Vol. of the water sample taken in the titration flask	Burette Reading	Vol. of the titrated EDTA used (V_2) ml
		T.R	F.I.R
1	10	0.0	1.0
2	10	1.0	2.5
3	10	1.5	2.0

Determination of permanent hardness (Boiled water)

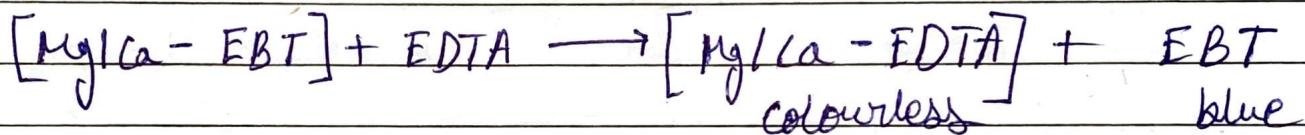
S.No	Vol of the water supply taken in the titration flask	Burette Readings	Initial reading	Final reading	Vol. of the titrable used (EDTA) in ml
1.	10	10.0	0.4		0.4
2.	10	0.4	0.8		0.4
3.	10	0.8	1.2		0.4



Free Ca^{2+} or Mg^{2+} ions in water from stable metal ions in EDTA complex.



- Once the free metal ions are complexed, the EDTA replaces Ca or Mg ions from the unstable indicator and the indicator is set free. Since the indicator is blue at above pH, the end point is appearance of blue colour.



Thus, the amount of EDTA used corresponds to the hardness of water.

The temporary hardness is removed by boiling and after the removal of ppt. by filtration the permanent hardness of filtrate is determined by titration with EDTA as above. The temporary hardness will be given by the difference of total hardness & permanent hardness.

1. Titration of EDTA with standard hard water (STH) to determine strength of given EDTA solution.

Calculations;

i) Total hardness

$$M_1 V_1 = M_2 V_2$$

$$(M_1 = 0.01) \leftarrow \text{ATQF for 1 mol/l}$$

$$\text{and } M_2 = 0.05 \quad M_1 = \frac{0.01 \times 0.05}{10} = 0.0005$$

Total hardness is terms of CaCO_3 equivalent =

Molar mass of CaCO_3 + Mol. wt. of CaCO_3 by position in the periodic table.

Equivalent weight of CaCO_3 = $\frac{\text{Molar mass}}{2}$

$$\Rightarrow M_1 \times 100 \times 1000 \text{ mg/L (or ppm)}$$

$$\Rightarrow 0.005 \times 100 \times 1000$$

$$\Rightarrow 50 \text{ ppm} \quad \leftarrow \text{ATQF for 1 mol/l}$$

ii) Permanent hardness;

$$M_3 V_3 = M_4 V_4$$

$$M_3 = \frac{0.01 \times 0.4}{10} = 0.004$$

Permanent hardness in terms of CaCO_3 eq. $\Rightarrow M_3 \times \text{Mol. amt of CaCO}_3$

$$\Rightarrow M_3 \times 100 \times 1000 \text{ mg/L}$$

$$\Rightarrow 0.0004 \times 100 \times 1000 = 40 \text{ ppm}$$

iii) Temporary hardness

$$\text{Temporary hardness} = (\text{Total hardness} - \text{Permanent hardness})$$

$$= (50 - 40) \text{ ppm}$$

$$= 10 \text{ ppm}$$



Procedure

1. Rinse and fill the burette with EDTA solution.
2. Pipette out 20ml of the standard hard water sample into a conical flask.
3. Add 2ml of ammonia buffer solution and 2-3 drops of EBT indicator.
4. Titrate the solution till the wine red colour changes to deep blue.
5. Repeat the titration to get three concordant reading.

II. Titration of EDTA with given water sample for determination of total hardness of water sample

1. Rinse and fill the burette with EDTA solution.
2. Pipette out 20ml of the given hard water sample into a conical flask.
3. Add 2ml of ammonia buffer solution & 2-3 drop of EBT indicator.
4. Titrate the solution till the wine red colour changes to deep blue.
5. Repeat the titration to get 3 concordant readings.

Result

1. Total Hardness of given water sample = 50 ppm
2. Permanent Hardness = 40 ppm
3. Temporary Hardness = 10 ppm

Observations

Indicator \rightarrow Phenolphthalein & methyl orange
 End point \rightarrow Pink to colourless & yellow to red respectively

Volume of water sample = 10 ml

End point for phenolphthalein

S.No	Initial reading of burette (ml)	Final reading of burette (ml)	Total HCl used (F - I) ml
1.	0	14.2	14.2
2.	14.4	18.6	4.2
3.	28.8	33.0	4.2

$$\text{Concordant reading} = 4.2 \text{ ml} = (x)$$

End Point for methyl orange;

S.No	Initial reading of burette (ml)	Final reading of burette (in ml)	Total amt. of HCl used (final - initial) ml
1.	4.2	14.4	10.2
2.	18.6	28.8	10.2
3.	33.0	43.2	10.2

$$\text{Concordant reading} = 10.2 \text{ ml} = 2 \text{ ml}$$

$$\text{Methyl orange end point} \Rightarrow y = x + 2 \Rightarrow (4.2 + 10.2) \text{ ml} = 14.4 \text{ ml}$$



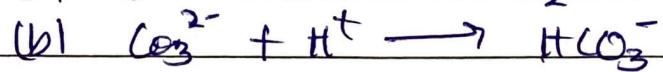
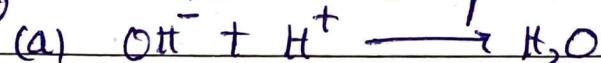
EXPERIMENT - 8

AIM: Determination of alkalinity in given sample of water.

Apparatus Required: Burrette, pipette, conical flask, measuring flask

Chemicals: standard HCl solⁿ, phenolphthalein, methyl orange.

Theory: In water sample alkalinity may be present due to following three ions i.e. OH^- , CO_3^{2-} and HCO_3^- . Thus on the basis of above three ions possible combination of ions causing alkalinity of water are; (a) OH^- (b) CO_3^{2-} (c) HCO_3^- (d) OH^- and CO_3^{2-} (e) CO_3^{2-} & HCO_3^- . The presence of OH^- & HCO_3^- ions together is not possible since they combine together & form CO_3^{2-} ions, $\text{OH}^- + \text{HCO}_3^- \rightarrow \text{H}_2\text{O} + \text{CO}_3^{2-}$. Thus the extent of alkalinity in the given water sample may be determined by titrating water sample with standard acid using phenolphthalein & methyl orange indicator according to the pH of the water sample.





Procedure

- (a) Pipette out 20ml of water sample in to conical flasks & add 2 drops of phenolphthalein indicator. (b) Rinse and fill the burette with N/10 HCl (c) Titrate the water sample with HCl from burette with constant shaking till pink colour disappears (d) Note this reading this corresponds to phenolphthalein end point (e) until a sharp colour change from yellow to pink takes place (f) make this reading, it corresponds to MO end pt. (g) repeat the same procedure atleast 3 times. to get reading.

Result :

When alkaline is present due to CO_3^{2-} + HCO_3^- ions. Alkalinity due to CO_3^{2-} ions is ~~4200 mg/L~~ ppm. Alkalinity due to HCO_3^- ions is ~~3000 mg/L~~ or ppm

Precautions :

- (a) Apparatus should be thoroughly cleaned (b) Rinse the burette with the solution to be taken it. (c) Always read the lower numbers in case of colourless solution.

Implications

- (a) Higher alkalinity levels in surface water will buffer acid rain & other acid wastes preventing pH

Calculations

phenolphthalein \rightarrow water and Acid

$$N_1 V_1 = N_2 V_2$$

$$N_1 \times 10 = \frac{1}{10} \times 1000$$

to

$$N_1 = \frac{4.2}{10} \times 50 \times 1000$$

$$10 \times 10$$

$$P = 2100 \text{ ppm (or } M/L)$$

Methyl orange (M) \rightarrow water, OH⁻ Acid

$$N_1 V_1 = N_2 V_2$$

$$N_1 \times 10 = \frac{1}{10} \times 1000$$

~~$$N_1 = 14.4 \times 50 \times 1000$$~~

~~$$10 \times 10$$~~

~~$$M = 7200 \text{ ppm (or } mg/L)$$~~

from results we get

$$P < \frac{1}{2} M$$

so OH⁻ is absent & CO₃²⁻ and HCO₃⁻ ions are present

In water

$$\text{Alkalinity due to } CO_3^{2-} = 2P = 2 \times 2100 = 4200 \text{ ppm}$$

$$\text{Alkalinity due to } HCO_3^- = M - 2P = (1200 - 4200) \text{ ppm}$$

~~$$= 3000 \text{ ppm}$$~~



that are harmful aquatic life.

- (b) Alkalinity is also important considering treatment of waste water & drinking water b/c it influences clearing processes.
- (c) It protects the living organism who require pH range.