

Name of experiment :- Viscosity of solution.

Aim of experiment :- determination of percentage composition of sugar solution from viscosity.

Chemical required :- Sugar sol<sup>2</sup> and water.  
sample(pure).

Apparatus required :- pipette, funnel, conical flask  
beaker, Ostwald viscometer,  
stop watch.

Procedure :-

1. first of all, the following sugar solution was prepared

i) 0% (pure water sample)

ii) 25% (sugar solution)

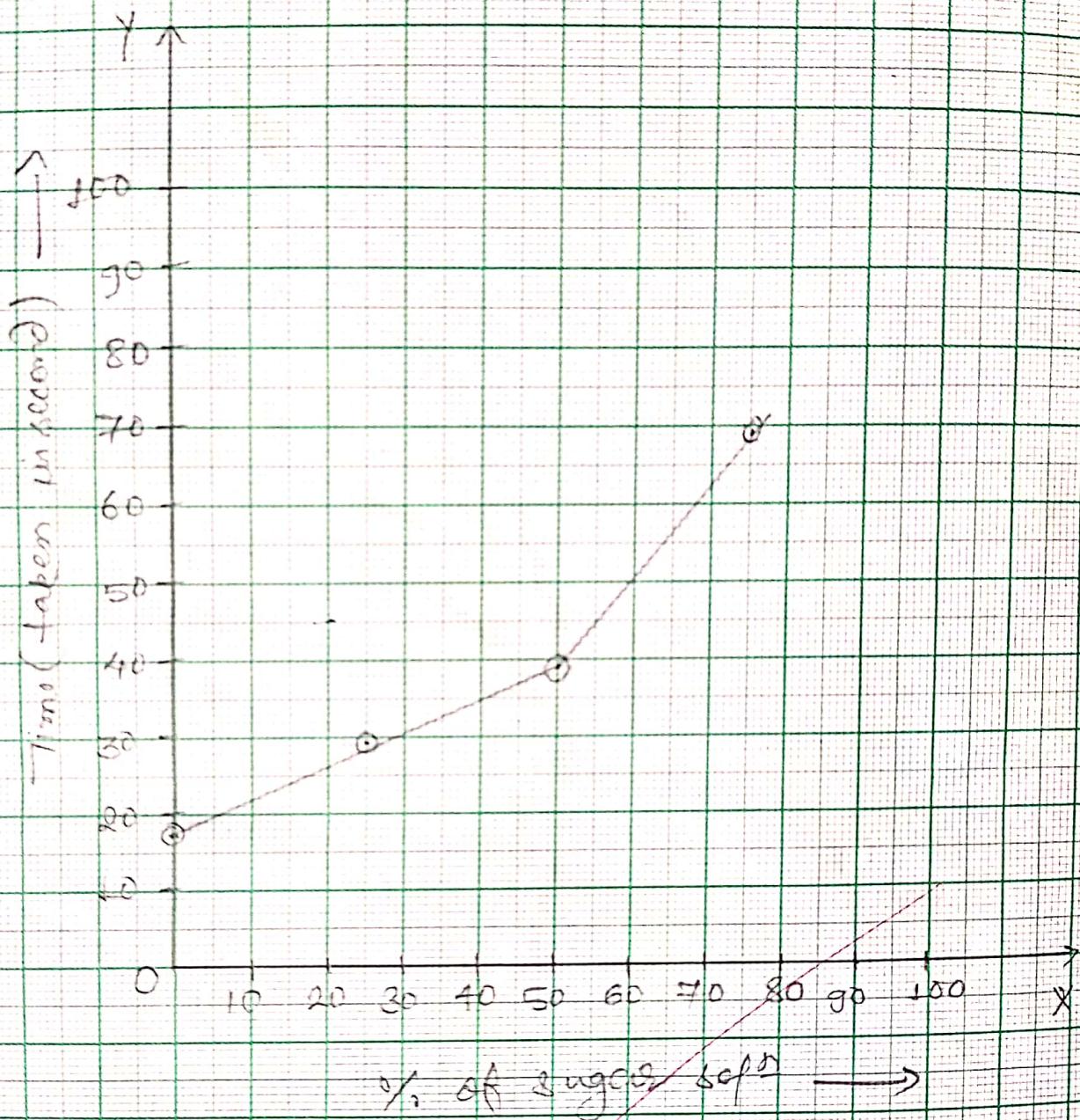
iii) 50% (sugar solution)

iv) 75% sugar solution.

2. Then, the time of flow in each case was determined at room temperature.

3) A straight line graph was plotted between the time of flow and percentage composition.

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- 4) Determine the time of flow for unknown solution.
- 5) From the graph, determined the percentage composition of unknown sugar solution.

Observation Table :-

| S.No | Sample                     | Time of flow of liquid (in s) |                |                | Mean  |
|------|----------------------------|-------------------------------|----------------|----------------|-------|
|      |                            | T <sub>1</sub>                | T <sub>2</sub> | T <sub>3</sub> |       |
| 1    | Pure water 0°              | 18.2                          | 18.22          | 17.3           | 17.67 |
| 2.   | 25% sugar sol <sup>o</sup> | 81.2                          | 29.42          | 29.1           | 29.67 |
| 3.   | 50% sugar sol <sup>o</sup> | 37                            | 41             | 41.14          | 39.33 |
| 4.   | 75% sugar sol <sup>o</sup> | 69                            | 69.9           | 70             | 69.33 |

Precautions :-

- i) Note down the time in stop watch accurately.
- ii) Prepare the sugar sol<sup>o</sup> in proper concentration.

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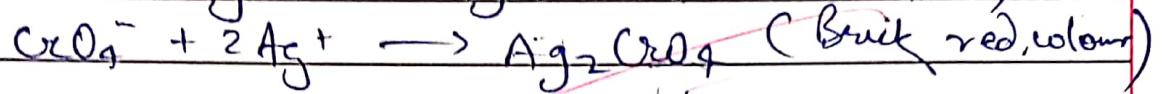
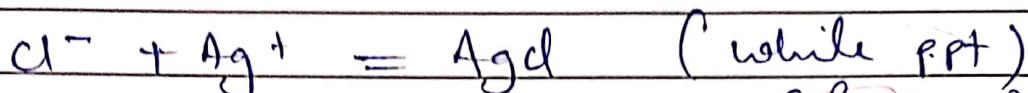
Aim :- To determine the concentration of chloride ion in the given sample of water using  $\text{AgNO}_3 \text{ sol}^{\ominus}$

Apparatus required :- Burette, pipette, beaker, conical flask, funnel and Burette stand.

Chemical required :-  $\text{H}_2\text{O AgNO}_3 \text{ sol}^{\ominus}$  and  $\text{K}_2\text{CrO}_4 \text{ sol}^{\ominus}$  as indicator.

Theory. The method to be employed in this experiment makes use of the fact that out of two sparingly soluble salt of silver, silver chloride (solubility  $1.1 \times 10^{-5} \text{ mol l}^{-1}$ ) and silver chromate (solubility  $7.5 \times 10^{-5} \text{ mol l}^{-1}$ ) the former is slightly less soluble than the latter. Chloride ion is titrated with a standard solution of  $\text{AgNO}_3$  using potassium chromate as indicator, chloride ion reacts first and is removed quantitatively as white precipitate of silver chloride and then at the end point, a brick red ppt. of  $\text{Ag}_2\text{CrO}_4$  appears.

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Procedure :-

- 1) Place 10 ml of the given sample of NaCl in a clean conical flask with the help of a pipette and add 10 drops of potassium chromate solution.
- (2) Add silver nitrate solution slowly from the burette shaking the liquid constantly till a permanent brick red colour just appears.
- (3) Repeat the process two or three times till concordant reading is obtained. Calculate the normality and strength of the chloride ion using the relations:

$$N_1 V_1 = N_2 V_2$$

$$\text{f strength} = \text{normality} \times \text{Equivalent weight}$$

## Procedure :-

## OBSERVATION TABLE

| S.No. | Vol. of water sample | Burette reading<br>N/10 $\text{AgNO}_3$ sol <sup>2</sup> | Concordant<br>Reading | Indicator<br>use)                    |
|-------|----------------------|--|-----------------------|--------------------------------------|
|       |                      | Initial final Diff                                       |                       |                                      |
| 1     | 10                   | 0 1.7 1.7  |                       |                                      |
| 2     | 10                   | 31.7 2.0 2.3 1.7   |                       | $\text{K}_2\text{CrO}_4$<br>solution |
| 3     | 10                   | 4.0 5.9 1.9  |                       |                                      |
| 4     | 10                   | 5.9 7.6 1.7  |                       |                                      |

## Calculation

Using Normality eq<sup>2</sup> -

$$N_1 V_1 = N_2 V_2$$

~~(water sample)      (AgNO<sub>3</sub> sol<sup>2</sup>)~~

$$\cdot N_1 \times 10 = \frac{N}{10} \times 1.7$$

$$N \times 1.7 = 0.017 N$$

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Strength of chloride ion :-

$$\text{Normality} \times \text{Equivalent wt}$$

$$= 0.017 \times 35.5$$

$$= 0.6035 \text{ gm/lit.}$$

Result :-

The amount of  $\text{Cl}^-$  ion present in given water sample =  $0.6035 \text{ gm/lit.}$

Precaution :-

- (i) Use distilled water for preparing  $\text{AgNO}_3$  solution and for washing all the glass apparatus.
- (ii) If water is acidic, add a little  $\text{CaCO}_3$  to neutralise acidity before titration.

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Name of the Experiment :

To determine the acidic value of given lubricant oil sample.

Apparatus required :

Burette, conical flask, pipette, beaker, glass rod, watch glass, burette stand.

Indicator : phenolphthalein.

Theory :- The acid value of lubricant oil is defined as the no. of milligrams of potassium hydroxide required to neutralize the free present acid in one gm of the oil sample. For determination of acid value, at first a known weight of oil sample is dissolved in suitable solvent and titrated with a standard alcoholic potassium hydroxide solution to a definite end point.

In good lubricant oils, the acid value should be minimum (0.1) increase in acid value should be taken as an indicator of oxidation of the oil which

may lead to gum and sludge formation by sides corrosion.

Procedure :-

- (i) A clean and dry beaker was weighed
- (ii) Beaker containing oil sample was weighed accurately
- (iii) About 5 gm of oil was transferred in conical flask at the room and added 100 ml suitable solvent with a measuring cylinder
- (iv) The flask was heated for about 30 minute and cooled the flask at the room temp.
- (v) 10 to 12 drop of phenolphthalein indicator were added in the above solution.
- (vi) The solution was titrated against the standard  $\frac{1}{10}$  KOH solution until a pink colour appears at the end point.
- (vii) The volume of alkali used in titration was recorded
- (viii) The titration was repeated twice or more to get concordant reading

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## Observation Table :-

| S.no | Vol. of oil<br>sample<br>(in ml) | Burette reading N/10<br>KOH soln | Concordant<br>reading | Indicator<br>used |
|------|----------------------------------|----------------------------------|-----------------------|-------------------|
|      |                                  | initial                          | final                 | diff              |
| 1    | 10                               | 0                                | 0.7                   | 0.7               |
| 2    | 10                               | 0.7                              | 1.2                   | 0.5               |
| 3    | 10                               | 1.2                              | 1.9                   | 0.7               |

## Calculation :-

1) Initial weight of beaker ( $x_1$ ) = 111.1 gm

2) final weight of the beaker  
+ lubricant oil ( $x_2$ ) = 116.2 gm

3) weight of oil sample ( $x_2 - x_1$ ) = 5 gm

4) Vol. of the N/10 KOH used = 0.7 ml

$$\text{Acid volume} = \frac{V}{x_2 - x_1} \times 5.6$$

$$= \frac{0.7 \times 5.6}{5}$$

$$= 0.784$$

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Result :-

(1) The  $\text{N}/10 \text{ KOH}$  sol<sup>n</sup> should be freshly prepared.

2)

The acid value of the given lubricant oil is  $y$  mg of  $\text{KOH}$  is required to neutralize 2 gm of lubricant oil

Precaution :-

(1) The  $\text{N}/10 \text{ KOH}$  sol<sup>n</sup> should be freshly prepared

(2) Use smaller weight of sample should be taken

.

(3) The titration should be rapidly completed and first appearance of pink colour should be taken as end point.

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Aim :- Quantitative analyses of given salt.

Physical appearance :-

Colour - white

smell - No

Solubility - soluble in water

Deliquescence :- No

State - Crystalline

Dry tests of basic radical :-

| Experiment  | Observation                | Result  |
|---|----------------------------|---|
| (i) Action of heat :-<br>heated a pinch of<br>salt in a dry test<br>tube and noted<br>the following |                            |   |
| a) gas evolved  | No gas evolved             | may be $\text{CO}_2$ , $\text{NH}_3$<br>$\text{Cl}^-$ , $\text{Br}^-$ , $\text{I}^-$ absent |
| (b) Sublimation   | No sublimation             | May be $\text{NH}_4^+$<br>$\text{I}^-$ absent   |
| (c) Decomposition   | cracking sound<br>observed | $\text{Pb}(\text{NO}_3)_2 + \text{KI}$<br>barium nitrate<br>may be present.                 |

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|                       |                                    |   |
|-----------------------|------------------------------------|---|
| (2) colour of residue | Brown when hot<br>yellow when cold | $\text{Pb}(\text{XO}_4)_2 \xrightarrow{\Delta} \text{K}\text{I}$<br>may be $\text{Pb}^{2+}$ present |
|-----------------------|------------------------------------|---|

~~(2) Charcoal cavity test~~

|   |   |                                 |
|---|---|---------------------------------|
| mixed a pinch of salt with double the quantity of $\text{NO}_3\text{CO}_3$ and heated the mixt. | Brown residue when hot & yellow when cold | May be $\text{Pb}^{2+}$ present |
| in charcoal cavity  |   |                                 |
| in a reducing plane   |   |                                 |

|   |  |  |
|---|--|--|
| (3) Cobalt nitrate charcoal cavity test | did not perform this test residue in charcoal cavity was not white | $\text{Zn}^{2+}, \text{Mg}^{2+}, \text{Al}^{3+}$<br>$\text{PO}_4^{2-}$ , may be absent |
|---|--|--|

~~4) Flame test~~

|  |  |                                 |
|--|--|---------------------------------|
| prepared a paste of the salt with cone-Hg and performed flame test | Dull bluish colour of the flame was obtained | May be $\text{Pb}^{2+}$ present |
|--|--|---------------------------------|

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## (5) Preliminary test for acid radical :-

|  |                        |   |
|--|------------------------|---|
| (a) Treated a pinch of the salt with dil. $H_2SO_4$  | No gas evolved         | May be $Cl^-$ , $Br^-$ , $I^-$<br>$NO_3^-$ , $CO_3^{2-}$ , $SO_4^{2-}$ absent |
| (b) Treated a pinch of the salt with conc. $H_2SO_4$ | No gas evolved         | May be $Cl^-$ , $Br^-$ ,<br>$I^-$ , $CO_3^{2-}$ absent                        |
| (c) Heated a pinch of salt with conc. $NaOH$         | No ammonia gas evolved | May be $NO_3^-$ absent.   |

## (6) Confirmatory test for acid radical :-

|  |                            |  |
|--|----------------------------|--|
| (a) To the salt sol <sup>1/2</sup> added dil. HCl  | No effervescence           | $CO_3^{2-}$ absent                                   |
| (b) To the salt sol <sup>1/2</sup> added $BaCl_2$ sol <sup>1/2</sup>   | No white ppt               | $SO_4^{2-}$ absent                                   |
| (c) To the salt sol <sup>1/2</sup> added conc. $HNO_3$ + $AgNO_3$  | No white ppt or yellow ppt | $NO_3^-$ confirmed<br>$Cl^-$ , $Br^-$ , $I^-$ absent |
| (d) To the salt sol <sup>1/2</sup> added fresh sol <sup>1/2</sup> + conc. $H_2SO_4$ by the side of test tube | Dark brown ring formed     | $NO_3^-$ confirmed                                   |

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## (7) Group Analysis of Basic Radical :-

|   |  |                  |                                       |
|---|--|------------------|---------------------------------------|
| (i)   | Salt sol <sup>2-</sup> with dil HCl  | white ppt        | group-I present                       |
| (ii)  | filtrate of above sol <sup>2-</sup><br>+ H <sub>2</sub> S  | No black<br>ppt  | group-II<br>absent                    |
| (iii)   | Boiled of H <sub>2</sub> S of grp-II<br>Salt sol <sup>2-</sup> + added<br>NH <sub>4</sub> Cl + NH <sub>4</sub> ON  | No ppt           | group-III<br>absent                   |
| (iv)  | Above sol <sup>2-</sup> + H <sub>2</sub> S   | No ppt           | group-IV absent                       |
| (v)   | Boiled of H <sub>2</sub> S of group-IV<br>+ NH <sub>4</sub> Cl + NH <sub>4</sub> ON + NH <sub>4</sub> Cl<br>+ (NH <sub>4</sub> ) <sub>2</sub> W <sub>3</sub> SO <sub>4</sub> <sup>2-</sup> | No ppt           | group-V<br>absent                     |
| (vi)  | Qualitative test, no<br>common reagent   | Analysis         | group-VI                              |
| (vii) (a) flame test                              |  | No flame         | Na <sup>+</sup> K <sup>+</sup> absent |
| (b) charcoal cavity Test -<br>cobalt nitrate test |  | No pink<br>flame | Mg <sup>2+</sup> absent               |

~~group analysis of I.~~

Boiled the above ppt of group-I with 5-10 ml of water divided the solution obtained into two part :-

| Experiment   | Observation | Result                     |
|--|-------------|----------------------------|
| (a) Potassium iodide test:-<br>To the first of the pollution was added   | yellow ppt  | Pb <sup>2+</sup> confirmed |
| (b) Potassium chromate test:<br>To the second part of the solution K <sub>2</sub> CrO <sub>4</sub> sol was added | Yellow ppt  | Pb <sup>2+</sup> confirmed |

Result :-

Hence, the given salt contains following radical

i) Basic radical — Pb<sup>2+</sup>

ii) Acid radical — NO<sub>3</sub><sup>-</sup>

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Name of the Experiment :-

To study the effect of concentration of acetic acid on its adsorption by active charcoal.

Apparatus required :- conical flask, funnel burette, pipette and chemical balance

Chemical required : Active charcoal, acetic acid phenolphthalein &  $\text{NaOH}$  sol<sup>n</sup>

Theory :-

The surfaces of solids and liquids possess unbalanced forces such as Van der waals forces and chemical bond forces. The surfaces tend to satisfy the residual forces attracting and retaining molecules from environment.

Adsorption is enrichment of a substance in the surface layer of a solid or liquid compared with the bulk region.

The solid or liquid on which adsorption occurs is called adsorbent. The substance which is adsorbed called adsorbate

Absorption are two types :-  
Physisorption & chemisorption

If the adsorbate is bound to the surface by van der waal's forces, adsorption is called physical adsorption or van der waal physisorption. If adsorbate is bound to the surface by chemical bond forces, the adsorption is called chemical adsorption or Langmuir adsorption or chemisorption.

Absorption occurs with release of energy. The enthalpy changes for adsorption of 1 mole of an adsorbate on a adsorbent surface is called heat of adsorption.

Absorption from solution :-

Solid surface can adsorb solute from  $\text{sol}^{\pm}$ . The adsorption in most cases leads to formation of layer of single molecule in thickness on the surface of the solid.

Absorption is an equilibrium process when a solid adsorbent is added to a  $\text{sol}^{\pm}$ , a stage is reached when the

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amount of solute adsorbed per unit time. Thus, after an initial decrease in concentration of the solute concentration as well as the amount adsorbed each equilibrium values. The extent of adsorption is usually written as  $X/m$ . where  $X$  is mass of the solute adsorbed at equilibrium and  $m$  is the mass of adsorbent. The extent adsorption  $X/m$  is related to the equilibrium concn  $c$  of the solute. A curve drawn bet<sup>n</sup>  $X/m$  &  $c$  at a constant temperature is called an adsorption isotherm.

At low values of  $c$ , the curve is a straight line. This is expressed by the relation

$$\frac{X}{m} \propto c \quad \text{or} \quad \frac{X}{m} = \text{const} \times c \quad \text{--- (1)}$$

At high value of  $c$ ,  $\frac{X}{m}$  is independent of values of  $c$ , In this range of concentration we have

$$\frac{X}{m} \propto \frac{1}{c} \quad \text{const} \quad \text{--- (2)}$$

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In intermediate range of concentration,  $x/m$  is proportional to  $c$  raised to powers between 1 and 0. For small range of concentration values, we have

$$\checkmark \frac{x}{m} \propto c^{\frac{1}{n}} \text{ or } \frac{x}{m} = k c^{\frac{1}{n}} \quad \text{--- (3)}$$

Eq (3) is known as freundlich isotherm.

Taking logarithms on both sides of eq (3) we have

$$\log \frac{x}{m} = \log k + \frac{1}{n} \log c \quad \text{--- (4)}$$

It is evident from eq (4) that a plot of  $\log x/m$  against  $\log c$  should be a straight line with a slope  $1/n$  and intercept equal to  $\log k$ .

The weight  $x$  of the solute adsorbed is given by change in molar concentration of the solute after adsorption ( $c_0 - c$ ) multiplied by the molecular weight of the solute  $M$ , and the volume of soln  $V$ , in litre

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$$\boxed{X = (C_0 - C) M V}$$

Procedure :-

- (1) Prepare five solution (100ml each) of acetic acid of exactly  $0.4\text{M}$ ,  $0.20\text{M}$ ,  $0.10\text{M}$ ,  $0.05\text{M}$  &  $0.02\text{M}$  concentration.
- (2) Take six  $250\text{ ml}$  conical flask and number them 1 to 5. Place in each of them exactly weighed  $1\text{ g}$  of active charcoal.
- (3) To flask 1 containing weighed charcoal, add  $100\text{ ml}$  of  $0.4\text{M}$  acetic acid solution, to flask 2,  $100\text{ ml}$  of  $0.20\text{M}$  acetic acid solution and so on. Stopper the flask and allow them to stand for about 1 hour shaking them at small interval.
- (4) After about 1 hour, determine the equilibrium concentration of acetic acid solution. Take flask 1, filter the acid through filter paper. Pipette out  $10\text{ ml}$  of the filtrate.

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into a clean conical flask and titrate it against 0.05 N NaOH sol<sup>n</sup> using phenolphthalein as indicator. Repeat the procedure for acetic acid solution of other conical flask.

### Observation:-

Strength of NaOH sol<sup>n</sup> = N/10

Weight of charcoal = 01 g

Vol of acetic acid sol<sup>n</sup> taken  
for titration = 10 ml

Draw a table for 10% sol<sup>n</sup>

| S.no | Vol. of sol <sup>n</sup> | Burette reading N/10 NaOH sol <sup>n</sup> | concentr-<br>dent | Indicator<br>used |
|------|--------------------------|--|-------------------|-------------------|
|      |                          | Initial                                    | final             | difference        |
| 1    | 10 ml                    | 0  | 5.3               | 5.3               |
| 2    | 10 ml                    | 5.3  | 10.9              | 5.6               |
| 3    | 10 ml                    | 10.9                                       | 15.2              | 5.3               |

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Draw a table for 20% sol<sup>1</sup>

| S. no. | Vol. of<br>sol <sup>1</sup> | Burette reading N/10<br>NaOH sol <sup>2</sup> | Concordant | Indicator<br>used |
|--------|-----------------------------|---|------------|-------------------|
| No.    | Initial                     | final   | difference |                   |
| 1      | 10ml                        | 0   | 15.7       | 15.7              |
| 2      | 10ml                        | 15.7  | 31.4       | 15.7              |
| 3      | 10ml                        | 31.4  | 41.3       | 15.9              |

Draw a table for 30% sol<sup>1</sup>

| S. no. | Vol. of<br>sol <sup>1</sup> | Burette reading N/10<br>NaOH sol <sup>2</sup> | Concordant | Indicator<br>used |
|--------|-----------------------------|---|------------|-------------------|
| No.    | Initial                     | final   | difference |                   |
| 1      | 10ml                        | 0   | 20.4       | 20.4              |
| 2      | 10ml                        | 20.4  | 40.8       | 20.4              |
| 3      | 10ml                        | 40.8  | 61.8       | 20.8              |

Draw a table for 40% sol<sup>1</sup>

| S. no. | Volume<br>of<br>solution | Burette reading N/10<br>NaOH sol <sup>2</sup> | Concordant | Indicator<br>used |
|--------|--------------------------|---|------------|-------------------|
| No.    | Initial                  | final   | difference |                   |
| 1      | 10 ml                    | 0   | 30.2       | 30.2              |
| 2      | 10ml                     | 30.2  | 60.8       | 30.6              |
| 3      | 10ml                     | 60.8  | 91.0       | 30.2              |

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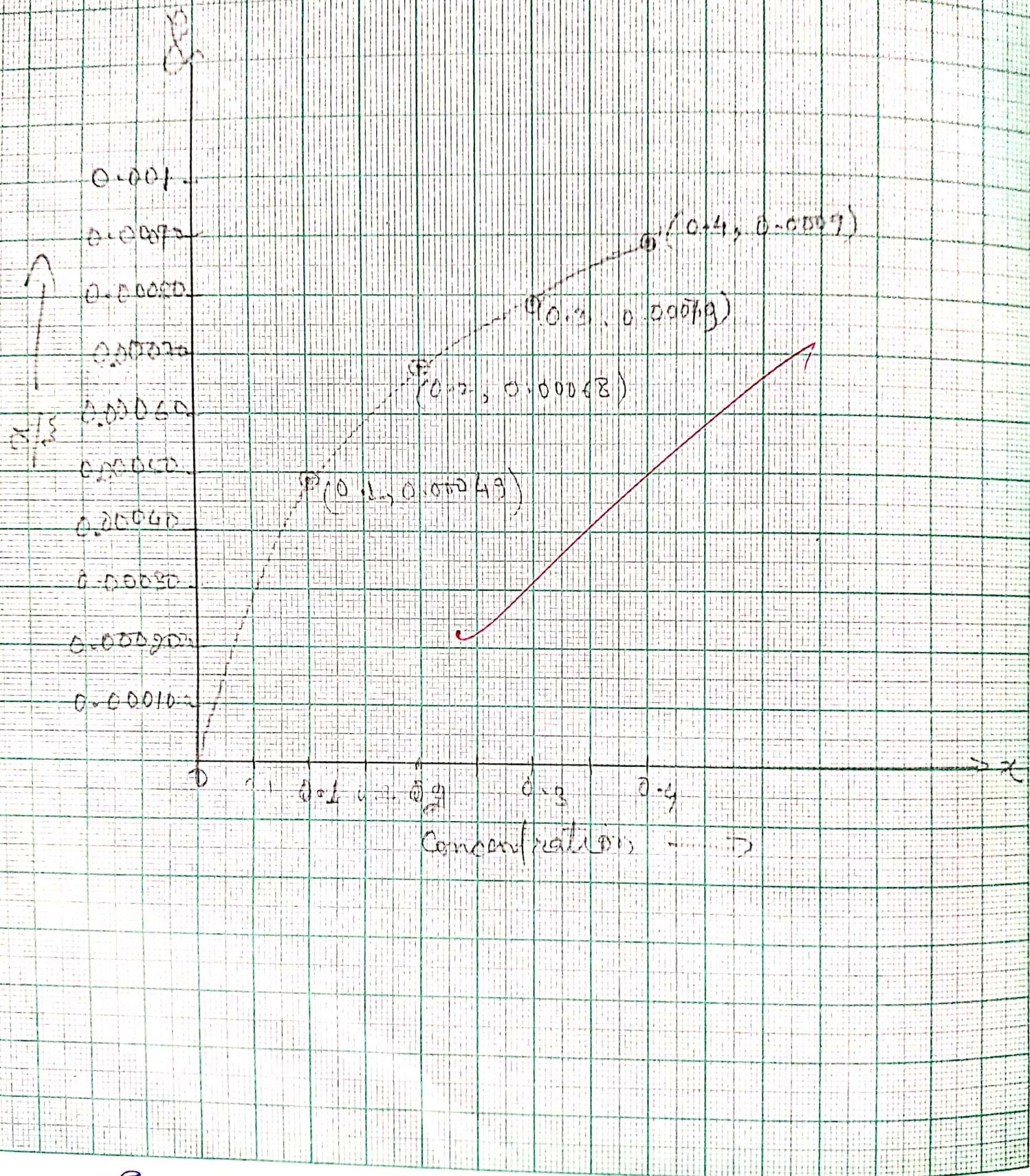
Results

From the above conservation, calculate equilibrium concentration of acetic acid,  $C$  and the extent of adsorption. Tabulate the result as shown in the table given below.

Plot  $\chi_m$  against equilibrium concentration  $C$  and  $\log \chi_m$  against  $\log C$ . find out the intercept and slope of the straight line obtained by plotting  $\log \chi_m$  against  $C$ . Calculate  $\alpha$  from the slope &  $k$  from intercept.

| Sorbs | Concentration | $\chi_m$ |
|-------|---------------|----------|
| 1     | 0.1           | 0.00049  |
| 2     | 0.2           | 0.00068  |
| 3     | 0.3           | 0.00079  |
| 4     | 0.4           | 0.00090  |

Plot  $\chi_m$  against equilibrium concentration of  $C$  and  $\log \chi_m$  against  $\log C$ . find out the intercept and slope of the straight line obtained by plotting  $\log \chi_m$  against  $C$ .



Graph plot betw  $\gamma_m$  against equilibrium concn  $C$ .

## Application

- (I) charcoal is used to remove impurities from cane sugar, beet sugar & glucose.
- (II) Activated charcoal is used for removing odours from air in air conditioners.
- (III) Adsorption is an important step in catalysis
- (IV) Chromatography is based on selective adsorption of a no. of constituents present together in a sol<sup>n</sup> or gas phase.

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