



**B.E. FIRST YEAR –ENGINEERING CHEMISTRY LAB**

**VIVA-VOCE**

**VOLUMETRIC ANALYSIS**

1. Why hot liquids should not be taken in the Burette?
  - A. Hot liquids should not be placed in the burette because the instrument is calibrated at a much lower temperature(15 to 20° C)
2. Which meniscus is read in case of colored solution taken in a burette?
  - A. In case of colored solution the top of the meniscus read on the burette scale as lower part is not visible.
3. What are the requirements of a standard substance?
  - A. A standard substance (primary standard) is required to fulfill the following conditions:
    - i. It must be in a highly purified state.
    - ii. It must be stable in air
    - iii. It should be readily soluble in water.
4. What do you mean by the term end point in a titration?
  - A. End point means completion of the reaction between the two solution , one taken in the titration and the other added drop by drop from the burette.
5. What is redox titration?
  - A. The reactions which involve simultaneous oxidation and reduction are called redox titrations and the titrations involving redox reactions are called redox titrations.
6. What is permangnometry?
  - A. Redox titrations involving  $\text{KMnO}_4$  as the oxidizing agent are called permangnometry.
7. Why is dilute  $\text{H}_2\text{SO}_4$  must suitable as compared to  $\text{HCl}$  and  $\text{HNO}_3$  in Potassium permanganate titrations?
  - A.  $\text{HCl}$  reacts with  $\text{KMnO}_4$  to liberate  $\text{Cl}_2$  gas and consumes some  $\text{KMnO}_4$ , higher results are obtained.  $\text{HNO}_3$  is a stronger oxidizing agent than  $\text{KMnO}_4$  , so it will oxidize  $\text{Fe}^{+2}$  to  $\text{Fe}^{+3}$  so lower results of the titration will be obtained.
8. Why does  $\text{KMnO}_4$  act as self indicator?
  - A.  $\text{KMnO}_4$  solution is purple in color due to presence of  $\text{MnO}_4^-$  ions. In presence of dil.  $\text{H}_2\text{SO}_4$  it reacts with reducing agents ( $\text{Fe}^{+2}$  or Oxalic acid) and gets reduces to  $\text{Mn}^{+2}$  ions. So the color disappears. At the end point, when all the reducing agent has been oxidized, the excess drop of  $\text{KMnO}_4$  added is not reduced and pink color is observed in the solution. The color is light pink since solution is very dilute.

9. In  $\text{KMnO}_4$  titration  $\text{KMnO}_4$  should be added in small lots, why?
- A. If  $\text{KMnO}_4$  is added in larger amount, a brownish precipitate of hydrated  $\text{MnO}_2$  formed which interferes in getting the correct end point. The same appears if dil.  $\text{H}_2\text{SO}_4$  is not added before the titration.
10. Why only a very small excess of  $\text{SnCl}_2$  is added during the reduction of  $\text{Fe}^{+3}$  ions?
- A. If large excess of  $\text{SnCl}_2$  is added during reduction, a much larger amount of  $\text{HgCl}_2$  will have to be added to destroy excess of  $\text{SnCl}_2$ . Further a very thick ppt of  $\text{Hg}_2\text{Cl}_2$  will be formed, which reacts very slowly with  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.
- B.
11. What is meant by internal indicator, external indicator and self indicator? Give one example of each.
- A. Internal indicator: An indicator which is added to the reaction mixture to indicate the end point of titration. Ex. Phenolphthalein in acid-base titration.  
External indicator: An indicator which is not added to reaction mixture. But it is used externally to indicate end point of titration. Ex.  $\text{K}_2[\text{Fe}(\text{CN}_6)]$  is used as an external indicator in titration of  $\text{Fe}^{+2}$  ions with  $\text{K}_2\text{Cr}_2\text{O}_7$  solution.  
Self indicator: When one of the reactants it acts as indicator and no external substance is required to indicate the end point of titration. Ex.  $\text{KMnO}_4$  acts as self indicator in its titrations.
12. What is oxidation state of Cr in  $\text{K}_2\text{Cr}_2\text{O}_7$  ?
- A. +6
13. Is  $\text{KMnO}_4$  a primary standard? Give reason for your answer.
- A.  $\text{KMnO}_4$  is not a primary standard because it cannot be obtained in a high state of purity. It contains small amount of  $\text{MnO}_2$  as impurity.
14. What are Iodine titrations?
- A. The redox titrations using iodine directly or indirectly as an oxidizing agent are called iodine titration.
15. What do you understand by Iodometric titration?
- A. Iodine titration in which some oxidizing agents liberate iodine from KI and then liberated iodine is titrated against standard solution of reducing agent added from a burette.
16. Name some oxidizing agents which can be titrated by iodometry?
- A. Acidified  $\text{CuSO}_4$ , acidified  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{KMnO}_4$ ,  $\text{Fe}^{+3}$  ion,  $\text{Cl}_2$ ,  $\text{Br}_2$  etc.
17. Why hypo is commonly used as a reducing agent in iodine titrations?
- A. Hypo is preferred to other reducing agents in iodometry because it is a primary standard.
18. Which indicator is used in iodine titrations and what is color change at the end point
- A. Freshly prepared starch solution is used as an indicator. Starch gives blue color with iodine. Just disappearance of blue color is the end point of these titrations.
19. What are complexometric titrations?
- A. Titrations depending upon the combination of ions, other than  $\text{H}^+$  or  $\text{OH}^-$ , to form a soluble slightly dissociated complex ion or compound are called complexometric titrations.
20. Name the most important complexing agent employed in complexometry?
- A. Ethylene diamine tetraacetic acid. (EDTA)
21. What form of EDTA is used in titrimetric analysis?
- A. Used as the disodium salt of EDTA.
22. Give some examples of titrations involving EDTA as a complexing agents?

- A. Estimation of temporary and permanent hardness of water and estimation of metal ions such as  $\text{Cu}^{+2}$ ,  $\text{Ni}^{+2}$ ,  $\text{Zn}^{+2}$  and  $\text{Mg}^{+2}$  etc.
23. Which type of ligand is EDTA?
- A. It serves as a hexadentate ligand and acts as a chelating agent.
24. Name the most widely used indicator in EDTA titrations. How does it act?
- A. In EDTA titrations the commonly used indicator is Erichrome Black T called Ero=T. It shows a color change from red to blue in the pH range 7-11.
25. At what pH the hardness of water is estimated by EDTA method? How this pH is maintained?
- A. The pH value is adjusted to about 10 by using a buffer solution of  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{OH}$ . At higher pH values  $\text{CaCO}_3$  or  $\text{Mg}(\text{OH})_2$  may get precipitated and the indicator may change its color. At lower pH values, Mg- indicator complex becomes unstable and a sharp end point cannot be obtained.
26. What is a buffer solution?
- A. A buffer solution is defined as a solution which resists any change in its pH value even when small amounts of the acid or the base are added to it. A buffer solution gives acidic as well as basic ions in solution which destroy the excess of any acid or base added keeping the pH constant.
27. What is an acidic buffer? Give an example.
- A. It is solution of a mixture of weak acid and salt of weak acid with a strong base. (Ex.  $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$ )
28. What is a basic buffer? Give an example.
- A. It is the solution of a mixture of a weak base and a salt of this weak base with a strong acid (Ex.  $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl}$ ).

## **INSTRUMENTATION ANALYSIS**

- Define Ohm's law.
 

A. Ohm's law state that "the ratio of the potential difference (E) applied across the ends of a conductor to the current (I) flowing through it is always constant at constant temperature.  
Mathematically,  $E/I = R$ , where R is the resistance of conductor
- What is conductance and what are its units?
 

A. The reciprocal of resistance is called conductance. Its units are  $\text{ohm}^{-1}$  or mho or Siemens (S)
- What is specific conductance and what are its units?
 

A. Specific conductance is defined as the conductance of one centimeter cube (1c.c.) of the solution. It is denoted by K (kappa)  
Specific conductance = Cell constant/ observed resistance  
Its units are  $\text{Ohm}^{-1}\text{cm}^{-1}$  or  $\text{mho cm}^{-1}$  or  $\text{S cm}^{-1}$
- What is equivalent conductance and what are its units?
 

A. Equivalent conductance is the conductance of all the ions produced by dissociation of one gram equivalent of a solute in solution. It is denoted by  $\lambda$ .  
Equivalent conductance =  $K \times 1000 / N$   
Units of Equivalent conductance are  $\text{Ohm}^{-1}\text{cm}^2(\text{g eq})^{-1}$ .
- What is molar conductance and what are its units?

- A. Molar conductance is the conductance of all the ions produced by dissociation of one mole of a Solute in solution. It is denoted by  $\mu$ .  
 Molar conductance =  $K \times 1000 / M$   
 Units of molar conductance are  $\text{Ohm}^{-1} \text{mol}^{-1}$ .
6. What is the effect of dilution on conductance?  
 A. Conductance increases with dilution because on dilution dissociation increases and hence the number of ions increases.
7. What is the effect of dilution on specific conductance?  
 B. Specific conductance decreases with dilution because the number of ions per c.c of solution decreases on dilution, although total number of ions in the given volume increases due to increase in dissociation.
8. What is a conductivity cell?  
 A. The vessel in which the measurement of conductivity of the solution is to be made is known as conductivity cell. They are of various shapes and sizes depending upon the nature of the solution taken.
9. Why ordinary water is unsuitable for conductivity measurements? What is conductivity water?  
 A. Ordinary water is unsuitable for conductivity measurements because it possesses large conductance due to the material dissolved from the container and due to  $\text{CO}_2$  and  $\text{NH}_3$  dissolved from air. So, water is specially purified by distilling it a number of times after addition of a little  $\text{KMnO}_4$ . Such water is known as conductivity water and should have a conductivity not more than  $2-3 \times 10^{-8} \text{ ohm}^{-1}$ .
10. What are the advantages of conduct metric titrations?  
 A. Conduct metric titrations have a number of advantages over volumetric titrations involving the use of indicators:  
 a. These titrations can be used for colored solutions where ordinary indicators fail to give the end point.  
 b. These can be used for the titration of even very dilution solutions of the order of  $10^{-4} \text{ M}$ .  
 c. No extra care is needed near the end point as it is simply the intersection of two lines.  
 d. These can be used for the titration of mixtures of weak and strong acids.
11. Name three electrodes, which are usually employed to measure pH of a solution. Which one is most suitable?  
 A. Hydrogen electrode, Quinhydrone electrode and glass electrode. Glass electrode is the most suitable for this purpose.
12. What is a combined electrode? What is the mechanism of its working?  
 A. Electrode combining reference electrode and a glass electrode is termed as combined electrode. These are convenient to use and are common these days. The schematic of the cells formed may be represented as:  
 $^+ \text{Ag}, \text{AgCl}, | \text{experimental solution} | \text{KCl (Salt solution)} \text{Hg}_2\text{Cl}_2(\text{s}) \text{Hg Pt}^-$   
 The glass electrode acts as  $-ve$  electrode and the calomel electrode acts as  $+ve$  electrode.
13. Why is hydrogen electrode not generally used in pH measurements ?  
 A. i. it is difficult to set up.  
 ii. It cannot be used in redox system.  
 iii. It cannot be used in the presence of  $\text{Hg}, \text{As}, \text{S}, \text{Fe}^{+3}, \text{MnO}_4$  etc.

14. Why are solutions of acids and bases in water acts as Type equation here. electrolytes?  
 A. They consist of hydrated ions and therefore conduct electricity.
15. Define a reference electrode?  
 A. It is a Standard hydrogen electrode. It is obtained by dipping a platinum foil in 1M HCl solution through which hydrogen gas is passed at 25° C under 1atm pressure.  
 Its electrode potential is taken as 0.
16. Glass electrode is preferred to quinhydrone electrode in measuring pH of solution. Give reasons?  
 A. Glass electrode is simple, not easily oxidized and attains equilibrium rapidly. It can be used safely up to pH 10. Whereas quinhydrone electrode can be used upto pH 8, it cannot be used in redox solution.
17. What is an electrochemical cell?  
 A. It is a device to convert the chemical energy of a redox reaction into electrical energy by bringing about the redox reaction indirectly in two separate halves.
18. What is electrode potential?  
 A. The tendency of an electrode to lose or gain electrons, when it is in contact with its own ions.
19. Define reduction potential?  
 A. The tendency of electrode to lose electrons, when it is in contact with solution of its own ions.
20. Define oxidation potential?  
 A. The tendency of electrode to gain electrons, when it is in contact with solution of its own ions.
21. Define a reference electrode?  
 A. An electrode whose electrode potential is accurately known or whose electrode potential has been arbitrarily fixed.
22. What is a fuel cell?  
 A. A device for converting the energy of fuel directly into electrical energy.
23. Why do electrochemical cells stop working after sometime?  
 A. An electrochemical cell produces electrical energy at the cost of redox reaction. When the redox reaction is completed, the cell stops working.
24. What is function of salt bridge in a cell?  
 A. It completes the circuit. Moreover it maintains neutrality of the solutions in the two half cells.
25. What is cell constant? give its units.  
 A. It is the ratio between the distance of two parallel plates of the cell and the area of the electrode.  
 Its unit is cm<sup>-1</sup>.
26. State Beer=Lambert's Law.  
 A. The absorbance (A) is directly proportional to the molar concentration (C) as well as path length (l) i.e.  $A \propto Cl$  or  $A = \epsilon Cl$ , where  $\epsilon$  is molar absorptivity coefficient. Mathematically, the law can also be stated as:  

$$I_t = I_0 10^{-\epsilon Cl}$$
27. What is colorimetry?  
 A. The method of analysis which involves the measurement of absorption of light radiations in the visible region of the spectrum is called colorimetry.
28. What is the basis of colorimetry?

- A. The variation of the color of the solution with change in concentration of the ions forms the basis of colorimetry.
29. What is visible spectrum? What happens when visible spectrum is made to fall upon a colored solution?
- A. The visible region of spectrum is considered to extend from 3800-7800Å. When a beam visible light passes through a colored solution contained in a tube, absorption of radiation energy take place and there is loss in energy of the radiation. The emerging radiation is always less energetic than the entered one.
30. What is a calibration curve? How is it drawn?
- A. Calibration curve is a graph between optical densities (absorbance) against concentration. It will be straight line for those solution which obey Beer's law .using standard solution of different concentration, a calibration's curve for a suitable solute in solution is drawn.
31. How can we select proper wavelength for given solution?
- A. The absorbance of the given solution at different wavelength is measured. The plot of absorbance verses its wavelength gives  $\lambda_{\max}$ , which is the suitable wavelength for the colorimetric determination of the given solution.
32. Name the types of instruments employed in absorption measurements?
- A. There are three types:
- i. Colorimeter.
  - ii. Absorption meter.
  - iii. Spectrophotometer.
33. What is the difference between a colorimeter and spectrophotometer?
- A. Colorimeter determines the concentration of a substance by measurement of relative absorption of light. in such instrument the absorption in the visible region is generally employed.