

- Aim : to determine The strength of given copper sulphate solution in gm/litre by titrating it against an intermediate Solution of hypo. For this you have been provided standard solution of  $\text{CuSO}_4$ .
- Reaction :
  - $2\text{CuSO}_4 + 4\text{KI} \rightarrow 2\text{CuI}_2$  (white ppt) +  $2\text{K}_2\text{SO}_4$
  - $2\text{CuI}_2 \rightarrow \text{Cu}_2\text{I}_2 + \text{I}_2$
  - $2\text{Na}_2\text{S}_2\text{O}_3 + \text{I}_2 \rightarrow \text{Na}_2\text{S}_4\text{O}_6 + 2\text{NaI}$
  - $\text{I}_2 + \text{Starch} \rightarrow \text{deep blue}$ .
- Apparatus and reagent : Burette, Pipette, conical flask, measuring cylinder, dropper, hypo, copper sulphate, potassium iodide.
- indicator : starch
- End point : The appearance of milky white colour.
- Procedure :-
- 1. Prepare a standard copper sulphate solution by dissolving required amount of copper sulphate in distilled water in 1000 ml volumetric flask. Add few

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drops of acetic acid to prevent hydrolysis.

2. Wash the burette, Pipette and conical Flask with distilled water.
3. Rinse the burette with hypo solution & Fill hypo solution in it.
4. Rinse the Pipette with copper sulphate and take 25 ml of Standard copper sulphate solution in the conical flask.
5. Add 10 mL KI Solution in conical flask. The solution becomes brown.
6. Start titration immediately with hypo solution till the colour changes to pale yellow.
7. Add 2-3 drops starch as indicator, solution becomes blue due to adsorption of iodine on starch.
8. Add more hypo solution from the burette till the blue colour disappears.

The appearance of the milky white colour indicates the presence of end point. Note down the burette reading.

9. There is some times tendency for the blue colour to return due to liberation of adsorbed iodine from copper iodide. So that the first complete disappearance of blue colour is taken as the end point.
  10. Repeat the procedure till you get consecutive two same readings.
  11. Repeat the same procedure for the unknown copper Sulphate solution and obtain burette readings.
- o observation table :-

Titration of Standardized copper Sulphate solution with intermediate hypo solution.

Calculation

$$N_1 = \text{Normality of known } \text{CuSO}_4 = \frac{N}{40}$$

$$V_1 = \text{Volume of known } \text{CuSO}_4 = 10 \text{ mL}$$

$$N_2 = \text{Normality of HPO} = ?$$

$$V_2 = \text{Volume of HPO} = 6.7 \text{ mL}$$

$$N_2 = \frac{N_1 V_1}{V_2} \text{ of HPO} = 0.0373 \quad \therefore N_3 V_3 = N_4 V_4$$

$$N_3 = N_2 \text{ Normality of HPO} = 0.373$$

$$V_3 = \text{Volume of HPO} = 5.3 \text{ mL}$$

$$N_4 = \text{Normality of unknown} = ?$$

$$\therefore V_4 = \text{Volume of unknown} = 10 \text{ mL}$$

$$N_4 = \frac{N_3 V_3}{V_4} = \frac{0.373 \times 5.3}{10} = 0.01976$$

Strength of unknown of  $\text{CuSO}_4$

$$= N_4 \times E.W \text{ of } \text{CuSO}_4$$

$$= 0.0197 \times 249.68 \\ = 4.9186 \text{ g/L}$$

S.No	volume of copper Sulphate (ml)	Burette reading initial	Burette reading Final	volume of HYPO Solution (ml)
	10 ml	0.0m	6.4	
	10 ml	0.0m	7.2ml	6.1ml
	10 ml	0.0m	7	

- Titration of unknown copper Sulphate solution with Standardized hypo Solution :-

S.No.	Volume of Copper Sulphate (ml)	Burette reading initial	Burette reading Final	Volume of HYPO Solution (ml)
	10 ml	0.0m	5.6	
	10ml	0.0ml	5.4	5.3
	10ml	0.0m	5.1	

- Calculation :

→ Calculation of normality of intermediate HYPO -

$$N_1 =$$

$$V_1 = 25 \text{ ml}$$

$$N_2 =$$

$$V_2 =$$

→ Calculation of normality of unknown Copper Sulphate.

Expt. No. \_\_\_\_\_

$$N_3 = \\ V_3 = 25 \text{ ml}$$

$$N_4 = \\ V_4 =$$

Now apply :  $N_3 V_3 = N_4 V_4$

Strength (in gm/l) = Normality  $\times$  Equivlant weight

$$= N_3 \times 249.68 \text{ gm/l}$$

$\Rightarrow$  Result  $\Rightarrow$  The Strength of given unknown copper sulphate solution = 4.9186 gm/l

$\Rightarrow$  Precautions :-

1. The Starch solution should be added Just near the end point in successive titration.
2. Dirty brown white precipitate of cuprous iodide may be formed due to adsorption of iodine by it. This can be avoided by adding 5 ml of 10% of solution of potassium thiocyanate.
3. No mineral acid should be present as  $Cu^{2+}$  is soluble and cuprous ions so formed will be oxidised back to cupric ions by the iodine liberated due to reaction.

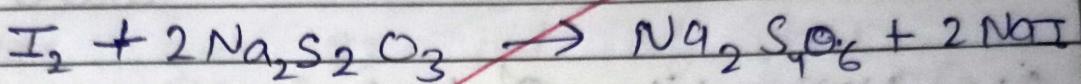
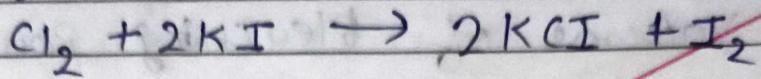
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Expt. No. 2

# Aim: To determine the available chlorine in a given sample of water.

• Reaction:



# Apparatus & Reagent:- Burette, Pipette, conical flask, watch glass, weighing bottle, glass rod, dropper, 250 ml measuring flask.

Bleaching Powder, chemical iodide, glacial acetic acid, hypo

• Indicators :- Starch

• End point: blue colour disappears.

⇒ Procedure:

I: weight out about 2-3 gm of bleaching powder in a pre-weighed & clean

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WRITO-LINE

calculation

$$N_1 V_1 \neq N_2 V_2$$

$N_1$  = normality of bleaching powder in water  
 $V_1$  = volume of bleaching powder in water (50)

$$N_2 = \text{normality of Hypo} = \frac{N}{50}$$

$$V_2 = \text{volume of Hypo solution} = 3.0 \text{ ml}$$

$$N_1 = \frac{N_2 V_2}{V_1} = \frac{\frac{N}{50} \times 3}{50} = \frac{3}{50 \times 50} = N_2$$

Strength of chlorine =  $N_1 \times$  equivalent weight of chlorine

$$\frac{3}{50 \times 50} \times \frac{38.25}{10} \times 1000$$

$$= 53.25 \text{ g/l}$$

weighing bottle.

2. Transfer it to a porcelain dish or watch glass; make its paste & transfer it quantitatively to 250 ml standard flask & make up to the mark with distilled water.
3. Pipette out 25 ml of the homogeneous solution from the 250 ml standard flask to a conical flask.
4. Add about 25 mg of solid KI & about  $\frac{3}{4}$  test tube of glacial acetic acid. titrate the liberated iodine against hypo solution till the light yellow colour appears. Then add to this solution 10-15 drops of starch solution & continue adding hypo solution till the colour disappears.
5. Repeat the titration to get at least two concordant values.

⇒ Observation Table:-

S.No.	Volume of Bleaching powder (ml)	Burette reading initial	Burette reading Final	Volume of Hypo solution (ml)
1:	50 ml	0 ml	3.2 ml	
2:	50 ml	0 ml	3.0 ml	3.0 ml
3:	50 ml	0 ml	3.0 ml	

⇒ Result :-

Available chlorine in given sample of bleaching powder in percent = 53.25 g/l

⇒ Precautions :-

1. The glass apparatus used in the experiment should be washed with distilled water.
2. The volume of indicator should be same in all titration.
3. All the Reagents should be freshly prepared.
4. End point of titration should be carefully observed.

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\* Object : To determine the pH of a given water sample.

• Apparatus & material required :-

pH meter, buffer Solution of pH 4 & 9, water sample, breakers etc.

• Principal =)

pH is a quantitative measure of the acidity of a solution. It can be measured using a pH meter. In the measurement of pH a specially designed glass electrode is used, which has a thin glass bulb filled with 0.1 NHCl in which Ag / AgCl electrode as a wire is dipped. This glass electrode works as working electrode which is coupled with a calomel reference electrode to complete the cell & used to determine the pH of samples along with a pH meter. Generally combined electrode electrodes

are used.

• Procedure:

1. Switch on the PH meter for about 15 minutes for its warm up.
2. Set the temperature control room temperature.
3. clean the bulb of PH electrode with distilled water & dry the surface with soft issue paper.
4. Dip the PH electrode ~~paper~~ in the Standard buffer of PH=4.
5. Adjust the PH control switch so as to read ~~to~~ 4.0 on the scale.
6. wash the electrode with distilled water & put it in the solution of PH=9 & adjust the PH scale so as to read 9.
7. Repeat the step (3-6) until the PH meter reading do not change at all.

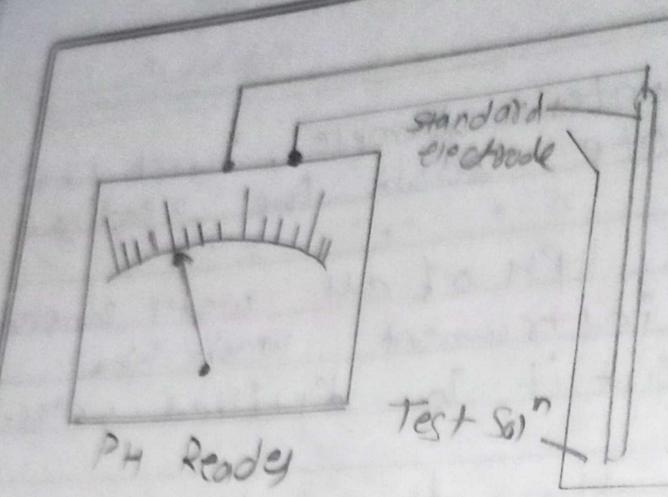
8. Take the water sample, insert the electrode & note down the reading.
9. After measuring pH of all water samples switch off the instrument wash the electrode & put it in distilled water.
10. Always keep the function switch to the stand by mode after measuring the pH of sample.

SN°	Sample	p.H
1	$K_2Cr_2O_7$	5.9
2	$CuSO_4$	2.9
3	HCl	1.5
4	$H_2SO_4$	1.0
5	NaOH	11.3

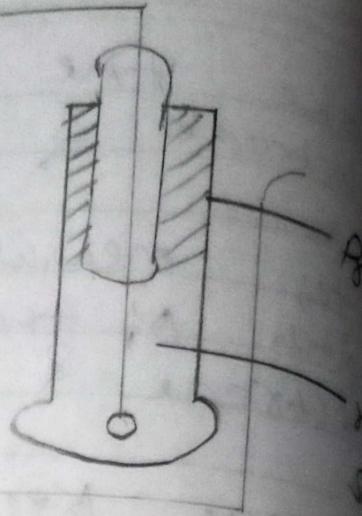
Result :-

Sample no. 1 is  $K_2Cr_2O_7$  = Acidic

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Q : A pH meter



\*

(i)

(ii)

(iii)

(iv)

(v)

(vi)

Sample no. 1 is  $\text{CuSO}_4$  = Acidic  
Sample no. 2 is  $\text{NaCl}$  = Acidic

#### \* Precautions :-

- (i) Proper time must be given for warming up the instrument.
- (ii) Electrode must be carefully handled as the glass membranes are very sensitive & may break.
- (iii) Electrode must be immersed properly in the solution & the bulb should not touch the walls or bottom of breaker.
- (iv) PH reading should be taken when the electrode has attained the temperature of solution.
- (v) The titrant must be added in smaller & smaller amounts as the equivalence point reaches.
- (vi) The electrode should be kept dipped in distilled water when not in use.

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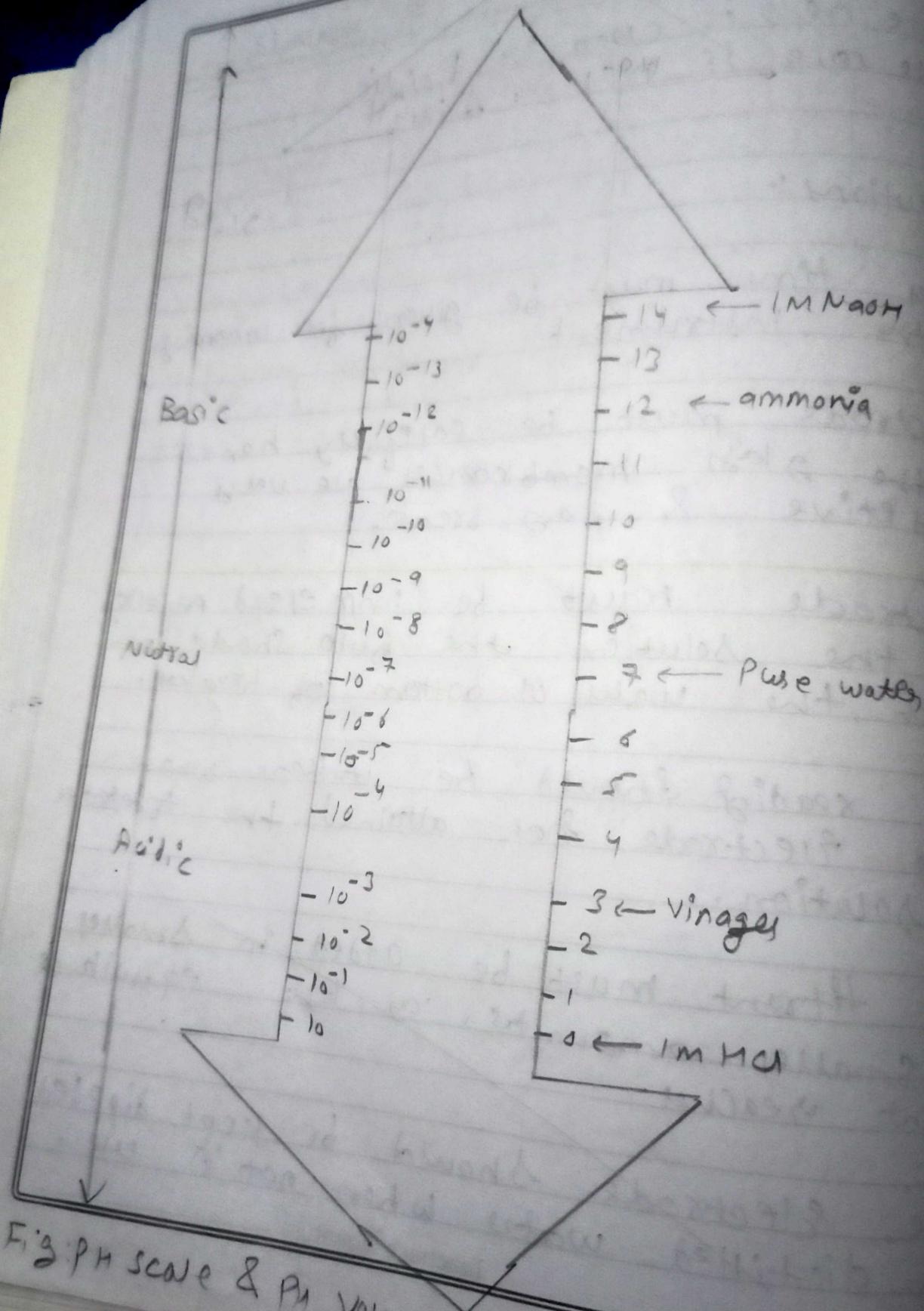


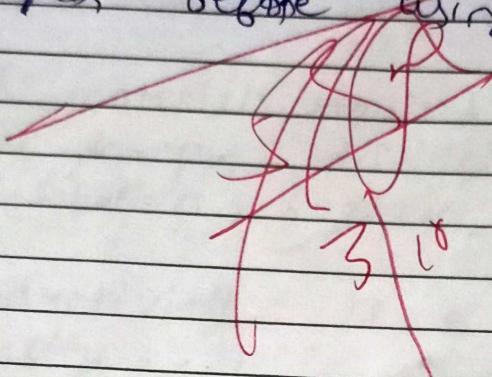
Fig: pH scale & PI value  
of some common substance

Date \_\_\_\_\_

Expt. No. \_\_\_\_\_

Page No. 13

vii) Electrodes should be washed with distilled water and wipe it with tissue paper before using for another solution.



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- Object: To determine the conductivity of a given water sample using conductivity meter.
- Apparatus & materials required: Conductivity meter, water sample, distilled water, sample 0.01 N KCl solution, beakers etc.
- Theory: Conductivity is a good indication of water quality. It is the ability of a material to transfer an electric charge from one point to another. If a solution is a good conductor, it consists primarily of ions. If a solution is a poor conductor, it primarily consists of molecule. The conductivity of a solution is measured with the help of a conductivity cell using conductivity meter.
- Procedure:
  1. Switch on the conductivity meter for about 15 to 20 minutes.
  2. Wash the conductivity cell in distilled water.

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3. Set the function switch to check position.
  4. Display must read 1.000 otherwise set it with CAL Control Knob of conductivity meter.
  5. Adjust the temperature knob to room temperature.
  6. Dip the washed & dried conductivity cell in the beaker containing sample solution.
  7. After completion of experiment switch off the apparatus & put the cell in distilled water.
- observation :

SNo	Sample	conductivity
1	$C_2O_4H_2$	0.04
2	$FeSO_4$	0.17
3	$H_2SO_4$	0.16
4	$HCl$	0.05

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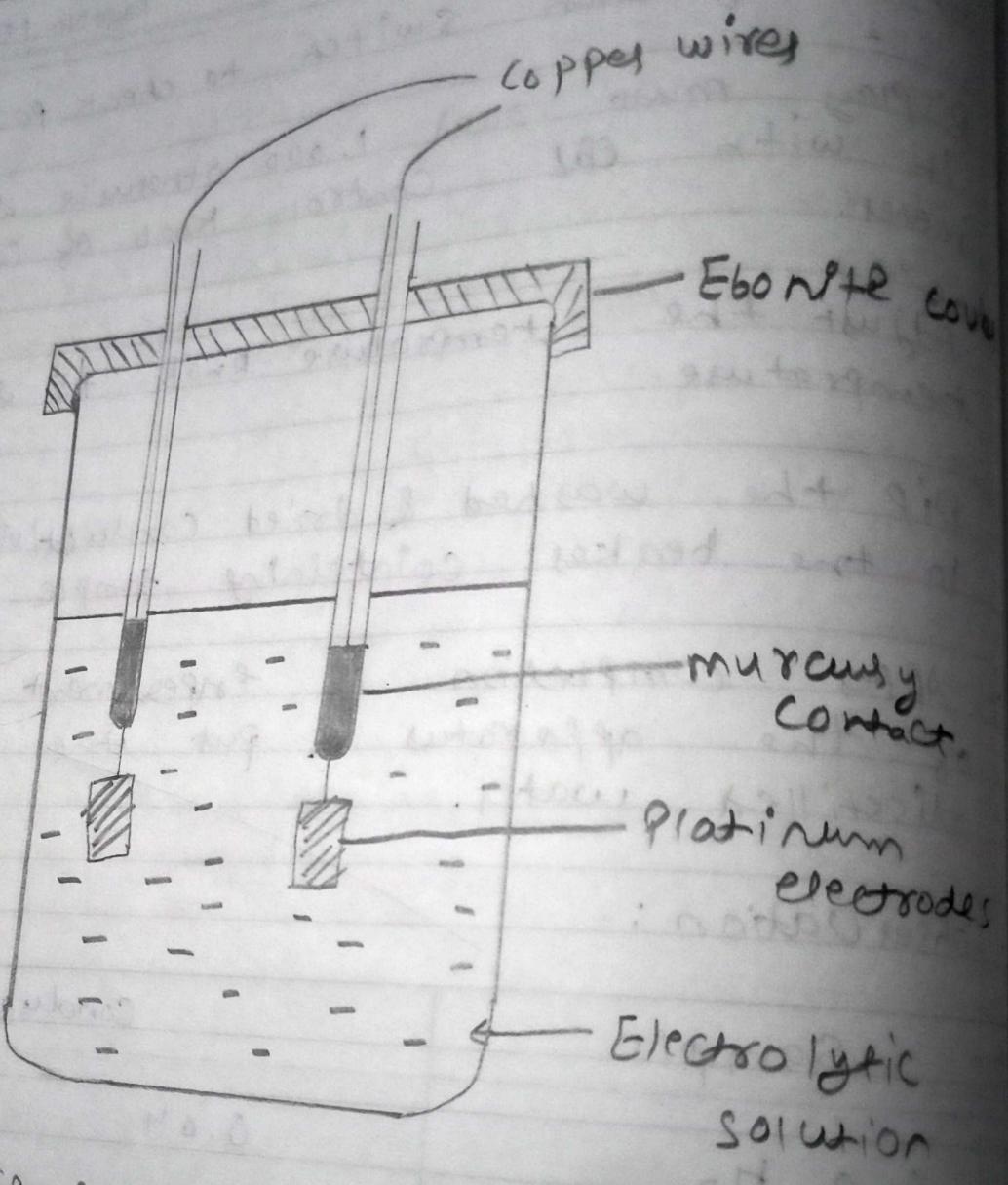


Fig.: A conductance cell

5	$\text{CuSO}_4$	0.01
6	$\text{NaOH}$	0.10
7	$\text{FeSO}_4$	0.17

• Result :

Conductivity of given water sample are

Sample no. 1 is  $\text{C}_2\text{H}_5\text{OH}$  : 0.04

Sample no. 2 is  $\text{FeSO}_4$  : 0.17

Sample no. 3 is  $\text{H}_2\text{SO}_4$  : 0.16

Sample no. 4 is  $\text{HCl}$  : 0.05

Sample no. 5 is  $\text{CuSO}_4$  : 0.01

Sample no. 6 is  $\text{NaOH}$  : 0.11

Sample No. 7 is  $\text{FeSO}_4$  : 0.17

• Precautions :

1. Always calibrate the cell constant of conductivity cell.
2. Temperature of the sample should be carefully noted w.r.t conductivity values with the temperature.

3. The conductivity cell should be handled carefully.
4. conductivity cell should be completely dipped in the solution.

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